AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Final Report: 2019 Benchmark Reserve Capacity Price for the 2021-22 Capacity Year

January 2019

Important notice

PURPOSE

AEMO has prepared this document under clause 4.16 of the Wholesale Electricity Market Rules to provide information about the proposed revised value for the 2019 Benchmark Reserve Capacity Price for the 2021–22 Capacity Year, as at the date of publication.

DISCLAIMER

This document or the information in it may be subsequently updated or amended. This document does not constitute legal or business advice, and should not be relied on as a substitute for obtaining detailed advice about the Wholesale Electricity Market Rules, or any other applicable laws, procedures or policies. AEMO has made every effort to ensure the quality of the information in this document, but cannot guarantee its accuracy or completeness.

Accordingly, to the maximum extent permitted by law, AEMO and its officers, employees and consultants involved in the preparation of this document:

- make no representation or warranty, express or implied, as to the currency, accuracy, reliability or completeness of the information in this document; and
- are not liable (whether by reason of negligence or otherwise) for any statements or representations in this document, or any omissions from it, or for any use or reliance on the information in it.

VERSION CONTROL

Version	Release date	Changes
1	04/02/2019	

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: Maximum 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 for the BRCP for the 2019 Reserve Capacity Cycle. The 2019 BRCP applies for the 2021-22 Capacity Year, covering the period from 8:00 am on 1 October 2021 to 8:00 am on 1 October 2022.

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 broad methodology applied to determine the BRCP has not changed since the last five-yearly review completed in 2011[2], and includes the following costs:

- 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 bulk transmission system.
- 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 final value of the 2019 BRCP for the 2021-22 Capacity Year

AEMO proposes a value of $154,200 per MW per year for the 2019 BRCP, 0.4% higher than the 2018 BRCP of $153,600 per MW per year.

Changes from the 2018 BRCP

Table 1 shows the year-on-year variation in the input parameters between the 2018 BRCP (for the 2020-21 Capacity Year) and the 2019 BRCP.

[1] The Market Procedure: Maximum Reserve Capacity Price has not been updated to reflect the amendments to the WEM Rules that commenced on 1 July 2016 as a result of the Electricity Market Review. The Economic Regulation Authority is now responsible for the Market Procedure, which is available at https://www.erawa.com.au/electricity/wholesale-electricity-market/market-procedures. All references to the Independent Market Operator (IMO) and the Maximum Reserve Capacity Price in the Market Procedure should be to AEMO and the BRCP respectively.

[2] Clause 4.16.9 of the WEM Rules requires the Economic Regulation Authority to carry out a five-yearly review of the Market Procedure referred to in clause 4.16.3 (which is currently the Market Procedure: Maximum Reserve Capacity Price). Clause 1.17.5(e) of the WEM Rules modifies this requirement: the Economic Regulation Authority 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.

Table 1 Breakdown of variance between 2018 and 2019 BRCP

	Impact ($)*	Impact (%)	BRCP (AU$)
2018 BRCP			153,600
Escalation factors	-2,800	-1.8	150,800
Power station cost	2,200	1.4	153,000
Margin M	100	0.1	153,100
Fixed fuel cost	0	0.0	153,100
Land cost	0	0.0	153,100
Transmission cost	400	0.3	153,500
WACC	1,200	0.8	154,700
Fixed operating and maintenance (O&M)	-500	-0.3	154,200
2019 BRCP	600	0.4	154,200

* Rounded to the nearest $100 – zero dollar values indicate an impact of less than $50.

The 2019 BRCP remains broadly consistent with the 2018 BRCP. The decrease in escalation factors has been offset by an increase in the Weighted Average Cost of Capital (WACC) and power station capital costs due to a weakening AUD/USD exchange rate.

Public consultation

The draft BRCP report was published for consultation on 10 October 2018. AEMO received submissions[3] from Perth Energy and Merredin Energy.

Perth Energy notes that the decrease in insurance costs is inconsistent with its own experience of increasing insurance premiums. This year, AEMO sourced multiple insurance quotes from several independent brokers to test the market for a range of insurance premiums. AEMO applied an average of these premiums, which resulted in a decrease in insurance costs from the 2018 BRCP. AEMO considers this to be more representative of current insurance market conditions, compared to the approach taken in previous years.

Other issues raised relate to the following methodology concerns:

- Perth Energy and Merredin Energy consider that the WACC does not accurately reflect the current market risk and cost of capital.
- Merredin Energy considers that the use of a 160 MW OCGT as the reference power station is not reflective of expected growth in peak demand in the WEM.

