Economic Regulation Authority

Procedure Change Proposal: Benchmark Reserve Capacity Price

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Invitation to make submissions

Submissions are due by 4:00 pm WST, Monday 6 May 2024

The ERA invites comment on this paper and encourages all interested parties to provide comment on the matters discussed in this paper and any other issues or concerns not already raised in this paper.

We would prefer to receive your Procedure Change Submission via our online submission form https://www.erawa.com.au/consultation. A copy of the submission form is provided in Appendix 1 also.

You can also submit your Procedure Change Submission through:

Email: publicsubmissions@erawa.com.au
Post: Level 4, Albert Facey House, 469 Wellington Street, Perth WA 6000

Please note that submissions provided electronically do not need to be provided separately in hard copy.

All submissions will be made available on our website unless arrangements are made in advance between the author and the ERA. This is because it is preferable that all submissions be publicly available to facilitate an informed and transparent consultative process. Parties wishing to submit confidential information are requested to contact us at info@erawa.com.au.

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Contents

Executive summary **2**

1. Introduction **4**

1.1.1 The procedure change process 5
1.2 Changes to the WEM design 6
1.2.1 Current WEM Procedure 7
1.3 Stakeholder feedback 8
1.3.1 Industry working group 8
1.3.2 Call for submissions 8

2. Scope and framework of the ERA's review **10**

2.1 Matters outside the ERA's scope 11

3. Proposed amendments to the WEM Procedure **13**

3.1 Flexible BRCP and Peak BRCP 13
3.2 BESS technical specifications 14
3.2.1 BESS sub-chemistry 14
3.2.2 Design specifications and assumptions 15
3.3 Capital costs 17
3.3.1 Supply and installation costs 17
3.3.2 Transmission connection cost 18
3.3.3 Land costs 21
3.3.4 Other costs 23
3.4 Fixed O&M costs 25
3.5 Annualisation 26
3.5.1 Annuity period 26
3.5.2 Rate of return – WACC 28
3.5.3 Annuity tilt 30
3.6 Cost estimation and adjustment method 32
3.7 Procedure administration 34

List of appendices

Appendix 1 WEM procedure change proposal submission form **35**

Appendix 2 Proposed WEM Procedure (draft) **37**

Appendix 3 Current WEM Procedure **38**

Appendix 4 GHD draft report **39**

Appendix 5 Rate of return (WACC) **40**

Appendix 6 Annuity approach **61**

Appendix 7 Workbook underlying annuity tilt analysis **67**

Appendix 8 List of Tables **68**

Appendix 9 List of Figures **69**

Executive summary

In Western Australia's Wholesale Electricity Market (WEM), the reserve capacity mechanism (RCM) is used to encourage efficient investment in capacity to ensure supply can reliably meet consumer electricity demand.

Suppliers receive payments for each unit of reliable capacity product – referred to as capacity credits – they commit to provide. The Benchmark Reserve Capacity Price (BRCP) and the total supply of capacity credits, relative to required capacity, are used to calculate the price of capacity credits.[1]

This procedure change proposal advocates a complete re-write of the existing WEM Procedure that the Economic Regulation Authority uses to annually determine the BRCP, as extensive changes are required following recent market reforms.

Recent changes to the WEM Rules introduced a Flexible Capacity product to complement the existing capacity product, now called Peak Capacity. As a result, the ERA must determine two BRCPs – Flexible BRCP and Peak BRCP – in its annual BRCP determinations from 2025.

The BRCP must reflect fixed costs incurred in developing and operating a hypothetical Benchmark Capacity Provider. The Flexible BRCP and Peak BRCP comprise annualised capital costs and annual fixed operating and maintenance (O&M) costs, expressed per unit of Flexible Capacity Credit and Peak Capacity Credit that is expected to be assigned to the Flexible Benchmark Capacity Provider and Peak Benchmark Capacity Provider respectively.

In December 2023, the Coordinator determined the Benchmark Capacity Providers – for both the Flexible BRCP and Peak BRCP – as lithium-ion Battery Energy Storage System (BESS) with 200-megawatt (MW) injection and 800-megawatt hour (MWh) storage capacity connected at a 330-kilovolt (kV) transmission line near Kwinana or Pinjar.[2] Previously the single BRCP was based on the cost of a 160 MW open cycle gas turbine (OCGT).

Under the WEM Rules, the ERA must review the WEM Procedure outlining the method to determine the BRCP within one year of the Coordinator's decision.[3] Any amendments to the WEM Procedure must be consistent with the WEM objectives, the WEM Rules and the overarching legislative instruments.[4] Prior to amending a WEM Procedure, the ERA must publish a procedure change proposal for stakeholder feedback.[5]

To develop this procedure change proposal, the ERA consulted with an industry working group established by the Market Advisory Committee (MAC) to advise the ERA on its review of the WEM Procedure. The ERA also engaged GHD to provide technical advice on the cost components, estimation method and drivers of BESS technologies.

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1 A capacity credit is a notional unit equivalent to 1 megawatt (MW) of capacity provided by a facility during a capacity year that reflects the contribution of facility to meeting the reliability standard of the system. Capacity suppliers receive payments consistent with the number of capacity credits they hold, and in return, commit to providing their capacity to AEMO in a capacity year. The capacity payments provide incentives for investment when the system requires new capacity.

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

3 Wholesale Electricity Market Rules (WA), 1 April 2024, Clause 4.16.9(b), (online).

4 The overarching legislative instruments include the *Electricity Industry Act 2004* and the *Electricity Industry (Wholesale Electricity Market) Regulations 2004.* See: Wholesale Electricity Market Rules (WA), 1 April 2024, Clause 2.9.3, (online).

5 Wholesale Electricity Market Rules (WA), 1 April 2024, Clause 2.10.5B, (online).

This procedure change proposal outlines the ERA's reasons for its proposed amendments of the WEM Procedure. The ERA's proposed changes include:

- Changes to capital cost and fixed O&M cost components and estimation methods driven by the change in the reference technology from an OCGT to BESS.
- Greater detail on the Benchmark Capacity Providers' technical specifications and operating assumptions to give effect to the Coordinator's determination.
- Introducing a mechanism to address investors' expectation of future decrease in BESS capital costs due to technological advances and manufacturing economies of scale – to appropriately incentivise investment in capacity.

The ERA notes the change in the reference technology underlying the BRCP determination – and the resulting changes to the determination method as outlined in the WEM Procedure – can notably push the BRCPs higher in the medium-term compared to the expected BRCP based on the previous OCGT reference technology. This could result in higher reserve capacity prices in the near future, raising the overall supply cost of electricity to consumers.

The ERA expects to complete its review of the WEM Procedure by July 2024, so the updated WEM Procedure can be used for the ERA's 2025 determination – which must be completed by 15 January 2025 – and apply for the 2027/28 Capacity Year.

The ERA is seeking stakeholder feedback on the amendments as proposed in this paper, including the draft new WEM Procedure provided in Appendix 2. The ERA will consider this feedback in developing the procedure change report and updated WEM Procedure, which will take effect on a date specified by the ERA.

1. Introduction

To ensure reliable supply of electricity, generation needs to continuously meet consumer demand. To achieve this in Western Australia, the RCM provides an investment signal to install capacity in the South West Interconnected System (SWIS).

The Australian Energy Market Operator (AEMO) procures capacity two years in advance of a capacity year.[6] AEMO uses the reliability planning criterion outlined in the WEM Rules to establish the reserve capacity targets, which is the level of capacity required to maintain system adequacy.[7] AEMO then invites capacity suppliers to offer their capacity and assigns capacity credits to those suppliers consistent with their estimated contribution to meeting the planning criterion.[8] Capacity suppliers receive payments consistent with the number of Flexible Capacity Credits and Peak Capacity Credits they hold, and in return, commit to providing their Flexible Capacity and Peak Capacity to AEMO in the capacity year. The capacity payments provide incentives for investment when the system requires new capacity. Electricity retailers fund the procurement of capacity and recover their cost from consumers through retail electricity tariffs.[9]

The WEM Rules specify reserve capacity price curves to calculate the price of Flexible Capacity Credits and Peak Capacity Credits respectively, expressed in dollars per megawatt per year ($/MW/Year), for a capacity year.[10] The prices of Flexible Capacity Credits and Peak Capacity Credits depend on the Flexible BRCP and Peak BRCP respectively, and the level of excess capacity in the WEM relative to the capacity required in the planning criterion.[11]

The BRCPs are based on the lowest annualised capital cost and annual fixed O&M cost of a benchmark new entrant facility that can provide capacity to the SWIS for a capacity year commencing two years into the future.[12]

The ERA must determine the BRCP annually using a WEM Procedure.[13] 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 providers, where the Coordinator determines a change in the technology of the benchmark capacity provider.[14,15]

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

7 Wholesale Electricity Market Rules (WA), 1 April 2024, Rule 4.5.9, (online).

8 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.

9 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.

10 Wholesale Electricity Market Rules (WA), 1 April 2024, Clause 4.29.1, (online).

11 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. Coordinator of Energy, 2023, *BRCP Reference Technology Review, Consultation paper*, p. 9, (online).

