AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Final Report: 2021 Benchmark Reserve Capacity Price for the 2023-24 Capacity Year

December 2020

Important notice

PURPOSE

AEMO has prepared this document under Section 4.16 of the Wholesale Electricity Market Rules to provide information about the proposed value for the 2021 Benchmark Reserve Capacity Price for the 2023-24 Capacity Year, as at the date of publication.

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VERSION CONTROL

Version	Release date	Changes
1	17/12/2020	

Executive summary

Each year, the Australian Energy Market Operator (AEMO) is required to propose a revised value for the Benchmark Reserve Capacity Price (BRCP) for the Western Australian Wholesale Electricity Market (WEM) in accordance with the Wholesale Electricity Market Rules (WEM Rules) and the Market Procedure: Benchmark Reserve Capacity Price (Market Procedure)[1].

The BRCP is used in the calculation of the maximum price that may be offered in a Reserve Capacity Auction, or as an input in the determination of the administered Reserve Capacity Price if an auction is not required. It aims to establish the marginal cost of providing one additional megawatt (MW) of Reserve Capacity in the relevant Capacity Year.

This report presents the proposed value of the BRCP for the 2021 Reserve Capacity Cycle. The 2021 BRCP value of $151,700 per MW per year applies for the 2023-24 Capacity Year, covering the period from 8:00 am on 1 October 2023 to 8:00 am on 1 October 2024.

The BRCP is calculated by undertaking a technical, bottom-up cost evaluation of the entry of a new 160 MW liquid-fuelled open cycle gas turbine (OCGT) generation facility in the South West interconnected system (SWIS) in the relevant Capacity Year.

The methodology applied to determine the BRCP is defined by the Economic Regulation Authority (ERA) and has remained mostly unchanged since the last five-yearly review completion in 2011[2].

In May 2020[3], at the request of the Western Australian Minister for Energy, the ERA delayed the review of the methods for setting the annual BRCP and energy price limits until after 1 October 2022[4].

ERA consulted with the BRCP Working Group[5] in August 2020[6] on the scope of the Market Procedure review. There was consensus at the BRCP Working Group meeting that the ERA should limit the scope of its review of the Market Procedure to the Weighted Average Cost of Capital (WACC) and its underlying variables. The ERA published a Procedure Change Proposal in September 2020[7].

The ERA published Version 7 of the Market Procedure (effective 9 November 2020). The ERA amended the WACC calculation by moving from a real to nominal WACC. The Market Procedure amendments included changes to the expected inflation and the real risk-free rate of return formulas, and updates to the Capital Asset Pricing Model (CAPM) parameters pertaining to the market risk premium, the debt insurance costs and the franking credit value.

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[1] The Economic Regulation Authority (ERA) is responsible for the 'Market Procedure: Benchmark Reserve Capacity Price' Version 7, containing the revision of the WACC parameters and effective from 9 November 2020, is available at: https://www.erawa.com.au/electricity/wholesale-electricity-market/market-procedures.

[2] Clause 4.16.9 of the WEM Rules requires the ERA to carry out a five-yearly review of the Market Procedure referred to in clause 4.16.3 of the WEM Rules (which is currently titled Market Procedure: Benchmark Reserve Capacity Price). Clause 1.17.5(e) of the WEM Rules modified this requirement so that the ERA was not required to carry out the next review of the Market Procedure referred to in clause 4.16.3 (including any public consultation process in respect of the outcome of the review) before 31 October 2017. The status of this review is published here: https://www.erawa.com.au/electricity/wholesale-electricity-market/methodology-reviews/benchmark-reserve-capacity-price-and-energy-price-limits-review-2019.

[3] ERA notice, Suspension of the method reviews: https://www.erawa.com.au/cproot/21237/2/NOTICE---Suspension-of-BRCPEPL-method-reviews.pdf.

[4] This suspension was due to prior commitments pertaining to the State Government's energy reform process.

[5] BRCP working group: https://www.erawa.com.au/rule-change-panel-brcp-working-group established by the Market Advisory Committee under clause 2.3.17 of the WEM Rules.

[6] Rule Change Panel – establishment of the BRCP working group: https://www.erawa.com.au/cproot/21385/2/BRCP-Working-Group----Terms-of-Reference-28-July-2020-.pdf .

[7] Procedure change proposal: Calculation of Benchmark Reserve Capacity Price (EEPC_2020_02): https://www.erawa.com.au/cproot/21445/2/Review-of-BRCP-market-procedure-2020---BRCP-procedure-change-proposal---Approved-for-publishing.pdf.

AEMO followed the updated methodology outlined in the current Market Procedure at the time of this publication. As such, the following costs are included in the calculation of the 2021 BRCP:

- Power Station balance of plant costs.
- Land costs.
- Costs associated with the development of liquid fuel storage and handling facilities (to allow 14 hours of continuous operation).
- Costs associated with the connection of the power station to the SWIS.
- Allowances for legal costs, insurance costs, financing costs and environmental approval costs.
- Reasonable allowance for a contingency margin.
- Estimates of fixed operating and maintenance costs for the power station, fuel handling facilities and the transmission connection components.

The complete methodology used to determine the BRCP is outlined in the Market Procedure.

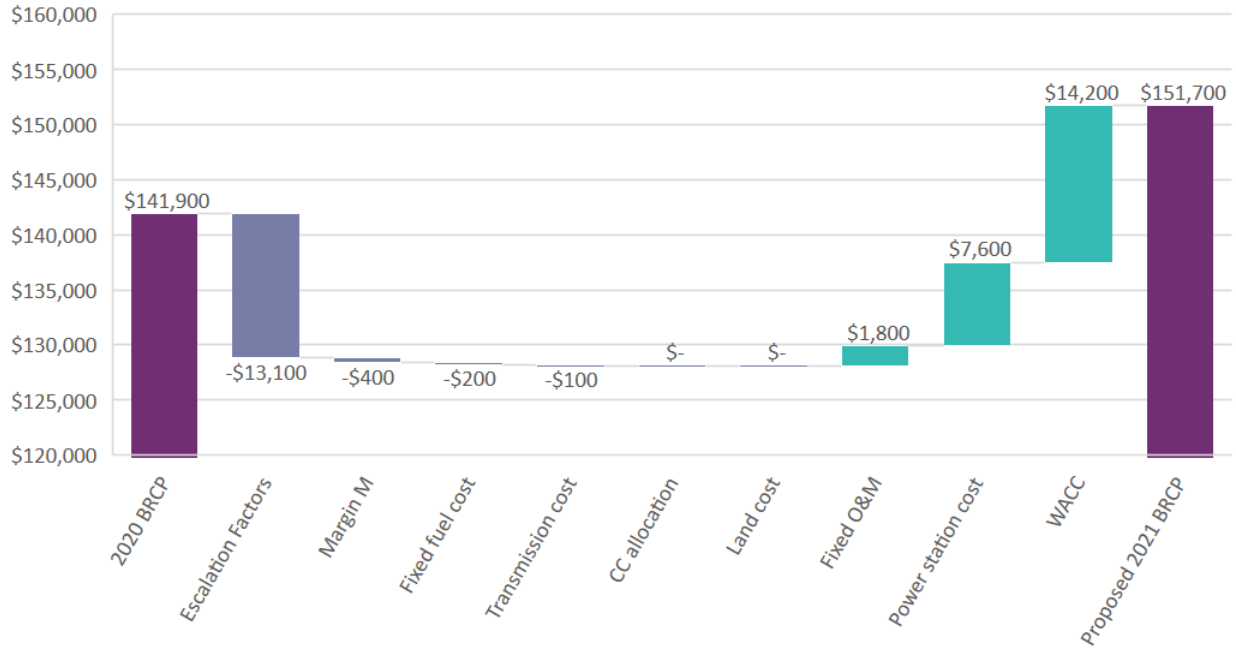
Proposed value of the 2021 BRCP for the 2023-24 Capacity Year

