Economic Regulation Authority

Energy Offer Price Ceiling 2024

Draft determination

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Invitation to make submissions

Submissions are due by 4:00 pm WST, Tuesday, 7 May 2024

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

We would prefer to receive your comments via our online submission form https://www.erawa.com.au/consultation

You can also send comments through:

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

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

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Executive summary

Since 1 October 2023, the Wholesale Electricity Market (WEM) has operated under new rules where energy and five frequency co-optimised essential system services (FCESS) are co-optimised and dispatched in five-minute intervals. Offers in the WEM are capped at the Energy Offer Price Ceiling to mitigate the exercise of market power. The Energy Offer Price Ceiling acts as a backstop mechanism to limit offer price mark-ups in the energy market and provides a safety net for final consumers.

Under the transitional provisions for market price limits, the alternative maximum STEM price for September 2023 (that is $738/MWh) was applied as the Energy Offer Price Ceiling from 1 October 2023. That price ceiling will be replaced by the value determined in this review. The ERA must review the Energy Offer Price Ceiling at least once every three years following this first review.

Under the revised WEM Rules, the ERA must determine a single Energy Offer Price Ceiling, rather than two separate price ceilings for gas and diesel generation as in the previous WEM.

Prior to 1 October 2023, the energy price limit was based on the estimated short-run marginal cost of the highest-cost 40 MW open cycle gas turbine (OCGT) in the South West Interconnected System (SWIS). The new WEM Rules do not specify a reference technology.

The ERA considered various technologies, given the current generation profile in the WEM, and analysed a list of facilities for which potential offers could exceed the current energy price ceiling. Following this analysis, the ERA has identified Merredin Power Station as the highest-cost facility operating in the WEM. The new Energy Offer Price Ceiling is estimated at $1,500/MWh.

This estimated new Energy Offer Price Ceiling would represent a significant increase over the current energy price ceiling. The requirement under the new WEM rules to evaluate fuel costs at the minimum dispatchable loading level – rather than at 'minimum capacity' under the previous WEM rules – is the largest factor underlying this increase.[1] At this minimum dispatchable loading level, the operation of the plant is highly costly and possibly unstable.

The ERA notes that the use of minimum dispatchable loading level may not reflect the intent of the rules to mitigate the exercise of market power associated with the inclusion of price markups. Market participants typically aim to achieve dispatch of at least their minimum stable generation to avoid unstable dispatch and extreme mechanical wear and tear. The use of a cost measure at a more-commonly observed generation level may better reflect the intent of the rules.

While the new WEM rules still afford the ERA strong mechanisms to mitigate the exercise of market power, such as the rules governing how market participants formulate price-quantity pairs as outlined in the Offer Construction Guidelines, we consider that the section of the new WEM rules guiding the Energy Offer Price Ceiling may warrant a rule change.

The new WEM Rules also require the ERA to determine whether indexation should apply to the Energy Offer Price Ceiling and, if so, to determine the frequency and formula for indexation. Owing to volatility in input costs, especially fuel prices, the ERA considers that the Energy Offer Price Ceiling should be indexed monthly to reflect changes in the price of diesel. The ERA will also index the non-fuel component of the Energy Offer Price Ceiling every quarter in accordance with Consumer Price Index changes. Since the loss factors are updated

1 A similar analysis for the new Energy Offer Price Ceiling based on a heat rate corresponding to our estimate of minimum stable generation would arrive at an Energy Offer Price Ceiling of $800/MWh.

once every year, the Energy Offer Price Ceiling will be updated accordingly to include changes in the loss factors.

The ERA is seeking feedback from stakeholders on the estimated new level of the Energy Offer Price Ceiling, and on the ERA's approach and analysis. After considering feedback from the stakeholders the ERA will publish a final determination. The final value of the new Energy Offer Price Ceiling will be implemented at least five business days after the final determination is published.

1. Introduction

As of 1 October 2023, the WEM operates under new rules. Energy and five FCESS are co-optimised and dispatched in five-minute dispatch intervals.

Offers in the energy and five FCESS markets are based on the cost of supply and are subject to market price limits to mitigate the exercise of market power.[2]

The market price limits comprise:

- The Energy Offer Price Ceiling: this applies to offers from all facilities in the real-time market for energy.
- The Energy Offer Price Floor: this is currently set at negative $1,000/MWh and is not part of this review.
- The FCESS Offer Price Ceiling: this applies to offers from facilities in the five FCESS markets and is currently set at $300 per megawatt per hour for regulation and contingency reserve services and $0 per megawatt per second for the RoCoF control service. This is not part of this review.

The ERA determines the market price limits according to the timeframes set out in the WEM Rules. In September 2023, the ERA determined the FCESS Offer Price Ceilings, which are to be next reviewed by 1 June 2026. The ERA will review the Energy Offer Price Floor for the first time by 1 June 2025 and every three years thereafter. The Energy Offer Price Ceiling, which is the subject of this draft determination, is to be reviewed by 1 June 2024, and at least once every three years thereafter. [3,4]

Under the previous WEM Rules, the ERA determined the energy price limits, that is, the maximum STEM price and the alternative maximum STEM price every year. In January 2023, the ERA published energy price limits review determining the maximum STEM price as $324/MWh and the alternate maximum STEM price as $989/MWh. The latter was indexed by AEMO every month to include changes in price of distillate.

Under the transitional provisions the alternative maximum STEM price for September 2023 – that is, $738/MWh – was applied as the Energy Offer Price Ceiling from 1 October 2023. That ceiling will ultimately be replaced by the value determined in this review.

Since January 2022, there has been a marked increase in the number of trading intervals where prices reached the maximum STEM price, compared to previous years. Figure 1 illustrates this, as well as instances in the old market in 2022 and 2023 where intervals cleared at the alternative maximum STEM price. Over 2022 and 2023, fuel scarcity and significant weather events contributed to the energy market price clearing at the ceiling. Since the commencement of the new market, and the adoption of the alternative maximum STEM price

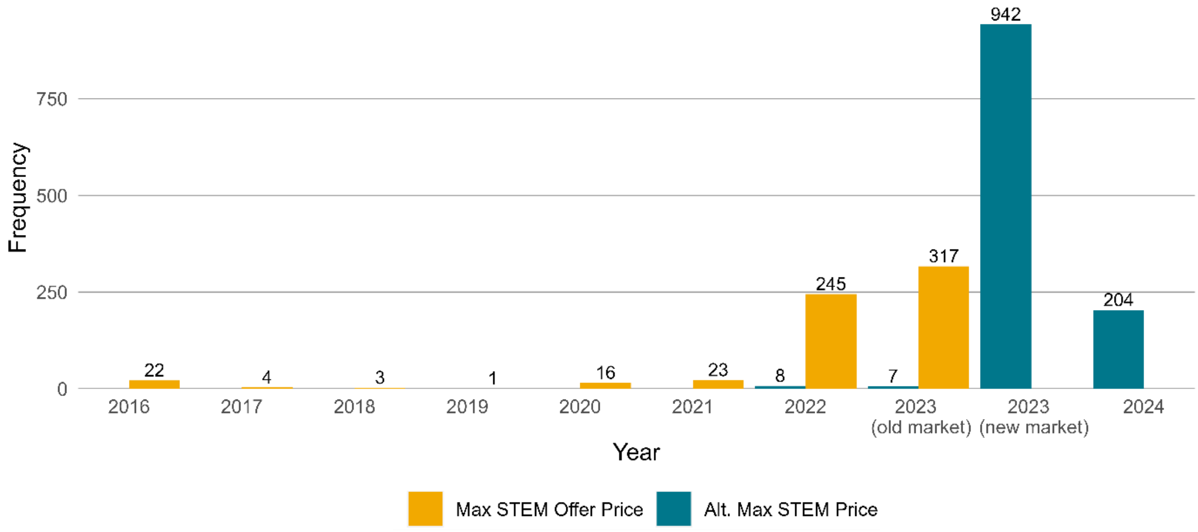
2 Other market power mitigation mechanisms in the new WEM include mandatory provision of capacity in the real-time market for energy, general trading conduct obligations on market participants, requirements to construct market offers in accordance with the offer construction guideline published by the ERA, market power tests, and ex-post market monitoring conducted by the ERA. Energy Policy WA published its market power mitigation strategy for the new WEM in November 2022 (online).

3 Wholesale Electricity Market Rules, 13 December 2023, 2.26.1, (online).

4 Wholesale Electricity Market Rules, 13 December 2023, 1.61.2, (online).

as the sole Energy Offer Price Ceiling, a significant rise in intervals clearing at this price has been observed. [5]

Figure 1: Number of times the real-time market cleared at the Energy Offer Price Ceiling



Source: ERA's analysis using public data published by AEMO

Note: 2023 data is split at new market start (1 October 2023). 2024 data is for the period 1 January – 31 January 2024.