12 Wholesale Electricity Market Rules (WA), 1 April 2024, Rules 4.16.1 and 4.16.2, (online).

13 Ibid, Rule 4.16.9.

14 Ibid, Rule 4.16.9(b).

15 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).

To conduct 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*.[16]
- Follow the procedure change process outlined in the WEM Rules and a WEM Procedure.[17,18] These obligations are summarised in section 1.1.1.

This procedure change proposal is published as part of the ERA's review of the WEM Procedure and proposes the ERA's amendments to the WEM Procedure for stakeholder consultation.[19] This paper is organised as follows:

- The rest of 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.
- Chapter 3 outlines proposed changes to the WEM Procedure and the ERA's reasons for change.
- The draft proposed WEM Procedure is provided in Appendix 2.

1.1.1 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.[20,21] Any person can make a submission to the ERA using the form provided in Appendix 1.[22]

The ERA may seek advice from the Market Advisory Committee (MAC) when conducting this review.[23] 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.[24]

After considering stakeholder feedback on its proposal, the ERA will 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 submission.
- 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.

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16 Wholesale Electricity Market Rules (WA), 1 April 2024, Rule 2.9.3(a), (online).

17 Ibid, Rule 2.10.

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

19 To amend a WEM Procedure, the ERA must publish a procedure change proposal which includes the proposed replacement of the WEM Procedure and the reasons for the replacement. Wholesale Electricity Market Rules (WA), 1 April 2024, Rule 2.10.6, (online).

20 Wholesale Electricity Market Rules (WA), 1 April 2024, Rule 2.10.13, (online).

21 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), 1 April 2024, Rules 2.10.17 and 2.10.18, (online).

22 Wholesale Electricity Market Rules (WA), 1 April 2024, Rule 2.10.7, (online).

23 Ibid, Rule 2.10.9.

24 Ibid, Rule 2.3.17.

- 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.[25]

1.2 Changes to the WEM design

Through the Energy Transformation Strategy, the State Government is implementing reforms to improve the effectiveness of the WEM.[26] Changes to the WEM now allow BESS to participate in the real-time energy and ESS markets and receive capacity credits.[27] There are further reforms currently underway.[28]

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. This is designed to complement the existing capacity product, now called "Peak Capacity", which is reserve capacity that contributes to meeting system peak demand. As a result, the ERA must determine two BRCP from its next determination – a Peak BRCP and a Flexible BRCP.[29,30]

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

- The appropriate reference technology (the benchmark capacity providers) and the underlying technical parameters such as size and capabilities.[31]
- The uncongested network location.
- Whether the BRCP is to be assessed based on a gross or net Cost of New Entry (CONE).[32,33]

In December 2023, the Coordinator determined that both Flexible and Peak Benchmark Capacity Providers must be 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

25 Wholesale Electricity Market Rules (WA), 1 April 2024, Rules 2.10.10 and 2.10.12B, (online).

26 Government of Western Australia, *Energy Transformation Strategy*, (online).

27 An explanation of the new market design is available at: Australian Energy Market Operator, 2023, *Wholesale Electricity Market Design Summary*, (online).

28 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, *Reserve Capacity Mechanism Review*, (online).

29 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.

30 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.

31 Benchmark Capacity Providers comprise of Benchmark Peak Capacity Provider and Benchmark Flexible Capacity Provider. Benchmark Peak Capacity Provider is a notional new facility of the Facility Technology Type which can provide Peak Capacity at the lowest annual capital cost and annual fixed operating and maintenance costs as determined by the Coordinator of Energy. Benchmark Flexible Capacity Provider is a notional new Facility of the Facility Technology Type which 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), 1 April 2024, Rule 4.16.11, (online).

32 Wholesale Electricity Market Rules (WA), 1 April 2024, Rule 4.16.12, (online).

33 Gross CONE represents total capital investment and fixed costs the marginal new entrant reference facility (benchmark capacity provider) incurs to enter the market. Net CONE represents 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.

(kV) transmission line.[34] The Coordinator also determined that the BRCP will be calculated on a gross CONE basis, consistent with the current approach to determine the BRCP.[35,36]

1.2.1 Current WEM Procedure

The current WEM Procedure outlines the method to determine the BRCP based on the expected cost incurred to develop the previous reference facility, which was a 160 MW distillate-fuelled open-cycle gas turbine (OCGT). The calculation estimates the following components:

- Total capital cost comprising engineering, procurement and construction costs, transmission interconnection costs, fixed fuel cost, land cost, a contingency margin, and 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 – currently set equal to 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:

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

Following the Coordinator's determination of the benchmark capacity providers and changes to the WEM design, the current WEM Procedure needs to be updated. Given the significant number of amendments required to update it in line with the reforms, the ERA proposes to replace the WEM Procedure entirely rather than amend specific clauses. Therefore, a marked-up copy of the WEM Procedure would not be helpful and is not included with this proposal. Appendix 2 provides the draft updated WEM Procedure for stakeholder feedback.

The ERA previously reviewed the WEM Procedure in 2020.[37] The scope of that review was limited to the WACC component of the BRCP due to overlaps with ongoing market reforms at the time.[38] In recent annual BRCP determinations, various stakeholders have also raised

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

35 Ibid.

36 In 2022, the Minister for Energy provided the Coordinator of Energy with a draft statement of policy principles to apply penalties on 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).

37 Economic Regulation Authority, 2020, *EEPC_2020_02, Review of the BRCP Market Procedure,* (online).

38 The WACC is a component of the development of the reference technology's capital costs and is discussed further in section 3.5.2 of this paper.

concern that the current calculation method of the BRCP has several shortcomings which also must be reviewed.[39]

1.3 Stakeholder feedback

1.3.1 Industry working group

In November 2023, the MAC established a working group to advise the ERA on this review.[40,41] The ERA considered the working group's feedback when developing this procedure change proposal.[42]

The working group will consider the procedure change proposal at its meeting in April 2024.

1.3.2 Call for submissions

The ERA is seeking stakeholder feedback on its proposed WEM Procedure. Stakeholders are encouraged to seek clarification or further details on the contents of the WEM Procedure if required.

The ERA intends to complete its review by July 2024 so the updated WEM Procedure is in effect for the ERA's determination of the 2025 BRCP, which applies for the 2027/28 capacity year and must be completed by 15 January 2025.[43]

To support its review of the WEM Procedure, the ERA is particularly interested in receiving responses to the following questions. These questions are presented throughout the paper and listed below.

Questions for stakeholders

1. Should the BESS sub-chemistry be specified in the WEM Procedure? **[Section 3.2.1]**
2. Is the lithium iron phosphate BESS a reasonable lithium sub-chemistry for the WEM Procedure? **[Section 3.2.1]**
3. Is the proposed approach for specifying that the Benchmark Capacity Providers must achieve 200 MW injection capacity and 800 MWh energy storage on day 1 of operation reasonable? **[Section 3.2.2]**
4. Is it reasonable for the WEM Procedure to *not* specify the degree of oversizing required for the Benchmark Capacity Providers to achieve 200 MW injection capacity and 800 MWh energy storage? **[Section 3.2.2]**

[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] Market Advisory Committee, 23 November 2023, *Meeting Minutes – Item 9,* (online).

[41] 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: Economic Regulation Authority, 2023, *WEM Procedure: Benchmark Reserve Capacity Price Review Working Group,* (online).

[42] Ibid.

[43] Wholesale Electricity Market Rules (WA), 1 April 2024, Rules 1.63.2 and 4.16.1, (online).

5. Is the process outlined in section 3.4 of the proposed WEM Procedure a reasonable approach for estimating transmission costs of the Benchmark Capacity Providers? **[Section 3.3.2.1]**
6. Is estimating land costs as single, average land cost based on average land prices across the Kwinana and Pinjar regions a reasonable approach for the WEM Procedure? **[Section 3.3.3]**
7. What is a reasonable approach to account for the treatment of expected degradation of the Benchmark Capacity Providers? **[Section 3.3.3.1]**
8. Is it reasonable for the WEM Procedure to specify a 15-year capital annuity period? **[Section 3.5.1]**
9. Is it reasonable to retain the nominal pre-tax WACC for the purpose of estimating a long-term required rate of return? **[Section 3.5.2]**
10. Is it reasonable to retain the Annual Components (risk free rate, debt risk premium and corporate tax rate) and Fixed Components (market risk premium, equity beta, debt issuance costs, franking credit value and gearing ratio) of the WACC? **[Section 3.5.2]**
11. After considering new information and sources related to BESS projects, is it reasonable to increase the equity beta? **[Section 3.5.2]**
12. Is the annuity tilting approach a reasonable method to account for the expected decrease in BESS capital costs? **[Section 3.5.3]**
13. Is it reasonable to specify the value of the tilt multiplier (1.24) in the WEM Procedure? **[Section 3.5.3]**
14. Is it reasonable to estimate capital costs of the Benchmark Capacity Providers as at 1 April of Year 3 of the Reserve Capacity Year? **[Section 3.6]**
15. Is it reasonable to estimate fixed O&M costs of the Benchmark Capacity Providers as at 1 October of Year 3 of the Reserve Capacity Year? **[Section 3.6]**
16. Is it reasonable to use the WACC to account for the cost of capital in the period between the investor raising the capital and receiving revenue from capacity credits? **[Section 3.6]**

General questions for feedback on all procedure change proposals:

17. Please provide your views on the procedure change proposal, including any objections or suggested revisions.
18. Please provide an assessment whether the Procedure Change Proposal is consistent with the WEM Objectives and the WEM Rules.
19. Please indicate if the procedure change proposal will have any implications for your organisation (for example changes to your IT or business systems) and any costs involved in implementing these changes.
20. Please indicate the time required for your organisation to implement the changes, should they be accepted as proposed.

