FINAL REPORT: 2018 BENCHMARK RESERVE CAPACITY PRICE FOR THE 2020–21 CAPACITY YEAR

FOR THE WHOLESALE ELECTRICITY MARKET

December 2017

AUSTRALIAN ENERGY MARKET OPERATOR

IMPORTANT NOTICE

Purpose

AEMO has prepared this document under section 4.16 of the Wholesale Electricity Market Rules to provide information about the proposed revised value for the 2018 Benchmark Reserve Capacity Price for the 2020–21 Capacity Year, as at the date of publication.

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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 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 revised value for the BRCP for the 2018 Reserve Capacity Cycle. The 2018 BRCP will apply for the 2020-21 Capacity Year, covering the period from 8:00 am on 1 October 2020 to 8:00 am on 1 October 2021.

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 2018 BRCP for the 2020–21 Capacity Year

AEMO proposes a final value of $153,600 per MW per year for the 2018 BRCP, 2.5% higher than the 2017 BRCP of $149,800 per MW per year.

[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 now 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 is 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.

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Changes from the 2017 BRCP

Table 1 shows the year-on-year variation in the input parameters between the 2017 BRCP (for the 2019–20 Capacity Year) and the 2018 BRCP.

Table 1 Breakdown of variance between 2017 and 2018 BRCP

	Impact ($)[3]	Impact (%)	BRCP (AU$)
2017 BRCP			**149,800**
Escalation factors	4,100	2.7%	153,900
Power station cost	100	0.1%	154,000
Margin M	-	0.0%	154,000
Fixed fuel cost	100	0.1%	154,100
Land cost	-	0.0%	154,100
Transmission cost	-100	-0.1%	154,000
WACC	-700	-0.5%	153,300
Fixed O&M	300	0.2%	153,600
2018 BRCP	**3,800**	**2.5%**	**153,600**

The 2018 BRCP remains broadly consistent with the 2017 BRCP. However, higher escalation factors (largely due to higher commodity price, inflation, and labour cost forecasts) have increased the 2018 BRCP by 2.5% compared to the 2017 BRCP.

Public consultation

The draft BRCP report was published for consultation on 16 November 2017.

AEMO received a submission[4] from Perth Energy. Perth Energy stated that the small changes in most of the costs that make up the BRCP appear to be fair and reasonable. Perth Energy also raised the following points:

- The cost of insurance may warrant review to ensure that exposure to reserve capacity refunds is covered if a significant incident occurs.
- AEMO is required to follow the process prescribed in the Market Procedure when calculating the WACC. AEMO and others have previously expressed concern that this procedure may not result in a valid WACC figure. Until the Market Procedure, which now rests with the Economic Regulation Authority, is modified AEMO is not permitted to determine the WACC by an alternative process.

AEMO acknowledges these comments. The estimate of the cost of insurance includes a consideration for potential exposure to refunds. The concerns around the process followed to determine the WACC have previously been raised with the ERA for their consideration when the ERA completes the next five-yearly review of the Market Procedure.

A more detailed response to Perth Energy's submission, along with other methodology issues raised previously by stakeholders, can be found in Chapter 4.

[3] Rounded to the nearest $100, zero dollar values indicate an impact of less than $50.
[4] See https://www.aemo.com.au/Stakeholder-Consultation/Consultations/Draft-Report-2018-Benchmark-Reserve-Capacity-Price-for-the-2020-21-Capacity-Year.

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1. INTRODUCTION

The Benchmark Reserve Capacity Price (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. The BRCP 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 revised value for the BRCP for the 2018 Reserve Capacity Cycle, which applies to the 2020-21 Capacity Year. The draft report was published on AEMO's website[5] on 16 November 2017. AEMO has considered all submissions received as part of the public consultation period prior to submitting the final 2018 BRCP to the Economic Regulation Authority (ERA) for approval in accordance with clauses 2.26.1 and 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: Maximum Reserve Capacity Price (Market Procedure).[6]

In preparing the 2018 BRCP, AEMO used publicly available information including advice from independent consultants, Western Power, and the Western Australian Land Information Authority (Landgate).

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

Table 2 Consultants and agencies

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
Landgate	Land costs
PricewaterhouseCoopers (PwC)	Debt risk premium (DRP)
Western Power	Transmission connection costs and relevant escalation factors

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

[5] See https://www.aemo.com.au/Stakeholder-Consultation/Consultations/Draft-Report-2018-Benchmark-Reserve-Capacity-Price-for-the-2020-21-Capacity-Year.

