GHD Advisory

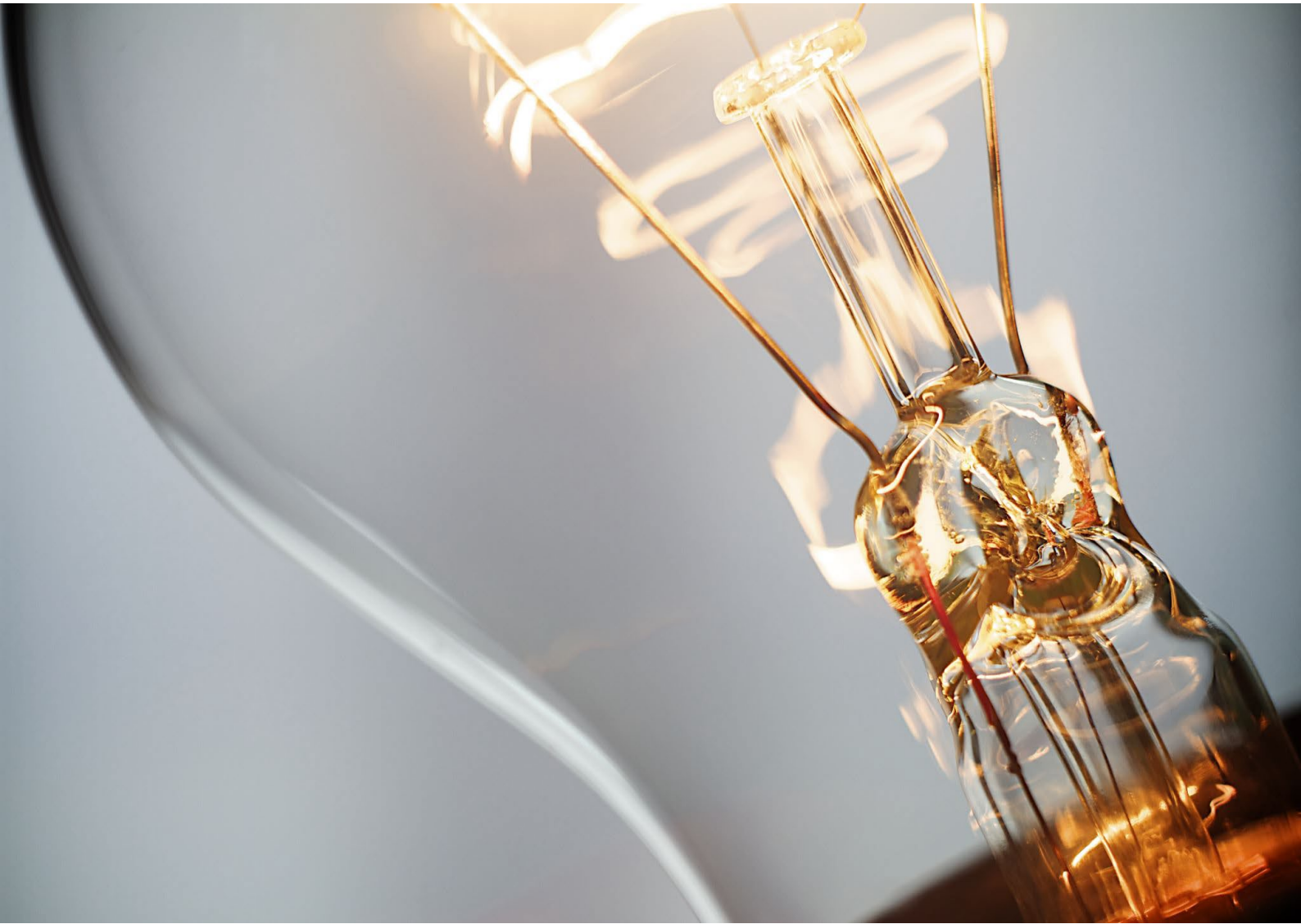
Benchmark Reserve Capacity Price costs

2027/28 Capacity Year

Economic Regulation Authority

22 October 2024

→ The Power of Commitment



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Acronyms and abbreviations

The following acronym and abbreviations are used in this report.

Table 1 Acronyms and abbreviations

Term	Definition
AC	Alternating current
AEMO	Australian Energy Market Operator
BESS	Battery Energy Storage System
BoP	Balance of plant
BRCP	Benchmark reserve capacity price
CPI	Consumer price index
DAP	Development Assessment Panel
DC	Direct current
DSOC	Declared sent-out capacity
EP Act	Environmental Protection Act 1986
EP Act	Environmental Protection Act 1986
EPBC Act	Environmental Protection and Biodiversity Conservation Act
ERA	Economic Regulation Authority
ETAC	Electricity Transfer Access Contract
FEED	Front-end engineering design
GHD	GHD Pty Ltd
GPS	Generator Performance Standard
GRV	Gross rental value
HV	High voltage
IWC	Interconnection Works Contract
kV	Kilovolt
kW	Kilowatt
LFP	Lithium iron phosphate
MW	Megawatt
O&M	Operation and maintenance
OEM	Original Equipment Manufacturers
PCS	Power conversion system
PD Act	Planning and Development Act 2005
PPA	Power purchase agreement
RBA	Reserve Bank of Australia
RCM	Reserve capacity mechanism
SWIS	South West Interconnected System
WEM Rules	Wholesale Electricity Market Rules
WP	Western Power
WPI	Wage price index

1. Introduction

1.1 Overview

In Western Australia's Wholesale Electricity Market (WEM), the reserve capacity mechanism (RCM) provides price signals to encourage investment in capacity to ensure that supply can meet consumer electricity demand, and to retire capacity when there is an excessive surplus.

Capacity suppliers receive payments for each unit of available capacity product (known as Capacity Credits) that they make available over a capacity year. The Benchmark Reserve Capacity Price (BRCP) and the total supply of capacity credits are used to calculate the price of each capacity credit. The BRCP must reflect the fixed costs incurred in developing and operating a hypothetical 200MW / 800MWh (4-hour duration) lithium-ion Battery Electric Storage System (BESS). This includes the annualised capital costs and annual fixed operating and maintenance (O&M) costs.