2. Scope and framework 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 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 Flexible BRCP and Peak BRCP that:

- Reflects 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 which suitably aligns with 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 in the SWIS for the relevant capacity year.
- Is clear and unambiguous in its interpretation; provides certainty to industry on how the BRCP will be determined annually; and complements the energy market reforms.
- Is consistent with the WEM Objectives, WEM Rules, the Electricity Industry Act and Regulations.

To fulfil the objectives 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 3.5.3.

Second, the ERA identified 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. GHD's draft report is available in Appendix 4. To demonstrate the application of its recommended cost estimation methods and guide the development of changes to the Procedure, GHD conducted a bottom-up evaluation and produced an indicative BRCP, which is included in its draft report.

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 be reviewed in the

ERA's annual BRCP determinations.[44] 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 will provide transparency and certainty for investors. This is discussed further in section 3.2.1.

Chapter 3 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 mechanism 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, including reasonable methods to estimate those costs.

4. Method to annualise capital costs: As capital costs are fixed costs that are incurred at the start of the project, the costs must be annualised to derive an annualised capital cost for the BRCP. The WEM Procedure must provide guidance on how to determine an annualised capital cost. This includes guidance on 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.

5. 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.

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

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

2.1 Matters outside the ERA's scope

As part of the review of the WEM Procedure, the ERA will not review the parameters of the BRCP 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.[45]

Given the Coordinator has determined an unconstrained network location for the Benchmark Capacity Providers, the application of network access quantities (NAQ) will not affect the allocation of capacity credits and therefore the method to determine the BRCP.[46] The ERA's

[44] The ERA cannot specify a fixed value in the WEM Procedure for a parameter that is likely change from year to year. Instead, the ERA must specify principles or procedures for determining that parameter. Wholesale Electricity Market Rules (WA), 1 April 2024, Rule 4.16.4, (online).

[45] Wholesale Electricity Market Rules (WA), 1 April 2024, Rule 4.16.12, (online).

[46] The NAQ 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 NAQ. See: Wholesale Electricity Market Rules (WA), 1 April 2024, Clause 4.15, (online).

future reviews of the WEM Procedure may have to consider the timing and effect of NAQ if the Coordinator determines a constrained network location.

The Coordinator has indicated it may review its determination of the Benchmark Capacity Providers more frequently if the reference technology costs materially change before its next triennial determination.[47] A change in the Coordinator's determination of Benchmark Capacity Providers requires the ERA to review the WEM Procedure within one year. The ERA can review the WEM Procedure more frequently than once every five years. The ERA must consult with stakeholders when it reviews the WEM Procedure.

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

3. Proposed amendments to the WEM Procedure

This chapter outlines the ERA's proposed amendments to the WEM Procedure. The relevant clauses of the proposed WEM Procedure (Appendix 2) are noted in the yellow boxes. Questions for stakeholder feedback are highlighted in grey boxes.

3.1 Flexible BRCP and Peak BRCP

As explained in Chapter 1, the WEM Procedure must provide guidance on determining both Flexible BRCP and Peak BRCP. 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 Flexible BRCP and Peak BRCP.[48,49,50]

To avoid repetition, the WEM Procedure is drafted to provide guidance on both Flexible BRCP and Peak BRCP together. A reference to the BRCPs in the WEM Procedure is a reference to both Flexible BRCP and Peak BRCP, unless particularly expressed. Similarly, a reference to Capacity Credits in the WEM Procedure is a reference to both Flexible Capacity Credits and Peak Capacity Credits, unless particularly expressed.

If the Coordinator's future determinations results in different Peak and Flexible Benchmark Capacity Providers – resulting in different methods to determine Peak BRCP and Flexible BRCP respectively – the ERA will review and amend the WEM Procedure accordingly.

48 Facilities receiving Flexible Capacity Credits must meet all the same requirements as Peak Capacity Credits and the ramping requirements as 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 Amendment (Reserve Capacity Reform) Rules 2023*, Rule 4.20.5A(a). This rule is not yet in force and is awaiting commencement by the Minister for Energy, (online).

49 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 3.2.2 of this paper and detailed in GHD's report. GHD's draft report is provided in Appendix 4. See: GHD, 2024, *Benchmark lithium BESS costs, BRCP procedure update*, Report for the Economic Regulation Authority, p.4.

50 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 Amendment (Reserve Capacity Reform) Rules 2023*, Rule 4.20.5A(a). This rule is not yet in force and is awaiting commencement by the Minister for Energy, (online).

Proposed 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 2.1.5 summarises the Coordinator's determination of the Benchmark Reserve Capacity Providers.
- 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 2.2.3 outlines the formula for determining the BRCPs.
- Clause 2.1.6 outlines the same design specifications for both Benchmark Capacity Providers.

3.2 BESS technical specifications

3.2.1 BESS sub-chemistry

The Coordinator determined that the Peak and Flexible Benchmark Capacity Providers must be lithium-ion BESS. Lithium-ion BESS battery cells consist of various sub-chemistries.[51] Battery 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.

The ERA proposes to specify that the Benchmark Capacity Providers are a lithium iron phosphate (LFP) BESS in the WEM Procedure. The ERA considered GHD's advice 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 – compared to other lithium sub-chemistries.[52]

Given the preferred qualities of the LFP sub-chemistry and the fact 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 reasonable for the

[51] For instance, common lithium sub-chemistries include nickel manganese cobalt (NMC), nickel cobalt aluminium (NCA) and titanate (LTO). GHD's draft report is provided in Appendix 4. See: GHD, 2024, *Benchmark lithium BESS costs, BRCP procedure update*, Report for the Economic Regulation Authority, p.5.

[52] GHD's draft report is provided in Appendix 4. See: GHD, 2024, *Benchmark lithium BESS costs, BRCP procedure update*, Report for the Economic Regulation Authority, p.7.

purpose of the BRCP determination.[53] Feedback from the MAC working group was generally supportive of this recommendation.[54]

The ERA may review the appropriateness of specifying any sub-chemistry, and the LFP sub-chemistry in particular, as part of its future reviews of the WEM Procedure. This is supported by GHD's recommendation to review the choice of sub-chemistry in three years' time as BESS technologies continue evolving.

Proposed WEM Procedure

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

Questions for stakeholders

1. Should the BESS sub-chemistry be specified in the WEM Procedure?
2. Is the LFP BESS a reasonable lithium sub-chemistry for the WEM Procedure?

3.2.2 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 BESSs, which are classified as electric storage resources in the WEM Rules, they are likely to 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.[55,56]

The ERA assumes 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.[57]

To achieve this capability, the ERA adopts GHD's recommendation that the Benchmark Capacity Providers be sized in a way to provide 200 MW injection capacity and 800 MWh energy storage.[58] The sizing accounts for the BESS's:

- Energy capacity degradation caused by 'calendar fade' and high ambient temperatures.[59]
- Power capacity characteristics that can vary based on the requirements in the WEM Rules.[60]

53 Ibid.

54 BRCP WEM Procedure Review Working Group, 6 February 2024, Meeting minutes, Item 3.1, (online).

55 Wholesale Electricity Market Rules (WA), 1 April 2024, Rules 4.10.1(fA)(ii), 4.11.3 and 4.11.3A, (online).

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

57 Wholesale Electricity Market Rules (WA), 1 April 2024, Rule 4.1.29, (online).

58 GHD's draft report is provided in Appendix 4. See: GHD, 2024, *Benchmark lithium BESS costs, BRCP procedure update*, Report for the Economic Regulation Authority, p.18.

59 Calendar fade is a type of battery degradation that occurs irrespective of how often or whether the BESS is operational. For instance, the battery containers will degrade over the delivery and installation period.

60 For instance, the WEM Rules specify certain voltage stability requirements and generator performance standards that require the BESS to ensure sufficient reactive power at the point of connection and

The ERA proposes 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 BESS design and the WEM Rule requirements. This is consistent with GHD's recommendation.[61]

The ERA proposes that the WEM Procedure will specify that the ERA will evaluate, as part of its annual BRCP determinations, the factors affecting power and energy capacity requirements to identify the appropriate sizing to achieve the Coordinator's determination of the Benchmark Capacity Providers.

Proposed 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.

continuous control of reactive power compensation. Wholesale Electricity Market Rules (WA), 1 April 2024, Rules A12.4.2, A12.3.3.3, (online).

61 GHD's draft report is provided in Appendix 4. See: GHD, 2024, *Benchmark lithium BESS costs, BRCP procedure update*, Report for the Economic Regulation Authority, p. 19.

