Economic Regulation Authority

Energy Offer Price Ceiling 2024

Second Draft determination

6 November 2024

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Invitation to make submissions

Submissions are due by 4:00 pm WST, Wednesday, 4 December 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:

Email: publicsubmissions@erawa.com.au
Post: Level 4, Albert Facey House, 469 Wellington Street, Perth WA 6000

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

The Energy Offer Price Ceiling caps offers in the real-time market for energy. It is intended to act as a backstop mechanism to limit price offer mark-ups in the real time energy market and provide a safety net for final consumers.

On 8 April 2024, the ERA published a draft determination proposing a new value for the Energy Offer Price Ceiling at $1500/MWh, based on the method specified in the Wholesale Electricity Market (WEM) Rules that were in place at the time of new market start (1 October 2023). The proposed value was substantially higher than the Energy Offer Price Ceiling of $738/MWh in place at the time and still in effect in the market now.

The main factor contributing to the proposed increase was that under the WEM Rules in place at new market start, the ERA was required to evaluate the heat rate of the highest cost facility (Merredin Power Station) at minimum dispatchable loading level, as specified in AEMO's Standing Data ([redacted]MW).

Public submissions on the first draft determination raised two main issues:

- Stakeholders raised concerns over the frequency of price cap events in the new market and the potential for increased costs to consumers should price cap events continue under the proposed higher Energy Offer Price Ceiling.
- Stakeholders argued that the use of minimum dispatchable loading level to evaluate heat rate costs is against the intent of the WEM Rules to mitigate the exercise of market power. Stakeholders suggested that minimum dispatchable loading level should not be used as the output level at which fuel cost is evaluated, as operation at this output is generally avoided by generators because it is inefficient.

Due to the high frequency of cap events since the new market commenced on 1 October 2023, and the ERA's findings in the first draft determination, Energy Policy WA (EPWA) amended the WEM Rules on 22 May 2024 to postpone the deadline for the ERA's final determination from 1 June 2024 to 1 January 2025.

Since the first draft determination, EPWA has also changed a number of WEM Rules under its cost review of Frequency Control Essential System Services (FCESS). These Rule changes were gazetted on 29 October 2024. These changes include WEM Rule 2.26.2(a)(iii), specifically to the output level at which the ERA must estimate the fuel cost of the highest cost facility, and the information sources that can be used. The ERA is now required to estimate the highest cost facility's fuel cost using the heat rate evaluated at minimum stable loading level, based on the ERA's assessment of available information.

This second draft determination presents the ERA's evaluation of the Energy Offer Price Ceiling applying the new methodology under the WEM Rules, and opens consultation on these findings. Merredin Power Station remains the highest cost facility operating in the South West Interconnected System (SWIS). The ERA has evaluated its minimum stable loading level at 6MW, which reflects the minimum output level that Merredin has been observed to be able to operate at for a sustained period. This output level results in a proposed value for the Energy Offer Price Ceiling of $1100/MWh.

The proposed Energy Offer Price Ceiling of $1100/MWh is greater than the current Energy Offer Price Ceiling of $738/MWh, but below the $1500/MWh proposed in the ERA's first draft determination in April 2024.

This decrease is primarily due to a decrease in the fuel cost component of the Energy Offer Price Ceiling calculation, as a result of evaluating fuel costs at a higher point on the heat rate curve (operating a generator at higher outputs is more fuel efficient). Diesel prices have also come down marginally since the first draft determination.

Only one cost factor in the Energy Offer Price Ceiling calculation has increased since the first draft determination, albeit by a small margin. Merredin Power Station has been dispatched more frequently at lower levels of output since the first draft determination, which puts additional stress on the machinery (wear and tear) and increases variable operation and maintenance costs.

The ERA invites stakeholder feedback on the proposed value of the Energy Offer Price Ceiling and the method discussed in this draft determination. The ERA will consider this feedback as part of its final determination.

1. Introduction

Since 1 October 2023, the WEM has operated under a set of new rules. Energy and five FCESS markets have been 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.[1]

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 Rate of Change of Frequency 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 is required to 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 second draft determination, is to be reviewed by 1 January 2025, and at least once every three years thereafter. [2,3]

Prior to 1 October 2023, the ERA annually determined the energy price limits, which were the maximum Short-Term Energy Market (STEM) price and the alternative maximum STEM price. In January 2023, the ERA determined a maximum STEM price of $324/MWh and an 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 for the commencement of the new WEM, 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 WEM, and the adoption of the alternative maximum STEM price

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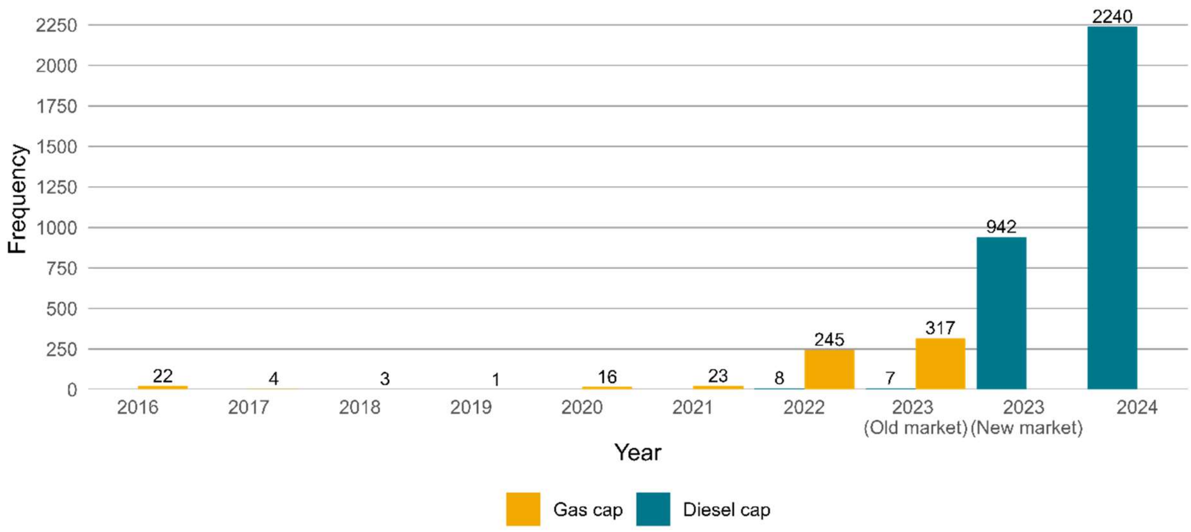
1 Other market power mitigation mechanisms in the new WEM include mandatory provision of capacity in the real-time market for energy, general trading conduct obligations on market participants, requirements to construct market offers in accordance with the offer construction guideline published by the 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).