The Economic Regulation Authority (ERA) must calculate the 2027/2028 Benchmark Reserve Capacity Price (BRCP) following the WEM Procedure: Benchmark Reserve Capacity Price (Market Procedure)[1] as required by clause 4.16 of the Wholesale Electricity Market Rules (WEM Rules) [2].The WEM Procedure documents the method and processes that the ERA follows annually to determine the Flexible BRCP and Peak BRCP for each Reserve Capacity Cycle. In accordance with 4.16.2 and 4.16.2A of the WEM Rules, the two BRCPs going forward are:

– Peak BRCP expressed in $/MW of Peak Capacity Credits per year, that reflects the expected annualised capital cost and fixed operating and maintenance costs of the Benchmark Peak Capacity Provider. The Benchmark Peak Capacity Provider is a notional new facility expected to provide Peak Capacity at the lowest annual capital cost and fixed operating and maintenance cost.
– Flexible BRCP expressed in $/MW of Flexible Capacity Credits per year, that reflects the expected annualised capital cost and fixed operating and maintenance costs of the Benchmark Flexible Capacity Provider. The Benchmark Flexible Capacity Provider is a notional new facility expected to provide Flexible Capacity at the lowest annual capital cost and fixed operating and maintenance cost. Facilities receiving Flexible Capacity Credits must meet all the same requirements as Peak Capacity Credits and the Flexible Capacity ramping requirements as determined by the Coordinator of Energy.

The BESS considered for costing must achieve both the Peak and Flexible Capacity service requirements and be based on identical design assumptions & characteristics as determined by the Coordinator of Energy. Therefore, the capital and O&M costs associated with the peak & flexible capacity providers will be identical.

The ERA has commissioned GHD to provide annualised capital cost and fixed O&M costs associated with constructing a hypothetical 200MW / 800MWh BESS that is to connect to the Southwest Interconnected System (SWIS) in the Pinjar or Kwinana regions.

The WEM Procedure outlines the method used to determine the BRCP, which is calculated by undertaking a technical, bottom-up, cost evaluation of the entry of a new BESS that must:

– Use a lithium iron phosphate sub-chemistry.
– Have an installed capacity that enables 200 MW injection on 1 October of Year 3 of the Reserve Capacity Cycle.
– Have enough energy storage capacity to enable 800 MWh charge and discharge on 1 October of Year 3 of the Reserve Capacity Cycle.
– Include the minimum level of equipment or systems required by the WEM Rules.

[1] Economic Regulation Authority, *WEM Procedure: Benchmark Reserve Capacity Price*, Version 8, effective 1 August 2024.
[2] WA Gov, *Wholesale Electricity Market Rules*, effective 7 October 2024.

1.2 Scope

The WEM Rules mandate that the Benchmark Reserve Capacity Prices be determined each year. The corresponding scope of works sets out what is to be costed to assist the ERA's Benchmark Reserve Capacity Price determination:

– The capital costs and "M margin" for a 200MW / 800MWh BESS connecting to Western Power's transmission network. This includes cost components set out in Sections 3.2 to 3.10 of the WEM Procedure: Benchmark Reserve Capacity Price. This includes any reasonable cost escalations. This report addresses the following components of capital cost:
  - Supply and installation costs.
  - Owner's design and project management costs.
  - Legal, financing and insurance costs.
  - Environmental and development approval costs.
  - Connection, registration and licencing costs.
– The annualised fixed O&M costs for a 200MW / 800MWh BESS connected to the transmission network. This includes those cost components set out in Section 5 of the WEM Procedure: Benchmark Reserve Capacity Price. This report addresses the following components of annual fixed O&M costs:
  - Fixed maintenance costs of the BESS (lithium battery energy storage system).
  - Corporate overheads and related consulting services.
  - Transmission related O&M costs.
  - Any other reasonable fixed O&M costs.

1.3 Limitations

This Report has been prepared by GHD for the Economic Regulation Authority and may only be used and relied on by the Economic Regulation Authority for the purpose agreed between GHD and the Economic Regulation Authority as set out in this Report.

GHD otherwise disclaims responsibility to any person other than the Economic Regulation Authority arising in connection with this Report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this Report were limited to those specifically detailed in the Report and are subject to the scope limitations set out in the Report.

The opinions, conclusions and any recommendations in this Report are based on conditions encountered and information reviewed at the date of preparation of the Report. GHD has no responsibility or obligation to update this Report to account for events or changes occurring subsequent to the date that the Report was prepared except as required under the ERA's Request for Quote for this project.

The opinions, conclusions and any recommendations in this Report are based on assumptions made by GHD described in this Report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this Report on the basis of information provided by the Economic Regulation Authority and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the Report which were caused by errors or omissions in that information.

GHD has prepared the cost estimates set out in this Report ("Cost Estimate") using information reasonably available to the GHD employee(s) who prepared this Report; and based on assumptions and judgments made by GHD, including inputs provided by others including the Economic Regulation Authority and its consultants.

The Cost Estimate has been prepared for the purpose of estimating the 2025 benchmark reserve capacity price for the 2027-28 capacity year and must not be used for any other purpose.

The Cost values provided are estimates only (+/-50%). Actual prices, costs and other variables may be different to those used to prepare the Cost Estimate and may change. Unless as otherwise specified in this Report, no detailed quotation has been obtained for actions identified in this Report. GHD does not represent, warrant or guarantee that the project can or will be undertaken at a cost which is the same or less than the Cost Estimate.

Where estimates of potential costs are provided with an indicated level of confidence, notwithstanding the conservatism of the level of confidence selected as the planning level, there remains a chance that the cost will be greater than the planning estimate, and any funding would not be adequate.

2. BESS specifications

Table 2 below outlines BESS specifications mandated in the WEM Procedure Benchmark Reserve Capacity Prices. The capital and O&M cost estimates presented in this report were developed for a BESS whose specifications align with that mandated in the WEM Procedure and summarised in Table 2.