Questions for stakeholders

3. Is the proposed approach for specifying that the Benchmark Capacity Providers must achieve 200 MW injection capacity and 800 MWh energy storage on day 1 of operation reasonable?
4. Is it reasonable for the WEM Procedure to *not* specify the degree of sizing required for the Benchmark Capacity Providers to achieve 200 MW injection capacity and 800 MWh energy storage?

3.3 Capital costs

The ERA sought advice from GHD on capital cost components of a BESS.[62] GHD advised that capital costs account for approximately 95 per cent of the estimated BRCP and typically include the following components:

- BESS supply and installation costs.
- 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.

Proposed 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.

3.3.1 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 Benchmark Capacity Providers and typically include all enabling electrical infrastructure, cables, conduits, transformers, switchgear, protection and control equipment for the BESS and its substation.

[62] GHD's draft report is provided in Appendix 4. See: GHD, 2024, *Benchmark lithium BESS costs, BRCP procedure update*, Report for the Economic Regulation Authority, p. 20.

- Civil balance of plant that are infrastructure costs incurred in developing the Benchmark Capacity Providers that typically includes the foundations, transformer bunds, and equipment pads for the BESS and its substation.
- Installation labour and temporary equipment hire that typically includes 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 proposes the WEM Procedure specifies 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.

Proposed 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 system, electrical and control balance of plant incurred in developing the Benchmark Capacity Providers, civil balance of plant, and installation labour and temporary equipment hire.

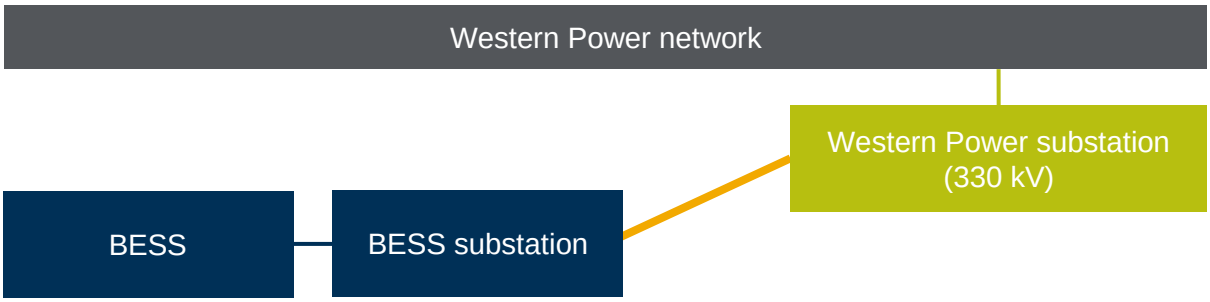
3.3.2 Transmission connection cost

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 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 below.

Figure 1: Stylised illustration of the transmission connection arrangement



Source: ERA

There are two main factors that affect the estimate of transmission connection costs:

1. 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 utilise existing infrastructure and reduce costs associated with building the required infrastructure.

2. Availability and cost of acquiring land within the regions specified by the Coordinator – Kwinana and Pinjar – that is in proximity of existing shared transmission infrastructure.[63]

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.

- First, 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.[64]
- Second, a site-specific approach may be considered 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.
- Third, 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 significant increase in the resources and time required for analysis –

63 As noted in section 1.2, 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 3.3.3.

64 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: Energy Policy WA, Market Advisory Committee, *Meeting Agenda, 8 February 2024, Item 6 – Western Power: Update on Transmission Network Infrastructure*, (online).

and the resulting cost to industry – without a corresponding significant impact on the estimated overall BRCP.[65,66]

3.3.2.1 The ERA's proposed approach

In proposing its approach 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.

The ERA proposes that the approach to estimate transmission costs include:

- Costs to develop a 330 kV substation that will be dedicated to the Benchmark Capacity Provider and owned by Western Power.[67] 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 line 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.[68] 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.

The ERA's next review of the WEM Procedure may consider the appropriateness of the site-specific approach to estimate transmission costs as the SWISDA upgrades are completed and there is greater certainty in estimating costs.

65 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.

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

67 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, (online).

68 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.

Proposed WEM Procedure

- Clause 3.4.1 requires the ERA to estimate the costs to connect a Benchmark Capacity Provider to the transmission network.
- Clauses 3.4.2 to 3.4.5 explain how the ERA may seek a provider (like Western Power or a reasonable alternative) to estimate transmission costs.
- 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.

Question for stakeholders

5. Is the process outlined in section 3.4 of the proposed WEM Procedure a reasonable approach for estimating transmission costs of the Benchmark Capacity Providers?

3.3.3 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, a substation, and transmission network connection assets such as the Western Power substation and buffer zones.

GHD advised that a land size of 6.5 hectares is sufficient for the purpose of the BRCP determination.[69] 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.[70]

As noted earlier, the Coordinator determined that the Benchmark Capacity Providers must be located near Kwinana or Pinjar on a 330kV transmission line.[71] The ERA considered various

[69] 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 draft report is provided in Appendix 4. See: GHD, 2024, *Benchmark lithium BESS costs, BRCP procedure update*, Report for the Economic Regulation Authority, p. 18.

[70] Ibid.

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

methods to determine land cost that fulfils the Coordinator's determination and complement the ERA's approach to estimate transmission costs.[72,73]

The ERA proposes the WEM Procedure specifies that the ERA must estimate a single, average land cost based on average land prices across the Kwinana and Pinjar regions. As explained in section 3.3.2, the ERA considered the availability of existing transmission infrastructure as well as the availability of land in both regions.[74,75]

The ERA considers 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 3.3.2, and is also consistent with the method to estimate the land cost input in the current BRCP determination method.

Proposed WEM Procedure

- Clause 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.

Question for stakeholders

6. Is estimating land costs as single, average land cost based on average land prices across the Kwinana and Pinjar regions a reasonable approach for the WEM Procedure?

3.3.3.1 Future-proofing for BESS degradation

As noted in section 3.2, a BESS's energy and power capacity degrades over time due to various reasons. Degradation costs associated with cycling of BESS vary with the production of energy and essential system services and can be included in offers in the Real-Time Market.

72 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.

73 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.

74 See section 3.3.2 for a discussion on the availability of 330 kV lines.

75 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.

When making an investment decision, a BESS investor will consider the effect of BESS degradation on its expected capacity credit revenue over time.[76] 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.

While the costs incurred to augment lower capacity would be recovered through the Real-Time Market – consistent with the ERA's Offer Construction Guideline – the ERA is considering how the WEM Procedure can emulate the decision-making process of an investor that would allow for the optionality to augment a BESS's lower capacity due to degradation in the future.[77]

The ERA is seeking feedback on how the WEM Procedure can address a BESS investor's treatment of expected BESS degradation. For instance, the ERA is considering whether the WEM Procedure must stipulate 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.

Question for stakeholders

7. What is a reasonable approach to account for the treatment of expected degradation of the Benchmark Capacity Providers?

3.3.4 Other costs

GHD advised that there are various other capital cost components of the Benchmark Capacity Providers.[78] 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 agreement with Western Power.[79]
  - Market registration and certification of reserve capacity with AEMO.[80]
  - Obtaining a generation licence from the ERA.[81]

[76] Degradation is expected to progressively reduce the number of capacity credits that can be assigned to a BESS, and therefore reduce capacity revenues over time.

[77] Economic Regulation Authority, 2023, *Offer Construction Guideline*, (online).

[78] GHD's draft report is provided in Appendix 4. See: GHD, 2024, *Benchmark lithium BESS costs, BRCP procedure update*, Report for the Economic Regulation Authority, p. 23.

[79] 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 draft report is provided in Appendix 4. See: GHD, 2024, *Benchmark lithium BESS costs, BRCP procedure update*, Report for the Economic Regulation Authority, pp. 23-24.

[80] 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 draft report is provided in Appendix 4. See: GHD, 2024, *Benchmark lithium BESS costs, BRCP procedure update*, Report for the Economic Regulation Authority, pp. 24-25.

[81] Electricity generators with capacity less than 100 MW must obtain a generation licence from the ERA as part of the construction process. GHD's draft report is provided in Appendix 4. See: GHD, 2024, *Benchmark lithium BESS costs, BRCP procedure update*, Report for the Economic Regulation Authority, p. 25.

- Obtaining environmental, development and building approvals associated with the development and construction of the BESS.[82]
- Obtaining project management and owner's engineer 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.[83]

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

The ERA proposes that the WEM Procedure specify 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.

82 For instance, this may include costs associated with obtaining environmental approvals under *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 *Dangerous Goods Safety (Storage and Handling of Non-explosives) Regulations 2007*. GHD's draft report is provided in Appendix 4. See: GHD, 2024, *Benchmark lithium BESS costs, BRCP procedure update*, Report for the Economic Regulation Authority, pp. 26-29.

83 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 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 draft report is provided in Appendix 4. See: GHD, 2024, *Benchmark lithium BESS costs, BRCP procedure update*, Report for the Economic Regulation Authority, pp. 31-33.