2 Wholesale Electricity Market Rules, 30 October 2024, 2.26.1, (online).

3 Wholesale Electricity Market Rules, 30 October 2024, 1.61.2 (online).

as the sole Energy Offer Price Ceiling, a significant rise in intervals clearing at this price has occurred. [4]

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 – 30 September 2024.

Since 1 October 2023, the number of times the market clearing price was equal to the price cap has increased substantially. From January to September 2023, the market clearing price equalled the diesel cap only seven times, as compared to 942 times in the first three months of the new market. In 2024, there have been 2,240 price cap events so far.

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 January 2025.

According to WEM Rule 2.26.2(a), the ERA must use a specific formula with precisely defined parameters. On 29 October 2024, rule changes were gazetted which will change the definition of heat rate in the formula:[5]

WEM Rule 2.26.2(a) has been amended as follows:

> In conducting a review of the EOPC, the ERA must calculate the EOPC by:
>
> (a) Applying the following formula:

[4] 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).

[5] Wholesale Electricity Market Amendment (FCESS Cost Review) Rules 2024, Attachment 2, (online).

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

where:

(i) 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.

(ii) 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.

(iii) Heat Rate is the mean heat rate at the minimum stable loading level based on the ERA's assessment of available information, for the highest cost Facility in the SWIS, expressed in GJ/MWh.

(iv) Fuel Cost is the mean unit fixed and variable fuel cost for the highest cost Facility in the SWIS, expressed in $/GJ.

(v) Loss Factor is the marginal loss factor for the highest cost Facility in the SWIS, relative to the Reference Node, as determined in accordance with Section 2.27 of the WEM Rules.

Further, WEM Rule 2.26.2 states that 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.[6] The Energy Offer Price Ceiling is to be rounded up to the nearest multiple of $100/MWh.[7] 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]

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.

Table 1 outlines the changes in the relevant WEM Rules before and after 1 October 2023 and the resulting implications on this review.

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

Parameter	Pre-1 October 2023 WEM Rule	Post 1 October 2023 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

6 Wholesale Electricity Market Rules, 30 October 2024, 2.26.2(a), (online).

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

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

Parameter	Pre-1 October 2023 WEM Rule	Post 1 October 2023 WEM Rule	Implication
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

The gazetted amendment to WEM Rule 2.26.2(a)(iii) on 29 October 2024 requires the ERA to use the minimum stable loading level output to estimate heat rate of the highest cost facility, based on ERA's assessment of available information.

This second draft determination incorporates these WEM Rule amendments and proposes a new value for the Energy Offer Price Ceiling.

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 variable operating and maintenance (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 multiples 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 confidential . 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.

1.4 Stakeholder responses

The public consultation period on the ERA's first draft determination in April closed on 31 May 2024. The ERA received seven public submissions, from AEMO, Collgar Renewables, Newgen Power Kwinana, Synergy, Perth Energy, Newmont Mining and the Chamber of Minerals and Energy. Two main issues emerged in the stakeholder submissions.

First, all stakeholders except Collgar stated concern over the frequency of cap events in the new WEM and the potential for increased costs to final consumers should those cap events continue under the new, higher Energy Offer Price Ceiling.

Second, all stakeholders except Collgar and AEMO expressed a view that the use of minimum dispatchable loading level to evaluate heat rate costs is against the intent of the rules to mitigate the exercise of market power. Stakeholders suggested that heat rate should be evaluated at minimum capacity, rather than minimum dispatchable loading level, as operation at the latter is generally avoided by generators as it is inefficient and unstable.

AEMO submitted that the WEM Rule requirements to monthly index a highly variable price input (diesel), as well as to round up the Energy Offer Price Ceiling value to the nearest $100/MWh, could result in substantial month-to-month variation in the price ceiling. As the Energy Offer Ceiling Price is an input into the FCESS Clearing Price Ceiling, this volatility may have future impacts on FCESS costs. The ERA is aware that diesel price volatility will affect the Energy Offer Price Ceiling due to indexation, but indexation is required to tie the ceiling to fuel costs, which are approximately 80 per cent of the total costs included in the Energy Offer Price Ceiling. This is especially important since the interim period between successive reviews can be as much as three years.

Collgar Renewables recommended that, since the reference technology for the ERA's review of the Benchmark Reserve Capacity Price has changed to a battery from a diesel generator, the method for determining the Energy Offer Price Ceiling should also be reviewed to ensure the market mechanism is well-aligned with evolving market dynamics. The ERA has considered a set of facilities to determine the highest cost facility operating in the SWIS, as required by the WEM Rules, and reflects the principle that the Energy Offer Price Ceiling should cap prices at the point which allows all generators to recover their efficient variable costs. The set of facilities under consideration included thermal generators, batteries and renewable generators.

A summary of all stakeholder submissions and the ERA's response to these responses is provided in Appendix 5.

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.

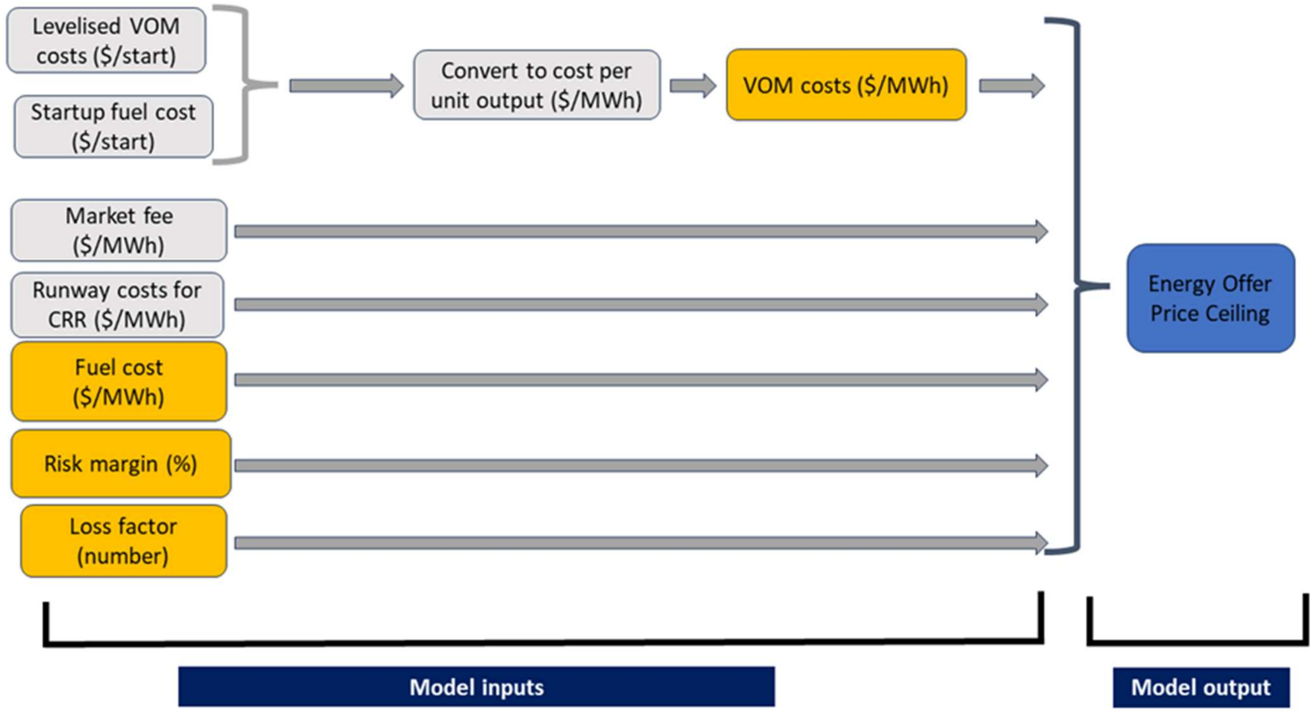
The ERA will set the Energy Offer Price Ceiling at a level that strikes the balance between being:

- 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 a low level of 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 are not expected to apply all the time, the supply cost calculated for Energy Offer Price Ceiling is expected to be greater than the highest cost generator's supply cost most of the time and greater than the price at which the highest cost generator might be expected to offer energy into the real-time market.

Unless otherwise stated, the ERA has adopted a modelling approach and process that is consistent with its previous energy price limits determination process in the old market. The ERA has only updated the approach where it was required by the WEM 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)[9]
- 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).

These 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

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

facility types able to operate in the WEM. This includes thermal facilities using coal, gas or diesel, renewable generators, and electric storage resources (batteries).

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 WEM 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.

Currently, Synergy's KBESS1 and Collie Battery Trust's ESR are the only batteries participating in the WEM. The ERA's analysis of their current offer behaviour suggests that these batteries track the market clearing price in their offers and are 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 was experienced in the SWIS over 2022/23, but there is uncertainty whether offers from coal facilities can be constructed to validly account for this scarcity.[10] The ERA does not consider that the volatility in coal prices over the past few years provides a reasonable expectation of sustained coal prices. For this review, the ERA does not consider a coal facility to be the highest cost facility because the price ceiling is not intended to be based on unforeseen price shocks.

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.[11]

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.

In November 2023, 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

10 Government of Western Australia media statement, 1 December 2023 (online).

11 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).

information provided and the operational profile of these facilities until 30 September 2024, the ERA has selected Merredin Power Station as the highest cost facility operating in the SWIS.

Merredin Power Station was determined as the highest cost facility in the ERA's first draft determination, and remains the highest cost facility for the second draft determination after incorporating the current dispatch profiles of all the above-mentioned facilities.

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 FCESS runway costs 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 October 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 overhaul costs over an expected dispatch output based on Merredin's dispatch profile as observed over October 2023 to October 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.[12]

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.

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.

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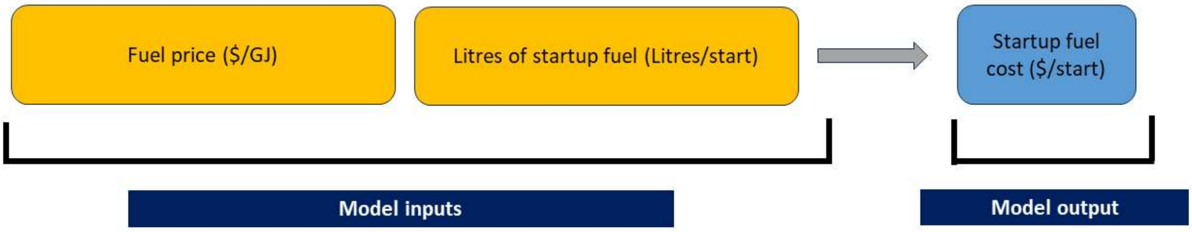
[12] This approach is similar to the approach used by the ERA in the 2022 energy price limit review where Pinjar was identified as the highest cost facility (online). Appendix 1 explains the concept of levelised costs.

Figure 3: Model inputs and output for startup fuel cost



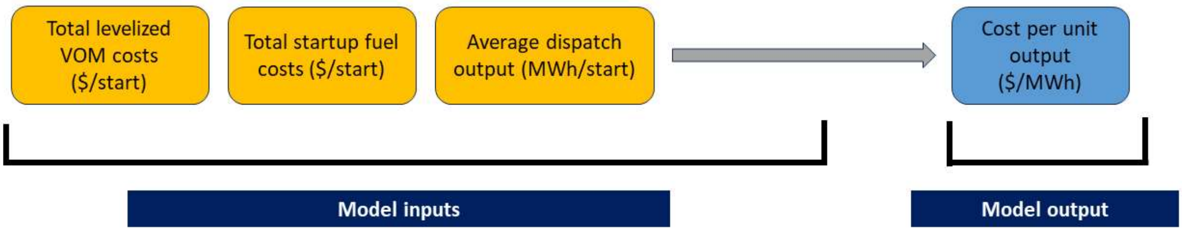
Fuel costs related to shut down

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.[13] 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 did not receive any feedback on exclusion of shutdown costs in its first draft determination and these costs have been excluded from Energy Offer Price Ceiling calculation in this second draft determination.