AEMO acknowledges these concerns, but it is required to follow the methodology prescribed in the Market Procedure when calculating the WACC and selecting the reference power station. AEMO anticipates that the Economic Regulation Authority (ERA) will consider these concerns as part of the five-yearly review of the Market Procedure. A more detailed response to both submissions, along with other methodology issues raised previously by stakeholders, can be found in Chapter 4.

[3] See https://www.aemo.com.au/Stakeholder-Consultation/Consultations/Draft-Report-2019-Benchmark-Reserve-Capacity-Price-for-the-2021-22-Capacity-Year?Convenor=AEMO%20WEM.

Contents

Executive summary **3**

1. Introduction **7**

1.1 Overview of input parameters 7

1.2 Supporting documentation 8

2. Input parameters **8**

2.1 Escalation factors 8

2.2 Capital costs 9

2.3 Operating and maintenance costs 13

3. Proposed value of the 2019 BRCP **16**

3.1 Annualised capital costs (ANNUALISED_CAP_COST) 16

3.2 Annualised operating and maintenance costs (ANNUALISED_FIXED_O&M) 16

3.3 BRCP calculation 16

4. Stakeholder submissions and methodology concerns **19**

A1. WACC **22**

A2. Historical BRCP cost breakdown **23**

Measures and abbreviations **24**

Tables

Table 1 Breakdown of variance between 2018 and 2019 BRCP 4

Table 2 Organisations and input parameters 7

Table 3 Cost escalation forecast 8

Table 4 Escalation factors by financial year 9

Table 5 BRCP components for 2018 and 2019 17

Table 6 Breakdown of variance between 2018 and 2019 BRCP 17

Table 7 AEMO's responses to issues raised in public consultation 19

Table 8 Methodology concerns 20

Table 9 WACC parameters for the 2018 and 2019 BRCP 22

Figures

Figure 1 Commonwealth Government bond yields, September 2017 to October 2018 12

Figure 2 Historical BRCP component cost breakdown 23

1. Introduction

The Benchmark Reserve Capacity Price (BRCP) is a dollar per MW per year value which aims to establish the marginal cost of providing 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 110% of the BRCP when submitting their 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 presents the proposed revised value for the BRCP for the 2019 Reserve Capacity Cycle, which applies to the 2021-22 Capacity Year. A draft report was published on AEMO's website[4] on 10 October 2018. AEMO has considered all submissions received as part of the public consultation period prior to submitting the final 2019 BRCP to the Economic Regulation Authority (ERA) for approval in accordance with clause 4.16.7 of the Wholesale Electricity Market (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. The broad methodology and fixed input parameters used to determine the BRCP have not changed since 2011 due to the deferral of the five-yearly review of the Market Procedure.

In determining the 2019 BRCP, AEMO has used publicly available information, including advice from independent consultants, Western Power, and the Western Australian Land Information Authority.

The organisations and the input parameters they provided are shown in Table 2.

Table 2 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 operating 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 (PwC)	• Debt risk premium (DRP) • Relevant escalation factors
Western Power	• Transmission connection costs and relevant escalation factors

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

Throughout this report, cost and price estimates are expressed in Australian dollars, unless otherwise specified.

1.2 Supporting documentation

The following related documents are available on AEMO's website[5]:

- 2019 BRCP calculation spreadsheet, final report version.
- GHD report, *2019 Benchmark Reserve Capacity Price for the South West Interconnected System* (September 2018).
- PwC report, *Estimating the Escalation Factors for the 2019 Benchmark Reserve Capacity Price* (August 2018).
- PwC memo, *2019 Benchmark Reserve Capacity Price Debt Risk Premium for the South West Interconnected System* (November 2018).
- Landgate report, *Land values for the 2019 Benchmark Reserve Capacity Price* (August 2018).
- Weighted Average Cost of Capital (WACC) parameter calculation spreadsheet for final report.
- Western Power report, *Total Transmission Cost Estimate for the Benchmark Reserve Capacity Price for 2021/22* (September 2018).

2. Input parameters

This chapter provides information on the input parameters used to determine the 2019 BRCP.

2.1 Escalation factors

The 2019 BRCP calculation is based on a theoretical power station that would commence operation on 1 October 2021. Costs have been determined as at 2018 and have been escalated to 2021.

Different escalation factors are used depending on the parameter to be escalated, as summarised in Table 3.

Table 3 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/USD exchange rate were derived by PwC. The determination involved analysing commodity market trends and forecasts from leading investment banks. More information on PwC's methodology is provided in their report. GHD derived the power station capital cost, generation O&M and connection asset O&M 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	

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

Escalation factor	Component costs applied to	Source and methodology
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 is applied. For the first year outside of the RBA's forecast horizon, the average of the previous year's forecast and the mid-point of the RBA's target for inflation is used. For all periods beyond June 2022, 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 as per steps 2.4.1(d) and 2.4.2 of the Market Procedure. However, as five years of actual data was not available for the 2019 BRCP, the escalation rate is averaged over a period for which equivalent data is available. Western Power provides these escalation factors.