Proposed WEM Procedure

Clauses 3.6.1, 3.7.1, 3.7.3, 3.8.1, 3.9.1 and 3.2.1(a) require the ERA to estimate the:

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

3.4 Fixed O&M costs

The ERA sought advice from GHD on fixed O&M cost components of the BESS.[84] 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 include costs of electrical testing, inspections and preventative maintenance on the primary and secondary electrical equipment, structures, footing, buildings and civil items as well costs of section, inspection and preventative maintenance of inverter stations, battery modules, racks, 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.[85]

[84] GHD's draft report is provided in Appendix 4. See: GHD, 2024, *Benchmark lithium BESS costs, BRCP procedure update*, Report for the Economic Regulation Authority, pp. 35-39.

[85] 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 Western Power price list sets out the price of their transmission services charges.

The ERA proposes the WEM Procedure specify 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.

Proposed 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.

3.5 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 3.3)
- annualisation period (section 3.5.1)
- rate of return (section 3.5.2)
- annuity tilt (section 3.5.3).

3.5.1 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 return on capital (financing costs).

The ERA considers the annuity period must be specified in the WEM Procedure to provide certainty to industry on the period they can recover their costs over and provide appropriate price signals for future investment in generation capacity.[86]

To determine 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 well as advice from GHD, industry and financial institutions that typically finance BESS projects. The ERA proposes 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.

First, 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

[86] This is consistent with the approach in the current WEM Procedure, that determines the BRCP based on an OCGT, and specifies an annualisation period of 15 years. The current WEM Procedure is provided in Appendix 3.

currently a degree of uncertainty regarding the technical life.[87] Given the variability of actual technical life of BESS elements, investors generally look at the manufacturer warranties for the critical limiting elements. For a BESS, this element is the battery modules, and the warranty can vary depending on the type of degradation warrantied.[88] Warranties of components is typically shorter than the technical life of the whole asset.

Second, the ERA considered common contracted periods and the terms of finance available for grid-scale BESS projects in Australia to evaluate typical investor expectations of 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.[89] 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 economic life of the technology.[90,91] In response to the Coordinator's consultation paper, Synergy and Clean Energy Council considered a 25-year life to be too optimistic and provided that the BRCP determination method should align with market participants' expectation of economic life of electricity storage resource.[92] While the ERA acknowledges that the Coordinator's assumption of a 25-year period was adopted for the purpose of comparing technologies, the ERA considers a 25-year period is not likely to align with investors' expectation of BESS capital returns and therefore be against the purpose of the BRCP mechanism.

The ERA's proposed 15-year annuity period considers the guardrails of the BESS technology's end of the warranty period and potential technical life. The ERA acknowledges that the 15-year period may expose investors to 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

87 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. Typical lives of inverters, which are another key component of a BESS, also varies but is typically up to 20 years. GHD's draft report is provided in Appendix 4. See: GHD, 2024, *Benchmark lithium BESS costs, BRCP procedure update*, Report for the Economic Regulation Authority, pp. 11-16.

88 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. See GHD's draft report for further detail. GHD's draft report is provided in Appendix 4. See: GHD, 2024, *Benchmark lithium BESS costs, BRCP procedure update*, Report for the Economic Regulation Authority, pp. 11-16.

89 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, Meeting minutes, Item 3.3, (online).

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

91 The Coordinator noted the assumptions in its determination were included for the purpose of comparing reference technologies only and 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,* (online).

92 Ibid.

technical life – given that the BESS is a new technology – which may act a disincentive to investment. A 15-year annuity period also aligns with investors' expectations and project financing periods, while also remaining consistent with the annuity period in the current WEM Procedure (which is based on an OCGT as the reference technology). Setting an annuity period less than the technical life is not inconsistent with the approach for the previous gas plant reference technology.[93]

Proposed WEM Procedure

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

Question for stakeholders

8. Is it reasonable for the WEM Procedure to specify a 15-year capital annuity period?

3.5.2 Rate of return – WACC

The BRCP estimates 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 analysis.[94] 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 current WEM Procedure calculates a WACC to:

93 The BRCP annualisation period for the previous reference technology – an OCGT – was 15 years, compared to a longer technology life of 50 years.

94 The current WEM Procedure is provided in Appendix 3. See: *Market Procedure: Benchmark Reserve Capacity Price*, Version 7, Clause 2.9.

- 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.[95]
- 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.[96] As part of this review, the ERA has considered which WACC parameters must be updated through annual BRCP 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.[97,98] The ERA's analysis of the above is presented in Appendix 5 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.

To determine the rate of return for the BRCP in the WEM Procedure, the ERA proposes that the WEM Procedure:

- Retain a nominal pre-tax WACC, consistent with the current WEM Procedure.
- Retain the following sets 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.

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95 Ibid.

96 Wholesale Electricity Market Rules (WA), 1 April 2024, Rule 4.16.4, (online).

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

98 Synergies Economic Consulting, 2022, *Updating the ISP Discount Rate, A report produced for the Australian Energy Market Operator*, (online).

- Update the value of the market risk premium from 5.9 to 5.8, to current market conditions.
- Update the value of the debt issuance cost parameter from 0.100 per cent to 0.165 per cent, based on the 2022 gas rate of return instrument.[99]

Detailed analysis underlying the ERA's proposal related to the WACC parameters are presented in Appendix 5.

Proposed 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.

Question for stakeholders

9. Is it reasonable to retain the nominal pre-tax WACC for the purpose of estimating a long-term required rate of return?
10. Is it reasonable to retain the Annual Components (risk free rate, debt risk premium and corporate tax rate) and Fixed Components (market risk premium, equity beta, debt issuance costs, franking credit value and gearing ratio) of the WACC?
11. After considering new information and sources related to BESS projects, is it reasonable to increase the equity beta?

3.5.3 Annuity tilt

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.[100]

[99] Economic Regulation Authority, 2023, *2022 final gas rate of return instrument*, Amended 12 September 2023, (online).

[100] Bloomberg New Energy Finance, 2023, *Lithium-Ion Battery Pack Prices Hit Record Low of $139/kWh*, (online).

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 through 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) 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.

The ERA considers 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 of 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.

Based on the information available on the trajectory of BESS capital cost reductions, the ERA proposes that the WEM Procedure specifies an annuity tilt factor of 1.24. This tilt factor aligns with the more traditional approach used for straight-line depreciation in electricity and gas network regulation and is based on an assumption that BESS capital costs reduce by 4.4 per cent per year. This tilt also has been adjusted to handle net present value changes that result from annual changes to the BRCP. That is, the tilt factor targets keeping investors whole, or net present value neutral, by recognising ongoing reductions in BRCP revenues from BESS capital cost reductions. Further details regarding the tilting annuity are presented in Appendix 6 and Appendix 7.

The ERA proposes that the tilt factor remain fixed until the ERA's next review of the WEM Procedure. This provides more certainty to investors and is not unduly affected by the variability of yearly changes in cost. BESS costs are likely to stabilise as the BESS technology matures. As the BESS costs stabilise, the tilt factor can progressively be reduced towards 1, at which time it will reflect the constant annuity payment.

Proposed 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 1.24 of the constant annuity amount which is fixed in this Procedure until the next review.
$CAPITAL\ COST_{Annualised}$	$\boldsymbol{A} \times \boldsymbol{B}$

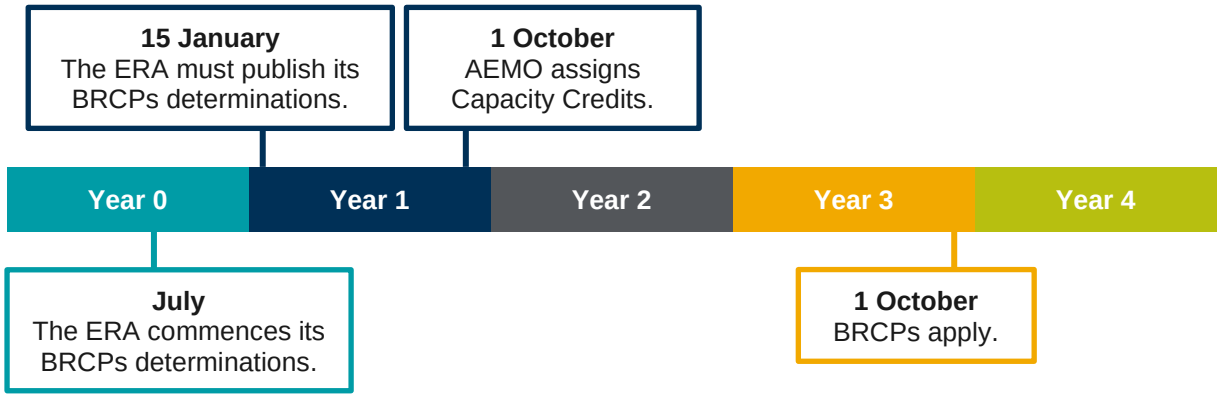
Questions for stakeholders

12. Is the annuity tilting approach a reasonable method to account for the expected decrease in BESS capital costs?
13. Is it reasonable to specify the value of the tilt multiplier (1.24) in the WEM Procedure?