Following the closure of the public consultation period, AEMO proposes a value of $151,700 per MW per year for the 2021 BRCP. This is 11.3% higher than the 2021 draft BRCP of $136,300 per MW per year and 6.9% higher than the 2020 BRCP of $141,900 per MW per year. The main driver for this increase is the WACC[8] value increasing from a real value of 3.34% in the draft report to a nominal value of 5.20% following the amendments to the WACC components of the Market Procedure.

Changes from the 2020 BRCP

Figure 1 shows the year-on-year variation in BRCP relating to changes in the input parameters between the 2020 BRCP and the proposed 2021 BRCP (for the 2023-24 Capacity Year).

Figure 1 Breakdown of variance between the 2020 and 2021 BRCP



[8] WACC has been calculated by AEMO in accordance with step 2.9 of the Market Procedure.

From Figure 1, the main factors contributing to the 6.9% increase compared to the 2020 BRCP are:

- Factors that contributed to the price increase:
  - A relative 10.0% impact on the BRCP (equal to an increase of $14,200 per MW) caused by moving from a real to a nominal WACC (refer to Section 2.2.7 of this report).
  - A 5.4% increase in power station costs (equal to an increase of $7,600 per MW) caused by a weakening of the AUD to United States Dollars (USD) exchange rate (refer to Section 2.2.1 of this report).
  - A 1.3% increase in fixed operating and maintenance (O&M) costs (equal to an increase of $1,800 per MW) caused by higher asset insurance costs, and increased generation and switchyard O&M costs in addition to the fixed network access charges.
- Factors that contributed to a price decrease:
  - A 9.2% decrease due to lower escalation factors (equal to a decrease of $13,100 per MW), reflecting the impact of COVID-19 on the steel and copper prices (refer to Section 2.1 of this report).
  - A 0.3% decrease in 'Margin M'[9] (equal to a decrease of $400 per MW), reflecting the lower cost of securing capital and project start-up when compared to total cost of the power plant.

With respect to prior years, the proposed 2021 BRCP is 1.27% higher than the 2019-20 BRCP and 1.62% lower than the 2021-22 BRCP, as referenced in Appendix 2, Figure 3.

Public consultation and stakeholder submissions

A draft version of this report was published for consultation on 26 October 2020. AEMO received submissions from Synergy and Alinta Energy.

- Synergy's submission raised concerns regarding the escalation factors, querying whether setting escalation factor forecasts in such depressed market conditions (as a result of COVID-19) is appropriate. Synergy maintained a position that scarcity of supply of construction materials and labour would partially offset negative material cost escalation factors. However, Synergy noted the potential increase of the BRCP as a result of the revised WACC calculation.
- Alinta Energy's submission challenged whether recent sharp decreases in spot steel and copper prices, driven by the impacts of COVID-19 on demand, would decrease the cost of constructing an OCGT to the extent outlined by the draft report. However, Alinta Energy supported the revised method for determining the WACC.

While AEMO acknowledges these concerns, it is obliged to follow the methodology prescribed in the Market Procedure when calculating the BRCP. AEMO anticipates that the ERA will consider these concerns in their next round of review of the Market Procedure.

[9] 'Margin M' covers legal, approval, financing, insurance, other costs, and contingencies during the construction phase.

Contents

Tables

Figures

1. Introduction

The Benchmark Reserve Capacity Price (BRCP) establishes the marginal cost per year of adding one additional megawatt (MW) of Reserve Capacity in the relevant Capacity Year.

The BRCP is used in the calculation of the maximum price that may be offered in a Reserve Capacity Auction. A Market Participant may offer up to 130% of the BRCP when submitting its Reserve Capacity Offer into the Reserve Capacity Auction. If an auction is not required, the BRCP is used as an input in the determination of the administered Reserve Capacity Price.

This report outlines the proposed BRCP value for the 2021 Reserve Capacity Cycle in line with clause 4.16.7 of the Wholesale Electricity Market Rules (WEM Rules). This value applies to the 2023-24 Capacity Year for consideration and approval by the Economic Regulation Authority (ERA) in line with clause 2.26.1 of the WEM Rules.

1.1 Overview of input parameters

The BRCP is calculated by undertaking a technical, bottom-up cost evaluation of the entry of a new 160 MW open cycle gas turbine (OCGT) generation facility in the South West interconnected system (SWIS) during the relevant Capacity Year. Most of the methodology used to determine the BRCP has not changed since 2011 due to the deferral of the five-yearly review of the Market Procedure.

AEMO and Market Participants have previously highlighted concerns with the BRCP methodology, particularly the reference equipment used for the determination, Weighted Average Cost of Capital (WACC), including the debt risk premium (DRP), insurance costs and transmission connection cost determination.

Recently, the ERA completed a review of the Market Procedure: Benchmark Reserve Capacity Price (Market Procedure) with a focus on the WACC parameters[10]. The updated Market Procedure, with an effective date of 9 November 2020, was used in the determination of the final 2021 BRCP report.

In determining the proposed 2021 BRCP, AEMO has used a combination of publicly available information and advice from independent consultants, Western Power, and the Western Australian Land Information Authority (Landgate). The organisations consulted and the corresponding input parameters they provided are shown in Table 1.

Throughout this report, cost and price estimates are expressed in Australian dollars (AUD) excluding GST, unless otherwise specified.

[10] ERA 2020 procedure change proposal: https://www.erawa.com.au/cproot/21445/2/Review-of-BRCP-market-procedure-2020---BRCP-procedure-change-proposal---Approved-for-publishing.pdf.