The escalation factors applied to the 2019 BRCP are listed in Table 4.

Table 4 Escalation factors by financial year

Escalation factor	2018-19	2019-20	2020-21	2021-22
Power station capital cost	5.30%	-1.10%	0.10%	0.60%
Generation O&M cost	1.90%	2.40%	2.10%	2.40%
Connection asset O&M cost	2.30%	3.30%	2.40%	2.30%
CPI	2.00%	2.25%	2.38%	2.50%
Transmission connection cost	1.17%	1.17%	1.17%	1.17%

Power station capital cost and generation operating and maintenance (O&M) escalation factors have generally decreased from the 2018 BRCP, due to a fall in the expected price of steel and copper in relevant international markets. The slight increase in the connection asset O&M escalation factor is driven by an expected lift in Western Australia's wage growth, attributed to improving conditions in the labour market. CPI escalation factors remain consistent with the 2018 BRCP. Escalation factors have not changed from the draft report.

2.2 Capital costs

2.2.1 Power station capital cost (PC)

The Siemens SGT5-2000E (33MAC) 175.6 MW OCGT was used as the reference equipment to determine the power station capital cost component of the 2019 BRCP, consistent with the 2018 BRCP. The unit is considered to be the most appropriate machine available to meet the criteria for the BRCP calculation[6]. Version 27.0 of Thermoflow's GTPro 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.

[6] 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 175.6 MW Siemens unit to represent the expected configuration of the 160 MW generator specified in the Market Procedure.

The total capital cost was escalated to 1 April 2021 using the power station capital cost escalation factor.

The proposed value of PC = $843,378.53 per MW.

The estimated PC has decreased by 0.4% (a decrease of around $3,400) from the 2018 BRCP, due to a lower escalation factor which has offset an increase in the original capital cost as a result of a lower AUD/USD exchange rate. This value has not changed from the draft report.

2.2.2 Capacity Credit (CC) allocation

GTPro was used to model the 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 = 151.4 MW.

The proposed CC value has not changed from the 2018 BRCP or the draft report.

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

'Margin M' covers legal, 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 = 17.15%.

The Margin M value in the 2019 BRCP is similar to last year's value (17.12%) and has not changed from the draft report.

2.2.4 Land costs (LC)

Land valuations were made 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 2018 and excluded transfer duty. AEMO has added the applicable transfer duty to the land parcel cost using the Office of State Revenue's online calculator[7].

AEMO calculated the average of the six valuations and escalated this to 1 April 2021 using the CPI escalation factor. The size of the land parcels for all regions was three hectares, except for Kemerton, where the minimum land size is five hectares.

The proposed value of LC = $2,295,990.53

The LC estimate decreased by 4.1% from the 2018 BRCP. This is due to a reduction of 6.7%, 4.8%, and 3.8% from last year's land cost estimate for the Pinjar, Kwinana, and Geraldton regions respectively. Land cost estimates for other regions remained consistent with those determined for the 2018 BRCP[8].

---

[7] Available at https://apps.osr.wa.gov.au/portal/0/home;jsessionid=JNLmA3sv1F6fF_lxDZGINReN2myw-2WfuMjTFmdhv9ITnzH6gMoy!1192205439.

[8] Landgate report, *Land values for the 2019 Benchmark Reserve Capacity Price* (August 2018).

This value has not changed from the draft report.

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 available in the five-year window, Western Power estimated the shallow connection cost in accordance with the methodology described in the Market Procedure. The methodology included the estimation of capital costs such as the procurement, installation, and commissioning of the substation, plus easement costs. Western Power provided an independent report to verify the accuracy of the estimates on the basis that the underlying data is commercial in confidence and therefore cannot be published.

Shallow connection cost estimates include construction of a substation, 2 kilometres (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).
- A new generator may not need to purchase the entire 12 hectares, instead securing easement rights for some or all of the land. AEMO estimates easement costs to be half of the land value.
- The land value includes transfer duty.

Easement costs have decreased by 4.1% from the 2018 BRCP, due to a fall in land values in the Pinjar, Kwinana, and Geraldton regions.

The shallow connection costs for the 2019 BRCP have increased by 1.6% compared to the 2018 BRCP.

The proposed value of TC = $179,028.00 per MW.

No escalation factors have been applied because Western Power has already escalated the TC estimate to 1 April 2021.

The TC estimate has increased by 2.4% from the 2018 BRCP value of $174,749. This is partly due to an increase in the escalation factor applied by Western Power. AEMO does not have visibility into other components of the TC estimate provided by Western Power for confidentiality reasons.