3.6 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).[101]

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

[101] Wholesale Electricity Market Rules (WA), 1 April 2024, Chapter 4, (online).

of the new facility a few months in advance of 1 October, to account for any construction overruns and allow for facility commissioning.[102] For computational simplicity, the ERA proposes that the WEM Procedure assume that capital works are completed by 1 April of a reserve capacity year (that is, six months in advance of the date that the BRCP applies). This is consistent with the assumption in the current WEM Procedure.

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.[103] For instance, construction labour costs are expected to vary year on year due to changes in wages and inflation.[104]

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

- Capital costs using a reasonable 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.
- Fixed O&M costs using a reasonable 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.

The ERA may engage a consultant to advise on reasonable 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 proposes 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.

102 Wholesale Electricity Market Rules (WA), 1 April 2024, Rule 3.21A, (online).

103 Ibid, Rule 4.16.4.

104 GHD suggested various cost drivers and suggested data sources for cost escalation. GHD's draft report is provided in Appendix 4. See: GHD, 2024, *Benchmark lithium BESS costs, BRCP procedure update*, Report for the Economic Regulation Authority, pp. 40-45.

Proposed 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 Apil 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.
  - Under clause 5.2.1, 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.
  - 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.
- Clauses 3.1.1(e) defines the WACC within the formula for estimating capital costs.
- Clause 4.2.2(b) explains that purpose of the WACC includes accounting for cost of capital in the period between the investor raising capital and receiving revenue from capacity credits.

Questions for stakeholders

14. Is it reasonable to estimate capital costs of the Benchmark Capacity Providers as at 1 April of Year 3 of the Reserve Capacity Year?
15. Is it reasonable to estimate fixed O&M costs of the Benchmark Capacity Providers as at 1 October of Year 3 of the Reserve Capacity Year?
16. Is it reasonable to use the WACC to account for the cost of capital in the period between the investor raising the capital and receiving revenue from capacity credits?

3.7 Procedure administration

The ERA has proposed the following amendments to improve the readability of the WEM Procedure.

Proposed 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 the WEM Procedure explains all aspects of the BRCP.

Appendix 1 WEM procedure change proposal submission form

Anyone can make a submission relating to a Procedure Change Proposal, during the period indicated for public submissions.

Submissions must be made using the WEM Procedure Change Proposal submission form, which is published on EPWA's website and provided overleaf.[105]

[105] Energy Policy WA, 2023, *WEM Procedure changes*, (online).

WHOLESALE ELCTRICITY MARKET

Submission to Procedure Change Proposal

EEPC_2024_01
WEM Procedure: Benchmark Reserve Capacity Prices

Submitted by	
Name:	
Phone:	
Email:	
Organisation:	
Address:	
Date submitted:	

Submission

Clause 2.10.7 of the WEM Rules provides that any person may make a submission for a Procedure Change Proposal (including proposals developed by AEMO, the ERA, the Coordinator of Energy or a Network Operator) by completing this Procedure Change Submission form.

Submissions should be provided by email to the nominated contact in the call for submissions published with the Procedure Change Proposal.

Please provide your views on the Procedure Change Proposal, including any objections or suggested revisions.

Please provide an assessment whether the Procedure Change Proposal is consistent with the Market Objectives and the Wholesale Electricity Market Rules.

Please indicate if the Procedure Change Proposal will have any implications for your organisation (for example changes to your IT or business systems) and any costs involved in implementing these changes.

Please indicate the time required for your organisation to implement the changes, should they be accepted as proposed.

Appendix 2 Proposed WEM Procedure (draft)

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

Appendix 3 Current WEM Procedure

The current *WEM Procedure: BRCP* (version 7) is available on the ERA's website (online).

Appendix 4 GHD draft 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 is report is available on the ERA's website (online).

Appendix 5 Rate of return (WACC)

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 covers 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 existing 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 BRCPs determinations, 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 [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 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 new BRCP Procedure review. ERA's annual review involves two sets of components listed in clauses 2.9.3 and 2.9.8 of the existing WEM procedure (and 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 Procedures 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 1.

Table 1: ERA gearing analysis as at February 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 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.[106]

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 it.

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 proposes to fix the gearing ratio 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 proposed 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

The ERA is proposing to retain the current approach on debt in the WEM procedure.

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 2.9.7(g) of the existing WEM Procedure specifies 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:

[106] 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 2.9.7(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 2.9.7(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 2.9.7(i) of the 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 2.9.8 of the WEM Procedure states that the risk free rate is to be reviewed annually.

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.

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 ERA continues to support the existing approach to determine the risk free rate, which will be updated annually.

Debt risk premium

Clause 4.2.6(h) of the proposed 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. 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 2.9.7(h) of the existing 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 2).

Table 2: ERA credit rating analysis as at February 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.[107]

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 proposes 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:[108,109]

- 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.
- 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.

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

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

109 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).

- 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.

As part of its 2022 review of the gas rate of return guidelines, the ERA refined and developed publicly available tools for its debt risk premium method. The tools and process documents are available on the ERA's website.[110] These set out the operating procedure for updating the debt risk premium estimates.

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.

Clause 2.9.8 of the existing WEM procedure sets debt issuance costs at 0.1 per cent of the amount of debt, which must be reviewed at each ERA review of the BRCP WEM Procedure.

In the 2022 gas rate of return instrument review, the ERA updated debt-raising costs to 0.165 per cent per annum to best estimate the cost in the market environment.

The ERA proposes to update debt issuance costs to 0.165 per cent for the BRCP to reflect the latest available estimate.

The ERA recommends that the proposed 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:

[110] Economic Regulation Authority, 2023, *2022 Gas Rate of Return Instrument (amended)*, , (online).

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 proposes to continue 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:

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

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. In order 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.[111]

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

The following details how the ERA proposes to determine 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 to analyse historical data over.

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.

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

For the estimation of the historic market risk premium for the BRCP, the ERA proposes to use 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.[112]

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 and geometric average.[113]

A thorough consideration of arithmetic and geometric means is in the explanatory statement to the 2022 Final Gas Rate of Return Instrument.[114]

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 proposes using both of the arithmetic and geometric means, with different weightings to estimate the historic market risk premium.

The ERA considers that is its 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 average and the arithmetic average.
- Given the volatility of returns over time, an investor may consider different investment horizons.

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112 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.

113 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:

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

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

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

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

- 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 proposes to calculate 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 3.

Table 3: 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**	

Source: ERA analysis.

For the 2024 BRCP procedure review, the ERA proposes a historic market risk premium estimate 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 assumed 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.[115]

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 that the DGM and does not place a large reliance on the model's market risk premium estimate.

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 4. The average of these estimates will be the DGM estimate.

Table 4: Dividend growth model estimates of the market risk premium (%)

	Jul 2023	Aug 2023	Sep 2023	Oct 2023	Nov 2023	Dec 2023	Mean
DGM implied return	9.61	9.66	9.90	10.48	10.23	9.82	9.95
Risk Free Rate	4.04	4.13	4.21	4.63	4.58	4.19	4.29
DGM market risk premium	5.58	5.53	5.69	5.85	5.65	5.64	5.66
DGM estimate							**5.7**

Source: ERA analysis.

For the BRCP, the ERA proposes using a DGM market risk premium estimate of 5.7 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.

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

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 (5.7 per cent) provide the basis from which the ERA uses it regulatory discretion to decide on an appropriate estimate.

For the BRCP the ERA proposes adopting a market risk premium of 5.8 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.

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

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 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:

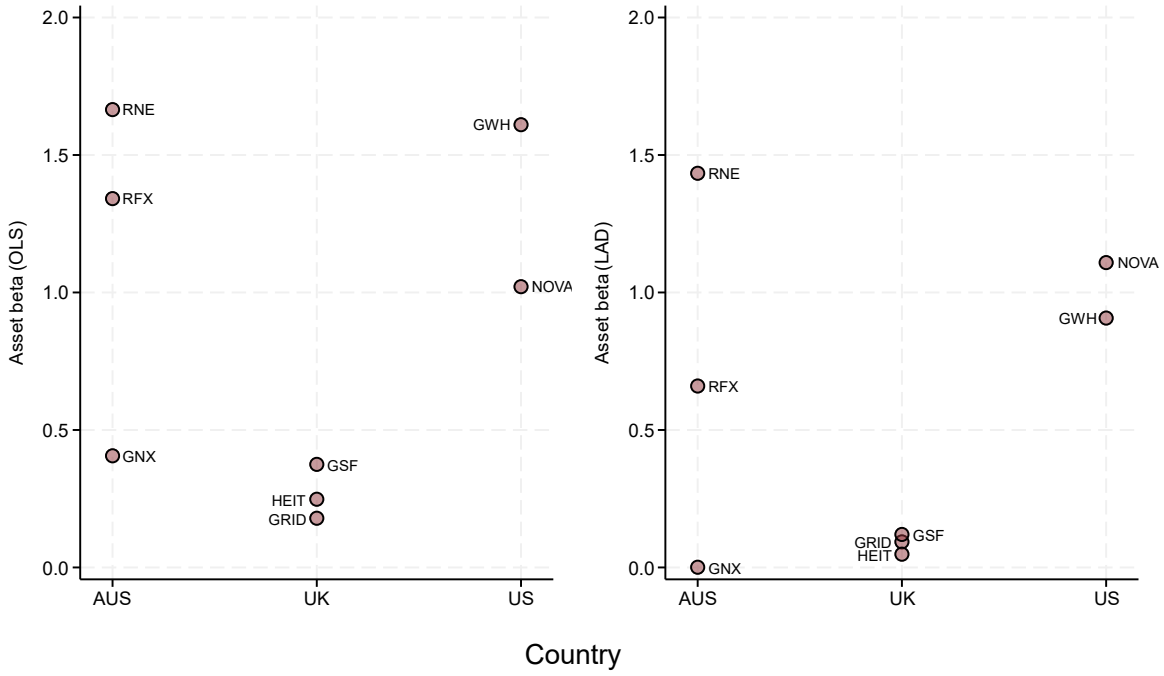
- The type of business, and associated capital assets, that the firm operates measured by asset or 'un-levered' beta.
- The amount of financial leverage (gearing) employed by the firm, which levers or 'amplifies' the asset beta to arrive at equity beta.