1.1 The ERA's obligations under the WEM Rules

The ERA must determine the Energy Offer Price Ceiling at least once every three years, with the first review due by 1 June 2024. The ERA must use the following formula and determine appropriate values for each of the parameters in the formula:[6]

$$(1 + risk\ margin) \times \frac{Variable\ O\&M + (Heat\ rate \times Fuel\ cost)}{Loss\ Factor}$$

where:

- *Risk Margin* is a measure of uncertainty in the assessment of the mean short run average cost for the highest cost Facility in the SWIS, expressed as a fraction.
- *Variable Operating and Maintenance (VOM)* is the mean variable operating and maintenance cost for the highest cost Facility in the SWIS, expressed in $/MWh, and includes, but is not limited to, start-up related costs.

[5] Tight coal supply situations were reported over 2022 and early 2023 in various media outlets. In Q2 2023, and specifically in June 2023, AEMO reported difficult system operating conditions when demand was particularly high coupled with forced outages of scheduled generators and low wind conditions. In Q3 and Q4 2024, higher than average temperatures were observed which pushed up electricity demand. The use of distillate in the fuel mix increased substantially when compared to previous years. In general, a reduction in the quantity of energy made available in the energy market and more expensive generation being dispatched appears to be a factor in the energy market price clearing at the ceiling. Source: AEMO, Quarterly Energy Dynamics, 2023 and 2024 (online).

[6] Wholesale Electricity Market Rules, 13 December 2023, 2.26.2(a), (online).

- *Heat Rate* is the mean heat rate at the minimum dispatchable loading level specified in Standing Data for the highest cost Facility in the SWIS, expressed in GJ/MWh.
- *Fuel Cost* is the mean unit fixed and variable fuel cost for the highest cost Facility in the SWIS, expressed in $/GJ.
- *Loss Factor* is the marginal loss factor for the highest cost Facility in the SWIS, relative to the Reference Node.

The ERA must determine values for each factor described consistently with the Offer Construction Guideline, as it applies to the highest cost generating facility in the SWIS.[7] The Energy Offer Price Ceiling is to be rounded up to the nearest multiple of $100/MWh. The ERA must also determine whether an indexation process should apply to the Energy Offer Price Ceiling to reflect movements in input costs and, if so, determine the formula for the indexation calculation and the frequency at which indexation will apply.[8]

The ERA is seeking submissions from stakeholders on the draft determination and will consider those submissions when preparing its final determination.

1.2 Changes to the rules and implications for this determination

Prior to 1 October 2023, the energy price limit was based on the estimated short-run marginal cost of the highest cost 40 MW open cycle gas turbine in the SWIS. Additionally, two price ceilings were determined – the maximum STEM price that applied to offers from all facilities except those using diesel, and the alternative maximum STEM price that applied to offers from diesel-fuelled facilities.

The revised WEM Rules do not specify a generating technology and a single price ceiling is applied to offers from all facilities. The choice of the highest cost facility is no longer dependent on the type of technology or the fuel used. The ERA’s approach to choosing the highest-cost facility is explained in Section 2.1.

For the fuel cost component of the Energy Offer Price Ceiling, the heat rate is now defined at the minimum dispatchable loading level for the highest cost facility as specified in standing data. Previously, the ERA determined the heat rate at minimum capacity by modelling different output levels to estimate a minimum stable generation level for the chosen facility. Section 2.4.1 explains the ERA’s approach to choosing a value for this parameter.

Further, a rounding up factor of the nearest multiple of $100/MWh is to be applied to the value determined for the Energy Offer Price Ceiling.[9]

The application of indexation has also changed to enable the ERA to develop a method and frequency to apply indexation, whereas in the previous rules the alternative maximum STEM price was indexed monthly on the fuel component.[10]

Table 1 outlines the changes between the previous and current WEM Rules and the resulting implications on this review.

7 Wholesale Electricity Market Rules, 13 December 2023, 2.26.2(a), (online).

8 Ibid. 2.26.2(c), (online).

9 Ibid. 2.26.2(b), (online).

10 Ibid. 2.26.2(c), (online).

Table 1: Changes in WEM Rules and implications for this review

Parameter	Previous WEM Rule	Current WEM Rule	Implication
Number of price ceilings	2 price ceilings – Maximum STEM price (for gas) and Alternative maximum STEM price (for diesel)	Single price ceiling	No restriction to determine the price ceiling by fuel type i.e. fuel agnostic
Choice of technology	Specified as 40 MW OCGT	Highest cost facility	No restriction on choice of technology
Heat rate	Mean heat rate at minimum capacity	Mean heat rate at the minimum dispatchable loading level specified in Standing Data	Heat rate value restricted to a specific output level of facility
Rounding up	Not required	Rounding up to the nearest $100/MWh	Introduces headroom
Indexation	Alternative maximum STEM price indexed for fuel component	Determine if indexation required and if so, the methodology and frequency	Determine if/how to index

1.3 Information for the ERA’s determination

The determination of the Energy Offer Price Ceiling requires data to estimate the facility’s fuel costs, heat rate and VOM costs. The ERA requested and received data from asset owners on their respective generating units, which included:

- historical data, such as dispatch profiles, heat rates, and fuel and non-fuel costs
- estimates of the facility’s VOM costs
- forecasts or assumptions underlying future fuel and non-fuel costs.

The ERA has evaluated the information received from all sources and used the best available inputs into the Energy Offer Price Ceiling calculation. Where required, the ERA has sought to verify information provided by asset operators with original equipment manufacturers and by analysing the operating patterns and cost profiles of other similar equipment operating in the SWIS. Where multiple sources of information were available, the ERA has placed a greater weight on the most reliable source of information.

Some of the information required for the ERA’s analysis is either confidential or commercial in-confidence. As a result, the underlying confidential information has been redacted in this document, but the ERA’s analysis resulting from the provided information is published.

2. Determination process

The WEM Rules require the ERA to determine the Energy Offer Price Ceiling based on the supply cost of the highest cost facility operating in the SWIS, in accordance with the Offer Construction Guideline.

The method outlined in the WEM Rules makes explicit allowance for the fact that there is uncertainty in estimating such costs. There is no single supply cost for all operating conditions, so the Energy Offer Price Ceiling is set after considering a range of possible values.

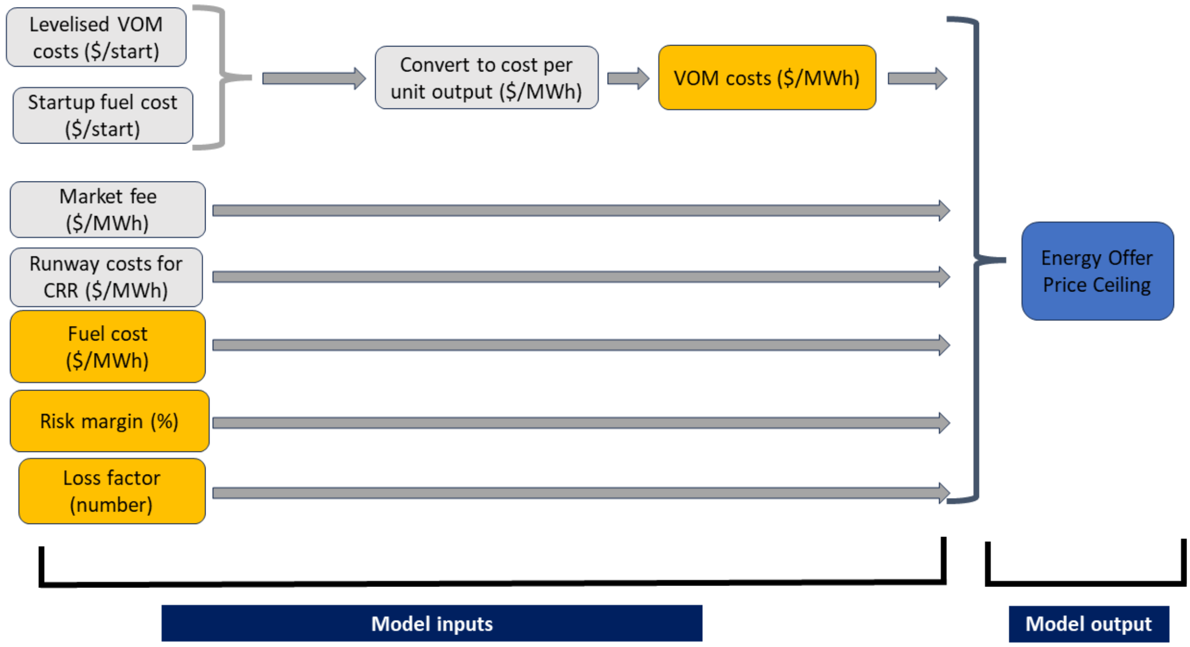
The ERA will set the Energy Offer Price Ceiling at a level that strikes the balance between being:

- Low enough to limit the ability of generators with market power to charge prices above their reasonable expectation of the short run average cost of the electricity supplied. This protects market customers from high prices that could result from generators exercising market power in the energy markets.
- High enough so that the high-cost generators in the SWIS can recover their costs of supply in the presence of highly variable market conditions. Supply costs can change due to changes in input costs and operating conditions.