This value has not changed from the draft report.

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 the tank with diesel to a level sufficient for 14 hours of operation. An estimate of FFC was calculated as at 30 June 2018, which is escalated to 1 April 2021 using the CPI escalation factor. The cost of diesel includes delivery and excise rebate, but excludes GST.

The proposed value of FFC = $7,109,637.85.

The FFC estimate increased by 2.0% from the 2018 BRCP. This is largely associated with an increase in the price of delivered diesel to $0.756 per litre (7% higher than the 2018 BRCP).

This value has not changed from the draft report.

2.2.7 Weighted average cost of capital

The WACC is determined by using the Capital Asset Pricing Model to estimate the costs of equity and debt. The debt risk premium (DRP) was estimated by PwC, while the risk-free rate and expected inflation

components of the WACC were calculated using the latest information available from the RBA's website[9]. 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 provides more detail on the steps for estimating the WACC.

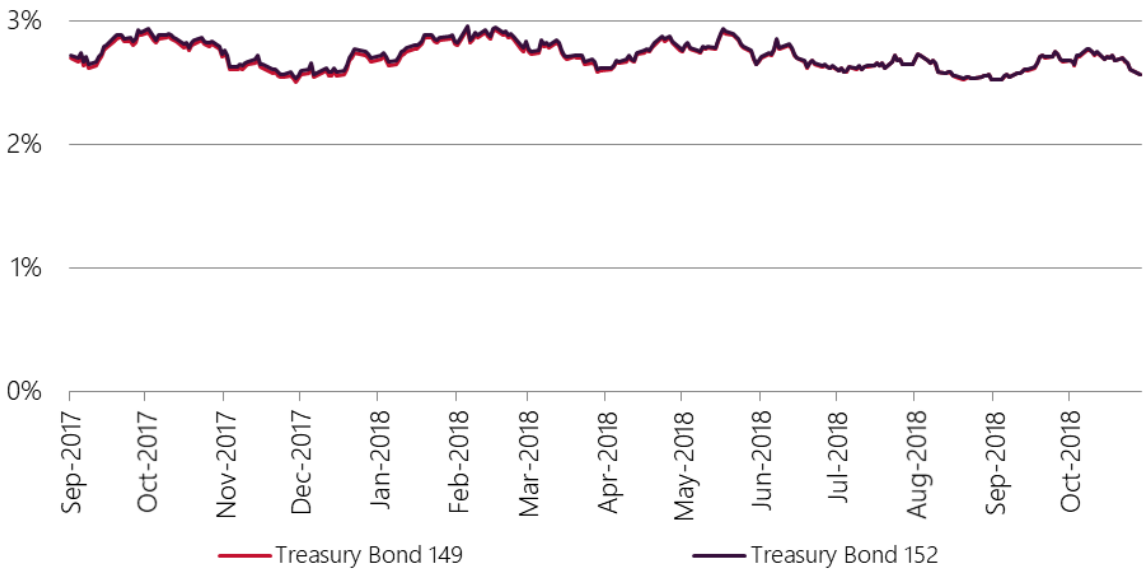
In the 2018 BRCP report, AEMO noted that the low values for the real risk-free rate, and subsequently the WACC, did not reflect current Australian market conditions[10]. While this year's real risk-free rate and WACC are slightly higher than last year, this note remains valid and is reflected in the methodology concerns detailed in Chapter 4.

Risk-free rate of return methodology

The nominal risk-free rate was calculated from the annualised yield of Commonwealth Government bonds with maturity dates of roughly 10 years. The rate was estimated using a 20-day average from market observations ending on 26 October 2018.

Commonwealth Government bond yields have remained relatively consistent since the 2018 BRCP, as shown in Figure 1. The nominal risk-free rate calculated from these bonds is 2.71%, an increase from 2.67% in the 2018 BRCP. The nominal risk-free rate has increased 0.11% from the value calculated in the draft report, due to a slight increase in government bond yields in October.

Figure 1 Commonwealth Government bond yields, September 2017 to October 2018



The nominal rate was then adjusted for inflation to determine the real risk-free rate of return. The Market Procedure requires AEMO to use the RBA's inflation forecasts or the mid-point of the RBA's target inflation range outside of the forecast period. Based on the RBA's forecasts and target of 2% to 3%, the expected rate of inflation is 2.42%. This value has not changed from the draft report. The RBA's November Statement of Monetary Policy has kept the expected rate of inflation consistent.

The above parameter values have resulted in a real risk-free rate of 0.28%. This is higher than the draft report value of 0.18%, due to the increase in the nominal risk-free rate.

[9] See http://www.rba.gov.au/statistics/tables/ and http://www.rba.gov.au/publications/smp/index.html.