Table 2 Peak & Flexible BRCP reference technology specifications[3]

Parameter	BRCP service requirement	Comment
WEM Rule requirements		
Capacity	200 MW injection	Have an installed capacity that enables 200 MW injection on 1 October of Year 3 of the Reserve Capacity Cycle.
Energy Storage	800 MWh	Have enough energy storage capacity to enable 800 MWh charge and discharge on 1 October of Year 3 of the Reserve Capacity Cycle.
Connection Voltage	330 kV	
Location	Located in an unconstrained part of the network with connection near/in the Kwinana or Pinjar regions	
Operating temperature	41ºC	
Lithium sub chemistry	Lithium iron phosphate (LFP)	
Land requirements	6.5 ha	

[3] Clauses 2.1.5 and 2.1.6 of the WEM Procedure: Benchmark Reserve Capacity Price.

3. Development of capital cost estimate

The capital cost for the hypothetical 200MW / 800MWh BESS facility in the Kwinana or Pinjar region has been estimated using a bottom-up approach utilising GHD benchmarks, publicly available information and pricing estimates recently sourced from tier 1[4] equipment suppliers of major equipment components of a BESS facility.

The pricing of the battery modules and power conversion system (PCS) were informed by recently obtained price estimates from various leading tier 1 Original Equipment Manufacturers (OEMs) and the remaining costs were informed by GHD benchmarks based on recent real-world project data.

Key components of the capital cost for a BESS system fall broadly into one of five categories:

– Battery modules/enclosures.
– Power Conversion System (PCS).
– Balance of plant (BoP).
– Construction.
– Indirect costs.

3.1 Estimate qualifications and exclusions:

The following are the assumptions, qualifications and exclusions underpinning the cost estimate.

1. The expected estimate accuracy range is +50% to -50%.
2. The cost estimate is based on start of Q4 2024 (October 1) Australian Dollars. Escalation factors to estimate costs for 1 April 2027 are discussed in section 5. Foreign exchange rates used to develop this estimate are the following[5]:
    a. AUD:USD | 1.00 : 0.69
    b. AUD:EUR | 1.00 : 0.62
3. It is assumed that the construction roster will be based on 10 hours per day, 6 days per week throughout the year except for 2-week Christmas Shutdown typically from the 24th of December to the 6th of January.
4. Cost of lithium-ion battery modules is informed by pricing information received from tier 1 lithium-ion containerised battery energy storage suppliers and benchmarked against the GHD internal project database.
5. Cost of the power conversion system is informed by pricing information received from tier 1 BESS PCS providers and benchmarked against the GHD internal project database.
6. Remaining components were priced using GHD's internal project database and publicly available information where relevant.
7. No allowance has been made to cover for industrial unrest, loss of shipment and force majeure.
8. No allowance has been made for outside of battery limit scope of work i.e. access roads, overhead/underground transmission lines, etc.
9. Forward escalation and inflation beyond the estimate base date is excluded.

[4] Direct suppliers of a final product.
[5] Based on Yahoo Finance October 1 2024 values

3.2 Supply & delivery cost

3.2.1 Battery modules/enclosures

Battery modules are typically offered by OEMs as containers. The battery containers include racks of battery modules, thermal management systems such as air conditioning or liquid cooling, control equipment and a fire suppression system.

Based on the obtained costing information from OEM supplier engagement, the estimated cost for LFP battery modules/enclosures (including delivery to site) is $177,600,000 ($222 per kWh of rated battery capacity). This includes the estimated uplift to enable power and energy capacity that aligns with the specified technical requirements (200 MW/800 MWh) at an ambient temperature of 41 degrees.

3.2.2 Power conversion system (PCS)

The PCS comprises of multiple inverters that convert DC power to AC. One inverter will be connected to multiple battery containers in uniform groups.

Based on OEM supplier engagement, the estimated cost for the PCS is $27,800,000 ($139 per kW of rated capacity). The total cost includes sufficient power capacity uplift required to compensate for temperature deratings, reactive power requirements and transformer losses to meet the BESS's base requirements.

3.2.3 Balance of Plant (Materials & Equipment)

The Balance of Plant (BoP) covers all supply and delivery cost of cables, conduits, cable ladders, transformers, pre-cast concrete culverts, switchgear, switchrooms and other materials and equipment relevant to a BESS facility.

More specifically, electrical and control BoP includes all enabling electrical infrastructure, cables and conduits, transformers, switchgear, protection, and control equipment for the batteries and the BESS substation. The civil BoP consists of the foundations, transformer bunds and equipment pads for the batteries and substation.

Based on the GHD database, which draws upon multiple real-world projects of a comparable scope, the total cost for electrical and control and civil BoP is estimated to $28,479,120 (approximately $36 per kWh).

3.2.4 Summary of material supply costs

Table 3 summarises the BESS supply and delivery (to site) costs of a facility which achieves the specified technical requirements.

Table 3 BESS supply and delivery costs

Item	Unit Cost	Unit	Estimated cost
Lithium-Ion Battery Modules	$222	$/kWh	$177,600,000
Power Conversion System	$139	$/kW	$27,800,000
Balance of Plant - Materials & Equipment	$36	$/kWh	$28,479,120
Total			**$233,879,120**

3.3 Construction cost

3.3.1 Site preparation construction contract

Site preparation construction works include all costs for civil and bulk earthworks activities required to prepare the pad for the BESS facility, temporary construction facilities and laydown yard. This activity is completed before the arrival of the materials, equipment and the main works contractor on site. A cost allowance of $3,950,894 is

allocated for the site preparation construction contract based on the GHD internal database which draws upon multiple real-world projects of a comparable scope.

3.3.2 Main works construction contract

The main works contractor or sometimes referred to as the BOP contractor is responsible for constructing the BESS Facility. Cost for the main works contractor includes the following:

– Labour cost.
– Construction equipment and fuel.
– Site establishment and operation of temporary construction facilities.
– Contractor supplied material including concrete, imported fill, structural steel etc.
– Other costs including supervision, health and safety, training, tools and consumables, etc.

Based on GHD's database, a cost of $66,400,000 is estimated for the main works construction contract.

3.3.3 Summary of construction costs

The table below summarises BESS construction costs.