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 2024/25 value, published by AEMO is $2.94/MWh. [14]

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 and additional Rate of Change of Frequency procured in a dispatch interval. The Offer Construction Guideline allows for the

13 ERA, Offer Construction Guideline, p 10-11 (online).

14 AEMO, WA Budget and Fees 2024-25 (online).

inclusion of these costs in energy offers and notes that generators must not attempt to over-recover these costs through their offers.[15]

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

2.3 Results for the variable cost component

Table 2 outlines the results for the parameters included in the estimation of VOM costs. 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	2.94
Runway costs	$/MWh	[redacted]
Total VOM and other variable costs	**$/MWh**	[redacted]

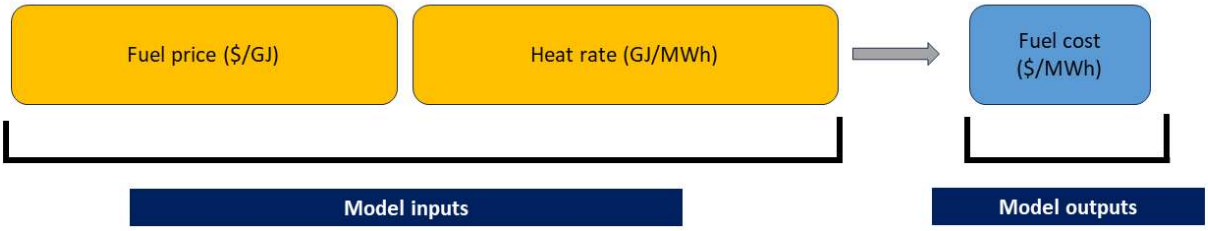
Note: The 'Levelized VOM costs' and startup costs are calculated using a Monte Carlo simulation of parameters from the distribution of model inputs. For this reason, the values shown in this table cannot be reproduced arithmetically. See Appendix 2 for further details.

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.

[15] At the time of writing, the ERA's Offer Construction Guidelines are under review and the removal of runway costs from a market participants efficient variable costs is being considered. However, as this change is not in effect at the time of writing, runway costs have been included in the calculation of EOPC. Given that the calculated value of EOPC is rounded up to the nearest $100, the proposed EOPC is the same whether runway costs are included or not.

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 stable loading level based on ERA's assessment of available information. This will be a change from the WEM Rules prior to 20 November 2024, where the fuel cost component was determined using minimum dispatchable loading level as specified in AEMO's Standing Data. In the first draft determination, the ERA stated that 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.

This resulted in high fuel cost for the first draft determination and the ERA consequently proposed a high value of Energy Offer Price Ceiling of $1500/MWh.

According to the newly gazetted WEM Rules' scheduled changes, the ERA is required to evaluate the heat rate at minimum stable loading level, based on ERA's assessment of available information.

Minimum stable loading level

Minimum stable loading level is not defined under the WEM Rules, although for a scheduled facility, Appendix 1(b)xx of the WEM Rules refers to the minimum stable loading level as a parameter to be recorded in AEMO's Standing Data as a pre-condition for registration for a market participant.

AEMO's registration technical data guide defines the sent-out capacity when a facility is operating at minimum stable loading level as follows:[16]

> The minimum stable Injection level of the Facility, expressed in MW for primary Non-Liquid Fuel. It is the technical minimum Injection level at which the Facility can remain in stable operation. This is a level that the Facility would not normally be dispatched to (see Minimum Dispatchable Load Level), but may be directed to operate at by AEMO if required (e.g. under emergency conditions). Note that this is generally equal to Minimum Generator Capacity and may be equal or lower than the Minimum Dispatchable Generation. The value specified must be applicable for an ambient temperature of 15 ºC.

There are nine instances in the period since new market start to 30 September 2024 where AEMO issued dispatch advisories to Merredin Power Station to dispatch at 6MW. Merredin Power Station was able to follow these dispatch advisories successfully and was dispatched

16 Registration Technical Data Guide version 4.2, AEMO, published May 2024 (online).

at 6MW (approximately) over stable durations ranging from 45 minutes to 3 hours and 55 minutes.

This implies that 6 MW is a reasonable estimate of the minimum stable loading level for Merredin Power Station as it was able to follow AEMO's dispatch advisory at this level of output for a sustained period. The heat rate of the facility at 6MW is [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).[17] 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 (June 2024 to September 2024) and add a transportation cost of 1.2c/L.[18]
- Remove GST (10 per cent) and diesel excise ($0.488/L) that would not be paid by local generators.[19]
- Convert the cost of diesel from Australian cents per litre to $/GJ based on the estimated calorific content of diesel.[20]

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

Table 3: Reference diesel price

Item	Cents per litre	$/GJ
Perth TGP	170.79	
TGP less GST	155.26	
TGP less GST and excise	106.86	27.69

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

18 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.

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

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

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. [21]

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, the commencement of 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 September 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.[22] For this review, the risk margin is set as the difference between the mean and 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.

[21] Wholesale Electricity Market Rules, 30 October 2024, 2.26.2(a)i, (online).

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

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 0.9498 to apply from 1 July 2024.[23]

23 Western Power, 2024/25 Loss Factor Report, page 6 (online).

3. Draft determination

The estimated new Energy Offer Price Ceiling, calculated under the new WEM Rules, is $1100/MWh (Table 4). This value is greater than the current transitional Energy Offer Price Ceiling of $738/MWh, but is lower than the $1500/MWh proposed in the ERA's first draft determination in April 2024 prior to the WEM Rule changes.

The decrease is primarily due to a decrease in fuel cost. An Energy Offer Price Ceiling of $1100/MWh is based on heat rate being evaluated at Merredin Power Station's minimum stable loading level of 6 MW, as determined by ERA's assessment of available information.

For comparison, the proposed value of $1500/MWh in the first draft determination was based on heat rate evaluated at minimum dispatchable loading level as specified in AEMO's Standing Data which was [redacted] MW.

The ERA has used 6MW as Merredin Power Station's minimum stable loading level for this draft determination. Information from SCADA data and AEMO's dispatch advisories issued to Merredin Power Station demonstrate that the facility was able to be dispatched at 6MW for sustained periods of time.

Additionally, Merredin Power Station has been dispatched more frequently since October 2023 and the higher number of start-ups over this period has led to an increase in VOM costs from $[redacted]/MWh to $[redacted]/MWh.[24]

Table 4: Calculation of the Energy Offer Price Ceiling

Component	Unit	Proposed value
Mean heat rate at minimum capacity	GJ/MWh	[redacted]
Mean fuel cost	$/GJ	27.70
Fuel cost	$/MWh	[redacted]
Mean variable O&M cost	$/MWh	[redacted]
Loss factor	-	0.9498
Average variable cost distribution – Mean	$/MWh	1028.97
Average variable cost distribution – 85th percentile	$/MWh	1038.41
Risk margin	%	0.92
Energy Offer Price Ceiling (without the round up factor)	$/MWh	1038.41
Energy Offer Price Ceiling	**$/MWh**	**1100**

24 Figure 11 below shows that the number of start-ups for Merredin has increased substantially over 2024.

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 (CPI) (all goods, weighted average of eight capital cities), as published by the Australian Bureau of Statistics (ABS).[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 TGP over the preceding three months (June 2024 to September 2024).[27]
- Remove GST (10 per cent) and diesel excise ($0.506/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]

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[25] Wholesale Electricity Market Rules, 30 October 2024, 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).