Table 1 Organisations and input parameters

Organisation	Cost estimates provided
GHD (Australia)	• Power station capital costs and relevant escalation factors • Margin for legal, approval, financing, insurance, other costs, and contingencies • Fixed fuel costs • Generation operation and maintenance (O&M) costs and relevant escalation factors • Switchyard O&M costs and relevant escalation factors • Transmission line O&M costs and relevant escalation factors
Western Australian Land Information Authority (Landgate)	• Land costs
PricewaterhouseCoopers Australia (PwC)	• DRP • Relevant escalation factors
Western Power Corporation	• Transmission connection costs and relevant escalation factors • Network access charges
Independent insurance broker	• Asset replacement insurance costs

1.2 Supporting documentation

The following documents relate to the calculation of the proposed 2021 BRCP and are available on AEMO's website[11]:

- 2021 BRCP calculation spreadsheet, final version.
- GHD report, 2021 Benchmark Reserve Capacity Price for the South West Interconnected System (October 2020).
- PwC report, 2021 Benchmark Reserve Capacity Price Cost Escalation Factors (September 2020).
- PwC memo, 2021 Benchmark Reserve Capacity Price Debt Risk Premium for the South West Interconnected System (November 2020).
- Landgate memo, Land values for the 2021 Benchmark Reserve Capacity Price (August 2020).
- Western Power report, Total Transmission Cost Estimate for the Benchmark Reserve Capacity Price for 2023/24 (September 2020).

[11] Available at: http://www.aemo.com.au/Electricity/Wholesale-Electricity-Market-WEM/Reserve-capacity-mechanism/Benchmark-Reserve-Capacity-Price.

2. Input parameters

This chapter provides information on the input parameters used to determine the 2021 BRCP.

2.1 Escalation factors

The 2021 BRCP calculation is based on the cost of a theoretical power station that would commence operation on 1 October 2023. Costs have been determined as at 2020 and have been escalated to 2023.

Different escalation factors are used depending on the parameter to be escalated, as summarised in Table 2.

Table 2 Cost escalation forecast

Escalation factor	Component costs applied to	Source and methodology
Power station capital cost	Power station capital cost	Base escalation factors such as steel, copper, labour and the AUD to United States Dollars (USD) exchange rate were derived by PwC. This involved analysing commodity market trends and forecasts from leading investment banks. More information on PwC's methodology is provided in its report. GHD derived the power station capital cost, generation O&M cost and connection asset O&M cost escalation factors from the base escalation factors provided by PwC. This methodology is summarised in GHD's report.
Generation O&M cost	Generation O&M cost	
Connection asset O&M cost	Switchyard O&M cost Transmission line O&M cost	
Consumer Price Index (CPI)	Asset insurance O&M cost Fixed network access and ongoing O&M charges Fixed fuel cost Land cost	A general measure of price inflation for all Australian households is forecast by the Reserve Bank of Australia (RBA). Where a forecast range is provided, the mid-point of the RBA's target inflation (2-3 per cent) is applied. For the first year outside of the RBA's forecast horizon, the average of the previous year's forecast and the target mid-point is used. For all periods beyond, the mid-point of the RBA's target for inflation is used.
Transmission connection cost	Transmission connection cost	This is estimated using the average change over five years in accordance with steps 2.4.1(d) and 2.4.2 of the Market Procedure. As five years of actual data was not available for the 2021 BRCP, the escalation rate was averaged over this period for which equivalent data is available. Western Power provided these escalation factors.

The escalation factors applied to the 2021 BRCP are listed in Table 3.

Table 3 Escalation factors by financial year

Escalation factor	2020-21	2021-22	2022-23	2023-24
Power station capital cost	-7.84%	-3.65%	-0.03%	2.98%
Generation O&M cost	-0.73%	-0.15%	1.16%	1.84%
Connection asset O&M cost	0.96%	0.95%	1.68%	2.53%
CPI	2.25%	1.25%	2.00%	2.50%
Transmission connection cost	0.73%	0.73%	0.73%	0.73%

The key changes in escalation factors from the 2020 BRCP are:

- A sharp decrease in the power station capital cost escalation factors from 2020-21 until 2022-23 due to large decreases in steel and copper prices. This decrease is a result of reduced international demand caused by COVID-19. In subsequent years, the forecast power station capital cost escalation factors are expected to recover slightly, with positive values from 2023-24.
- Both generation and connection O&M cost escalation factors decrease as a result of COVID-19 flatlining market expectations in the construction and utilities sectors.
- The transmission connection escalation factors also decreased compared to the previous BRCP report, but do not influence the transmission cost. This cost is already escalated by Western Power for the period to 1 April 2023.

More information on how these escalation factors are defined may be found under the 2021 BRCP related documents tab[12] which contains Western Power's report: *Total Transmission Cost Estimate for the Benchmark Reserve Capacity Price for 2023/24* and GHD's report: *2021 Benchmark Reserve Capacity Price for the South West Interconnected System*. Escalation factors have not changed from the draft report. However, the CPI for 2020-21 has since been revised down by the RBA.

2.2 Capital costs

2.2.1 Power station capital cost (PC)

The Siemens SGT5-2000E (33MAC) OCGT was used as the reference equipment to determine the power station capital cost component of the 2021 BRCP, consistent with previous BRCP calculations. Since the 2019 BRCP, Siemens has made improvements to the generator and has increased its gross output from 175.6 MW to 177.30 MW. This unit is the most appropriate machine available to meet the criteria for the BRCP calculation[13]. Version 29.0 of Thermoflow's GTPro/PEACE model was used to evaluate the plant equipment, engineering, procurement, and construction capital costs. Estimated costs were referenced against similar completed projects in Australia where possible.

The total capital cost was escalated to 1 April 2023 using the power station capital cost escalation factor.

The proposed value of PC = $816,437 per MW. This value has not changed from the draft report.

[12] Available at: http://www.aemo.com.au/Electricity/Wholesale-Electricity-Market-WEM/Reserve-capacity-mechanism/Benchmark-Reserve-Capacity-Price.

[13] There is currently no generator available in the market that matches the specifications of the Market Procedure. As a result, GHD has scaled the estimation for the 177.30 MW Siemens unit to represent the expected configuration of the 160 MW generator specified in the Market Procedure.

The estimated PC has decreased by 5.0% from the 2020 BRCP (equal to a decrease of $43,192 per MW). This is attributed to the global reduction in economic activity due to the COVID-19 pandemic, which resulted in sharp decreases in steel and copper prices.

2.2.2 Capacity Credit (CC) allocation

GHD used Thermoflow's GTPro/PEACE software to model the gross output of the 160 MW reference generator by adjusting the expected performance of the equipment to site conditions at Muja Power Station (41°C, 30% relative humidity, and 217 metres above sea level).

The proposed value of CC = 152.28 MW. This value has not changed from the draft report.

This proposed CC value remained unchanged from the 2020 BRCP. No further improvements by the manufacturer have been implemented to the reference generator since the 2020 BRCP.