Table 4 BESS construction costs

Item	Unit Cost	Unit	Estimated cost
Site Preparation Contract	$5	$/kWh	$3,950,894
Main Works Construction Contract	$83	$/kWh	$66,400,000
Total			**$70,350,894**

3.4 Transmission connection

The total transmission connection cost estimate provided by the ERA can be observed in the table below[6].

Table 5 Transmission connection costs

Item	Estimated cost
Substation	$12,560,000
Transmission line	$9,012,500
Line easement	$9,438,325
Total	**$31,010,825**

3.5 Land costs

Valuations have been provided by the ERA for a 6.5-hectare parcel of land in the Pinjar and Kwinana regions as outlined in the table below[7]. For the purposes of informing this estimate, an average value of these two land costs was utilised.

Table 6 Land cost

Item	Rate Per Hectare	Total Assessed Value
Pinjar	$1,025,000	$6,662,500
Kwinana	$1,800,000	$11,700,000

[6] Provided by ERA (27/09/2024)

[7] Provided by ERA (27/09/2024)

Item	Rate Per Hectare	Total Assessed Value
Average Total	**$1,412,500**	**$9,181,250**

3.6 Connection agreement and market registration costs

The substantial direct, upfront costs involved in connecting and registering a BESS to the SWIS and the WEM include:

– A network connection agreement with Western Power.
– Market registration and capacity credit participation and certification with AEMO.

Each cost item is discussed in turn below:

3.6.1 Network connection agreement

The network connection agreement is negotiated with Western Power, with Western Power and AEMO costs (the two parties involved in reviewing aspects of the connection) being passed on to connecting parties. Under current market conditions, the process can take up to 2.5 years and generally consists of the following steps:

1. Preliminary application

– Application requires high-level information about the size of the generation/load and the location (substation).
– Connection application does not need to detail the connection option but is required to hold a place in the connection queue. For this reason, it is best to get it in as soon as possible to hold a position.

2. High-level concept design

– For the high-level concept design, the customer must have selected a connection option.
– Western Power conducts steady-state modelling to establish if there are any voltage or thermal constraints likely and considers any potential issues to be mitigated and the mitigation measures required.

3. Detailed connection model assessment and dynamic studies

– Generator Performance Standard (GPS) studies and GPS model assessment are undertaken, with the study results being reviewed by AEMO as part of this process and AEMO's costs being passed on to the connecting parties.
– The dynamic study report and GPS registration form feeds into the final connection agreement(s).
– The detailed GPS studies form the majority of the network connection costs. The fees can vary depending on the suitability of the OEM models, access to Western Power wide-area model and if any of the performance standards need to be negotiated. For the purposes of the BRCP, we have assumed:
    – For the provided estimate, it is assumed that the owner negotiates for Western Power to undertake assessments using their wide-area model. This limits the owner's role in preparing the model but not conducting assessments to demonstrate GPS compliance (which is done by Western Power instead). Alternatively, if the owner undertakes the modelling to demonstrate GPS compliance, the fees could be higher depending on the extent to which GPS modelling is required (up to $400,000, however, Western Power's costs would then be lower).
    – It is assumed GPS are agreed with minimal negotiation of performance standards. An extended iterative negotiation process would increase costs beyond those assumed in the estimate provided.

4. Western Power connection access offer

– The connection offer is given at the conclusion of the detailed studies and on the basis of the estimated cost for the connection option. The process typically results in two agreements:
    – Access Contract or Electricity Transfer Access Contract (ETAC) – This is the standard access contract that Western Power proposes, governing access to their network. It covers the ongoing use of the network.
    – Interconnection Works Contract (IWC) – This covers the shared network connection works necessary to connect to the Western Power network. Western Power typically procures and constructs these

assets themselves. The costs associated with these assets, are based on Western Power inputs as documented in section 3.4 of this report.

5. Construction and procurement

– Once the connection agreement is in place, procurement and construction can commence.
– Western Power are involved in the commissioning process, including future tests required under the connection agreement to verify the GPS results.
– We have included the costs associated with this step after the connection agreement is in place as part of the overall development costs, given commissioning processes and testing are related.

Table 7 Network connection agreement costs

Item	Estimated cost	Comment
Preliminary application	$30,000	Assumes site has been identified. Cost could be higher if several sites are being considered.
Concept design	$50,000	Assumes the BESS size is 200MW / 800MWh.
Detailed connection model assessment (including GPS studies)	$750,000	Assumes the owner develops the models and Western Power conducts the GPS compliance assessment. Minimal negotiation of GPS standards.
Total cost	**$830,000**	

3.6.2 Market registration and reserve capacity certification

The market registration and accreditation process depend on the range of services being provided by the BESS. To provide Peak and Flexible Capacity services, the BESS must register as an Electric Storage Resource in the energy market and be certified for reserve capacity.

The market registration and accreditation process typically occur in parallel with the BESS development, with registration and accreditation concluding at the same time as commissioning tests.

The reserve capacity cycle runs two years ahead of the process for participation in the energy market. AEMO can make an early decision on the certifications of new facilities based on data including the Western Power Access Contract status, environmental approvals, financing etc. Certification happens in July and August annually (2 years ahead). Facility Tests (verification and testing of certified capacity) then occur in the commissioning phase.

We note the market registration and reserve capacity participation costs can vary widely between projects depending on the maturity of the proponent and their existing systems. For example, for projects that will form part of an existing portfolio of generation, the processes may be well understood, and associated contract management and settlement systems will already be in place.

Table 8 Market registration and reserve capacity certification

Item	Estimated cost	Comment
Market registration with AEMO	$30,000	Registration with AEMO.
Reserve capacity certification	$25,000	

For clarity, we note that BESS can provide essential system services in addition to energy and there are different registration and accreditation processes for these services. These have not been contemplated as the purpose of the BRCP is to compensate the BESS for costs associated with only the Peak and Flexible Capacity provider.

3.6.3 ERA licensing

The Electricity Industry Act[8] specifies requirements for those entities intending to construct and operate certain classes of assets or operate as a retailer. This includes a requirement for those parities seeking to construct or operate generating works exceeding 100 MW to obtain a generator licence.