The ERA has based its draft determination on an operational scenario of the highest cost facility supplying energy for a short period of time at its estimated stable generation level and when its cost of fuel consumption is high. The Energy Offer Price Ceiling should reflect the upper boundary of the supply cost for the highest cost generator so that, under a set of extreme operating conditions, the generator is able to recover its generation costs. As these extreme conditions do not apply all the time, the supply cost calculated for Energy Offer Price Ceiling will tend to be greater than the highest cost generator's supply cost under "normal" conditions and greater than the price at which the highest cost generator might be expected to offer energy into the real-time market under normal conditions.

Unless otherwise stated, the ERA has adopted a modelling approach and process that is consistent with its previous energy price limits determination. The ERA has only updated the approach where it was required by the rules, for example, in selecting the highest cost facility, or where it has received new or more reliable information regarding input costs.

Figure 2: Relationship between model inputs and output for estimating the Energy Offer Price Ceiling



The process of estimating the Energy Offer Price Ceiling is illustrated in Figure 2. The Energy Offer Price Ceiling is comprised of the following components:

- VOM costs, including 'levelised' VOM costs, start-up fuel costs (Section 2.2).[11]
- Market fees (Section 2.2.5).
- Runway costs for Contingency Reserve Raise (Section 2.2.6).
- Fuel costs (Section 2.4).
- Risk margin (Section 2.5).
- Loss factor (Section 2.6).

The abovementioned parameters have been estimated for the highest cost facility. Section 2.1 explains the ERA's approach to choosing the highest cost facility.

2.1 Selecting the highest cost facility

2.1.1 Choice of technology

The WEM Rules do not specify a generating technology as the highest cost facility setting the Energy Offer Price Ceiling. As such, the ERA started with a consideration set that includes all facility types able to operate in the WEM. This includes thermal facilities using coal, gas or diesel, renewable generators, electric storage resources (batteries), demand side management (DSM) and other schedulable loads, and small aggregated distributed energy resources (DER).

11 'Levelised' VOM costs refers to maintenance and startup costs calculated as a present value incurred over the useful life of the generator.

Small aggregated DER currently do not participate in the market and so can be removed from the consideration set of facilities.

A DSM can be the highest cost facility because the value of lost load is generally higher than the cost of the most expensive fuel in the WEM. However, currently DSM is not required to submit price-quantity pairs in the energy market and therefore the Energy Offer Price Ceiling will not apply. DSM have therefore been discounted from the consideration set.

Renewable generators have negligible variable costs of production and will not be the highest cost facility.

Electric storage resources can be the highest cost facility under some conditions. A battery is expected to construct offers in the energy market based on its expectation of the cost of discharging in a future interval, compared to the current interval. Unless the battery is facing additional financial trade-offs that it must account for in its offers, it is reasonable to expect the battery to offer competitively in the energy market so that it receives energy revenue.

Currently, Synergy's KBESS1 is the only battery participating in the energy market. The ERA's analysis of Synergy's offer behaviour suggests that this battery tracks the market clearing price in its offers and is not the highest cost facility for the purposes of the Energy Offer Price Ceiling.

This reduces the consideration set to thermal facilities that use coal, gas and/or diesel. When fuel is scarce, a generator may seek to price its energy at the opportunity cost of using that fuel in the current interval versus a future interval. This is the same consideration that a battery would make in its offer prices.

Scarcity in coal supply has been experienced in the SWIS over 2022/23, and there is uncertainty whether offers from coal facilities in the energy market can be constructed to validly account for coal scarcity.[12] For this review, the ERA does not consider coal facility to be the highest cost facility.

As far as diesel and gas generators are concerned, the diesel price has tracked higher than the gas price historically (Figure 13). As the fuel cost tends to be the primary cost in the price limits, the ERA considers that a diesel-fuelled facility is the highest cost facility for the purposes of the Energy Offer Price Ceiling.[13]

2.1.2 Choice of facility

The ERA considered a list of facilities for which highest operating costs could exceed the current offer price ceiling if operated on diesel for a minimum stable output. These facilities were:

- Alinta Wagerup
- Perth Energy Kwinana Swift
- Pinjar units 1-5 and unit 7
- Parkeston Power Station
- Tesla units (Picton, Geraldton, Kemerton and Northam)
- Merredin Power Station.

[12] Government of Western Australia media statement, 1 December 2023, (online).

[13] In the previous price limit reviews, fuel costs have accounted for 60-70 percent of the alternative maximum STEM price. ERA, Energy Price Limits Review 2023, page 19 (online).

The ERA requested information on operating costs, functional parameters, and heat rates from the asset owners for these facilities. Based on the analysis of the cost information provided, the ERA has selected Merredin Power Station as the highest cost facility operating in the SWIS.

Merredin Power Station is an open cycle gas turbine facility with two GE Frame 6B turbines with a maximum capacity of [redacted] MW each, running exclusively on diesel. The power station is owned by Merredin Energy and operates to provide peaking power in the SWIS.

To estimate the costs for Merredin as the highest-cost facility, the ERA considered information from various sources including those provided by Merredin Energy, the original equipment manufacturer (GE Vernova), and cost profiles of other similar generators operating in the SWIS.

The rest of this paper outlines the ERA's analysis of the Merredin Power Station's costs.

2.2 Variable operation and maintenance costs

The VOM cost component of the Energy Offer Price Ceiling includes any costs incurred in operating a facility (other than the fuel costs for energy production) and conducting periodic maintenance works required to maintain the facility in an efficient and reliable condition. These costs mainly comprise maintenance services, parts and labour expenses. VOM costs include those maintenance expenditures that depend only on the use of the machine. For clarity, the VOM costs do not cover the cost of any maintenance that is run regardless of whether the unit operates or not. The WEM Rules do not specify a method for determining VOM costs but note it includes start-up costs and should be expressed on a $/MWh basis.

An estimate of a generator's average VOM costs on a $/MWh basis requires:

- An estimate of the generator's VOM costs. These costs can be estimated using a combination of VOM costs per operating hour ($/hour), VOM costs per start ($/start) or VOM costs per unit of output ($/MWh).
- An appropriate method to spread those costs over each start or operating hour of the units, and then subsequently over each unit of energy (MWh) generated.

The ERA has estimated Merredin Power Station's average VOM cost at $[redacted]MWh. This is based on information provided by Merredin Energy and generally comparable with the original equipment manufacturer's estimates and the estimated cost profiles of other similar machines operating in the SWIS.

Section 2.2.2 to Section 2.2.4 explain the components of VOM, that is, levelised VOM costs and startup and shutdown fuel costs. Estimation of other variable costs like market fee and runway costs for Contingency Reserve is outlined in Sections 2.2.5 and 2.2.6. Section 2.2.1 outlines the ERA's choice of period of analysis which results in the dispatch output used to convert the VOM costs into a $/MWh value. Section 2.3 provides results for the VOM costs.

2.2.1 Choice of period of analysis

To estimate the VOM costs in terms of $/MWh, the total VOM costs provided by Merredin Energy are amortised over forecasted output during a typical dispatch cycle (MWh/start). This output is forecasted using historical trends for the facility's dispatch profile.

Since January 2023, there has been a significant change in the dispatch profile of peaking generators. The frequency of starts has increased compared to historical averages. Recognising this trend, the ERA has amortised the VOM costs over an expected dispatch output based on Merredin's dispatch profile as observed over January 2023 to January 2024. Further analysis related to the period of analysis is presented in Appendix 3.

2.2.2 Estimation of levelised VOM costs

The ERA has determined maintenance and startup costs for Merredin Power Station as a 'levelised cost'. In this context, the levelised cost is the present value of major maintenance and startup costs incurred over the useful life of the generator.[14]

The estimation of VOM costs relies on the following information provided by Merredin Energy:

- costs of major inspections like combustion inspection and hot gas path inspection
- maintenance factors for each inspection type and each operation mode
- costs associated with additional maintenance items like fuel pumps, water pumps, etc.

Merredin Energy provided information on VOM costs in terms of cost per start. The ERA used the concept of levelised cost to convert the VOM costs into a $/MWh value. The estimation uses information on number of starts, maintenance factors and maintenance triggers, inspection costs and a weighted average cost of capital (WACC) to arrive at (a normal distribution of) levelised costs.

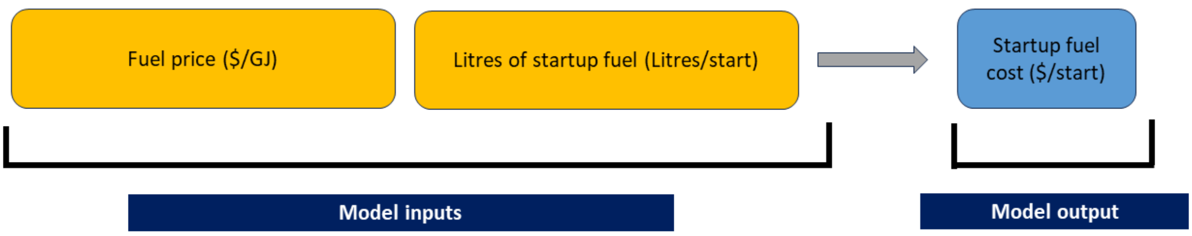
The discounted cost per start is converted to a discounted cost per MWh of electricity generated based on the possible duration of short dispatch cycles. The choice of short dispatch cycles for this conversion ensures the estimated cost per start is spread over a shorter period, and hence, the estimated cost per unit energy generated reflects very high-cost operating conditions of the units. This process is explained in Appendix 1.