[10] Section 2.2.7 of the 2017 BRCP report, at http://www.aemo.com.au/-/media/Files/Electricity/WEM/Reserve_Capacity_Mechanism/BRCP/2017/Final-Report-Benchmark-Reserve-Capacity-Price-for-the-2019-20-Capacity-Year.pdf.

Debt risk premium methodology

The Market Procedure requires AEMO to determine a methodology to estimate the DRP which in the opinion of AEMO is consistent with currently accepted Australian regulatory practice.

The ERA adopted 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*[11]. AEMO considers that this revised methodology represents currently-accepted Australian regulatory practice, and the DRP has been calculated accordingly. This methodology was implemented for the 2018 BRCP.

The revised 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 2.02% from market observations ending on 26 October 2018. The final DRP estimate decreased from the draft report value of 2.07%, due to a decrease in corporate bond yields from the earlier observation period used in the draft report.

Capital Asset Pricing Model results

The proposed value of the WACC (real terms) = 5.35%.

This is higher than the WACC (real terms) of 5.21% used in the 2018 BRCP and the draft report, due to an increase in the real risk-free rate.

Market Participants queried the WACC methodology outlined in the Market Procedure during the 2018 BRCP consultation period and previous BRCP determinations. AEMO has compiled a list of all other concerns regarding the methodology (see Chapter 4).

2.3 Operating and maintenance 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 were therefore not considered. An allowance for balance of plant (for example, service of pumps, fire systems) has been included.

A 15-year annuity was calculated based on individual component costs as at June 2018, which are derived from similar recent OCGT projects. These costs are then escalated to 1 October 2021 using the generation O&M escalation factor.

The proposed value of generation fixed O&M costs = $14,265.69 per MW per year.

The estimated generation O&M cost increased by 0.15% from the 2018 BRCP. This value has not changed from the draft report.

2.3.2 Switchyard O&M costs

Switchyard O&M costs were calculated from the isolator on the high voltage side of the generator 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 infrastructure. The cost estimate included labour, machinery parts, and general overheads incurred during routine maintenance, which occurs one week per year on average.

The 330 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 2018, which was then escalated to 1 October 2021 using the connection O&M escalation factor.

[11] Available at https://www.erawa.com.au/cproot/13880/2/GDS%20-%20ATCO%20-%20AA4%20-%20Amended%20Final%20Decision%20-%20PUBLIC%20VERSION.PDF.

The proposed value of switchyard O&M costs = $549.24 per MW per year.

The estimated switchyard O&M cost increased by 4.7% from the 2018 BRCP, due to an increase in the connection asset O&M escalation factors (see Section 2.1 for further information). This value has not changed from the draft report.

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 MVA (power factor of 0.8).

The 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 2018, which was then escalated to 1 October 2021 using the connection O&M escalation factor.

The proposed value of transmission line O&M costs = $34.29 per MW per year.

The estimated switchyard O&M cost increased by 5.4% from the 2018 BRCP, due to an increase in the connection asset O&M escalation factors (see Section 2.1 for further information). This value has not changed from the draft report.

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. AEMO has obtained advice on insurance costs from multiple independent brokers[12] and calculated an average insurance premium.

Premiums were calculated as follows:

- Asset replacement insurance was calculated as 0.24% of the limit of liability. 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 $424,447.13 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 period of time 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 calculates business interruption insurance as $126,459.76 per year.
- Public and products liability insurance is estimated as $116,768.03 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 cost of $22,663.71 per year for an annual insurance site survey is included.

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 where necessary to 1 October 2021 using the CPI escalation factor.

[12] The brokers prefer to remain anonymous to protect their competitive position.

The proposed value of asset insurance costs = $4,672.49 per MW per year.

The insurance cost estimates have decreased by 13.2% from the 2018 BRCP. This year, AEMO sourced multiple insurance quotes from independent brokers, which resulted in a considerable range of insurance premiums. An average of all premiums was then calculated and applied. AEMO considers this to be more representative of current insurance market conditions.

The proposed asset insurance costs value has increased 0.1% from the draft report value, due to the overall increase in the proposed 2019 BRCP.

2.3.5 Fixed network access and on-going charges

Network access charges were estimated using Western Power's network access tariffs (Price List) data from the 2016-17 Price List approved by the ERA[13]. The relevant tariff that applies to generation facilities is the Transmission Reference Tariff 2.

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 "Use of System" is the most expensive location, and hence was selected as the base tariff input for the estimation of the fixed network access charges. The other two input component costs were control system and transmission metering service charges. Total annual costs per MW were calculated as at July 2018 and have been escalated by CPI to 1 October 2021.

The proposed value of fixed network access costs = $10,254.73 per MW per year.