[8] Electricity Industry Act 2004

The Act defines generating works and storage works as follows:

– generating works means any wires, apparatus, equipment, plant or buildings used, or to be used, for, or in connection with, or to control, the generation of electricity.
– storage activity means an activity comprising all of the following:
  (a) receiving energy in the form of electricity;
  (b) storing the received energy in any form;
  (c) discharging the stored energy in the form of electricity;
– storage works means any wires, apparatus, equipment, plant or buildings used, or to be used, for, or in connection with, or to control, a storage activity;

It is clear that a BESS such as that assumed as the Benchmark Capacity Provider would be defined as storage works under the Act. It is however unclear whether a BESS would also be considered to be generation works. The uncertainty arises because a BESS is able to generate electricity, however in net terms a BESS is a load as over time it will always consume more electricity than it generates.

On balance GHD has assumed that a BESS will not be classified as generating works under the act and will therefore not require a generation licence.

3.6.4 Summary of connection agreement, market registration cost

The table below summarises the connection agreement and market registration costs. These costs typically involve labour and independent of the size of the plant at the 200 MW / 800 MWh level.

Table 9 Summary of connection and commissioning costs

Item	Estimated cost	Comment
Preliminary connection application	$30,000	Assumes site has been identified. Cost could be higher if several sites are being considered.
Concept design for connection	$50,000	Assumes the BESS size is 200 MW / 800 MWh
Detailed connection model assessment (including GPS studies)	$750,000	Assumes the owner develops the models and Western Power conducts the GPS compliance assessment. Limited negotiated GPS standards.
Market registration with AEMO	$30,000	Registration with AEMO.
Reserve capacity certification	$25,000	
Total	**$885,000**	

3.7 Environmental and development approvals

There are several federal, state and local government permits and approvals that are applicable to the development of a BESS.

Initially, environmental approvals under Part IV of the *Environmental Protection Act 1986* (EP Act) and the *Environmental Protection and Biodiversity Conservation Act* (EPBC Act) are conducted, as well as development approval under the *Planning and Development Act 2005* (PD Act). Depending on the outcome of these initial approvals, there may be further approvals required such as:

– Part V works approval under the EP Act.
– Native vegetation clearing permit (NVCP) under the EP Act.
– Building permit under the Building Act 2011 (BA Act).

Recent legislative amendments mean that some BESS developments undertaken by the Crown, Governor, public authority[9] or local government may be eligible for an exemption for development approval under the PD Act. However, as not all BESS developers will be eligible for this exemption (and some recent developments have

[9] A public authority is defined by section 4 of the PD Act to include a State Minister, a department of the public service, State trading concern, State instrumentality or State public utility, or any other person or body authorised to administer or carry on a social service or public utility for the benefit of the State.

sought approval despite being eligible for exemptions), we have assumed exemption does not apply and therefore included development approval costs under the PD Act.

3.7.1 Environmental Protection Act approvals

Approvals under the EPBC and EP Acts will only be triggered if there are areas on the site identified as containing matters of national environmental significance, for example, a threatened ecological community.

If approvals were triggered (as assumed), the costs associated with the native vegetation clearing permitting required would be around $30,000.

3.7.2 Development approval

Operating under the Development Assessment Panel Regulations 2011 (DAP Regulations), the Development Assessment Panel (DAP) is a panel that determines development applications as if it were the responsible planning authority, against the relevant local or regional planning scheme.

DAP will determine development applications within certain class and value thresholds set in the DAP Regulations. There are three types of DAP applications:

- Mandatory DAP applications.
- Optional "Opt-in" DAP applications.
- Local government delegated applications.

The BESS development used for the purpose of this report has been assumed to trigger a mandatory DAP application. The DAP application submitted to the local government will comprise the following:

- Completed application forms including landowner signatures. Forms may comprise DAP, local authority and region scheme forms.
- Copy of the Certificate of Title.
- A complete electronic set of development plans comprising a site plan, floor plan/s and elevations.
- Appropriate DAP and local government application fees.
- Supporting technical studies/reports, which may include:
    - Transport impact assessment (construction and operational traffic).
    - Modelling and noise impact assessment.
    - Hydrological study (flood risk, stormwater and fire water management).
    - Aboriginal heritage impact assessment.
    - Ecological assessment.
    - Geotechnical assessment.
    - Bushfire management plan/bushfire risk management plan.

Estimated costs associated with the preparation up to the lodgement of a DAP application are presented in Table 10 below.

Table 10 Development approval costs (required)

Item	Estimated cost
Prepare supporting technical studies for development application	
Transport impact assessment (construction and operational traffic)	$25,000
Modelling and noise impact assessment	$25,000
Hydrological study (flood risk, stormwater and fire water management)	$20,000
Aboriginal heritage impact assessment	$20,000
Ecological assessment	$40,000
Geotechnical assessment (preliminary / desktop)	$15,000

Item	Estimated cost
Bushfire management plan / bushfire risk management plan	$30,000
Hydrological Study	$30,000
Development Application Fees	
Development Assessment Panel	$34,196.00
Local Authority	$11,236.00
Prepare, lodge and manage Development Application to determination	
Cost to the owner to prepare, load and manage application	$35,000
Total cost	**$285,432**

3.7.3 Development approval conditions

Development approval is typically granted subject to a number of conditions, including subsequent approvals. Development approval conditions will typically be associated with the following stages of a BESS development:

– Conditions required to be satisfied prior to construction commencement.
– Conditions required to be satisfied prior to operation.
– Conditions required to be satisfied during operation (i.e. ongoing for the lifespan of the project).
– Conditions required to be satisfied at decommissioning.

Several conditions will require the preparation of additional documentation for the local authority. Indicative costs associated with the preparation of such documents are presented in the table below.

Table 11 Development approval conditional costs

Item	Estimated cost
Landscape plan	$10,000
Construction & Operational Management Plan	$30,000
Notifications on Certificates of Title	$5,000
Noise monitoring / operational noise analysis & reporting	$20,000
Total cost	**$65,000**

3.7.4 Building approval

A building approval may be requested by the local authority where an operations and maintenance building associated with a BESS facility is also functioning as a bushfire refuge to satisfy a condition of development approval, typically associated with a bushfire management plan.

