Economic Regulation Authority

Energy Offer Price Ceiling

Final determination

19 December 2024

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Executive summary

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

The ERA has calculated a final Energy Offer Price Ceiling of $1000/MWh, to apply from 1 January 2025.

On 8 April 2024, the ERA published a draft determination proposing an Energy Offer Price Ceiling of $1500/MWh. This value was based on the method set out in the Wholesale Electricity Market (WEM) Rules in place at the time when the new market was launched (1 October 2023). This was significantly higher than the current Energy Offer Price Ceiling of $738/MWh, which was carried over from the old WEM.

The main contributor to this increase was that under the WEM Rules, the ERA was required to evaluate the heat rate of the highest cost facility (Merredin Power Station) at the minimum dispatchable loading levels, as specified in the Australian Energy Market Operator's (AEMO) Standing Data ([redacted] MW).

Public submissions in response to this draft determination raised two main issues:

- Stakeholders were concerned over the frequency of cap events in the new market and the potential for increased costs to consumers should such cap events continue under the proposed higher Energy Offer Price Ceiling.
- Stakeholders argued that referencing the minimum dispatchable loading level to evaluate heat rates was against WEM Rules' intent to mitigate the exercise of market power. Stakeholders suggested that a minimum dispatchable loading level should not be used, as operating at this output is considered inefficient and generally avoided by generators.

Due to the high frequency of cap events since 1 October 2023, and our findings in the 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.

EPWA also proposed changes to the WEM Rules under its Frequency Co-optimised Essential System Services (FCESS) Cost Review. These included changes to WEM Rule 2.26.2(a)(iii), which sets out the output level at which the ERA must estimate the fuel cost of the highest cost facility, as well as the information that can be used.

As a result of these changes, the ERA must now estimate the highest cost facility's fuel cost using the heat rate evaluated at a minimum stable loading level based on the ERA's assessment of available information. The changes were gazetted on 29 October 2024.

Following these WEM Rule changes, the ERA released a second draft determination on 6 November 2024. This second draft determination estimated the Energy Offer Price Ceiling $1100/MWh, lower than the first draft decision due to evaluating fuel costs at a higher output point in the heat rate curve.

The ERA's final determination, of $1000/MWh, is lower than the second draft determination due to lower distillate fuel prices.

The ERA received submissions from Alinta Energy and Synergy, in response to the second draft determination.

This feedback is discussed within the body of this final determination and a summary is also provided at Appendix 3. However, whilst the ERA notes the feedback provided, it did not impact on the final Energy Offer Price Ceiling value.

The new Energy Offer Price Ceiling will commence on 1 January 2025 and is subject to review within three years.

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 the 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 $1000/MWh and is not part of this review.
- The FCESS Offer Price Ceiling: This applies to offers from facilities in each of the five FCESS markets and is currently set at $250/MW per hour for regulation and contingency reserve services and $0/MWs per hour 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 final 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 determined the energy price limits annually. Energy price limits consisted of the maximum Short-Term Energy Market (STEM) price and the alternative maximum STEM price.[4] 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 final determination.

Since January 2022, there has been a marked increase in the number of trading intervals where the energy market 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. During 2022 and 2023, fuel scarcity and significant weather events contributed to the energy market price clearing at the energy price limit.

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).

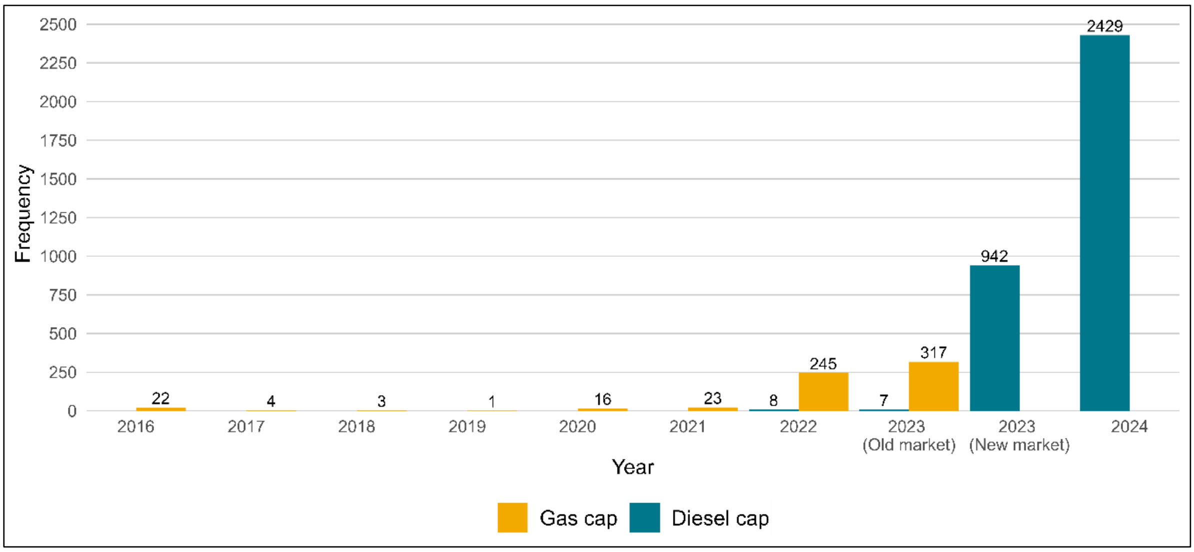
2 Wholesale Electricity Market Rules, 20 November 2024, 2.26.1, (online).