The fixed network access cost estimates have not changed from the 2018 BRCP or the draft report.

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

3. Proposed value of the 2019 BRCP

This chapter includes the proposed values for the annualised capital costs and annualised fixed operating and maintenance costs, and the 2019 BRCP for the 2021-22 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 was estimated from the component costs determined in Section 2.2.2. This is expressed as:

$$CAP\_COST = \left((PC \times (1+M) + TC) \times CC + FFC + LC\right) \times (1+WACC)^{\frac{1}{2}}$$

The proposed value of CAP_COST = $191,011,923.

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

This produced an ANNUALISED_CAP_COST = $18,835,625 per year.

The annualised capital cost estimate has increased by 1% from the 2018 BRCP and 0.8% from the draft report, due to an increase in the WACC.

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 2.2.3. 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 on-going charges

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

The proposed value of ANNUALISED_FIXED_O&M = $29,776 per MW per year.

The annualised fixed O&M cost estimate has decreased by 2.2% from the 2018 BRCP due to a decrease in asset insurance costs. The estimate remains consistent with the draft report.

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 2019 BRCP was estimated to be $154,186, which was rounded to the nearest $100.

The proposed BRCP = $154,200 per MW per year.

The proposed 2019 BRCP is 0.4% higher than the 2018 BRCP.

The proposed 2019 BRCP is 0.7% higher than the draft report, due to an increase in the WACC.

An overview of the variation of the components of the 2018 BRCP and 2019 BRCP is listed in Table 5.

Table 5 BRCP components for 2018 and 2019

	2018 BRCP	2019 BRCP	Unit
BRCP	153,600	154,200	AU$/MW/year
ANNUALISED_FIXED_O&M	30,437	29,776	AU$/MW/year
Generation O&M cost	14,244	14,266	AU$/MW/year
Switchyard O&M cost	525	549	AU$/MW/year
Transmission line O&M cost	32.53	34.29	AU$/MW/year
Asset insurance cost	5,381	4,673	AU$/MW/year
Fixed network access and on-going charges	10,255	10,255	AU$/MW/year
CAP_COST	190,747,133	191,011,923	AU$
Power station cost	846,751	843,379	AU$/MW
Margin M	17.12	17.15	%
Transmission cost	174,749	179,028	AU$/MW
Capacity credit allocation	151.4	151.4	MW
Fixed fuel cost	6,969,444	7,109,638	AU$
Land cost	2,394,088	2,295,991	AU$
WACC	5.21	5.35	%
ANNUALISED_CAPCOST	18,644,285	18,835,625	AU$/year
Term of finance	15	15	Years

The changes between the 2018 and 2019 BRCP values by input parameter are shown in Table 6. The majority of the changes relate to a decrease in escalation factors, which has been offset by an increase in the WACC and power station capital costs due to a weakening AUD/USD exchange rate.

Table 6 Breakdown of variance between 2018 and 2019 BRCP

	Impact ($)*	Impact (%)	BRCP (AU$)
2018 BRCP			153,600
Escalation factors	-2,800	-1.8%	150,800
Power station cost	2,200	1.4%	153,000
Margin M	100	0.1%	153,100
Fixed fuel cost	0	0.0%	153,100
Land cost	0	0.0%	153,100
Transmission cost	400	0.3%	153,500
WACC	1,200	0.8%	154,700

	Impact ($)*	Impact (%)	BRCP (AU$)
Fixed O&M	-500	-0.3%	154,200
2019 BRCP	600	0.4%	154,200

* Rounded to the nearest $100 – zero dollar values indicate an impact of less than $50.

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

4. Stakeholder submissions and methodology concerns

This chapter presents submissions on the 2019 BRCP draft report and highlights concerns with the current BRCP methodology.

The 2019 BRCP draft report and supporting documents were published for public consultation on 10 October 2018. Market Participants and other industry stakeholders were advised of the publication and an announcement was published in the West Australian on 11 October 2018. AEMO received submissions from Perth Energy and Merredin Energy. Table 7 summarises issues raised in submissions and AEMO's responses. Formal Market Participant submissions can be found on AEMOs website and are outlined in Table 8[14].