[6] 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 is 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.

1.3 Supporting documentation

The following related documents are available on AEMO's website:[7]

- 2018 BRCP calculation spreadsheet, draft report version.
- 2018 BRCP calculation spreadsheet, final report version.
- GHD report, *2018 Benchmark Reserve Capacity Price for the South West Interconnected System* (November 2017).
- PwC memo, "Determining the debt risk premium using the ERA's 'Bond Yield Approach'" (24 November 2017).
- Landgate report, *Land values for the 2018 Benchmark Reserve Capacity Price* (6 September 2017).
- Weighted Average Cost of Capital (WACC) parameter calculation spreadsheet for the draft report.
- Weighted Average Cost of Capital (WACC) parameter calculation spreadsheet for the final report.
- Western Power report, *Total Transmission Cost Estimate for the Benchmark Reserve Capacity Price for 2020/21* (12 October 2017).

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

2. 2018 BRCP INPUT PARAMETERS

2.1 Escalation factors

The 2018 BRCP calculation is based on a theoretical power station that would commence operation on 1 October 2020. Costs have been determined as at 2017 and have been escalated to 2020.

Different escalation factors (summarised in Table 3) were used depending on the parameter to be escalated.

Table 3 Cost escalation forecast

Escalation factor	Component costs applied to	Source and methodology
Power station capital cost	Power station capital cost	The methodology is derived by GHD and summarised in their report. The determination involves sourcing information from the Australian Bureau of Statistics, London Metal Exchange, Reserve Bank of Australia (RBA), and the CME Group.
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. 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 subsequent years, 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 2018 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 2018 BRCP are listed in Table 4.

Table 4 Escalation factors by financial year

Escalation factor	2017–18	2018–19	2019–20	2020–21
Power station capital cost	2.70%	2.80%	1.80%	3.80%
Generation O&M cost	2.70%	2.80%	1.80%	3.80%
Connection asset O&M cost	1.42%	1.71%	1.85%	1.88%
CPI	2.00%	2.25%	2.38%	2.50%
Transmission connection cost	0.4%	0.4%	0.4%	0.4%

Escalation factors have generally increased from the 2017 BRCP, except for the connection asset O&M cost, which is consistent with last year. Higher copper and steel price forecasts have contributed to slightly higher power station capital cost and generation O&M cost escalation factors this year. Slow growth in labour costs, associated with subdued activity in the resources and energy sector, continues to maintain relatively low connection asset O&M escalation factors. Escalation factors have not changed from the draft report, except CPI, which is updated to reflect the revised November 2017 forecast published by the RBA.[8]

2.2 Capital costs

2.2.1 Power station capital cost (PC)

GHD used the Siemens SGT5-2000E (33MAC) 175.6 MW[9] OCGT as the reference equipment to determine the power station capital cost component of the 2018 BRCP, consistent with the 2017 BRCP. The unit is considered to be the most appropriate machine available to meet the criteria for the BRCP calculation.[10] GHD used version 26.1 of Thermoflow's GTPro[11] model 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 2020 using the power station capital cost escalation factor.

The proposed final value of **PC = $846,751.15 per MW**.

The proposed PC value has increased by 4.5% (an increase of around $36,500) from the 2017 BRCP, predominantly due to higher escalation factors and an increase in the nominal power station capital cost. This value has not changed from the draft report.

2.2.2 Capacity Credit (CC) allocation

GHD used GTPro 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 final value of **CC = 151.4 MW**.

The proposed CC value is slightly higher than the 2017 BRCP CC value of 148.5 MW, due to efficiency improvements for the SGT5-2000E (33MAC) gas turbine. This value has not changed from the draft report.

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

'Margin M' covers legal, financing, insurance, approvals, 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 final value of **M = 17.12%**.

The proposed Margin M value in the 2018 BRCP is similar to the 2017 BRCP Margin M value, 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 considered most likely:

- Collie.

8 See table 6.1 of the Statement of Monetary Policy (SMP). Source: http://www.rba.gov.au/publications/smp/2017/nov/pdf/06-economic-outlook.pdf

9 This is the nameplate rating provided by GTPro and represents a slight increase in capacity for this model from last year due to efficiency improvements.