A building approval will also be required where the proposed works are not eligible for any exemptions under the PD Act.[10]

The indicative costs associated with the preparation of a building permit are presented in Table 12 below.

Table 12 Building approval costs

Description	Estimated cost	Comment
National Construction Codes design consultancy	$5,000	
Certificate of Design Compliance (BA3)	$5,000	

[10] Recent legislative amendments mean that some BESS developments undertaken by the Crown, Governor, public authority or local government may be eligible for an exemption for development approval under the PD Act.

Description	Estimated cost	Comment
Certificate of Construction compliance (BA17)	$3,000	
Building Application fee	$54,000	0.09% of estimated building works value but not less than $110.00 or as prescribed by the Department of Energy, Mines, Industry Regulation and Safety . Based on works value (including materials & construction) of electrical and civil BoP ($60,000,000).
Building Services levy	$82,200	0.137% where construction value >$45,000 or $61.65 minimum fee or as prescribed by the Department of Energy, Mines, Industry Regulation and Safety. Based on construction value (including materials & construction) of electrical and civil BoP ($60,000,000).
Construction Training Fund (CTF)	$120,000	0.2% where construction value >$20,000 (less $8.25 commission) or as prescribed by the Construction Training Fund. Based on construction (including materials & construction) value of electrical and civil BoP ($60,000,000).
Total cost	**$269,200**	

3.7.5 Dangerous goods licence

Lithium-ion batteries are regulated by the Department of Energy, Mines, Industry Regulation and Safety under the Dangerous Goods Safety Act 2004. Based on our experience working with the Department on recent BESS projects, we understand going forward BESS projects will no longer require a dangerous goods storage licence once installed.

Temporary storage of batteries during construction or any other storage other than the placement on their final support foundations requires a dangerous goods storage licence under the Dangerous Goods Safety (Storage and Handling of Non-explosives) Regulations 2007.

The costs associated with obtaining the dangerous goods licence required to store batteries prior to final installation are provided in Table 13.

Table 13 Dangerous goods storage licence costs

Description	Estimated cost	Comment
Dangerous goods storage licence	$50,000	Licence required for storage prior to final installation.

3.7.6 Summary of approval costs

Table 14 summarises the environmental and development approval costs. These costs typically involve labour and are independent of the size of the plant at the 200 MW / 800 MWh level.

Table 14 Summary of environmental and development approval costs

Item	Estimated cost	Comment
Clearing permit (EP Act)	$30,000	
Development approval (required)	$285,432	
Development approval conditions	$65,000	
Building approval	$269,200	
Dangerous goods licence	$50,000	Required for temporary battery storage.
Total	**$699,632**	

3.8 Owner's side engineering and construction management and support

This refers to owner's costs for engineering support and construction management support services. This includes the owner's project management team which are employees of the project owner assigned to manage and oversight for the overall delivery of the BESS facility project.

The project services considered in this section include project development by the developer, which will include all costs associated with the following:

– Concept/pre-feasibility study.
– Full feasibility.
– Costs for the engagement of an Owner's Engineer.
– Costs for the engagement of legal and financial services.
– Costs associated with the owner providing a project team.

The owner's engineer services consider the following costs:

– Feasibility studies, business case development and all site-related studies, specification, tendering, contractor selection and contract negotiations up to financial close.
– Construction management services to include design drawing and document reviews, overseeing construction activities, witness testing and commissioning activities and ensuring that the operating and maintenance manuals and as-built drawings are correct.

A cost of $17,597,550 is allocated for the owner's side engineering and construction management and support tasks based on the GHD internal database which draws upon multiple real-world projects of a comparable scope.

3.9 Owner's Indirect Cost

The allowance for owner's indirect cost covers for the following:

– 3rd party expediting and inspection.
– Legal costs associated with development and construction of the BESS including:
  - Contract conditions for specifications, tender analysis, and negotiations.
  - Negotiation of the PPA/Capacity/offtake contract.
  - Financing/ loan procurement.
  - Contracts for the construction phase.
– Construction insurance which assumes several risks that may occur during the construction phase of the BESS. Insurance for a plant of this nature generally covers the following key risks:
  - Loss due to fire and irreparable damage to the major plant components.
  - Loss of income of the power plant due to lengthy delays during the construction phase.
– Financial advisory and transaction costs associated with capital raising and setting up the project vehicle for financing during the construction phase.
– Operations readiness and commissioning.
– Capital and commissioning spares.
– Construction water supply.
– Stakeholder engagement and community relations.
– Owner's temporary site facilities, site vehicles, travel, accommodation, etc.

A cost of $8,279,207 has been allocated for this category.

3.10 Contingency

A deterministic contingency of 15% (of the pre-contingency total capital cost) has been assigned to the estimate to cover for project risk i.e. market forces, schedule delays, damage to equipment, wet weather events, scope omissions identified during construction, etc. This amounts to $55,790,022.

3.11 Summary of total costs

Table 15 summarises the upfront development and capital cost for the BESS and indicates the proportion of total cost each item represents.

Table 15 Summary of development and capital costs

Item	Estimated total cost	Proportion of total costs
Supply & Delivery Cost	**$233,879,120**	**54.7%**
– Lithium-Ion Battery Modules	$177,600,000	41.5%
– Power Conversion System	$27,800,000	6.5%
– Balance of Plant - Materials & Equipment	$28,479,120	6.7%
Construction Cost	**$70,350,894**	**16.4%**
– Site Preparation Contract	$3,950,894	0.9%
– Main Works Construction Contract	$66,400,000	15.5%
Transmission connection capital costs[11]	**$31,010,825**	**7.3%**
Land cost[12]	**$9,181,250**	**2.1%**
Other Indirect Costs	**$27,461,389**	**6.4%**
– Connection agreement and market registration costs	$885,000	0.2%
– Environmental and development approvals	$699,632	0.2%
– Owner’s Indirect Cost	$8,279,207	1.9%
– Owner's side engineering and construction management and support	$17,597,550	4.1%
Deterministic Contingency	**$55,782,522**	**13.0%**
Total cost	**$427,666,000**	**100.0%**

[11] Provided by ERA
[12] Provided by ERA

4. Fixed operating & maintenance costs

The ongoing fixed operating and maintenance costs for the BESS broadly fall into the following categories:

– BESS, BESS substation and BoP maintenance services.
– Corporate overheads and various consulting services.
– Connection asset fixed maintenance services.
– Transmission storage service charges (for use of the Western Power network).
– Local government rates.
– Site security services.