Table 7 AEMO's responses to issues raised in public consultation

Submitter	Component	Comment	AEMO's response
Perth Energy	Fixed O&M – Insurance	Annualised fixed O&M costs have decreased due to a reduction in insurance premiums compared to the 2018 BRCP. Perth Energy states that this is inconsistent with its own experience of an increase in insurance premiums.	In previous years AEMO has only sourced one insurance quote from an independent broker to determine insurance costs. By relying on one broker there is potential to apply an insurance quote that is not reflective of average insurance costs. This year, AEMO sourced multiple insurance quotes from several independent brokers to test the market for a range of insurance premiums. AEMO applied an average of these premiums, which resulted in a decrease in insurance costs from the 2018 BRCP. AEMO considers that this is more representative of current insurance market conditions.
Perth Energy	WACC	Perth Energy considers that the WACC methodology needs to be reviewed as it does not adequately reflect the current degree of risk in the RCM.	AEMO considers that all components of the WACC methodology should be reviewed as part of the five-yearly review conducted by the ERA. A more detailed commentary on the WACC methodology is provided in Table 8.
Merredin Energy	PC – Reference equipment	Merredin Energy considers that the use of a 160 MW OCGT as the reference power station is not reflective of expected growth in peak demand in the WEM.	AEMO considers that the reference generator should be reviewed as part of the five-yearly review conducted by the ERA. A more detailed commentary on the current reference power station is provided in Table 8.

[14] At http://www.aemo.com.au/Electricity/Wholesale-Electricity-Market-WEM/Reserve-capacity-mechanism/Benchmark-Reserve-Capacity-Price. The list is not exhaustive.

Submitter	Component	Comment	AEMO's response
		Merredin Energy considers this will increase price volatility and potentially deter new investment in the WEM.	
Merredin Energy	WACC	Merredin Energy considers that the WACC does not reflect the current cost of financing a power station. This is due to the following factors: • Equity beta –the current value for equity beta is too low, given the recent volatility in the electricity market and associated energy policy uncertainty. • Market risk premium – the current value for the market risk premium is too low, as it does not reflect the risks of financing a power station today. • Nominal return on debt – the current value for the nominal return on debt is too low as it does not consider low term funding costs.	AEMO considers that all components of the WACC methodology should be reviewed as part of the five-yearly review conducted by the ERA. Given the complexity of the CAPM, the annual components and the five yearly components should be reviewed together. A more detailed commentary on the WACC methodology is provided in Table 8.

Both AEMO and Market Participants have outlined concerns and provided feedback on the BRCP methodology during previous annual public consultation processes. AEMO considers the methodology concerns in Table 8 should be reviewed as part of the five-yearly review to be conducted by the ERA under clause 4.16.9 of the WEM Rules, and the Market Procedure amended where necessary.

Table 8 Methodology concerns

Component	Comment	Market Participant support
PC – REFERENCE EQUIPMENT	The methodology prescribed in the Market Procedure currently requires the theoretical reference power station to be a 160 MW OCGT. AEMO considers that the size of the reference power generator does not reflect future growth of peak demand in the WEM. AEMO notes that an OCGT power station has not been installed in the SWIS in the past 7 years, and that a power station of this configuration is no longer available for purchase on the market. Currently, AEMO selects a generator with a nameplate capacity close to 160 MW and scales this to a nameplate capacity of 160 MW to align with the requirements of the Market Procedure.	Tesla Corporation (2016, 2017) Synergy (2016) Community Electricity (2014, 2015) Merredin Energy (2019)
WACC – DRP	The methodology prescribed in the Market Procedure currently requires AEMO to determine the DRP using a methodology consistent with current accepted Australian regulatory practice. AEMO agrees that the DRP methodology should follow current Australian regulatory practice. However, AEMO notes that footnote 1 in the Market Procedure restricts the DRP methodology to a specific 'Bond-Yield Approach'. AEMO considers the DRP methodology should be reviewed.	Tesla Corporation (2016, 2017) Synergy (2017 Alinta (2014, 2015)
WACC	AEMO notes that the WACC methodology prescribed in the Market Procedure gives AEMO no discretion to deviate. In a situation where the methodology results in an irregular or nonsensical outcome for any input parameter, AEMO cannot consider an alternative approach. This may result in a BRCP determination that is not reflective of the current economic situation. AEMO notes that the proposed 2017 BRCP calculation resulted in a lower than expected WACC, due to an irregular real risk-free rate of return. This issue persisted in the calculation of the 2018 BRCP. AEMO considers that all components of the WACC methodology should be reviewed.	Perth Energy (2017, 2018, 2019) Tesla (2017) Alinta (2015) Merredin Energy (2019)

Component	Comment	Market Participant support
FIXED O&M – INSURANCE	The methodology prescribed in the Market Procedure currently requires the limit of liability for public and products liability insurance to be determined in accordance with Western Power's network access arrangement. Currently, the access arrangement requires a public liability insurance limit of not less than $50 million. After considering feedback from several independent brokers, AEMO considers that the limit of $50 million is too low.	Perth Energy (2018) Community Electricity (2014, 2015)
TC	The TC cost methodology prescribed in the Market Procedure is currently based on actual connection costs and access offers identified by Western Power. However, there is limited new generation capacity being built in the WEM that meets the requirements of the current Market Procedure. This is resulting in less project data available when calculating TC costs. Since the 2017 BRCP, the TC calculation has contained no actual project data.	