10 There is currently no generator available on 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.

11 Further information is available at: http://www.thermoflow.com/combinedcycle_PCE.html.

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

Landgate assessed hypothetical land sites 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 2017 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.[12]

AEMO calculated the average of the six valuations and escalated this to 1 April 2019 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 final value of **LC = $2,394,087.94**.

The proposed LC value has decreased by 1.5% from the 2017 BRCP. This is due to a reduction of 20% from last year's land cost estimate for the Kalgoorlie region. Land cost estimates for other regions remained consistent with, or were slightly higher than, those used for the 2017 BRCP.[13]

This estimate is 0.6% less than the value in the draft report due to the revised November 2017 forecast published by the RBA.

2.2.5 Transmission connection cost (TC)

TC was based on a weighted average of the capital contributions of generators connecting to the SWIS over the previous five years. Estimates were 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 includes 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 will not be published.

Shallow connection cost estimates included 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 estimated easement costs to be half of the land value.
- The land value includes transfer duty.

Easement costs have decreased by 1.8% from the 2017 BRCP, due to a fall in land values in the Kalgoorlie region.

The shallow connection costs for the 2018 BRCP have increased by 2.3% compared to the 2017 BRCP.

The proposed final value of **TC = $174,749.00 per MW**.

[12] Available at: https://rol.osr.wa.gov.au/Calculators/faces/Calculators?_afrLoop=247790592985840&_afrWindowMode=0&_adf.ctrl-state=re8l3w9ui_4.

[13] Refer to Landgate report, *Land values for the 2018 Benchmark Reserve Capacity Price* (6 September 2017).

No escalation factors have been applied, because Western Power has already escalated the TC estimate to 1 April 2020.

The proposed TC value has decreased by 0.4% from the 2017 BRCP value of $175,444. This is partly due to the decrease in easement costs. 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. GHD provided an estimate of FFC as of 30 June 2017, which was escalated to 1 April 2020 using the CPI escalation factor. The cost of diesel included delivery and excise rebate, but excluded GST.

The proposed final value of **FFC = $6,969,444.03**.

The proposed FFC value increased by 2.4% from the 2017 BRCP. This is largely associated with an increase in the price of delivered diesel to $0.707 per litre (7% higher than the 2017 BRCP), and slightly higher facility installation costs due to wage and materials escalation. This estimate is 0.6% less than the value in the draft report due to the revised November 2017 forecast published by the RBA.

2.2.7 Weighted average cost of capital

The WACC was 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 information available from the RBA's website.[14] 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 A provides more detail on the steps for estimating the WACC.

In the 2017 BRCP report, AEMO noted the low values for the real risk free rate and that subsequently the WACC did not reflect current Australian market conditions.[15] While this year's real risk free rate is marginally 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 a selection 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 17 November 2017.

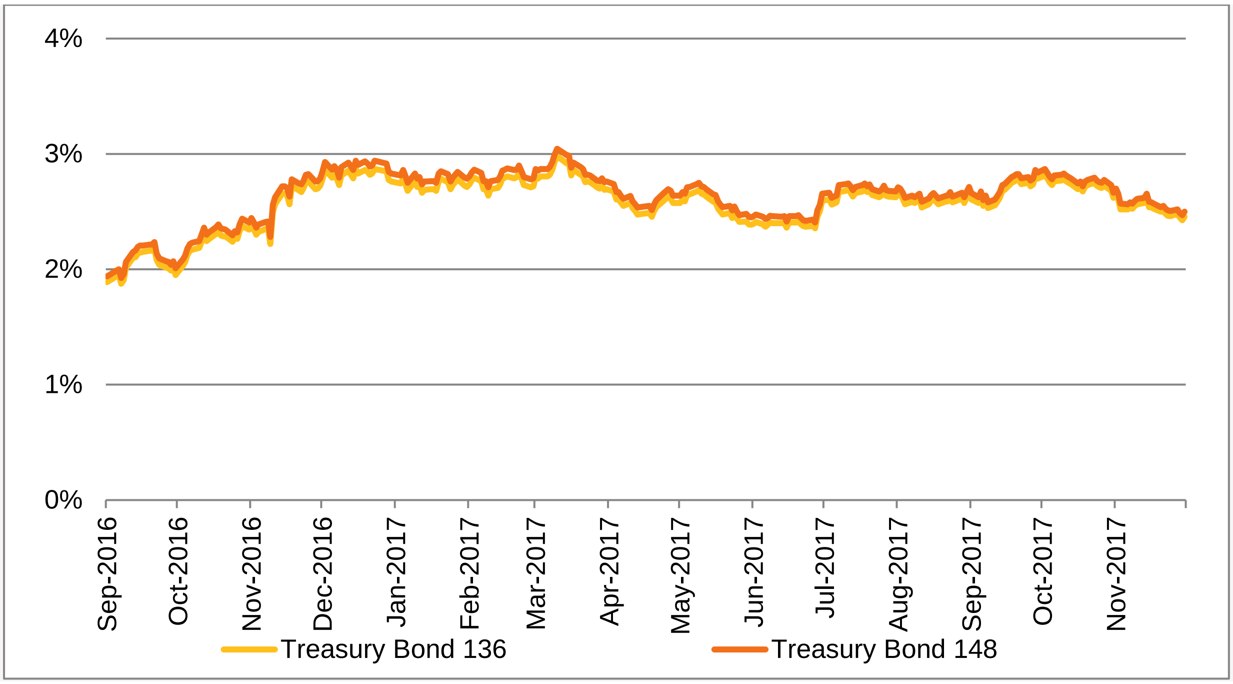
Commonwealth Government bond yields have increased since the 2017 BRCP, as shown in Figure 1.