The pricing of the fixed operating & maintenance costs was informed by the internal GHD database consisting of recent real-world project data and recently obtained price estimates from leading OEMs. Variable costs for the BESS plant such as battery module replacement have not been included in the fixed operating and maintenance costs.

As the capital costs estimates provided in section 3 include costs associated with delivering the warranted performance across the warranty period, no insurance costs associated with the performance of the BESS are included in the estimate of fixed operating and maintenance costs. The cost for insuring the BESS against loss due to exogenous events such a bush fire, flood etc are included within the provision for corporate overheads as discussed in section 4.4.

4.1 BESS, BESS substation and BoP

The fixed operating and maintenance costs are derived from GHD's operating and maintenance database for BESS projects.

Table 16 Fixed operating and maintenance costs

Item	Estimated cost per annum	Detail
BESS substation BESS substation costs include: – electrical testing, inspections and preventative maintenance on the primary and secondary electrical equipment, structures, footings, buildings and civil items, in accordance with the manufacturer's specifications. – transformer oil and insulation liquid inspection and maintenance, as required.	$344,096	
BESS and BoP Service, inspection and preventative maintenance of: – Inverter stations. – Battery modules, racks, energy management system, battery temperature monitoring and control, and container auxiliaries. – Earthing. – Protection, breakers, fuses, isolation. – Equipment dust ingress and moisture. – Cables. – SCADA and controls.	$4,198,000	Cost of preventative maintenance of battery containers and balance of plant. Cost basis uses data provided by tier 1 OEMs and the internal GHD database.
Total	**$4,542,096**	

4.2 Connection asset fixed operating and maintenance

The fixed operating and maintenance costs for the connection assets were calculated from the isolator on the high-voltage side of the generator transformer. The assets being maintained are a substation and a 2 km high voltage connecting line to the tie-in point.

Two types of ongoing maintenance were identified as needing to be separately accounted for:

– Connection switchyard maintenance. For the switchyard, routine maintenance is assumed to take an equivalent annual period of one week and would require the hire of a scissor lift and forklift, as well as project management, planning and organising by management and operations staff.
– Transmission line maintenance. For the overhead transmission line, we assume work would be organised by management and operations staff and that the inspection would be carried out by 2-3 people over a 2-day period and require the hire of a scissor lift, as well as requiring planning and project management. We assume this occurs approximately once every 5 years.

For both types of fixed operating and maintenance, the cost will change from year to year depending on what is required. The estimated costs are representative of a normalised spend over the period of the asset's lifetime.

The fixed operating and maintenance cost estimates are inclusive of:

– Labour cost for routine maintenance.
– Overheads (management, administration, operations, etc.).
– Hire cost of machinery and equipment to support routine maintenance.

Table 17 Fixed operating and maintenance costs – Connection substation and OHL

Item	Estimated cost per annum	Detail
Switchyard fixed operating and maintenance	$104,000	
Transmission line fixed operating and maintenance	$8,500	
Total	**$112,500**	

4.3 Transmission network service charges

Western Power charges the following transmission storage services (TRT3) tariff for ongoing use of the transmission network:

– A user-specific charge that is an amount per day that reflects the costs to Western Power of providing the Connection Assets under an Access Contract, which may consist of capital and non-capital costs.
– A variable use of system charge.
– A variable control system service charge.
– A fixed metering charge per revenue meter.

The TRT3 tariff that applies to transmission storage services also provides for excess network usage charges where the peak half-hourly demand exceeds the nominated declared sent-out capacity (DSOC). We have assumed the BESS operates within its DSOC at all times.

Table 18 summarises the estimated ongoing transmission storage services charges for the use of the Western Power network. Prices are based on the 2024/25 price list[13].

[13] Western Power, 2024/25 price list of the Western Power network. Available at: **https://www.westernpower.com.au/siteassets/documents/regulation/network-access-prices-2024-25.pdf**

Table 18 Transmission network service charges

Item	Units	Rate	Cost per annum	Detail
Use of system	c/kW/day	1.447	$1,056,310	Based on Table 8.21 of the Western Power 2024/25 Price list. Assuming an average of the Kwinana (1.58 c/kW/day) and Pinjar (1.314 c/kW/day) prices and assuming 200 MW.
Control system service price (Generators)	c/kW/day	0.255	$186,150	Based on Table 8.23 in the Western Power 2024/25 Price List and assuming 200 MW.
Metering charge	c/revenue meter/day	1014.995	$3,705	Based on Table 8.14 in the Western Power 2024/25 Price List and assuming one revenue meter.
Total			**$1,246,165**	

4.4 Corporate overheads and various consulting services

There are various ongoing corporate overheads and costs for consulting services that are necessarily covered in the fixed operating and maintenance costs. These include:

– Corporate overhead. This cost covers items such as superannuation contributions, work cover contributions, contribution to corporate office lease, the cost for office staff in the corporate office, ongoing training of staff, and employee insurance. This cost includes insurance to cover events that are not associated with plant warranties (damage from wildfires and flooding, etc)[14]
– Legal and regulatory costs. Although corporate overheads will allow for some coverage of ongoing legal and regulatory costs, these costs often increase due to unforeseen circumstances (for example, if there are legal disputes or significant regulatory changes). We have provided for an allowance for legal and regulatory costs that is outside of the normal allowance provided for in corporate overheads.
– Subcontractors. Typically, a service agreement would be in place to oversee or perform the maintenance provider activities for the OEM equipment, particularly the battery inverters. In addition, specialist BESS fire suppression subcontractors may be included as part of the operating and maintenance regime. Performance testing and maintenance activities outside of inspections and checks are expected to be performed 6 monthly or annually depending on the BESS component. Subcontractors may also be engaged for operating and maintenance of the BESS substation.
– Engineering Support. As part of general operation, technical engineering support falls within the scope of the operation of the BESS.