2.2.3 Estimation of startup and shutdown fuel costs

Fuel costs related to startup

Generators use fuel during startup in addition to the fuel used to generate electricity during dispatch. Fuel costs for startup (and shutdown) can be included in the fuel cost component or the VOM cost component in the Energy Offer Price Ceiling formula. Consistent with previous ERA energy price limits reviews, these costs have been included in total VOM costs because startup fuel costs are a part of the costs incurred when starting up the machine. Figure 3 shows that the startup fuel cost is derived from estimated fuel price and the quantity of fuel used during startup. Fuel prices have been estimated using the analysis under Section 2.4.2.

Figure 3: Model inputs and output for startup fuel cost



[14] This approach is similar to the approach used by the ERA in the 2022 energy price limit review where Pinjar was identified as the highest cost facility (online). Appendix 1 explains the concept of levelised costs.

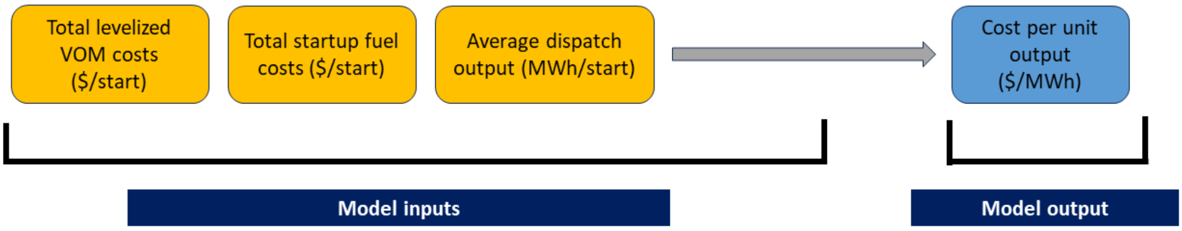
Fuel costs related to shut down

The Offer Construction Guideline allows for the inclusion of shutdown costs in energy offers. Shut down costs relate to fuel costs and additional maintenance costs incurred when shutting down a generator.[15] The ERA's analysis of energy offers for generators similar to Merredin suggests shutdown costs are not included in energy offers. This could be because these costs are negligible or are already recovered through other components of a market participant's offer. The ERA is seeking feedback and evidence on potential shut down costs incurred by generators to assist with determining if and how to include this in determining the Energy Offer Price Ceiling.

2.2.4 VOM cost per unit output

The total levelised costs and total startup fuel costs are divided by the distribution of dispatch output to arrive at the VOM cost per unit output in $/MWh as depicted in Figure 4.

Figure 4: Model inputs and output for cost per unit



The detailed analysis of estimating costs in terms of $/MWh is explained in Appendix 2.

2.2.5 Market fees

The Offer Construction Guideline allows for the inclusion of market fees in energy offers. Market fees constitute the sum of AEMO market fees, ERA regulation fees and Coordinator of Energy fees spread over the energy consumption forecast for the same period. The current 2023/24 value, published by AEMO is $1.81/MWh. [16]

2.2.6 Runway costs for Contingency Reserve Raise

The runway costs for contingency reserve raise are the proportional share of costs allocated to generators to pay for the contingency reserve raise quantity procured in a dispatch interval. The Offer Construction Guideline allows for the inclusion of these costs in energy offers and notes that generators must not attempt to over-recover these costs through their offers.[17]

The ERA estimated runway costs using AEMO's settlement data. The runway costs for Merredin Power Station during October 2023 to January 2024 amount to [redacted] This figure was divided by the total MWh of energy generated by Merredin Power Station during the period, resulting in average runway costs of $[redacted]/MWh.

[15] ERA, Offer Construction Guideline, p 10-11 (online).

[16] AEMO, WA Budget and Fees 2023-24 (online).

[17] ERA, Offer Construction Guideline, p 26 (online).

2.3 Results for the variable cost component

Table 2 outlines the results for the parameters included in the estimation of VOM costs. Other variables costs – market fees and runway costs – are also provided. The total variable costs are estimated to be $[redacted]/MWh.

Table 2: Estimate of variable costs for Merredin Power Station

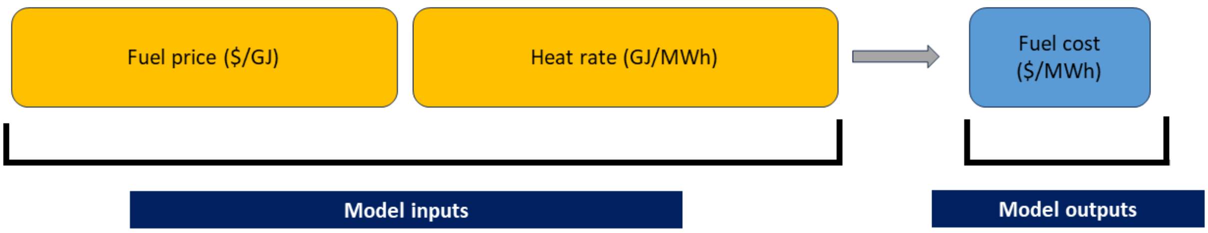
Item	Unit	Cost
Maintenance costs	$/start	[redacted]
Average duration of dispatch per start	Hours	[redacted]
Startup fuel consumption	$/start	[redacted]
Estimated mean output per start (short dispatch)	MWh/start	[redacted]
Levelized VOM costs	**$/MWh**	[redacted]
Costs associated with additional maintenance items	$/MWh	[redacted]
Market fees	$/MWh	1.81
Contingency raise runway costs	$/MWh	[redacted]
Total VOM and other variable costs	**$/MWh**	[redacted]

Note: The 'Levelized VOM costs' are calculated using a Monte Carlo simulation of parameters from the distribution of model inputs. For this reason, the values shown in this table cannot be reproduced arithmetically. See Appendix 2 for further details.

2.4 Fuel costs

The WEM Rules require estimation of fuel costs incurred during energy dispatch as the product of mean heat rate at minimum dispatchable loading level and fuel price. This process is depicted in Figure 5.

Figure 5: Model inputs and output for fuel costs



Sections 2.4.1 and 2.4.2 explain the process of how the ERA determined heat rate and fuel price.

2.4.1 Heat rate

The fuel cost component of the Energy Offer Price Ceiling requires using the mean heat rate at the minimum dispatchable loading level as specified in standing data for the highest cost facility. This is a change from the previous WEM Rules where the fuel cost component was determined using the mean heat rate at minimum capacity, and the ERA determined this by modelling different output levels for the facility to estimate its minimum stable generation. The rules now require taking the point on the heat rate curve that corresponds to the facility's minimum dispatchable loading level.

The minimum dispatchable loading level specified in AEMO's standing data is [redacted] MW which is considerably lower than other generators operating similar machines in the SWIS. At such low levels of output the machine uses a high quantity of fuel to generate limited energy, with the resulting heat rate of [redacted] GJ/MWh.

2.4.2 Fuel price

Merredin Power Station runs exclusively on diesel. This section explains the estimation of price of diesel, which is used to determine fuel cost for generation and startup.

Consistent with previous reviews, the price of diesel is sourced from the Perth Terminal Gas Price (TGP) (net of goods and services tax and excise).[18] The TGP includes shipping costs and therefore considers variations in these costs due to factors such as exchange rate changes. The ERA has based its estimate of diesel using the Perth diesel TGP, consistent with the approach taken in previous reviews.

Specifically, a historical three-month rolling average was used to generate a normal distribution of diesel prices which is used as an input in the model.

The ERA undertook the following approach to derive the reference diesel price for its analysis:

- Derive the average daily Perth TGP over the preceding three months (November 2023 to January 2024).[19]
- Remove GST (10 per cent) and diesel excise ($0.488/L) that would not be paid by local generators.[20]
- Convert the cost of diesel from Australian cents per litre to $/GJ based on the estimated calorific content of diesel.[21]

The outputs are shown in Table 3 below. For this determination, the ERA has relied on a reference diesel price of $29.04/GJ.

18 Australian Institute of Petroleum, Historical ULP and Diesel TGP Data, (online).

19 This is consistent with the previous energy price limits which considered prices over the three preceding months. The reference diesel price will be updated with more recent data for the ERA's final determination of the energy offer price ceiling.

20 Australian Taxation Office, 2024, Excise duty rates for fuel and petroleum products, Item 10.10 – Diesel, (online).

21 Department of Climate Change, Energy, the Environment and Water, *Australian national greenhouse accounts factors,* p.20 (online).

Table 3: Reference diesel price

Item	Cents per litre	$/GJ
Perth TGP	176.5	
TGP less GST	160.5	
TGP less GST and excise	110.9	29.04

The price of diesel will vary due to fluctuations in world oil prices and refining margins. Over the review period, the ERA will use prevailing average diesel prices to index the Energy Offer Price Ceiling every month. Indexation is explained in section 3.1.