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

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

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

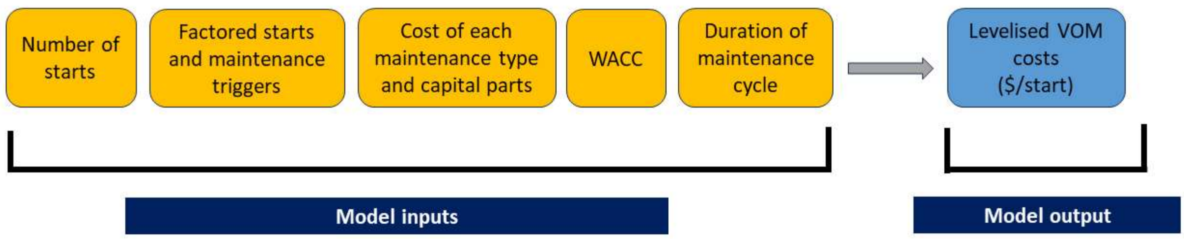
Indexation will apply to the Energy Offer Price Ceiling prior to rounding up to the nearest \$/MWh. Loss factor changes will also be included when updated by Western Power.

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 from October 2016 to October 2024.

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 7.13 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 2.41% 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 October 2023 - October 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 7**.[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.

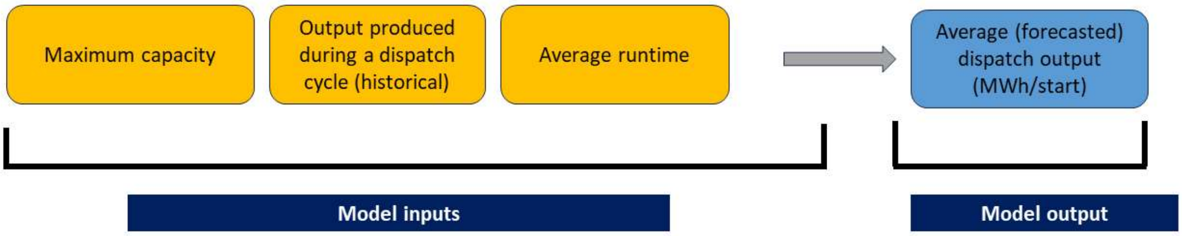
35 Jacobs, 2015, *Energy price limits for the Wholesale Electricity Market in Western Australia – Final report*, Tables 3-4, (online).

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-September 2024 is provided in this section as well.

Average output

During January 2023-September 2024, the average amount of energy generated by Merredin Power Station during short dispatch cycles was approximately [redacted] MWh for 6 MW generation as shown in Figure 8.

Figure 8: Distribution of dispatch output over short dispatch cycles for 6 MW minimum generation

[redacted]

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

Duration of dispatch (runtime)

The average duration of short dispatch cycles was approximately [redacted] hours during January 2023-September 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 6 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-October 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 29.91 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 81 times to be dispatched above minimum output.[38]

Calculation of model outputs

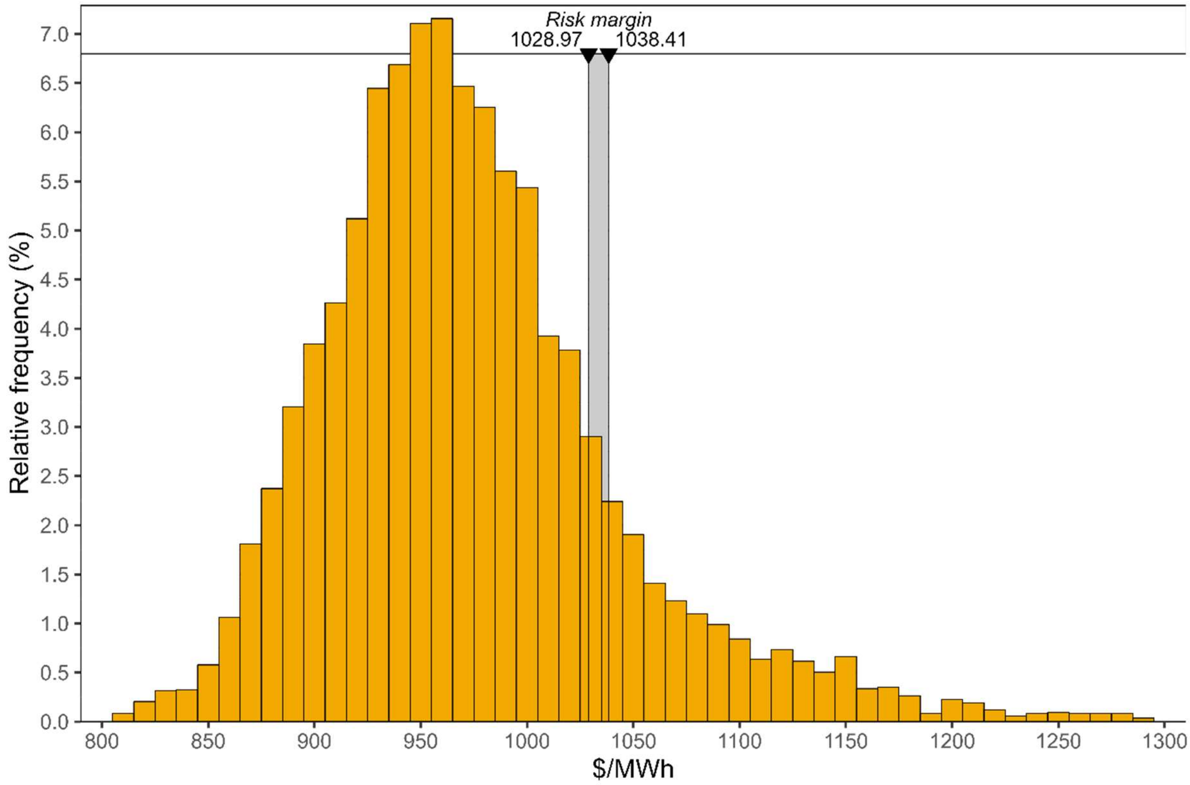
The ERA used input parameters explained above to generate probability distributions for the components of Energy Offer Price Ceiling which exhibit uncertainty: fuel cost and VOM costs. This was achieved by conducting Monte Carlo simulations.[39]

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. Note that this is close to the mean value due to a very long right-tail in the distribution. 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. The full range of values on the x-axis are not shown as the right-tail is very long.