2.2.3 Legal, approval, financing, insurance, other costs, and contingencies (M)

'Margin M' covers legal, regulatory approval, financing, insurance, other costs, and contingencies during the construction phase. It was estimated from similar costs associated with recent, comparable developments from GHD's data bank, excluding any project-specific abnormal costs. The costs were scaled to the reference equipment where relevant. Margin M was then added as a fixed percentage of the capital cost of developing the power station.

The proposed value of M = 16.69%. This value has not changed from the draft report.

Compared to last year's value of 17.16%, the Margin M value for the 2021 BRCP has decreased by 2.7%.

2.2.4 Land costs (LC)

Land valuations were obtained for the following six regions where development of a power station in the SWIS is most likely:

- Collie.
- Kalgoorlie.
- Kemerton Industrial Park.
- Kwinana.
- North Country (Eneabba and Geraldton).
- Pinjar.

Hypothetical land sites were assessed for each region in or near existing industrial estates for land that would be suitable for the development of a power station. Valuations were completed as at 30 June 2020 and exclude transfer duty. AEMO has added the applicable transfer duty to the land parcel cost using the Office of State Revenue's online calculator[14].

AEMO calculated the average of the six valuations and escalated this to 1 April 2023 using the CPI escalation factor[15]. The size of the land parcels adopted for all regions was three hectares. In line with the 2020 BRCP, an average estimate for the North Country (Eneabba and Geraldton) was used.

The proposed value of LC = $2,404,251. This value decreased 0.7% from the draft report.

The COVID-19 pandemic has had a significant impact on several economic sectors, particularly retail and entertainment. This led to increased unemployment and a retraction in Western Australia's economy. However, industries such as mining, and resources such as iron ore and gold, have experienced growth during this period, and the negative influences of the COVID-19 pandemic have not been as evident in the

[14] Available at: https://apps.osr.wa.gov.au/portal/0/home.

[15] Available at: https://www.rba.gov.au/publications/smp/2020/nov/economic-outlook.html.

industrial real estate markets. The LC estimate has decreased by 5.2% (equal to a decrease of $131,999) from the 2020 BRCP, due to lower CPI escalation factors.

2.2.5 Transmission connection cost (TC)

TC is based on a weighted average of the capital contributions of generators connecting to the SWIS over the previous five years. Estimates are based on actual connection costs and access offers identified by Western Power through its confidential database.

As there is no actual project data for a 160 MW OCGT available in the five-year window, Western Power estimated the shallow connection cost in accordance with the methodology described in the section 2.4.1(b) of the Market Procedure. The methodology includes the estimation of capital costs such as the procurement, installation and commissioning of the substation, plus easement costs. Western Power provided an independently audited report to verify the accuracy of the estimates on the basis that the underlying data is commercially confidential and therefore cannot be published.

Shallow connection cost estimates include construction of a substation, 2 km of overhead line to the power station, and an overhead line easement. AEMO provided easement costs to Western Power for use in estimating shallow connection costs. AEMO's easement cost estimate was based on the following assumptions:

- The easement is 12 hectares (2 km long and 60 metres wide) and includes transfer duty.
- A Market Participant may not need to purchase the entire 12 hectares for the generator, instead securing easement rights for some or all the land. AEMO estimates easement costs to be half of the land value.
- The land value includes transfer duty.

Easement costs have decreased by 4.3% (equal to a decrease of $211,557) from the 2020 BRCP, due to the decrease in LC (see Section 2.2.4 of this document for further information).

Shallow connection costs have also decreased by 3.6% (equal to a decrease of $877,944) from the 2020 BRCP. However, AEMO does not have visibility into the components of this calculation provided by Western Power for confidentiality reasons.

The proposed value of TC = $180,927 per MW. This value has not changed from the draft report.

The TC estimate has decreased by 0.5% (equal to a decrease of $833 per MW) from the 2020 BRCP. AEMO does not have information about why this occurred but expects this is due to the decrease in transmission and line easement costs.

No escalation factors have been applied because Western Power has already escalated the TC estimate to 1 April 2023.

2.2.6 Fixed fuel cost (FFC)

FFC is the cost associated with developing and constructing onsite liquid fuel storage and supply facilities and supporting infrastructure, including the initial cost of filling an onsite tank with sufficient diesel for 14 hours of continuous operation. An estimate of FFC was calculated as at 30 June 2020, which is escalated to 1 April 2023 using the CPI escalation factor. The cost of diesel includes delivery and an excise rebate.

The proposed value of FFC = $6,915,717. This value decreased 0.7% from the draft report.

This value has decreased by 4.1% (equal to a decrease of $297,847) since the 2020 BRCP. This is due to a significant decrease in the price of delivered diesel to $0.464 per litre (43.0% lower than the 2020 BRCP) and lower CPI.

2.2.7 Weighted average cost of capital (WACC)

The WACC is determined by using the Capital Asset Pricing Model to estimate the costs of equity and debt. The DRP was estimated by PwC, while the risk-free rate was calculated using information available from the

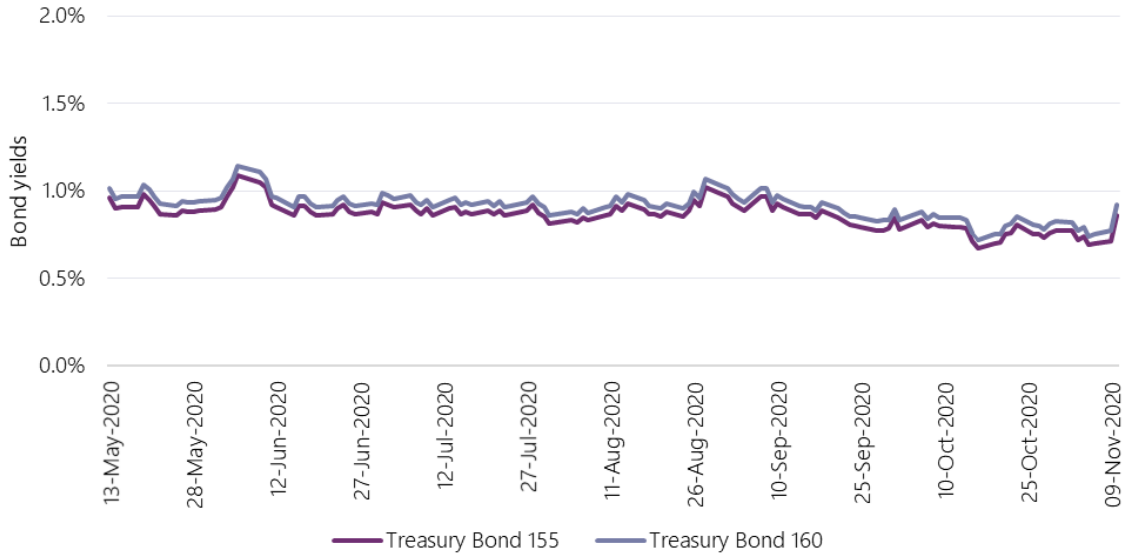
RBA website[16]. The nominal risk-free rate was determined using observed yields of Commonwealth Government bonds, while the DRP was derived using observed yields of corporate bonds. A corporate tax rate of 30% was assumed. Appendix A1 details the steps for estimating the WACC.