2.4.3 Results of fuel costs

The fuel cost for Merredin Power Station is determined to be $[redacted]/MWh.

2.5 Risk margin

The risk margin is a measure of uncertainty in the assessment of the mean short run average cost of the highest cost facility operating in the SWIS. The WEM Rules do not specify a method for calculating the risk margin. [22]

In the previous price limit reviews, the ERA generated distributions of the variable parameters used in the price limit calculation and determined a distribution for the short run average cost. The 80th percentile of the short run average cost distribution was chosen as the risk margin for the price limit.

The ERA acknowledges that factors like extreme weather conditions during 2022/23, operating in the new market, and input scarcity issues have contributed to higher uncertainty for market participants. For this review, the ERA has incorporated this uncertainty in the analysis by making use of current dispatch data (from January 2023 to January 2024) to account for the recent experience of generators. This ensures that the amortisation of total costs over average output during a typical dispatch cycle reflects current trends and that forecasted average output is more accurate.

As the price ceiling is being set for the forward three-year period, uncertainty about inputs used in the model, as well as operating conditions, needs to be incorporated in the analysis. This is done by generating probability distributions of variables such as starts per year, average output dispatched during a dispatch cycle, fuel price and runtimes.

These distributions are used to determine the distribution of VOM costs and fuel costs and ultimately, the distribution of short run average cost on which the Energy Offer Price Ceiling is based.

The price ceiling is set at a level higher than the mean value of the probability distribution of the short run average cost to account for the uncertainty in the underlying input cost calculations.[23] For this review, the risk margin is set as the difference between the mean and

[22] Wholesale Electricity Market Rules, 13 December 2023, 2.26.2(a)i, (online).

[23] This was the 80th percentile of the average variable cost distribution in the previous reviews. ERA, Energy Price Limits 2022 (online).

85th percentile of the short run average cost probability distribution, with the 85th percentile the effective value of the Energy Offer Price Ceiling.

2.6 Loss factor

The loss factor is calculated as the average marginal loss for power injected by a generator into the transmission network relative to a reference node. The SWIS currently has one reference node, the Southern Terminal 330 kilovolt (kV) bus-bar.

A loss factor greater than one implies that more electricity is delivered to the reference node than what was injected into the transmission network. In general, loss factors increase with demand at a node and decrease with increasing generation at a node.

The WEM Rules require Western Power to annually determine the loss factor for each connection point in its network and provide these values to AEMO. Western Power determined a loss factor of 0.93 to apply from 1 October 2023 [24]

[24] Western Power, 2023/24 Loss Factor Report, page 6 (online).

3. Draft determination

The estimated new Energy Offer Price Ceiling, calculated under the new WEM rules, is $1500/MWh (Table 4). This new value is significantly higher than the current price ceiling of $738/MWh.

Fuel costs make up for more than 80% of the estimated new Energy Offer Price Ceiling. This large increase in the fuel cost component of the offer price ceiling is largely due to the new WEM Rules requiring heat rate to be evaluated at the minimum dispatchable loading level as specified in AEMO's standing data. This level of output is [redacted] MW for Merredin Power Station, which is considerably lower than other GE Frame 6B generators operating in the SWIS. According to information available to the ERA, the minimum generation output for a Frame 6B generator is around [redacted] MW, more than three times the level specified in AEMO's standing data for Merredin Power Station.

The ERA considers that the new Energy Offer Price Ceiling would be calculated at a level much closer to the current price ceiling if it were based on minimum stable generation. Under the previous WEM Rules, the ERA determined minimum stable generation by modelling different values of output at which a facility could be dispatched over a reasonable period maintaining a level of stable generation. While there are insufficient data points to evaluate minimum stable generation for Merredin Power Station in this way, the minimum output of similar generators operating in the SWIS serves as a reasonable approximation of minimum stable generation. If this approximation of minimum stable generation were used in calculating the new Energy Offer Price Ceiling, the estimate would be around $800/MWh (after rounding up); that is, at a level much closer to the current price ceiling.

Table 4: Calculation of the Energy Offer Price Ceiling

Component	Unit	Proposed value 2024
Mean heat rate at minimum capacity	GJ/MWh	[redacted]
Mean fuel cost	$/GJ	29.04
Fuel cost	$/MWh	[redacted]
Mean variable O&M cost	$/MWh	[redacted]
Loss factor	-	0.93
Average variable cost distribution – Mean	$/MWh	1421.79
Average variable cost distribution – 85th percentile	$/MWh	1483.11
Risk margin	%	4.31
Energy Offer Price Ceiling (without the round up factor)	$/MWh	1483.11
Energy Offer Price Ceiling	**$/MWh**	**1500**

3.1 Indexation

Indexation should apply to the Energy Offer Price Ceiling to reflect movements in input costs. The ERA has determined the formula for the indexation calculation and the frequency at which indexation will apply.[25]

The indexation process allows updating the Energy Offer Price Ceiling at regular time intervals, to adjust input costs to reflect various factors driving market participants' offers in the WEM, without the need to review the Energy Offer Price Ceiling more frequently than every three years, subject to no material changes in market circumstances.

Quarterly indexation of the non-fuel component

Due to the length of time between triennial reviews, the ERA has determined that the non-fuel component should be indexed to reflect prevalent economic conditions. The ERA has determined that the non-fuel component will be indexed quarterly using the Consumer Price Index (all goods, weighted average of eight capital cities), as published by the Australian Bureau of Statistics.[26]

The non-fuel component in terms of $/MWh will be indexed quarterly as using the following formula:

$$non - fuel\ component(\$/MWh) \times \frac{current\ CPI}{base\ CPI}$$

where the current CPI is the CPI published by ABS for the most recent quarter, and the base CPI is the CPI published by ABS for the preceding quarter.

Monthly indexation of the fuel component

The fuel component is dependent on the distillate fuel price, which is subject to fluctuations in world oil prices, exchange rates and refining margins. The ERA has determined that this component should be indexed monthly to reflect the impact of those fluctuations. The ERA will use the following approach to derive the diesel price for the monthly indexation process:

- Derive the average daily Perth TGP over the preceding three months (November 2023 to January 2024).[27]
- Remove GST (10 per cent) and diesel excise ($0.488/L) that would not be paid by local generators.[28]
- Convert the cost of diesel from Australian cents per litre to $/GJ based on the estimated calorific content of diesel.[29]

The formula indexed fuel component in terms of $/MWh will be:

25 Wholesale Electricity Market Rules, 13 December 2023, 2.26.2, (online).

26 Australian Bureau of Statistics, Consumer Price Index, Australia series id: A2325826V (Perth) (online).

27 This is consistent with the previous energy price limits which considered prices over the three preceding months. The reference diesel price will be updated with more recent data for the ERA's final determination of the energy offer price ceiling.

28 Australian Taxation Office, 2024, Excise duty rates for fuel and petroleum products, Item 10.10 – Diesel, (online).

29 Department of Climate Change, Energy, the Environment and Water, *Australian national greenhouse accounts factors,* p.20 (online).

$$fuel\ component\ (GJ/MWh) \times \frac{net\ ex - termianl\ gate\ price(\$/Kl)}{conversion\ factor(GJ/Kl)}$$

Diesel price changes will be included in the Energy Offer Price Ceiling every month and the ERA will publish the indexed values on its website.

The ERA is also considering other suitable indices or escalation factors for its final determination and is seeking the views of market participants and other interested parties on this matter.[30]

Indexed Energy Offer Price Ceiling

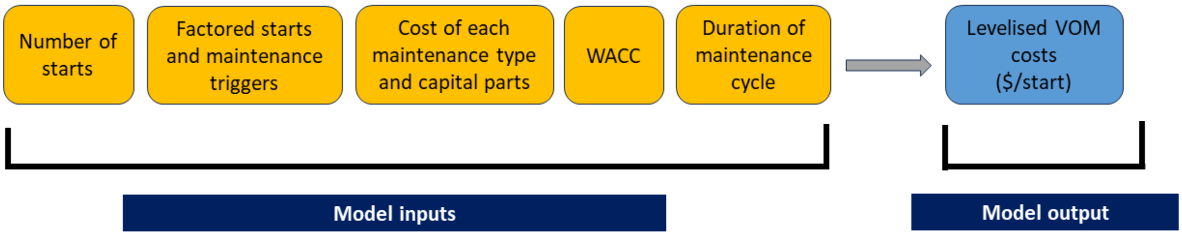
Indexation will apply to the Energy Offer Price Ceiling prior to rounding up to the nearest $/MWh. Loss factor changes will also be included when updated by Western Power.

30 Other potential indices could be the producer price index or a relevant fuel indexation.

Appendix 1 – Estimation of levelised VOM costs

The main components of the model used to estimate levelised VOM costs are outlined in Figure 6 and discussed below. The box at the end of this section provides further explanation of the concept of levelised costs.