The ERA estimates that the asset beta is 0.7 and the equity beta is 1.2. The equity betas are proposed 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.[116]

Figure 3: Asset beta estimates



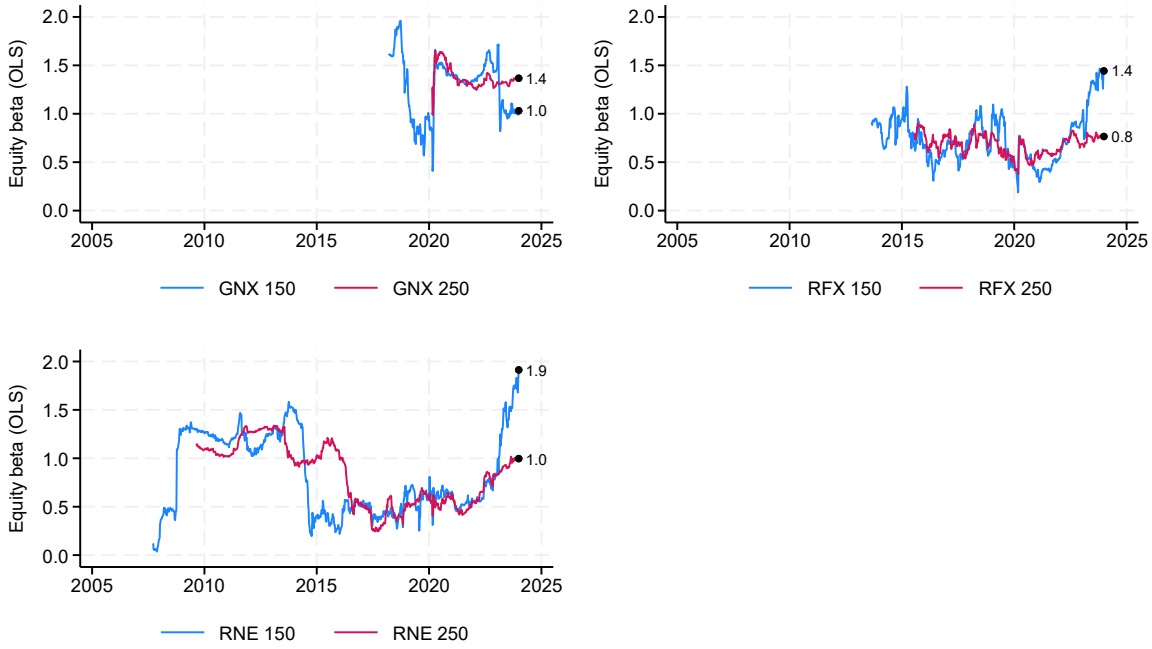
Source: ERA analysis from Bloomberg data.

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.

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

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:

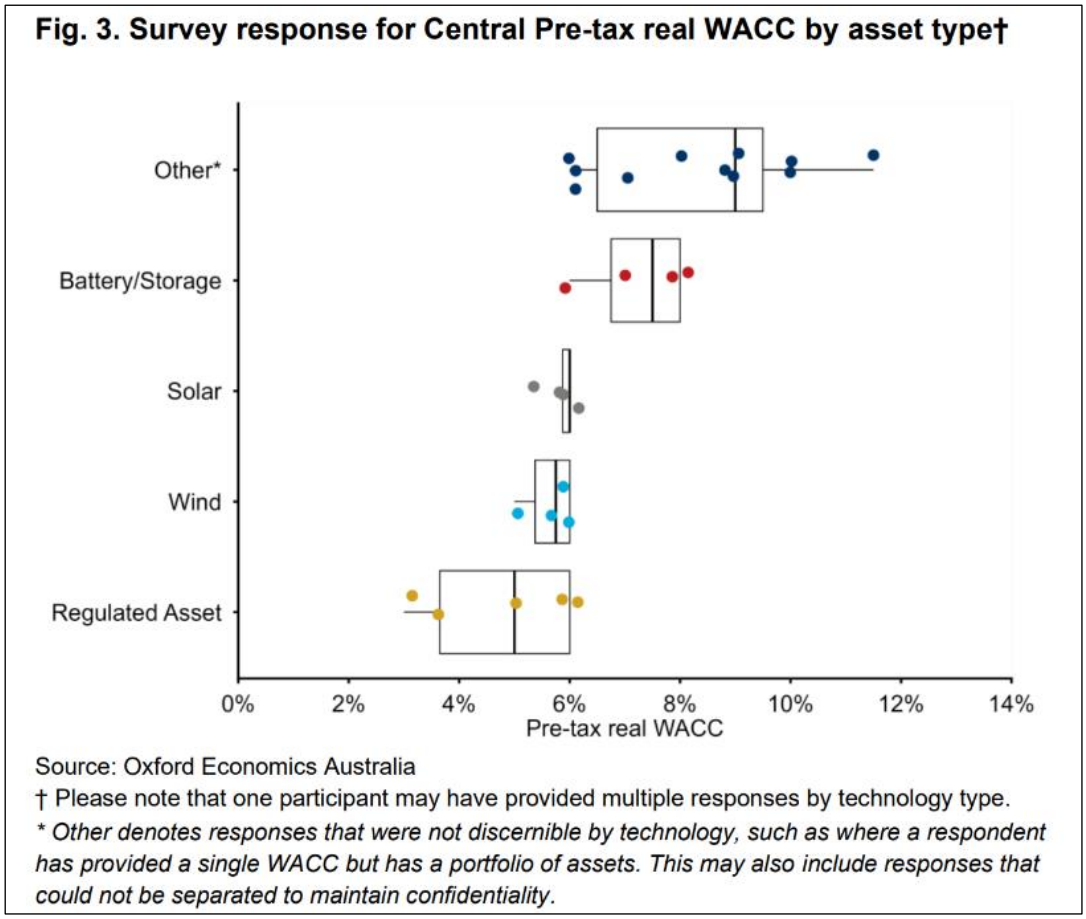
- It is likely that the BESS BRCP would have at least as much as risk as the previous reference technology that had an asset (equity) beta of 0.5 (0.83).
- The empirical estimate of betas, while noisy, provide support for an estimate of asset beta no greater than 1.0.
- The distribution of empirical 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.[117]

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

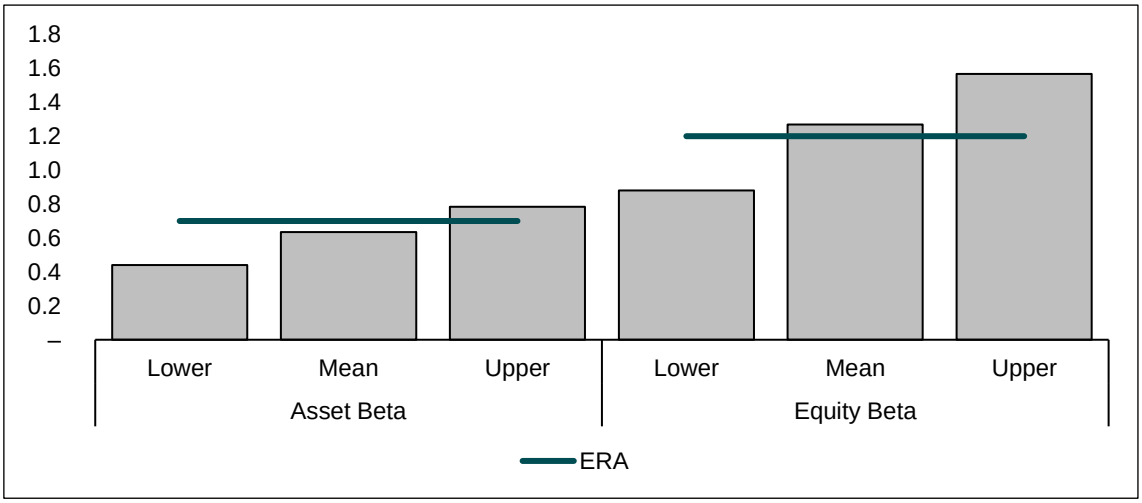


Source: Oxford Economics, 2023, Cost of capital survey 2023 – Report prepared for the Australian Energy Market Operator, p. 6, (online).

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.

[117] 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. 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.[118]

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 recommends fixing 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.