The nominal risk free rate calculated from these bonds is 2.67%, an increase from the 2.57% value in the 2017 BRCP. The nominal risk free rate has decreased 0.06% from the value calculated in the draft report, due to a slight decrease in Commonwealth Government bond yields.

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

[15] Refer to Section 2.2.7 of the 2017 BRCP report: 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

Figure 1 Commonwealth Government bond yields, September 2016 to November 2017



The nominal rate was then adjusted for inflation to determine the real risk free rate of return.

In accordance with the Market Procedure, AEMO is required 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 is a decrease from the expected inflation rate of 2.48% calculated in the draft report, due to updates to the RBA's forecasts.

The nominal risk free rate and expected inflation rate values have resulted in a real risk free rate of 0.24%. This is consistent with the real risk free rate calculated in the draft report. The decrease in the nominal risk free rate has been offset by the decreased inflation rate.

Debt risk premium methodology

The Market Procedure requires AEMO to determine the methodology to estimate the DRP, which AEMO considers 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.*[16] AEMO considers this revised methodology represents current accepted Australian regulatory practice, and the DRP has been calculated accordingly. This is the same methodology that was implemented for the 2017 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 1.80% from market observations ending on 17 November 2017. The final DRP estimate has decreased from the draft report value of 2.00%, due to a decrease in corporate bond yields from the earlier observation period used in the draft report.

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

Capital Asset Pricing Model results

The proposed value of the **WACC (real terms) = 5.21%**.

This is slightly lower than the WACC (real terms) of 5.29% used in the 2017 BRCP, and the draft report, due to the decreased DRP.

2.3 Operating and maintenance costs

2.3.1 Generation O&M costs

Generation O&M costs assumed 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 (such as service of pumps, fire systems) has been included.

A 15-year annuity was calculated based on individual component costs as at June 2017, which were derived from similar recent OCGT projects. These costs were then escalated to 1 October 2020 using the generation O&M escalation factor.

The proposed final value of **generation fixed O&M costs = $14,243.65 per MW per year**.

The proposed generation O&M costs value decreased by 2.3% from the 2017 BRCP. This is predominantly due to a decrease in GHD's council rates and subcontractor fees estimates[17], as well as a slightly higher CC value. 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 2017, which was then escalated to 1 October 2020 using the connection O&M escalation factor.

The proposed final value of **switchyard O&M costs = $524.80 per MW per year**.

The proposed switchyard O&M costs value remains consistent with the value calculated for the 2017 BRCP, based on the bottom-up estimate approach conducted by GHD. 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 megavolt amperes (MVA) (power factor of 0.8). A bottom-up approach was used to estimate the transmission costs based on the annual charge for the connection infrastructure.

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 2017, which was then escalated to 1 October 2020 using the connection O&M escalation factor.

The proposed final value of **transmission line O&M costs = $32.53 per MW per year**.

[17] Refer to Table 16 of GHD's report: 2018 Benchmark Reserve Capacity Price for the South West interconnected System.