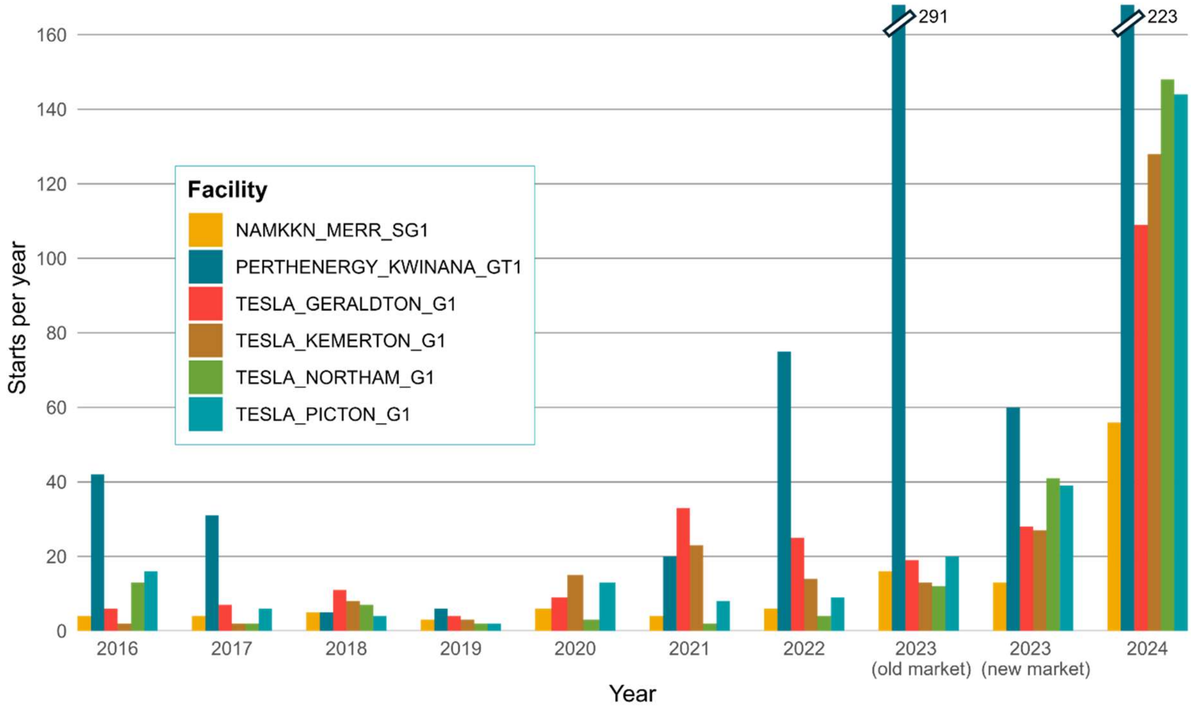
Appendix 3 - Choice of period of analysis

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 September 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

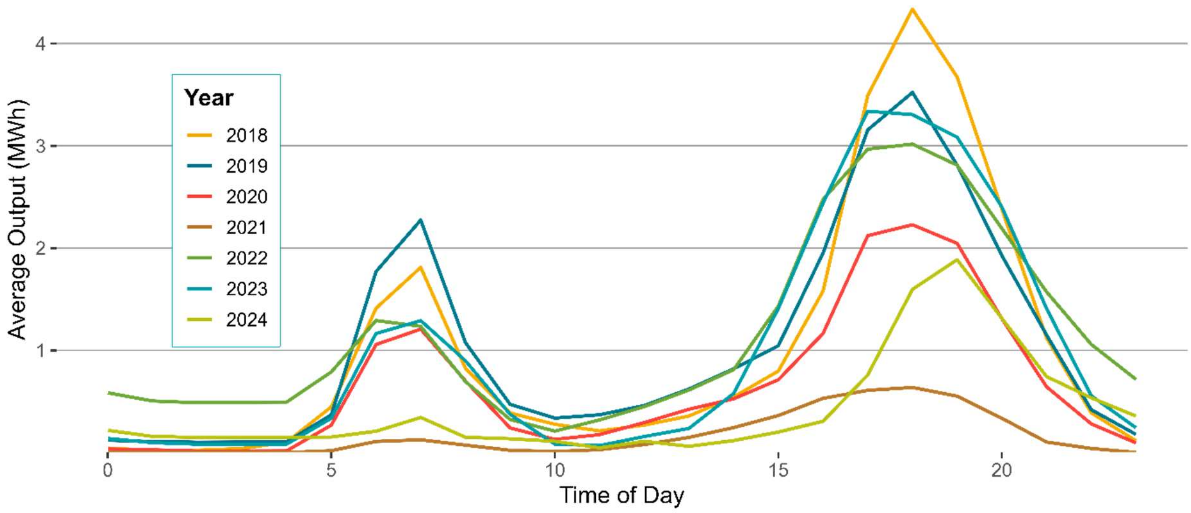
Note: 2024 figures are until 30th September 2024

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 remained consistent over the years. This is depicted in Figure 12 where it is also apparent that output is being dispatched only during the morning and evening peak periods.

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: Merredin Power Station's average generation per hour of day



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

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 - 30 September 2024.

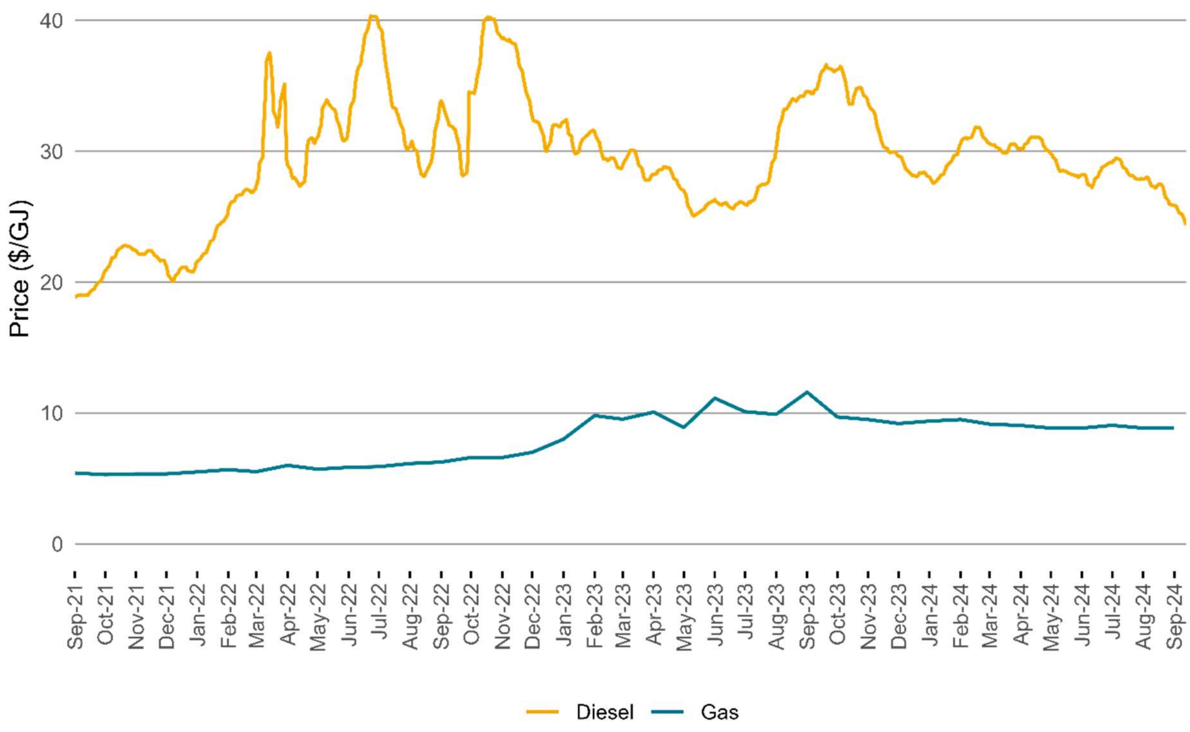
Levelised VOM costs have been amortised over average output Merredin Power Station generates over short dispatch cycles, that is dispatch cycles with a duration of less than or equal to four hours.