[118] 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 are able to 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 existing WEM Procedure applies 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.[119,120]

- 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 proposes to continue using a gamma of 0.5 in the WEM procedure and fixing the gamma value until the next BRCP review.

Illustrative rate of return for the BRCP

This section illustrates the effect that the ERA's proposed 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 5 details the updated rate of return for the BRCP's BESS project estimates for market data as at 30 December 2023. For comparison, Table 5 also provides the last BRCP published for the open cycle gas turbine, which was based on market data as at 31 October 2023.

Table 5: 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	4.24

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

120 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).

Parameter	2024 BRCP value	Updated BRCP for BESS
Equity beta	0.83	1.20
Market risk premium (%)	5.90	5.80
Pre-tax return on equity (%)	11.28	13.18
Cost of debt parameters		
Nominal risk free rate (%)	4.69	4.24
Debt risk premium (%)	2.153	1.986
Debt issuance costs (%)	0.100	0.165
Pre-tax return on debt (%)	6.94	6.39
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	10.47

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 10.47 per cent as illustrated in Table 5.

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 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%

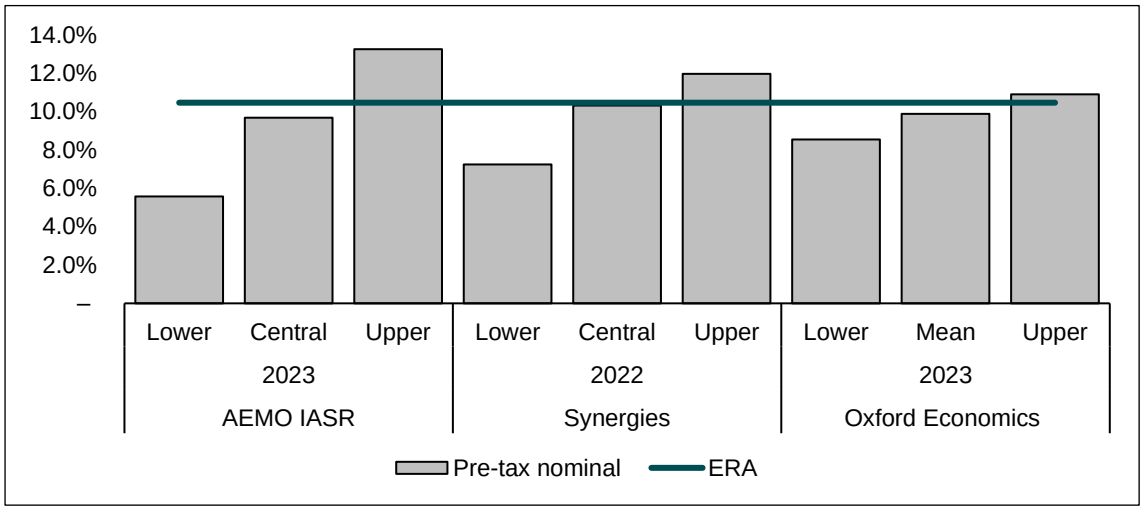
Source: AEMO 2023 IASR Report.[121]

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

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

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.[122,123,124]

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 indicative estimate of 10.43 per cent is within the range of reasonable values from these reference points.

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

123 Synergies Economic Consulting, 2022, *Updating the 2022 ISP Discount Rate*, (online).

124 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 6 Annuity approach

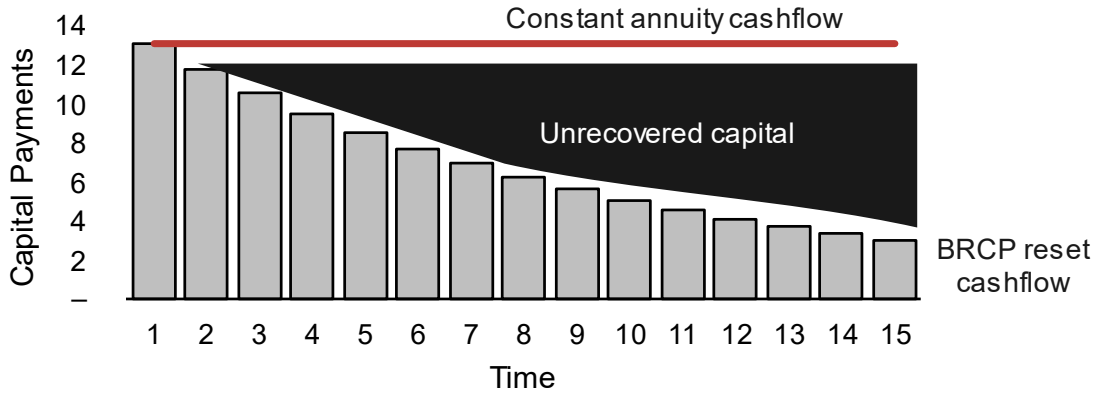
This appendix details the adjusted annuity approach which is being proposed as part of the BRCP calculation. A simplified Excel model is provided in Appendix 7.

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 Open Cycle Gas Turbine). 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.

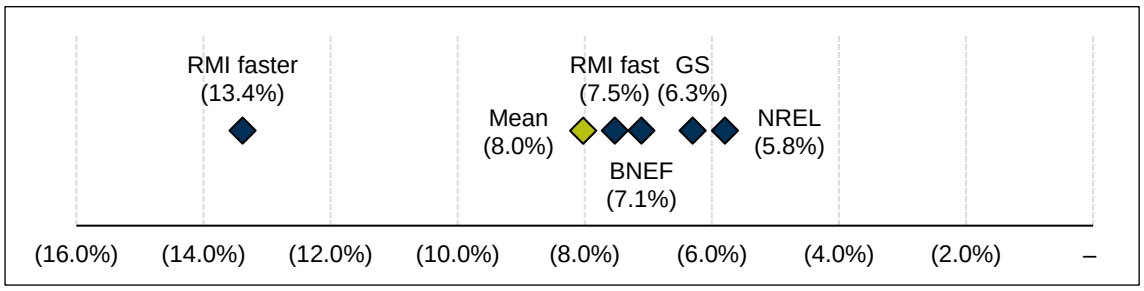
As illustrated in Figure 9, using a constant annuity approach that is updated annually to reflect current (expected lower) costs means that investors do not recover their required return of (depreciation) and return on (rate of return) capital over the life of the project. A constant annuity calculation, 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.

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 10Figure 9.

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



Source: Rocky Mountain Institute (2023),[125] NREL (2023),[126] ERA analysis.

Note: ERA analysis of the forecasts 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.

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 (8.0 per cent) to form its expectation of capital cost changes until the next BRCP WEM Procedure review reassesses this estimate.

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, such that the overall cost decline is approximately 4.4 per cent (8.0 per cent x 55 per cent) per year. This requires these cost declines to be factored into the BRCP to reduce investor reluctance in building capacity sooner.

Estimation of the tilt and multiple representation

The ERA is proposing adding 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.

[125] Rocky Mountain Institute, 2023, *X-Change: Batteries – The Battery Domino Effect*, December 2023, pp. 19-20, (online).

[126] National Renewable Energy Lab, 2023, *Cost Projections for Utility-Scale Battery Storage: 2023 Update*,(online).

The tilting formula is as follows:[127]

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

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 6. The values chosen are illustrative only, but the annuity period and the WACC are chosen to align with ones in the Procedure Change Proposal.

Table 6: 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.

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

Profile of cashflows: Constant capital costs and no resets

This worked example is to be read together with the Excel Workbook provided in Appendix 7.

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 V_0 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*$_t = V_t \times (A_1 + r)$.

	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 g* $= \underset{g}{argmin}(\sum$ *PV(Resetting Price Path) – 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 of 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 $1.24 \times PMT_t$). 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.

Appendix 7 Workbook underlying annuity tilt analysis

An Excel workbook explaining the annuity approach in Appendix 6 is published on the ERA's website (online).

Appendix 8 List of Tables

Table 1: ERA gearing analysis as at February 2024* 42
Table 2: ERA credit rating analysis as at February 2024 45
Table 3: Historic market risk premium (%) 50
Table 4: Dividend growth model estimates of the market risk premium (%) 51
Table 5: Illustrative rate of return for BESS BRCP 57
Table 6: Annuity tilting assumptions 63

Appendix 9 List of Figures

Figure 1: Stylised illustration of the transmission connection arrangement 18
Figure 2: Simplified timeline of a reserve capacity cycle 31
Figure 3: Asset beta estimates 53
Figure 4: Rolling equity beta estimate for Australian comparators using 150 and 250 week estimation windows 54
Figure 5: Oxford Economics 2023 survey of discount rates by technology type 55
Figure 6: Oxford Economics 2023 implied asset and equity beta estimates for battery storage assets 55
Figure 7: AEMO 2023 Inputs, Assumptions and Scenarios Report pre-tax real discount rates 58
Figure 8: Pre-tax nominal WACC reference points from AEMO, Synergies and Oxford Economics 58
Figure 9: Illustrative constant annuity cashflows versus cashflows under a resetting BRCP with ongoing cost reduction 60
Figure 10: Distribution of forecasts for battery cell changes per annum 61