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The proposed transmission line O&M costs value remains consistent with the value calculated for the 2017 BRCP, based on the estimate approach conducted by GHD assuming that a line inspection would be carried out over a two-day period each year that requires hiring a scissor lift. 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 an independent broker to calculate insurance premiums. The broker prefers to remain anonymous to protect its competitive position.

Premiums were calculated as follows:

- Asset replacement insurance was calculated as 0.28% of the limit of liability, as advised by the broker. 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 **$495,591.39 per year**.
- Business interruption insurance includes 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 **$146,713.12 per year**.
- Public and products liability insurance is estimated as **$130,554.65 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 2020 using the CPI escalation factor.

The proposed final value of asset insurance costs = **$5,381.29 per MW per year**.

The proposed asset insurance costs value has increased by 12.3% from the 2017 BRCP. This is due to an increase in business interruption, asset replacement, and public and products liability insurance premiums, in line with global energy sector insurance markets.

Changing weather patterns and increased risk of natural disasters continue to be a cause for concern among insurers. On top of this, insurers are reaching the limits of their exposure in specific locations and industries. Based on this, insurers are reviewing their portfolios and increasing premiums, declining risks they were once prepared to accept, or imposing further conditions on policies.

The proposed asset insurance costs value has decreased 0.3% from the draft report value due to the revised November 2017 forecast published by the RBA.

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.[18] 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 2017 and have been escalated by CPI to 1 October 2020.

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

The proposed fixed network access costs value has increased by 0.4% from the 2017 BRCP, due to slightly higher CPI forecasts. This is 0.6% lower than the value proposed in the draft report due to the revised November 2017 forecast published by the RBA.

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

3. PROPOSED VALUE OF THE 2018 BRCP

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. This is expressed as:

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

The proposed final value of **CAP_COST = $190,747,132.84**.

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

This produces an **ANNUALISED_CAP_COST = $ 18,644,285.14 per year**.

The annualised capital cost estimate has increased by 4.9% from the 2017 BRCP.

The estimate has decreased 0.6% from the draft report due to a decrease 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 2.3. 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 is omitted, as it forms part of a regulated utility's annual revenue entitlement.

The proposed final value of **ANNUALISED_FIXED_O&M = $ 30,437.00 per MW per year**.

The annualised fixed O&M cost estimate has increased by 1.0% from the 2017 BRCP.

The estimate has decreased 0.3% from the draft report due to slightly lower CPI forecasts.

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:

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

The proposed final value of the 2018 BRCP is estimated to be $154,582.87 which is then rounded to the nearest $100.

The proposed final **BRCP = $153,600 per MW per year**.

The proposed final 2018 BRCP is 2.5% higher than the 2017 BRCP.

The proposed final 2018 BRCP is 0.6% lower than the value proposed in the draft report. This is due to the slightly lower CPI forecast and decrease to the WACC.

An overview of the variation of the components of the 2017 BRCP and 2018 BRCP is listed in Table 5.

Table 5 BRCP components for 2017 and 2018

	2017 BRCP	2018 BRCP	Unit
BRCP	149,800	153,600	AU$/MW/year
ANNUALISED_FIXED_O&M	30,143	30,437	AU$/MW/year
Generation O&M cost	14,572	14,244	AU$/MW/year
Switchyard O&M cost	528	525	AU$/MW/year
Transmission line O&M cost	32.74	32.53	AU$/MW/year
Asset insurance cost	4,791	5,381	AU$/MW/year
Fixed network access and on-going charges	10,219	10,255	AU$/MW/year
CAP_COST	180,893,141	190,747,133	AU$
Power station cost	810,229	846,751	AU$/MW
Margin M	17.19	17.12	%
Transmission cost	175,444	174,749	AU$/MW
Capacity credit allocation	148.5	151.4	MW
Fixed fuel cost	6,803,924	6,969,444	AU$
Land cost	2,430,526	2,394,088	AU$
WACC	5.29	5.21	%
ANNUALISED_CAPCOST	17,776,436	18,644,285	AU$/year
Term of finance	15	15	Years

The changes between the 2017 and 2018 BRCP values by input parameter are shown in Table 6. Most of the changes relate to an increase in escalation factors.