Risk-free rate of return methodology

The nominal risk-free rate was calculated from the annualised yield of Commonwealth Government bonds with a 10 year maturity date. The rate was estimated as an annualized yield, 20-day average from market observations ending on 30 October 2020. Two trading days were excluded to maintain consistency with the Debt Risk Premium methodology[17].

As illustrated in Figure 2, the Commonwealth Government bond yields have remained relatively constant between May and September 2020, with a moderate decline from September to November 2020[18].

Figure 2 Commonwealth Government bond yields, May to November 2020



The nominal risk-free rate calculated from these bonds is 0.80%, a proportional decrease of 14.8% from the 0.94% calculated in the draft report. It also corresponds to a proportional decrease of 18.2% from the 2020 BRCP value of 0.98%. The lowest recorded of Commonwealth Government bond yields of all time occurred in November 2020[19].

Despite declines in the Standard and Poor's/Australian Stock Exchange 200 index (S&P/ASX 200)[20] starting mid-February, government bond yields have remained mostly constant. During the largest ASX decline between March and April, a spike in investment in government bonds occurred, as these bonds were used as a safe haven against the financial impacts of COVID-19.

Debt risk premium (DRP) methodology

Step 2.9.7(h) of the Market Procedure requires AEMO to determine the methodology to estimate the DRP, which, in the opinion of AEMO, is consistent with currently accepted Australian regulatory practice.

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[16] See RBA's statement of monetary policy available at: http://www.rba.gov.au/publications/smp/index.html.

[17] The sample excludes 5 October 2020 as it was Labour Day in New South Wales, and 12 October 2020 as it was Columbus Day in the United States. With only limited trading, US denominated bonds were displaying anomalous yields relative to the rest of the sample. As a result, the sample period was extended to 1-2 October to ensure the averaging period captured 20 days of trading data.

[18] Treasury bond data is available at: https://www.rba.gov.au/statistics/tables/ and https://www.rba.gov.au/statistics/tables/xls/f16.xls?v=2020-11-20-13-15-59.

[19] See slide 19: https://www.rba.gov.au/chart-pack/pdf/chart-pack.pdf?v=2019-09-20-11-27-36 and https://www.rba.gov.au/statistics/tables/.

[20] See: https://www2.asx.com.au/markets/company/xjo.

The methodology has remained the same since the 2018 BRCP determination. This is as a result of the ERA adopting a modified bond yield approach to estimate the DRP for *the Final Decision on Proposed Revisions to the Access Arrangement for the Mid-West and South-West Gas Distribution Systems*[21]. AEMO considers this revised methodology to be representative of the current accepted Australian regulatory practice and has calculated the DRP accordingly.

The modified bond yield approach uses a larger sample of bonds issued by Australian utilities on Australian and international markets to estimate a bond yield curve to calculate a 10-year DRP.

PwC estimated the DRP at 2.04% from market observations ending on 30 October 2020. **Proportionally, this value is 1.5% higher than the draft report value of 2.01%.** This differential is partially attributable to the October period average risk-free rate being around 10 basis points lower than the September average risk-free rate. The DRP value also decreased 8.5% from a value of 2.23% in the 2020 BRCP.

Capital Asset Pricing Model results

The proposed value of the WACC in nominal terms is 5.20%. This represents a proportional increase of 48.1% compared with a WACC of 3.51% in real terms, being the method used in the 2020 BRCP. It also represents a 55.5% increase compared with the WACC of 3.34% calculated (in real terms) in the draft report.

The recent finalisation of the change to the Market Procedure[22] has resulted in the adoption of a WACC based on nominal, rather than real, terms. The change to a nominal WACC removes the need to forecast inflation and, therefore, removes the effect of over or under estimation of inflation on the BRCP. This should improve the efficiency of pricing signals to the market.

2.3 Operating and maintenance (O&M) costs

2.3.1 Generation O&M costs

Generation O&M costs assume that the OCGT plant is based on a single gas turbine capable of delivering a nominal 160 MW output, using diesel fuel, with a 30-year operating life and a 2% capacity factor. Gas connection costs are therefore not considered. An allowance for balance of plant (service of pumps, fire systems etc.) has been included.

A 15-year annuity has been calculated based on individual component costs as at June 2020, which are derived from similar recent OCGT projects. These costs were then escalated to 1 October 2023 using the generation O&M escalation factor.

The proposed value of generation O&M costs = $13,931 per MW per year. This value has not changed from the draft report.

The estimated generation O&M costs decreased by 4.6% (equal to a decrease of $669) relative to the 2020 BRCP, due to the decrease in wages and PC (refer to Section 2.2.1 of this document).

2.3.2 Switchyard O&M costs

Switchyard O&M costs were calculated from the isolator on the high voltage side of the generator's transformer and do not include any generator transformer or switchgear associated costs.

A bottom-up approach was used to estimate the switchyard costs, based on the annual charge for the connection assets. The cost estimate includes labour, machinery parts, and general overheads incurred during routine maintenance, which occurs one week per year on average.

[21] Available at https://www.erawa.com.au/gas/gas-access/mid-west-and-south-west-gas-distribution-systems/access-arrangements/access-arrangement-for-period-2014-2019/decisions-and-proposals.

[22] Available at: https://www.erawa.com.au/electricity/wholesale-electricity-market/market-procedures/procedure-change-eepc_2020_02-review-of-the-benchmark-reserve-capacity-price-market-procedure.

The 330 kilovolt (kV) switchyard was assumed to have an average asset life of 60 years. A 15-year annuity was calculated based on the cost estimate as at June 2020, which was then escalated to 1 October 2023 using the connection O&M escalation factor.

The proposed value of switchyard O&M costs = $544 per MW per year. This value has not changed from the draft report.

The estimated switchyard O&M costs remained unchanged from the 2020 BRCP. A modest asset price increase was counterbalanced by the sub-unitary escalation factors (refer to the connection asset O&M escalation factors in Section 2.1 of this document).

2.3.3 Transmission line O&M costs

The new transmission line was assumed to be a single circuit 330 kV construction with two conductors per phase and was assumed to have an average asset life of 60 years. The rating of the line was selected to facilitate the transport of up to 200 megavolt amperes (MVA) (power factor of 0.8).