Figure 6: Model inputs and output for levelised VOM costs



Number of starts

Each start of the turbine contributes to expenditures on operation and maintenance. Higher frequency of starts increases the maintenance costs by increasing the use of the machine.

There is uncertainty in the number of times a generator will be started in the future. The ERA has accounted for this uncertainty by generating a normal distribution of starts based on observed historical trend of the frequency of starts during 2016 to 2023.

A large range of plausible values for starts per year is then sampled from the distribution to model how many maintenance events will plausibly occur over the remaining life of the facility.

Cost of each maintenance type and capital parts

Merredin Power Station undergoes two types of major inspections – the combustion inspection ($[redacted] and the hot gas path inspection ($[redacted]). Both inspections are costed per maintenance event. Other VOM costs provided by Merredin Energy included costs for parts like fuel pumps and water pumps.

The estimated cost provided by GE were for a typical GE Frame 6B turbine like those used in Merredin Power Station and were lower than Merredin Energy's estimates of the cost of parts. The ERA used GE's information to estimate the cost of parts.

Maintenance costs also depend on the operation modes as some operations put more stress on the machine than others. [redacted]

WACC (or discount factor)

Since the maintenance costs are expected to incur in the future, these costs are discounted by a discount factor to convert in terms of present value.

The ERA used a real pre-tax WACC of 7.04 per cent per year to estimate the present value of expected variable maintenance expenditure. This is based on a nominal pre-tax WACC of 9.54 per cent.[31] The ERA's analysis assumes variable maintenance expenditure remains constant in real terms over future periods.

Factored starts and maintenance triggers

There are many factors – such as dispatch cycle run time, power setting, fuel, and site environmental conditions – that influence equipment life.[32] GE has developed a maintenance planning method that accounts for these factors and specifies maintenance schedules based on the number of factored starts (or factored hours, as applicable).[33]

Each actual start contributes to the number of factored starts depending on operating conditions. Some dispatch conditions put more mechanical stress and wear on turbines than other dispatch conditions and bring forward maintenance works. Others might put less stress on the turbine than a baseline operating condition. Future maintenance work that is required can be planned having consideration for historical operating data. Merredin Energy provided the maintenance factors for different inspections under different operating modes as stated in Table 5.

Table 5: [redacted]

[redacted]

Since maintenance factors are specific to operational characteristics and site conditions, the ERA has used the maintenance factors provided by Merredin Energy in the analysis, after verifying with GE.

Duration of maintenance cycle

Actual starts are multiplied by maintenance factors to arrive at factored starts. These factored starts are used by equipment manufacturers like GE to undertake major maintenance works.

According to GE's maintenance planning method, different maintenance works become due after the specified number of factored starts (or factored hours, as applicable). A full maintenance cycle is as below:

---

31 The calculation of real WACC included an average inflation rate of 2.5% per annum using Reserve Bank of Australia's estimated inflation rate (Average annual inflation rate implied by the difference between 10-year nominal bond yield and 10-year inflation indexed bond yield; End-quarter observation series ID GBONYLD) during January 2023 - January 2024 (online). The WACC was sourced from ERA's Benchmark Reserve Capacity Price determination 2024 (online).

32 General Electric, 2021, *Heavy-Duty Gas Turbine Operating and Maintenance Considerations*, GER-3620P (01/21), p 31.

33 This planning method is based on expected operation of turbines and can be reviewed and adjusted as specific operating and mechanical status data becomes available.

- combustion inspection (non-DLN) at 600 factored starts
- hot gas path inspection at 1,200 factored starts
- combustion inspection (DLN) at 450 factored starts
- major overhaul at 2,400 factored starts.[34]

Depending on how many factored starts have taken place since the last inspection, a turbine can be at different stages in its maintenance cycle. This information is used to forecast the number of inspections a machine is expected to undergo in the future, as this number depends on the stage of the maintenance cycle the machine is currently in.

Estimating levelised costs

The distribution of starts per year, information on maintenance costs, factored starts, maintenance triggers, WACC and duration of maintenance cycles is used to construct a distribution of levelised costs in terms of $/start. Levelised costs are amortised over the average output the machine is expected to produce during a dispatch cycle to determine levelised cost in terms of $/MWh.

[34] General Electric, 2021, *Heavy-Duty Gas Turbine Operating and Maintenance Considerations*, GER-3620P (01/21), p 31. DLN stands for Dry Low NO_x operating mode or peak firing with water injection mode. Merredin Energy did not provide any information on major inspections, and these have not been included in the analysis.

Stylised example for the calculation of VOM cost per start

This example calculates levelised variable maintenance costs for Merredin Power Station based on data available from a previous review of the price limits in 2015.[35] For clarity, the calculation of the price limits in this review uses estimates of maintenance expenditures as provided by Merredin Energy, which differs from the values used in this stylised example.

The Merredin Power Station have a maintenance schedule as listed in **Table 6** below.

Table 6: Estimated maintenance schedule, Merredin Power Station

Overhaul type	Number of starts to trigger overhaul	Cost per overhaul
A	600	1,348,773
B	1200	4,517,420
A	1800	1,348,773
C	2400	4,138,774
Total		**11,353,739**

Depending on the number of factored starts per year, n_{fs}, the above maintenance expenditures occur in future periods. Assuming that the machine has just recently been under maintenance type C and a number of starts per annum, n_s, equal to 65, the cash flow profile of future maintenance expenditures is shown in **Table 7Table** .[36] For this example, each start of the machine is on average expected to contribute to 1.07 factored starts for maintenance type A ($MF_A = 1.07$) and 0.68 factored starts for maintenance type B and C ($MF_{B/C} = 0.68$).

For simplicity, this example shows a full maintenance cycle schedule that ends with the maintenance type C.

Table 7: Cash flow profile of future maintenance expenditure

			Year										
Maintenance type	**Maintenance factor, MF**	**Factored starts per year, n_{fs}**	**1**	**…**	**9**	**…**	**26**	**…**	**28**	**…**	**44**	**…**	**55**
A	1.07	70			A_1		A_2				A_3		
B	0.68	44							B				
C	0.68	44											C

An increase in the frequency of starts can increase the number of required maintenance events during the remaining life of the machine and bring those expenditures closer in time. That is, an increase in the frequency of starts increases the present value of future maintenance expenditures. The present value of the cash flow profile is estimated based on a real discount rate of 5 per cent per annum:

Present value for expenditure A_1: $PV_{A_1} = \frac{\$1,348,773}{(1+0.05)^9} = \$869,431$

Present value for 65 actual starts per year for 9 years: $PV_{65,t=9} = 462\ starts$

The present value of future maintenance expenditures A_1 is then divided by the discounted number of starts over the remaining life of the asset to estimate a levelised cost per start.

Levelised cost for expenditure A_1: $LC_{A_1} = \frac{PV_{A_1}}{PV_{65,t=9}} = \$1,882\ per\ start$

If the generator recovers $1,882 each time it starts the machine, it would be able to recover its maintenance expenditure A_1 by the time it becomes due on year nine. This is because the generator expects to recover $65 \times \$1,728$ per year over nine years, for which the present value is equal to $869,431.

The total levelised maintenance cost, LC_{total}, in this example is the sum of levelised costs for all expected maintenance expenditures:

$$LC_{total} = LC_{A_1} + LC_{A_2} + LC_{A_3} + LC_B + LC_C$$

The calculation of VOM cost is to account for the expected remaining life of the plant and exclude expenditures that are not likely to occur before the expected end of life of the generator. The calculation is also to account for uncertainty in the number of future starts.

A Monte Carlo simulation can be developed to account for uncertainties in the number of starts per annum (or any other variable factor), and to derive a distribution for total levelised maintenance costs per start.

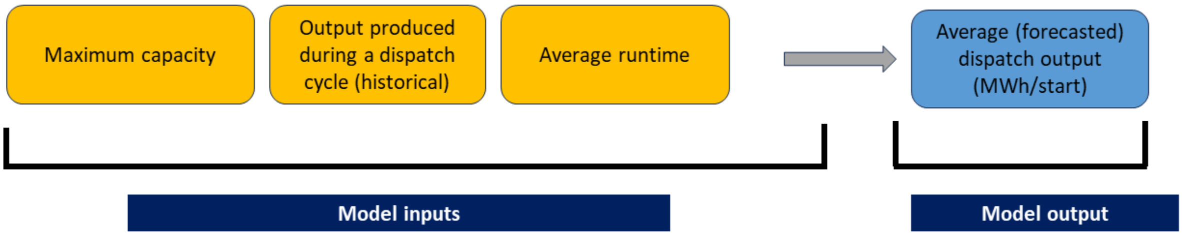
35 Jacobs, 2015, *Energy price limits for the Wholesale Electricity Market in Western Australia – Final report*, Tables 3-4, (online).

36 The original equipment manufacturer applies a factored starts to estimate the timing of maintenance as opposed to actual starts of the machine. General Electric, 2021, *Heavy-Duty Gas Turbine Operating and Maintenance Considerations*, GER-3620P (01/21), (online), pp. 35-36.