Table 19 Fixed operating and maintenance costs – Corporate overhead and consulting costs

Item	Estimated cost per annum	Detail
Corporate overhead	$250,000	
Legal and regulatory costs	$100,000	
Subcontractors	$240,000	Assuming one subcontractor engagement every other month (at $40,000 per month).
Engineering Support	$500,000	The basis for the fixed operating and maintenance estimate for engineering support is two engineers ($200,000 annually per engineer) with at least one other engineer on call (50% availability) per year.
Total	**$1,090,000**	

[14] Note that specific costs for insurance is dependent on location and project specific information. The estimated costs assume the site selection and BESS design assists to reduce vulnerability to damage from exogenous events.

4.5 Site security

Security primarily pertains to monitoring and oversight of the BESS remotely, with regular local inspections and checks of security performed in the interest of the safety of the BESS. Response requirements for emergency measures fall within 2-5 hours.

Table 20 Fixed operating and maintenance costs – Site security

Item	Estimated cost per annum	Detail
Security	$162,240	Assuming a single service provider overseeing security checks and reporting ($2,600 for 8 hours per week) with a 20% uplift to account for ad hoc local response and support. The annual expectation for security is $162,240.

4.6 Local Government rates

Local Government rates are to be based on a site that is 65,000 m^2 (6.5 hectares). The Landgate gross rental value (GRV) for a 3-hectare site in the 2024 BRCP determination was $859,078 ($28.64/m^2). Using an escalation of 3.8% (consumer price index), the current GRV is estimated to be $29.712/$m^2$ per annum. The GRV for a 6.5-hectare site was then calculated as $1,932,066 (assuming $29.712/$m^2$ per annum GRV).

We assume the plant will be located in the Kwinana or Pinjar region. The City of Kwinana Council[15] has a fee multiplier of $0.10667 and The City of Wanneroo Council[16] has a fee multiplier of $0.080134. This amounts to an average fee multiplier of $0.09340.

The Local Government rates are GRV x $0.09340 which results in Council rates of $180,459.

Table 21 Fixed operating and maintenance costs – local government rates

Item	Estimated cost per annum	Detail
Local government rates	$180,459	Average rates for The City of Kwinana and The City of Wanneroo based on escalated GRV from the 2024 BRCP.

4.7 Summary of fixed operating and maintenance costs

The table below summarises the fixed operating and maintenance costs and the relative proportions of the total fixed operating and maintenance costs.

Table 22 Summary of fixed operating and maintenance costs

Item	Estimated annual cost	Proportion of total annual cost
BESS, BESS substation and BoP maintenance	$4,542,096	62%
Transmission connection asset maintenance	$112,500	2%
Transmission network service charges	$1,246,165	17%
Corporate overheads and various consulting services	$1,090,000	15%
Site security	$162,240	2%
Local government rates	$180,459	2%
Total	**$7,333,460**	**100%**

[15] https://www.kwinana.wa.gov.au/CityOfKwinana/files/96/96a58c82-afa8-4403-a254-ef60da8e313b.pdf
[16] https://www.wanneroo.wa.gov.au/info/20086/rates/207/rates_information/6

5. Cost escalation approach for future costs

The BRCP being estimated will apply from 1 October in Year 3 of the Reserve Capacity Cycle. The WEM Rules require that a review be conducted of the BRCP each year. The current Procedure requires estimations to be made as of 1 April (capital costs) or 1 October (O&M costs) in Year 3 of the Reserve Capacity Cycle, depending on the cost category. The cost estimates developed by GHD are based on current pricing. Subsequently, GHD has applied relevant escalation factors to adjust the estimate to reflect costs as of the 2027 Capacity Year (Year 3 of the Reserve Capacity Cycle) in accordance with the WEM Procedure. These escalation factors were determined in consultation with the ERA and their application can be observed in the provided BRCP calculation model spreadsheet.

The table below showcases the implemented adjustments/escalation factors applied to capital, fixed operating and maintenance estimates to account for cost differences between now and the Year 3 Reserve Capacity Cycle. From the table below, it can be observed that most costs will be adjusted through taking into account a combination of CPI or WA – WPI. However, for battery modules and the PCS no adjustments are recommended due to the volatile nature of their prices.

Table 23 Adjustments to reflect future prices

Item	Adjustment
Capital costs	
– Lithium-ion battery modules/enclosures	None[17]
– Power Conversion System	None[18]
– BoP	CPI
– Construction Cost	WA WPI – Labour
– Transmission connection capital costs	Provided by Western Power
– Land cost	CPI
– Other Indirect Costs	WA WPI – Labour
Fixed operating and maintenance items	
– BESS operating and maintenance	80% WA WPI – Labour, 20% CPI
– Connection switchyard and transmission line operating and maintenance	80% WA WPI – Labour, and 20% CPI
– Transmission network service charges & Government Rates	CPI
– Site security & Corporate overhead	WPI

Table 24 Applied escalation factor values

	FY2025	FY2026	FY2027	FY2028
WPI[19]	3.75%	3.5%	3.0%	3.0%
CPI[20]	2.8%	3.2%	2.5%	2.5%

[17] Spot prices of key materials such as lithium carbonate have some impact on costs and trends in the price of lithium ion appears to l continue to trend down over time, reducing the potential for cost escalation. Available at **https://www.iea.org/reports/global-ev-outlook-2023/trends-in-batteries**

[18] BESS PCS in particular are a complex technology and expected to have continued development to improve system performance reducing the potential for cost escalation.

[19] Based on the Western Australia State Budget 2024-25, Budget Paper No. 3. Available at: **https://www.ourstatebudget.wa.gov.au/2024-25/budget-papers/bp3/2024-25-wa-state-budget-bp3.pdf**

[20] Based on RBA SMP August 2024. Available at **https://www.rba.gov.au/publications/smp/2024/aug/**. Note projections were only available till FY 2026, for future years CPI of median target range was assumed

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