The transmission line O&M cost estimate included labour, machinery parts, and general overheads incurred during routine maintenance. A 15-year annuity was calculated based on the cost estimates as at June 2020, which was then escalated to 1 October 2023 using the connection O&M escalation factor in Section 2.1 of this document.

The proposed value of transmission line O&M costs = $34 per MW per year. This value has not changed from the draft report.

The estimated transmission line O&M costs remained unchanged from the 2020 BRCP, due to a decrease in the connection O&M escalation factors (refer to Section 2.1 of this document).

2.3.4 Asset insurance costs

The fixed O&M component included annual insurance costs to cover power station asset replacement, business interruption, and public and products liability insurance.

For the 2020 BRCP, it was determined that quotes provided by multiple brokers were not directly comparable due to their differing policies, degrees of cover and the reputation of each broker. As a result, AEMO continues to source a quote from its vetted independent broker with a history in power generation insurance[23].

Premiums were calculated as follows:

- Asset replacement insurance premium was calculated as 0.37% of the limit of liability. This represents a 21.6% relative increase from the 2020 BRCP premium. The limit of liability was determined as the sum of the capital construction cost and value of fuel.
  - The capital cost and value of fuel were estimated as: PC x (1 + M) x CC + FFC.
  - AEMO calculated asset replacement insurance as $632,733 per year.
- Business interruption insurance included coverage for the potential refund liability for the facility for two years. While a construction period of one year was assumed in the application of WACC, a further period would be required prior to commencement of construction work following a loss event (for example, for service procurement, building approvals, and any demolition or clearing works).
  - AEMO calculated business interruption insurance as $192,330 per year.
- Public and products liability insurance is estimated as $133,089 per year. This liability includes 10% transfer duty for a limit of $50 million for any one occurrence, as required by Western Power in an Electricity Transfer Access Contract. A site survey annual cost of $10,000 is included.

[23] AEMO uses this broker for its insurance policies. Therefore, an internal vetting process has already been performed. This broker has requested to remain anonymous. This is a requirement under the agreement for the provision of the information.

The insurance premiums are assumed to cover:

- A newly constructed generation facility with on-site diesel storage.
- A facility located in a rural region of the SWIS with no cyclone risk.
- Machinery breakdown.
- Deductibles of $25,000 to $50,000 for public and products liability insurance, $500,000 for property damage, and 60 days for business interruption insurance.

Estimated insurance costs were escalated to 1 October 2023 using the CPI escalation factor.

The proposed value of asset insurance costs = $6,477 per MW per year. This value has increased by 1.9% from the draft report due to the overall increase in the proposed 2021 BRCP.

Insurance cost estimates have increased by 20.1% (equal to an increase of $1,084 per MW per year) relative to the 2020 BRCP. Overall insurance pricing in the second quarter of 2020 in the Pacific region increased 31%, continuing an upward trend that began in 2015. Underwriters continue to push for higher levels of pricing increases due to the combined effects of social inflation pressures (claims for commercial business liability), persistently low yields, and several large underwriting losses, including from COVID-19 and bushfires.

2.3.5 Fixed network access and ongoing charges

Network access charges were estimated using Western Power's network access tariffs (Price List) data from the 2020-21 Price List approved by the ERA[24]. The relevant tariff that applies to generation facilities is the Transmission Reference Tariff 2 (TRT2).

As network access charges vary by location, AEMO considered the list of six regions outlined in the Market Procedure and applied the unit price for the most expensive location. Muja Power Station substation is the most expensive location for transmission use of system charges and hence was selected as the base tariff input for the estimation of the fixed network access charges. The transmission use of system charges are based on the cost to Western Power of that generating asset's use of the SWIS, and are dependent on factors such as location, transmission line-length and complexity of the grid connection.

The other two input component costs are:

- Control system service charges – the general overhead of Western Power's control system costs applied proportionately per kilowatt (kW) to generators.
- Transmission metering service charges – a fixed daily charge per revenue meter.

Total annual costs per MW were calculated as at July 2020 and have been escalated to 1 October 2023 using the CPI.

The proposed value of fixed network access costs = $11,041 per MW per year. This value decreased 0.7% from the draft report.

The fixed network access cost estimates have increased by 4.2% (equal to an increase of $445 per MW per year) relative to the 2020 BRCP, due to an increase in control system and transmission use of system charges.

[24] Available at https://www.erawa.com.au/electricity/electricity-access/western-power-network/annual-price-lists-for-network-charges.

3. Proposed value of the 2021 BRCP

This chapter includes the proposed value for the annualised capital costs, annualised fixed operating and maintenance costs and the 2021 BRCP for the 2023-24 Capacity Year.

3.1 Annualised Capital Costs (ANNUALISED_CAP_COST)

The theoretical total capital cost (CAP_COST) of building a new power station in the SWIS and connecting it to the grid has been estimated from the component costs determined in Section 2.2 of this document. This is expressed as:

$$CAP\_COST = \left((PC \times (1+M) + TC) \times CC + FFC + LC\right) \times \sqrt{1 + WACC}$$

The proposed value of CAP_COST = $186,622,114. This value has increased by 0.9% from the draft report, (equal to an increase of $1,583,232 per MW), due to the increased value of the WACC.

CAP_COST was then annualised over a 15-year period using the WACC.

The proposed value of the ANNUALISED_CAP_COST = $18,222,883 per year. This value has increased by 14.7% from the draft report, (equal to an increase of $2,334,062 per MW per year) due to the increase in the WACC.

The annualised capital cost estimate increased by 8.1% relative to the 2020 BRCP. This increase was driven by the WACC. The WACC outweighted all other components, which trended lower compared to the 2020 BRCP.

3.2 Annualised Operating and Maintenance Costs (ANNUALISED_FIXED_O&M)

The theoretical annualised fixed O&M cost is the sum of individual O&M components calculated in Section 2.3 of this document. This is expressed as:

ANNUALISED_FIXED_O&M = generation O&M costs + switchyard O&M costs + transmission line O&M costs + asset insurance costs + fixed network access costs and ongoing charges

Depreciation was omitted, as it forms part of a regulated utility's annual revenue entitlement.

The proposed value of ANNUALISED_FIXED_O&M = $32,028 per MW per year. This value has increased by 0.1% from the draft report, (equal to an increase of $40 per MW per year), due to the higher BRCP that resulted in increased insurance costs.

The annualised fixed O&M cost estimate increased by 2.8% relative to the 2020 BRCP. This is primarily due to the higher BRCP (WACC driven increase), to which the asset insurance cost was applied.

3.3 BRCP Calculation

The BRCP was estimated by summing the annualised fixed O&M and annualised capital expenditure on a per MW basis. This is expressed as:

$$BRCP = ANNUALISED\_FIXED\_O\&M + \frac{ANNUALISED\_CAP\_COST}{CC}$$

The proposed value of the 2021 BRCP is estimated to be $151,695 per MW per year, which is then rounded to the nearest $100.