Appendix 2 - Dispatch parameters and estimation of model outputs

As mentioned in 2.2.4 levelised VOM costs and startup fuel costs are amortised over average dispatch output to determine VOM costs in terms of $/MWh. This section outlines the process of estimating average dispatch output expected to be generated by Merredin Power Station over the review period.

Figure 7: Model inputs and outputs for estimating average dispatch output



The model uses historical parameters like maximum capacity, output produced during a dispatch cycle and average runtime to estimate expected average output for Merredin Power Station during the review period. This is depicted in Figure 7.

The analysis of Merredin Power Station's other dispatch parameters like number of starts and capacity factor during January 2023-January 2024 is provided in this section as well.

Average output

During January 2023-January 2024, the average amount of energy generated by Merredin Power Station during short dispatch cycles was approximately [redacted] MWh for [redacted] MW generation as shown in Figure 8.

Figure 8: Distribution of dispatch output over short dispatch cycles for [redacted] MW minimum generation

[redacted]

Source: ERA's analysis based on public data published by AEMO

Duration of dispatch (runtime)

The average duration of all dispatch cycles was approximately [redacted] hours during January 2023-Janaury 2024. A distribution of short dispatch cycles less than 4 hours is used to derive the VOM cost on a $/MWh basis. The distribution of short dispatch cycle duration for Merredin Power Station units is presented in Figure 9.

Figure 9: Distribution of dispatch duration over short dispatch cycles for [redacted] MW minimum generation

[redacted]

Source: ERA analysis based on public data published by AEMO

The estimation model samples from the empirical distribution of short dispatch cycle duration, smoothed by a kernel-density estimate.

Maximum capacity

The analysis assumes a constant maximum capacity for the Merredin Power Station units throughout the period. Maximum capacity of the units is taken to be the maximum value observed over January 2023-January 2024.[37]

Average output dispatched during a typical dispatch cycle

The model accounts for the relationship between the expected energy generated during different dispatch runtimes. This relationship is captured by using short dispatch cycles for Merredin Power Station during the period of analysis. The model fits a linear model to determine the expected capacity factor subject to sampled run time. During a typical dispatch cycle, capacity factor is defined as follows:

$$capacity\ factor = \frac{output\ generated}{maximum\ capacity \times runtime}$$

The model then randomly samples from the residuals of the fitted line subject to run time and adds the residual to expected capacity factor using the linear regression coefficients derived earlier. This predicted capacity factor is used to generate output produced during a typical

[37] This is consistent with ERA's previous EPL reviews (online).

dispatch cycle. The average capacity factor of short dispatch cycles is 35.6 per cent during the sample period.

The distribution of output produced over short dispatch cycles is derived by multiplying runtime (hours), maximum capacity (MW) and predicted capacity factor over short dispatch cycles. The product of these three variables determines the output (MWh) or electricity generated per start of the machine.

Number of starts per year

There has been a marked increase in the number of times each unit started since 2023 compared to previous years. Over the study period, the Merredin Power Station started 30 times to be dispatched above minimum output.[38]

Calculation of model outputs

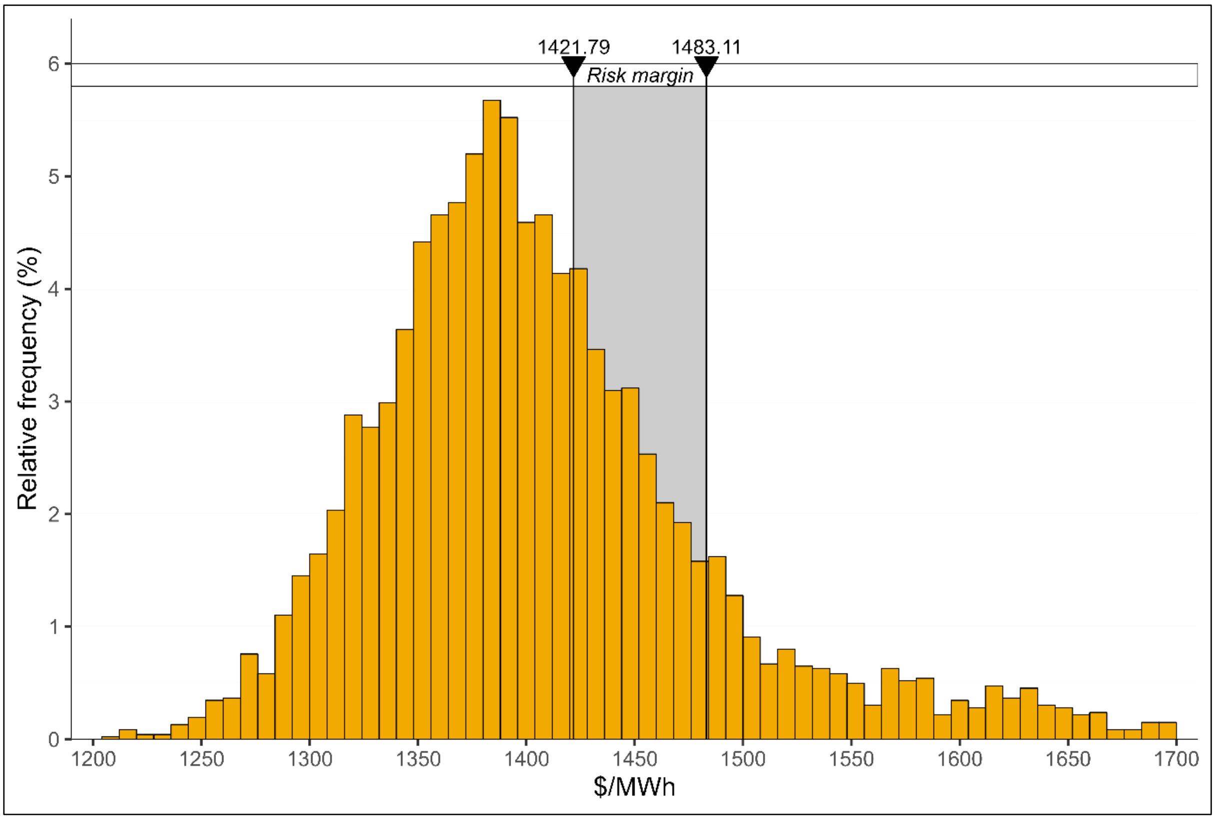
The ERA used input parameters explained above to generate probability distributions for the components of Energy Offer Price Ceiling which exhibit uncertainty: fuel cost and VOM costs. This was achieved by conducting Monte Carlo simulations.[39]

When generating a probability distribution for average variable cost, the ERA also calculated a risk margin based on 85th percentile of the distribution of average variable costs. The distribution and risk margins are shown in Figure 10.

38 This is different from the numbers mentioned in Figure 11 where the number of starts are counted regardless of whether output is generated for dispatch above minimum generation.

39 Monte Carlo simulation is a statistical technique that allows for risk in quantitative analysis and decision making. During a Monte Carlo simulation, values are sampled at random from the input probability distributions. Each set of samples is called an iteration, and the resulting outcome from that sample is recorded. Monte Carlo simulation iterates thousands of times, and the result is a probability distribution of possible outcomes. In this way, Monte Carlo simulation provides a much more comprehensive view of what may happen.

Figure 10: Average variable cost distribution



Note: The two vertical markers respectively represent the mean and 85th percentile of the distribution.

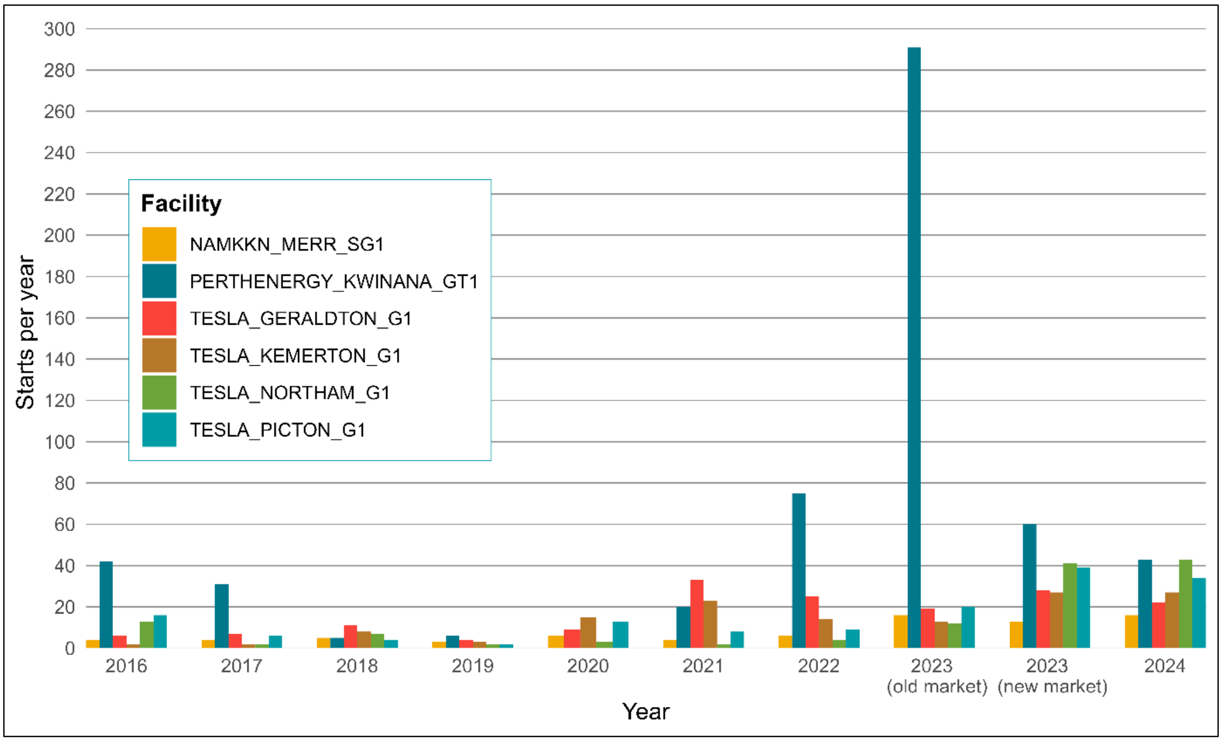
Appendix 3 - Choice of period of analysis

Levelised VOM costs provided as $/start are amortized over expected output produced by Merredin Power Station during a typical dispatch cycle to arrive at a $/MWh value.