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

Table 6 Breakdown of variance between 2017 and 2018 BRCP

	Impact ($)	Impact (%)	BRCP (AU$)
2017 BRCP			**149,800**
Escalation factors	4,100	2.7%	153,900
Power station cost	100	0.1%	154,000
Margin M	-	0.0%	154,000
Fixed fuel cost	100	0.1%	154,100
Land cost	-	0.0%	154,100
Transmission cost	-100	-0.1%	154,000
WACC	-700	-0.5%	153,300
Fixed O&M	300	0.2%	153,600
2018 BRCP	**3,800**	**2.5%**	**153,600**

4. STAKEHOLDER SUBMISSIONS AND METHODOLOGY CONCERNS

The 2018 BRCP draft report and supporting documents were published for public consultation on 16 November 2017. Market Participants and other industry stakeholders were advised of the publication and an announcement was published in the West Australian on 16 November 2017.

AEMO received one submission, from Perth Energy. Table 7 provides a summary of the issues raised in the submission and AEMO's response.

Both AEMO and Market Participants have outlined concerns and provided feedback on the BRCP methodology during previous annual public consultation processes. Formal Market Participant submissions can be found here and are outlined in Table 8.[19]

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 7 AEMO's responses to issues raised in public consultation

Submitter	Component	Comment	AEMO's response
Perth Energy	ANNUALISED FIXED O&M Asset Insurance Costs	One area that may warrant review is the cost of insurance though when spread over the cost of the station the influence on the BRCP is small. The insurance within the report includes business interruption insurance, whereas the major risk for a peaking station is that a significant incident could require the station to repay up to two years reserve capacity payments. For the notional 160 MW gas turbine this could amount to some $30 million.	The business interruption component of the asset insurance costs includes coverage for the potential refund liability for the facility for two years, as noted in Section 2.3.4.
Perth Energy	WACC	AEMO is required to follow a process that is prescribed in a procedure and they, and others, have previously expressed their concern that this procedure does not result in a valid WACC figure. Perth Energy notes, however, that until the procedure, which now rests with the Economic Regulation Authority, is modified, AEMO is not permitted to determine the WACC by an alternative process.	AEMO considers that all components of the WACC methodology should be reviewed. A more detailed commentary on the WACC methodology is provided in Table 8.

[19] List is not exhaustive

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. The average size of generators recently installed in the SWIS is approximately 20 MW. AEMO notes that an OCGT power station has not been installed in the SWIS since 2011, 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.	Community Electricity (2014, 2015) Synergy (2016) Tesla Corporation (2016, 2017)
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 one in the Market Procedure restricts the DRP methodology to a specific 'Bond-Yield Approach'. AEMO considers that the DRP methodology should be reviewed.	Alinta (2014, 2015) Synergy (2017) Tesla Corporation (2016, 2017)
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. This may result in a BRCP determination that is not reflective of the current economic situation. The proposed 2017 BRCP calculation resulted in a lower than expected WACC, due to an irregular real risk free rate of return. AEMO considers that all components of the WACC methodology should be reviewed.	Alinta (2015) Perth Energy (2017) Tesla (2017)
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 believes the limit of $50 million to be too low.	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. Limited new generation capacity is currently being built in the WEM, resulting in less project data available when calculating TC costs. The 2017 BRCP TC calculation contained no actual project data and resulted in an estimation 9.5% higher than the previous year.	

APPENDIX A. 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:

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

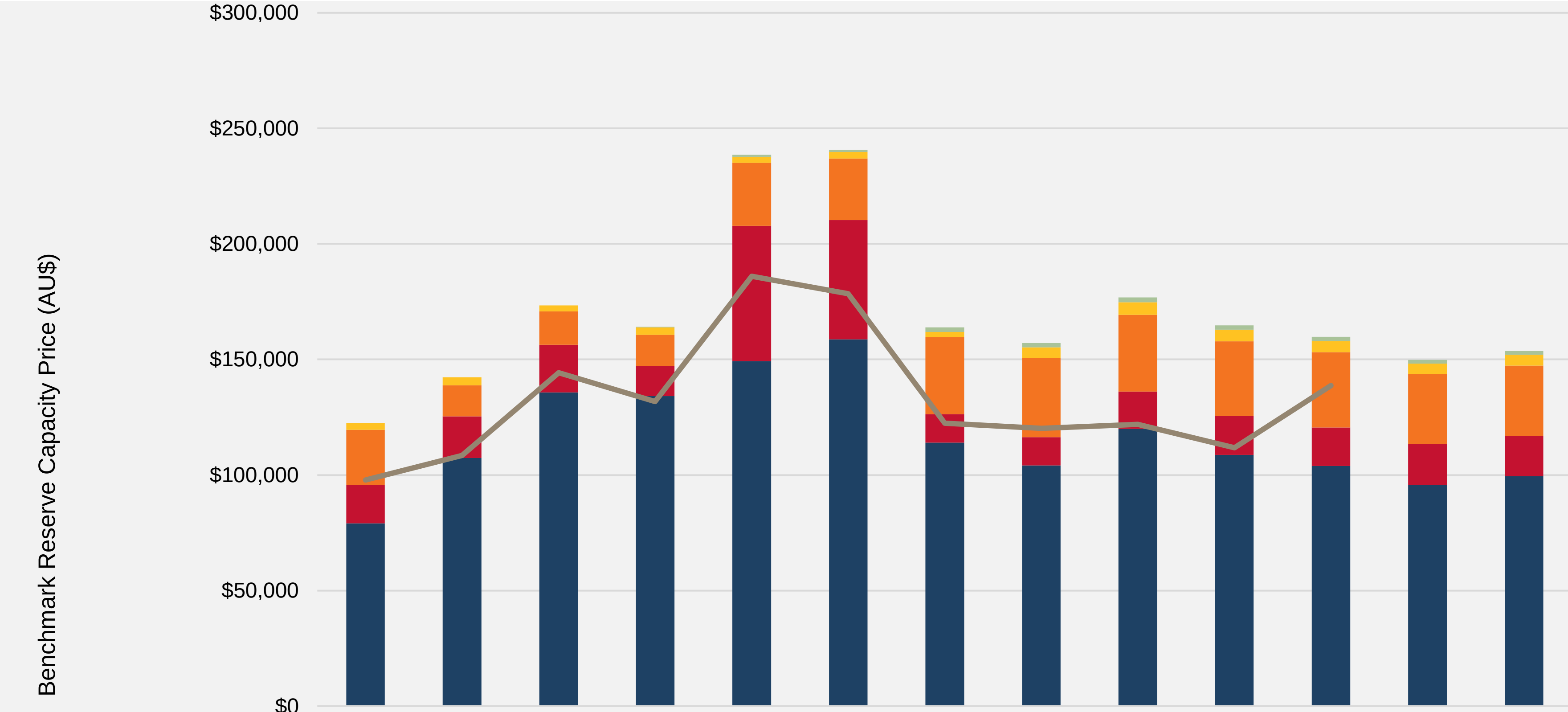
The WACC parameters applied in the 2017 BRCP and the proposed 2018 BRCP are shown in Table 9.

Table 9 WACC parameters for the 2017 and 2018 BRCP

Parameter	Notation	2017 value	2018 value
Nominal risk free rate of return (%)	R_f	2.57	2.67
Expected inflation (%)	i	2.39	2.42
Real risk free rate of return (%)	R_{fr}	0.18	0.24
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	2.22	1.80
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

APPENDIX B. HISTORICAL BRCP COMPONENT COST BREAKDOWN

Figure 2 Historical BRCP component cost breakdown



	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Land cost (LC)	$-	$-	$-	$293	$769	$818	$1,973	$1,783	$2,064	$1,912	$1,831	$1,650	$1,585
Fixed fuel cost (FFC)	$2,907	$3,456	$2,631	$3,151	$2,615	$2,825	$2,239	$4,680	$5,442	$5,061	$4,886	$4,620	$4,615
Fixed O&M cost	$23,900	$13,363	$14,392	$13,431	$27,335	$26,649	$33,384	$34,239	$33,238	$32,307	$32,582	$30,143	$30,437
Transmission cost (TC)	$16,558	$18,017	$20,672	$13,151	$58,493	$51,621	$12,329	$12,164	$16,127	$16,860	$16,624	$17,691	$17,520
Power station cost (PC)	$79,110	$107,404	$135,701	$134,091	$149,306	$158,710	$113,971	$104,178	$119,942	$108,649	$103,898	$95,745	$99,425
Reserve Capacity Price	$97,835	$108,459	$144,235	$131,805	$186,001	$178,477	$122,428	$120,199	$121,889	$111,753	$138,760		

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MEASURES AND ABBREVIATIONS

Units of measure

Abbreviation	Unit of measure
AU$	Australian dollar
MW	Megawatt

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
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
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
WA	Western Australia
WACC	Weighted average cost of capital
WEM	Wholesale Electricity Market