Accordingly, the proposed BRCP = $151,700 per MW per year. This value has increased by 11.3% from the draft report, (equal to an increase of $15,400 per MW per year) due to an increase in the WACC as a result of changing from a real to nominal basis.

The proposed 2021 BRCP is 6.9% higher than the 2020 BRCP (equal to an increase of $9,800). This difference is largely attributed to changing the basis of calculation from a real to a nominal WACC.

An overview of the variation of the components of the 2020 BRCP and the proposed 2021 BRCP is listed in Tables 4 and 5.

Table 4 BRCP components for 2020 and 2021

	2020 BRCP	Proposed 2021 BRCP	Variance	Unit
BRCP	141,900	151,700	6.9%	$/MW/year
ANNUALISED_FIXED_O&M	31,168	32,028	2.8%	$/MW/year
Generation O&M cost	14,600	13,931	-4.6%	$/MW/year
Switchyard O&M cost	544	544	-	$/MW/year
Transmission line O&M cost	34	34	-	$/MW/year
Asset insurance cost	5,393	6,477	20.1%	$/MW/year
Fixed network access and on-going charges	10,596	11,041	4.2%	$/MW/year
CAP_COST	194,116,340	186,622,114	-3.9%	$
Power station cost	859,629	816,437	-5.0%	$/MW
Margin M	17.16%	16.69%	-2.7%	%
Transmission cost	181,760	180,927	-0.5%	$/MW
Capacity Credit allocation	152.28	152.28	-	MW
Fixed fuel cost	7,213,564	6,915,717	-4.1%	$
Land cost	2,536,250	2,404,251	-5.2%	$
WACC	3.51% (real)	5.20% (nominal)	48.1%	%
ANNUALISED_CAPCOST	16,860,715	18,222,883	8.1%	$/year
Term of finance	15	15	-	years

Table 5 Breakdown of variance between 2020 and proposed 2021 BRCP

	Impact ($)	Impact (%)	BRCP ($ ex GST)
2020 BRCP			**141,900 ***
Escalation Factors	-13,100	-9.2%	128,800
Power station cost	7,600	5.4%	136,400
Margin M	-400	-0.3%	136,000
Fixed fuel cost	-200	-0.1%	135,800
Land cost	-	-	135,800
Transmission cost	-100	-0.1%	135,700
WACC	14,200	10.0%	149,900
CC allocation	-	-	149,900
Fixed O&M	1,800	1.3%	151,700
Proposed 2021 BRCP	9,800	6.9%	**151,700 ***

* BRCP values are rounded to the nearest $100.

A detailed breakdown of the historical BRCP since market start is provided in Appendix A2.

4. Stakeholder submissions

This chapter summarises submissions on the draft report and concerns with the current BRCP methodology.

The draft report and supporting documents were published for public consultation on 26 October 2020. On this date, Market Participants and other industry stakeholders were advised of the publication and an announcement was published in the West Australian newspaper.

AEMO received two submissions from Synergy and Alinta Energy, which are summarised in Table 6 along with AEMO's response. Formal Market Participant submissions and AEMO's response from previous BRCP determinations can be found on AEMO's website[25].

Table 6 AEMO's responses to issues raised in the 2021 BRCP public consultation

Submitter	Component	Comment	AEMO's response
Synergy	PC – REFERENCE EQUIPMENT	Synergy is cognisant that the proposed BRCP will be increased as a result of applying the revised Weighted Average Cost of Capital (WACC) calculations as set out in the BRCP Market Procedure commencing the 9 November 2020. However, Synergy does not consider this an adequate reflection of the marginal cost of adding one additional megawatt (MW) of Reserve Capacity for the 2023-24 Capacity Year. Synergy challenges whether the assumptions used in setting escalation factor forecasts in such depressed market conditions, particularly considering the economic impact of COVID-19, is appropriate. Synergy considers whether utilising historical escalation forecasts would be more appropriate.	While AEMO acknowledges Synergy's concern, it is obliged to follow the methodology prescribed in the Market Procedure when calculating the escalation factors. AEMO notes the reason behind the yearly calculation of the BRCP is to reflect efficient financing costs at that point in time. AEMO considers the escalation factors accurately reflect the economic and financial environment at the time of the report, with all indicators trending downwards as a result of COVID-19. AEMO notes the wages escalation factors are a very small part of the total power station cost escalation and that no evidence of wages increases, or labour scarcity was found. Using historical escalation forecasts would result in unnecessary financial burden for consumers. AEMO considers a review of the underlying generation technology is necessary. By considering the most recent types of generators installed in the SWIS, as well as new capacity firming technologies, more up-to-date projects could be considered. This would alleviate the reliance on cost escalation factors.
Alinta Energy - late submission	PC – REFERENCE EQUIPMENT	Alinta Energy supports AEMO updating its draft report to incorporate the ERA's recently revised method for determining the WACC in its final proposal. Alinta Energy considers that the forecast sharp decreases in spot steel and copper prices, driven by the impacts of COVID-19 on demand, would not decrease the cost of constructing an OCGT as significantly as outlined by the draft report.	While AEMO acknowledges Alinta Energy's concern, it is obliged to follow the methodology prescribed in the Market Procedure when calculating the escalation factors. AEMO notes the absence of recent projects that reflect the underlying technology described in the Market Procedure increases the probability of an error in estimating the theoretical power station costs. AEMO considers a review of the underlying generation technology is necessary in addition to the Capacity Credit pricing curve review

[25] All submissions made to date by Market Participants can be found at https://www.aemo.com.au/Electricity/Wholesale-Electricity-Market-WEM/Reserve-capacity-mechanism/Benchmark-Reserve-Capacity-Price.

Submitter	Component	Comment	AEMO's response
			proposed to occur after 30 September 2022[26]. By considering the most recent types of generators installed in the SWIS, as well as new capacity firming technologies, more up-to-date projects could be considered. This would alleviate the reliance on cost escalation factors.

[26] Wholesale Electricity Market Rules (WA), 7 August 2020, Clause 1.13.1.