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 September 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 over the previous 3 years



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).

Appendix 5 - Stakeholder Response Summary

Stakeholder feedback	ERA response
Synergy (electricity gentailer)	
Synergy agrees with the findings of the draft determination. Synergy recommends that the WEM Rules should be amended so that the value of the Energy Offer Price Ceiling is calculated based on minimum capacity. **Frequent price spikes and high proposed value of the Energy Offer Price Ceiling:** Market data indicates that a significant number of high price intervals in the energy and FCES markets occur close to the real-time market without sufficient forewarning for market participants to update their offers to mitigate against these occurrences. Several factors contribute to WEMDE's forecast inaccuracy like competing In-Service capacity of energy and FCESS services, market signals favouring minimum volume of generally out-of-merit open-cycle-gas-turbines, inaccuracy in forecasts related to DER and semi-scheduled facilities. Synergy expects that the occurrences of ceiling events will continue, regardless of the value of Energy Offer Price Ceiling. High-level analysis suggests that the total cost of the price cap events is $1,105 million under the current price ceiling and if the ceiling is increased to $1500/MWh, this will increase to $1,323 million. Lastly, since consumers do not directly observe and do not have the means or incentives to respond to the prices in real time market, there will be limited response from consumers for a higher price ceiling. **Heat rate evaluated at minimum dispatchable loading level:** A facility's minimum dispatchable loading level can be lower than the minimum stable loading level, which is generally equal to minimum capacity. Synergy supports that use of minimum dispatchable loading level may not reflect the intent of the rules to mitigate market power. The operation of a facility at its minimum dispatchable loading level is a least preferred operating state and is generally avoided wherever possible.	**Frequent price spikes and high proposed value of the Energy Offer Price Ceiling:** The ERA notes Synergy's arguments about occurrence of price spikes in the real time energy market irrespective of the value of the Energy Offer Price Ceiling and is in the process of investigating this issue based on available information. **Heat rate evaluated at minimum dispatchable loading level:** Synergy agrees with the findings of the draft determination.
AEMO (market operator)	
The significant increase in the price ceiling coincides with broader concerns around price increases since 1 October 2023, as evidenced	The ERA has considered Energy Policy WA's amendments to the WEM Rules under the FCESS cost review for this draft determination.

Stakeholder feedback	ERA response
by the ERA's recent analysis presented to the MAC on FCESS prices. Given the direct relationship between Energy Offer Price ceiling and the FCESS Clearing Price Ceiling, there may be value in awaiting the outcomes of Stage 1 of the ESS Framework Review (est. November 2024) before ERA makes its final determination. **Minimum dispatchable loading level and Merredin's Standing data:** Merredin Energy's 'minimum dispatchable loading level' was determined in 2012 under Western Power's commissioning regime, supported by a *Technical Rules Compliance Report*, comprising documents and evidence for the Standing Data. AEMO has subsequently reviewed SCADA data for the Facility, which indicates that Merredin Energy operated at its designated 'minimum dispatchable loading level' for a continuous period of seven minutes in June 2023, before ramping further. This indicates that the output assigned for this parameter in the Standing Data is a reasonable approximation of the Facility's minimum generator capacity. **Indexation:** The indexation approach does not present AEMO with any implementation issues, and AEMO will be able to update its systems to reflect pricing inputs on a monthly basis. Monthly indexation of a highly variable price input (diesel) coupled with a requirement to round up the Energy Offer Price Ceiling value to the nearest $100/MWh (in accordance with clause 2.26.2(b) of the WEM Rules) could result in substantial month-to-month variation in the ceiling price. As the Energy Offer Ceiling Price is an input into the FCESS Clearing Price Ceiling, this volatility may have future impacts on FCESS costs.	**Minimum dispatchable loading level and Merredin's Standing data:** The ERA acknowledges that minimum dispatchable loading level can be lower than minimum capacity as stated by Original Equipment Manufacturer, and that it depends on the fuel used by the generator (diesel in case of Merredin Power Station). The newly gazetted WEM Rules scheduled to come into effect on 20 November 2024 state that the fuel cost must be evaluated at minimum stable loading level based on ERA's assessment of available information. For this draft determination, the ERA has used 6MW which was demonstrated as the minimum stable output by Merredin Power Station when it successfully followed AEMO's dispatch advisories for a duration of around two hours on 26 June 2024 and 13 July 2024. **Indexation:** The ERA acknowledges that indexation linked to a volatile diesel price can lead to volatility in the Energy Offer Price Ceiling and FCESS costs. Indexing the ceiling with changes in diesel price is crucial to its applicability in the interim period of subsequent reviews (three years under the new WEM Rules).
The Chamber of Mineral and Industry (CME), WA (industry representative body)	
CME's members operate in competitive global markets and reliable, low emissions electricity at globally competitive prices is critical to both, the ongoing sustainability of existing operations, and the development of sustainable, competitive new industries. Low emission, reliable and cost-effective electricity is a critical enabler to capture the opportunities presented by global energy transition in WA, including value adding in critical and battery minerals, green hydrogen and manufacturing industries.	The ERA acknowledges that the proposed value of Energy Offer Price Ceiling in April 2024 draft determination of $1500/MWh will most likely lead to higher cost to final consumers. This was mentioned in the April 2024 draft determination. The ERA also notes that reliable, low cost and low emissions electricity is critical to capture the opportunities presented by the global energy transition in WA. **Proposed value of Energy Offer Price Ceiling:** The ERA notes that a higher Energy Offer Price Ceiling coupled with a possible increase in reserve capacity prices, owing to the ERA's BRCP