Dispatch output is forecasted using historical data. For this review, the ERA has forecasted expected dispatch output using dispatch data from January 2023 to January 2024.

Since January 2023, the dispatch parameters for peaking generators have experienced a different trend, as compared to past years. Figure 11 shows the number of starts for peaking generators, including Merredin Power Station, since 2016.

Figure 11: Diesel generator starts per year



Source: ERA analysis based on public data published by AEMO

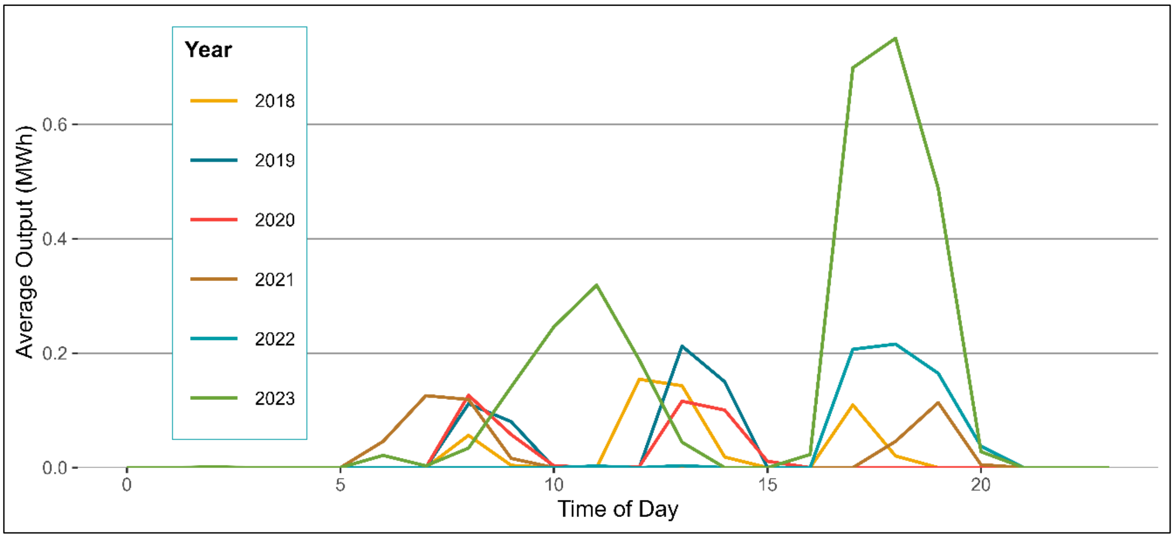
Note: 2024 figures only include January and February

As can be seen in Figure 11, there has been a marked increase in the number of starts for Merredin Power Station since January 2023.[40]

Merredin Power Station's average generation per hour of the day has changed since January 2023 as well. This is depicted in Figure 12. The green line shows the daily output which is much higher than previous years. The line also highlights that the output is being dispatched during peak intervals.

[40] All peaking generators have experienced a higher frequency of starts since January 2023. For some peaking generators the average dispatch output has been higher as well implying that they start more often, run for longer durations generating higher outputs. However, this was not the case for Merredin Power Station. The facility started more often, with similar runtimes and average output as previous years.

Figure 12: Average generation per hour of day



Source: ERA analysis based on public data published by AEMO.

The chart shows a significant increase in the average output in 2023 when compared to previous years. This observation is consistent with Merredin Power Station being dispatched more frequently.

Due to higher frequency of starts, this review has analysed dispatch cycle characteristics by considering the observed dispatch of Merredin Power Station during 1 January 2023 - 31 January 2024.

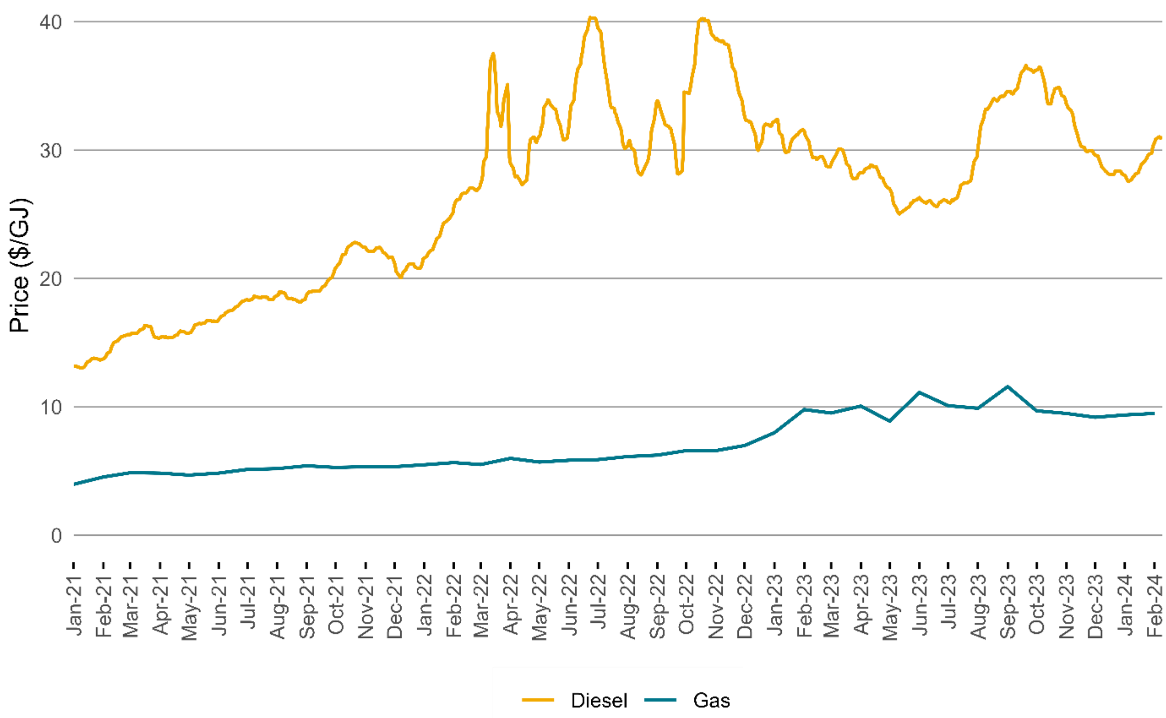
Levelised VOM costs have been amortised over average output Merredin Power Station generates over short dispatch cycles, that is dispatch cycles with a duration of less than or equal to four hours.

Prices in the energy market and the stack of generators have remained the same in the old and new market making January 2023 to September 2023 numbers comparable with October 2023 to January 2024 numbers. This was done by assuming that output was uniformly distributed throughout the previous 30-minute dispatch intervals.

For clarity, the entire distribution of the annual number of dispatch cycles (including cycles lasting more than four hours) is used when determining the discounted VOM costs. This is because the maintenance intervals are driven by all starts of the machine, rather than short dispatch cycles only. An adjustment is made to the distribution of actual starts to account for the ratio of each actual start that counts as a factored start. This adjustment converted the sampled annual number of actual starts to a sampled factored start. The sampled factored starts were then used to determine the timing of future maintenance cash flows.

Appendix 4 – Fuel price comparison

Figure 13: Comparison of gas and diesel prices



Source: *Diesel prices are calculated from the daily average terminal gate price, less GST and excise, then converted to $/GJ.*[41,42,43]
Gas prices are the monthly maximum prices on the gas trading spot market.[44]

41 Australian Institute of Petroleum, Historical ULP and Diesel TGP Data, (online).

42 Australian Taxation Office, 2024, Excise duty rates for fuel and petroleum products, Item 10.10 – Diesel, (online).

43 Department of Climate Change, Energy, the Environment and Water, *Australian national greenhouse accounts factors,* p.20 (online).

44 Gas Trading, Daily price history, (online).