A1. WACC

The pre-tax nominal WACC has been applied in the determination of the BRCP. The formula is:

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

where the nominal return on equity is calculated as:

$$R_e = R_f + \beta_e \times MRP$$

while the nominal return on debt is calculated as:

$$R_d = R_f + (DRP + d)$$

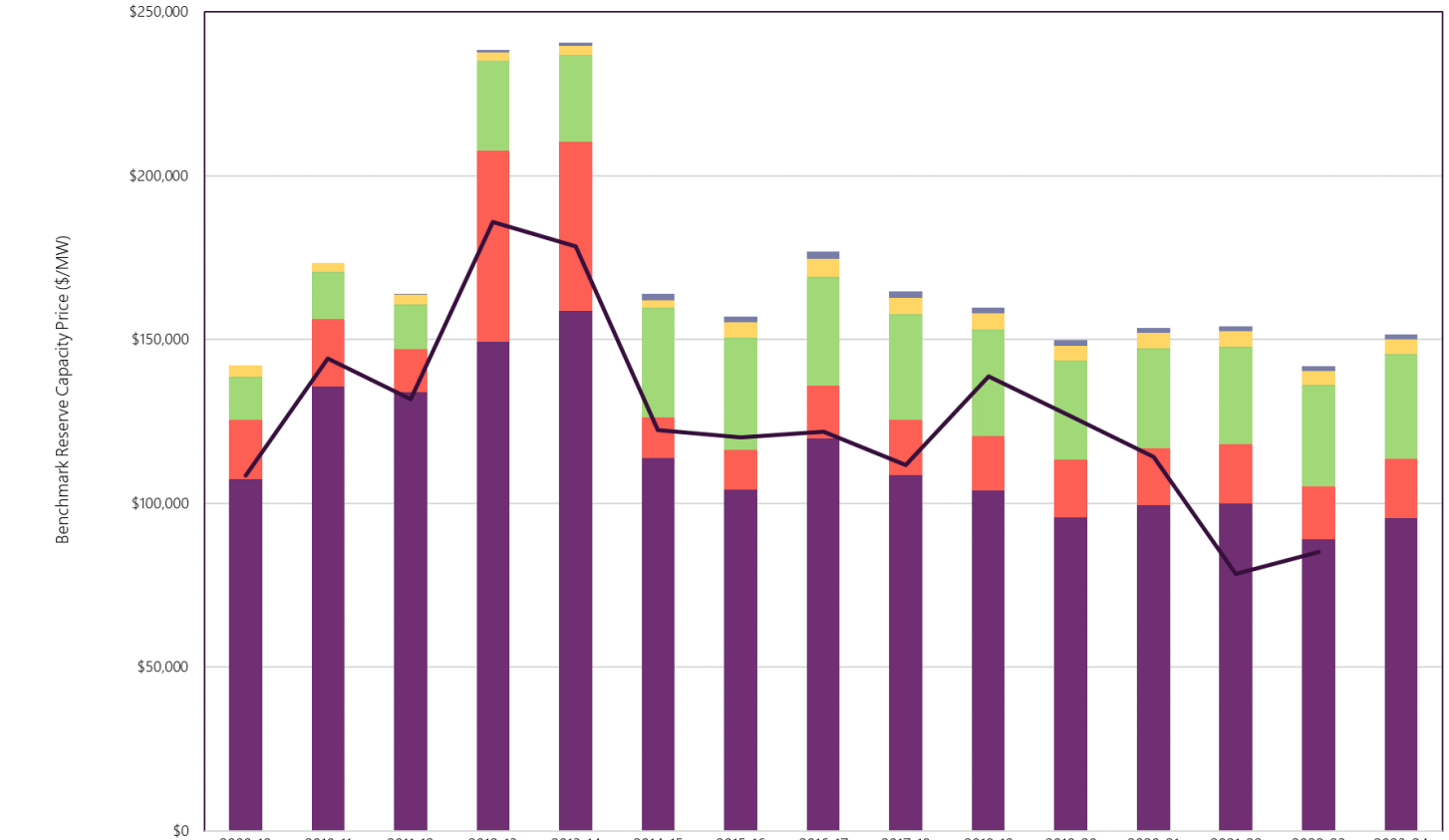
The WACC parameters applied in the 2020 BRCP and the proposed parameters for the 2021 BRCP are shown in Table 8.

Table 7 WACC parameters for the 2020 and proposed 2021 BRCP

Parameter	Notation	2020 value	Proposed 2021 value
Nominal risk-free rate of return (%)	R_f	0.98	0.80
Market risk premium (%)	*MRP*	6	5.90
Asset beta	β_a	0.5	0.5
Equity beta	β_e	0.83	0.83
Debt risk premium (%)	*DRP*	2.23	2.04
Debt issuance costs (%)	*d*	0.125	0.100
Corporate tax rate (%)	*t*	30	30
Franking credit value	γ	0.25	0.50
Debt to asset ratio (%)	*D/V*	40	40
Equity to total asset ratio (%)	*E/V*	60	60

A2. Historical BRCP cost breakdown

Figure 3 Historical BRCP component cost breakdown



	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24
Land cost (LC)	$-	$-	$293	$769	$818	$1,973	$1,783	$2,064	$1,912	$1,831	$1,650	$1,585	$1,535	$1,472	$1,581
Fixed fuel cost (FFC)	$3,456	$2,631	$3,151	$2,615	$2,825	$2,239	$4,680	$5,442	$5,061	$4,886	$4,620	$4,615	$4,753	$4,186	$4,548
Fixed O&M cost	$13,363	$14,392	$13,431	$27,335	$26,649	$33,384	$34,239	$33,238	$32,307	$32,582	$30,143	$30,437	$29,776	$31,168	$32,028
Transmission cost (TC)	$18,017	$20,672	$13,151	$58,493	$51,621	$12,329	$12,164	$16,127	$16,860	$16,624	$17,691	$17,520	$18,120	$16,062	$18,120
Power station cost (PC)*	$107,404	$135,701	$134,091	$149,306	$158,710	$113,971	$104,178	$119,942	$108,649	$103,898	$95,745	$99,425	$100,002	$89,002	$95,417
Reserve Capacity Price	$108,459	$144,235	$131,805	$186,001	$178,477	$122,428	$120,199	$121,889	$111,753	$138,760	$126,683	$114,134	$78,573	$85,294	

*Includes Margin M

Abbreviations

Abbreviation	Expanded name/definition
$ or AUD	Australian dollar
AEMO	Australian Energy Market Operator
ANNUALISED_CAP_COST	Annualised capital cost
ANNUALISED_FIXED_O&M	Annualised fixed operating and maintenance cost
BRCP	Benchmark Reserve Capacity Price
CAP_COST	Capital cost
CC	Capacity Credit
CPI	Consumer price index. Used as a general price inflation index during escalations.
DRP	Debt risk premium
ERA	Economic Regulation Authority
FFC	Fixed fuel costs
kV	Kilovolts
kW	Kilowatts
LC	Land cost
Margin M	Margin to cover legal, approval, financing and other costs and contingencies
MVA	Megavolt amperes
MW	Megawatt
OCGT	Open cycle gas turbine
O&M	Operating and maintenance
PC	Power station capital cost
PwC	PricewaterhouseCoopers Australia
RBA	Reserve Bank of Australia
S&P/ASX	Standard and Poor's/Australian Stock Exchange
SWIS	South West interconnected system
TC	Transmission connection costs
WACC	Weighted average cost of capital
WEM	Wholesale Electricity Market