Stakeholder feedback	ERA response
Proposed value of Energy Offer Price Ceiling: Given the high frequency of events where prices reached the ceiling, a higher Energy Offer Price Ceiling will result in higher costs by roughly doubling the price of electricity during such intervals. The ERA is also proposing changes to the methodology to determine benchmark reserve capacity prices (BRCP) that are expected to increase reserve capacity price. This would also be expected to increase the overall cost of electricity to final consumers. **Heat rate evaluation at minimum dispatchable loading level**: CME WA agrees with the ERA that use of minimum dispatchable loading level may not reflect the intent of the WEM Rules, particularly if such loading level would result in plant instability.	methodology review will increase the costs to final consumers substantially. **Heat rate evaluation at minimum dispatchable loading level**: No response required. CME agrees with the arguments made in the April 2024 draft determination.
Newmont Mining (electricity consumer)	
Redacted information in the report: The report is heavily redacted, so it is difficult to comment on the information provided by Merredin Power Station. **Proposed value of Energy Offer Price Ceiling and frequent peak events**: The energy price peaked 942 times in since during October-December 2023 and this is more than the number of such events since 2016. The ERA should consider the increase in weighted average cost of energy under the proposed EOPC. Newmont Mining agrees with the ERA in that the proposed EOPC will result in higher costs to energy consumers. This is completely avoidable. **Heat rate evaluation at minimum dispatchable loading level**: The heat rate is not suitable to determine costs of the chosen generator. The generator may not be stable at this output.	**Redacted information in the report**: The ERA got the redactions approved by Merredin Energy before publishing the Draft determination. Merredin Energy requested additional redactions to prevent divulging commercial-in-confidence information. **Proposed EOPC and frequent peak events**: No response required. Newmont Mining agrees with the ERA in that the proposed EOPC in April 2024 would have resulted in higher costs to energy consumers. **Heat rate evaluation at minimum dispatchable loading level**: No response required. Newmont Mining agrees with the arguments in the April 2024 discussion paper.
Newgen Power Kwinana (NPK) (electricity generator)	
Proposed value of Energy Offer Price Ceiling: By essentially doubling the Energy Offer Price Ceiling and given high prevalence of price ceiling events in the Real Time Market, this change will likely lead to a direct increase in the cost of Energy and Essential System Services in the broader context of already increasing cost.	**Proposed value of Energy Offer Price Ceiling:** No response required. Newgen Power Kwinana agrees with the ERA's position in the discussion paper. **Heat rate evaluation at minimum dispatchable loading level**: The final determination has been deferred till 1 January 2025 by EPWA. In the interim, has released this second draft determination to consult on the proposed value of

Stakeholder feedback	ERA response
Heat rate evaluation at minimum dispatchable loading level: The use of Merredin PS' minimum dispatchable loading level to set the Energy Offer Price Ceiling is also counter intuitive and can potentially be considered an outlier. NPK questions whether it would be more appropriate to consider a facilities minimum stable generation as this would most likely be the expected dispatch of any facility when there is a shortfall in Energy and a facility is required to synchronise. Whilst it's understood a Rule Change may be necessary to change the outcome of the Energy Offer Price Ceiling review, NPK suggests the Final Determination should be deferred to allow for a potential rule change.	the price ceiling at $1100/MWh according to the WEM Rule amendments gazetted on 29 October 2024
Perth Energy (electricity gentailer)	
Proposed value of Energy Offer Price Ceiling: The ceiling is a critical factor in holding electricity price increases to the minimum level possible. The proposed increase from $738 per MWh to $1500 has the potential, given the amount of time that wholesale prices are clearing at this cap, to force more costs onto customers. **Heat rate evaluation at minimum dispatchable loading level**: Energy Offer Price Ceiling should be determined by consideration of the minimum, sustainable, output level at which a generator would be dispatched during normal operation. While a generator may rarely, if ever, be dispatched at this load, it should be a level which the machine could sustain indefinitely if required. A rule change is warranted and the proposed Energy Offer Price Ceiling of $1500 per MWh is unreasonable.	**Proposed value of Energy Offer Price Ceiling:** The ERA agrees with Perth Energy that higher Energy Offer Price Ceiling will lead to higher costs to the consumers. This has been stated in the Draft determination. **Heat rate evaluation at minimum dispatchable loading level**: The final determination has been deferred till 1 January 2025 by EPWA. In the interim, has released this second draft determination to consult on the proposed value of the price ceiling at $1100/MWh according to the WEM Rule amendments gazetted on 29 October 2024.
Collgar Renewables (electricity generator)	
Proposed value of the Energy Offer Price Ceiling: Collgar supports the proposed value of the price ceiling but considers that the methodology used to arrive at the outcome is no longer fit for purpose. **Methodology review:** Collgar recommends that clause 2.26.2 be examined by Energy Policy WA (EPWA) and the ERA prior to the commencement of the next review to review the methodology used to determine the Energy Offer Price Ceiling. Recent changes in the technology used to assess both Capacity Credits for Peaking Capacity and Flexible Capacity to include a four-hour battery is a material shift in the	**Proposed value of the Energy Offer Price Ceiling:** No response required. Collgar supports the proposed Energy Offer Price Ceiling of $1500/MWh. **Methodology review:** The Draft determination has argued that the ERA started with a consideration set that included all facility types able to operate in the WEM. This included thermal facilities using coal, gas or diesel, renewable generators, and electric storage resources (batteries).. The formula under the current rules is generally applicable to thermal generators like open cycle gas turbines or diesel generators.

Stakeholder feedback	ERA response
Reserve Capacity Mechanism (RCM). It is no longer clear what forms of capacity will be available after a four-hour period of being called upon. This assessment of Reserve Capacity based on short term storage, rather than long term generation capacity, fundamentally shifts the approach to considering capital recovery risk in the development of new generation in the WEM. An outworking of this change is a shift in assessment of projected lifetime revenue when developing new Facilities for the capacity market, from a predominantly capacity based model to a hybrid energy-capacity model. This is more reliant on a higher energy price cap to ensure capital recovery and incentivise sufficient investment in new capacity that has the capability to deliver for longer than four hours.	Currently, the WEM Rules do not specify any process to change the methodology of the Energy Offer Price Ceiling.