A1. WACC

The pre-tax real WACC is applied in the determination of the BRCP. The formula is:

$$WACC_{real} = \left(\frac{1+WACC_{nominal}}{1+i}\right) - 1$$

where

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

and 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:

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

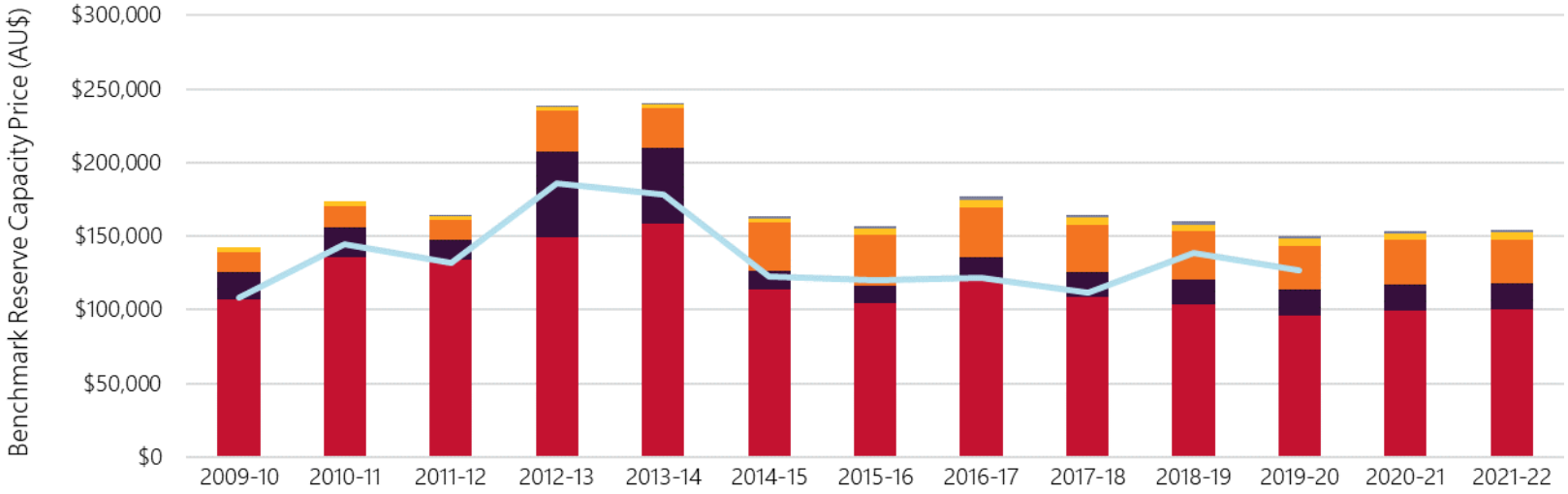
The WACC parameters applied in the 2018 BRCP and the proposed 2019 BRCP are shown in Table 9.

Table 9 WACC parameters for the 2018 and 2019 BRCP

Parameter	Notation	2018 value	2019 value
Nominal risk-free rate of return (%)	R_f	2.67	2.71
Expected inflation (%)	i	2.42	2.42
Real risk-free rate of return (%)	R_{fr}	0.24	0.28
Market risk premium (%)	MRP	6	6
Asset beta	β_a	0.5	0.5
Equity beta	β_e	0.83	0.83
Debt risk premium (%)	DRP	1.80	2.02
Debt issuance cost (%)	d	0.125	0.125
Corporate tax rate (%)	t	30	30
Franking credit value	γ	0.25	0.25
Debt to asset ratio (%)	D/V	40	40
Equity to total asset ratio (%)	E/V	60	60

A2. Historical BRCP cost breakdown

Figure 2 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
Land cost (LC)	$-	$-	$293	$769	$818	$1,973	$1,783	$2,064	$1,912	$1,831	$1,650	$1,585	$1,535
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
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
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
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
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		

Measures and abbreviations

Abbreviation	Expanded name
AEMO	Australian Energy Market Operator
ANNUALISED_CAP_COST	Annualised capital cost
ANNUALISED_FIXED_O&M	Annualised fixed operating and maintenance cost
AU$	Australian dollar
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
LC	Land cost
M	Margin to cover legal, approval, financing and other costs and contingencies
MW	Megawatt
PC	Power station capital cost
PwC	PricewaterhouseCoopers Australia
RBA	Reserve Bank of Australia
OCGT	Open cycle gas turbine
O&M	Operating and maintenance
SWIS	South West interconnected system
TC	Transmission connection costs
WACC	Weighted average cost of capital
WEM	Wholesale Electricity Market