3 Wholesale Electricity Market Rules, 20 November 2024, 1.61.2 (online).

4 The maximum STEM price applied to all facilities except those using distillate, and the alternative maximum STEM price applied to offers from distillate-fuelled facilities.

Since the commencement of the new WEM, and the adoption of the alternative maximum STEM price as the sole Energy Offer Price Ceiling, a significant rise in intervals clearing at this price has occurred. [5]

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



Source: ERA's analysis of AEMO public data
Note: 2023 data is split at new market start (1 October 2023). 2024 data is for the period 1 January – 31 October.

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 have changed the definition of heat rate in the formula:[6]

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

[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 Amendment (FCESS Cost Review) Rules 2024, Attachment 2, (online).

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 South West Interconnected System (SWIS).[7] The Energy Offer Price Ceiling is to be rounded up to the nearest multiple of $100/MWh.[8] 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.

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 that were using distillate, and the alternative maximum STEM price that applied to offers from distillate-fuelled facilities.

A number of changes were made at the launch of the new market on 1 October 2023, including the shift to a single offer price ceiling, a change in choice of technology and the mean heat rate used to calculate the Energy Offer Price Ceiling. These changes were incorporated into the ERA's first draft determination, released on 8 April 2024.[9]

On 29 October 2024, EPWA gazetted further changes to WEM Rule 2.26.2(a)(iii). These changes require the ERA to use the minimum stable loading level output to estimate the fuel cost of the highest cost facility, based on the ERA's assessment of available information.

The ERA incorporated these changes into the second draft determination, published on 6 November 2024.

Table 1 below outlines the changes in the relevant WEM Rules since before 1 October 2023 and the resulting implications for this final determination.

7 Wholesale Electricity Market Rules, 20 November 2024, 2.26.2(a), (online).

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

9 ERA, *Energy Offer Price Ceiling – draft determination*, 8 April 2024, (online).

Table 1: Changes in the WEM Rules and implications for the final determination

Parameter	Pre-1 October 2023 WEM Rule	Post 1 October 2023 WEM Rule	Changes at 20 November 2024
Number of offer price ceilings	Two offer price ceilings – Max STEM price (gas), and Alternative max STEM price (diesel)	Single offer price ceiling	No change
Choice of technology	Specified as 40MW OCGT	Highest cost facility	No change
Heat rate	Mean heat rate at minimum capacity	Mean heat rate at the minimum dispatchable loading level specified in the Standing Data.	Mean heat rate at the minimum stable loading level based on the ERA's assessment of available information.
Rounding up	Not required	Rounding up to the nearest $100/MWh	No change
Indexation	Alternative maximum STEM price indexed for fuel component	Determine if indexation is required, and if so, the methodology and frequency	No change

1.3 Information for the ERA's determination

The final 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 facilities 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.

1.4 Stakeholder responses (summary)

The public consultation period for the second draft determination closed on 4 December 2024. The ERA received two submissions. They were from Alinta Energy (Alinta) and Synergy.[10]

Alinta's submission was supportive of the proposed indexation but raised concerns relating to the dispatch profile used to determine the Energy Offer Price Ceiling. Alinta believes that the dispatch profile should reflect the maximum duration of a cycle under a fast start inflexibility profile. Under WEM Rules 7.4.45, the maximum length of a fast start inflexibility cycle is 60 minutes. The ERA's calculations were based on a mean runtime of short duration (less than 4 hours), keeping it aligned with the Energy Price Limit Review published in January 2023.[11]

Synergy's submission was supportive of the impact of recent WEM Rules changes and the implications they have had for determining the final Energy Offer Price Ceiling.

However, Synergy noted in its submission that as the capacity mix of the SWIS changes towards electric storage systems over the coming years, it expects the dispatch frequency of the current highest cost facility to fall. Should any material changes to the market occur, Synergy suggests that a review of the Energy Offer Price Ceiling be conducted earlier than January 2028.

A summary of both submissions and the ERA's response is provided in Appendix 3.

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[10] ERA, Energy Offer Price Ceiling, (online).

[11] ERA, *Energy Price Limits – Final Determination*, pp. 16-18, (online).

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 ERA determines the Energy Offer Price Ceiling by applying the formula set out in the WEM Rules (2.26.2(a)).

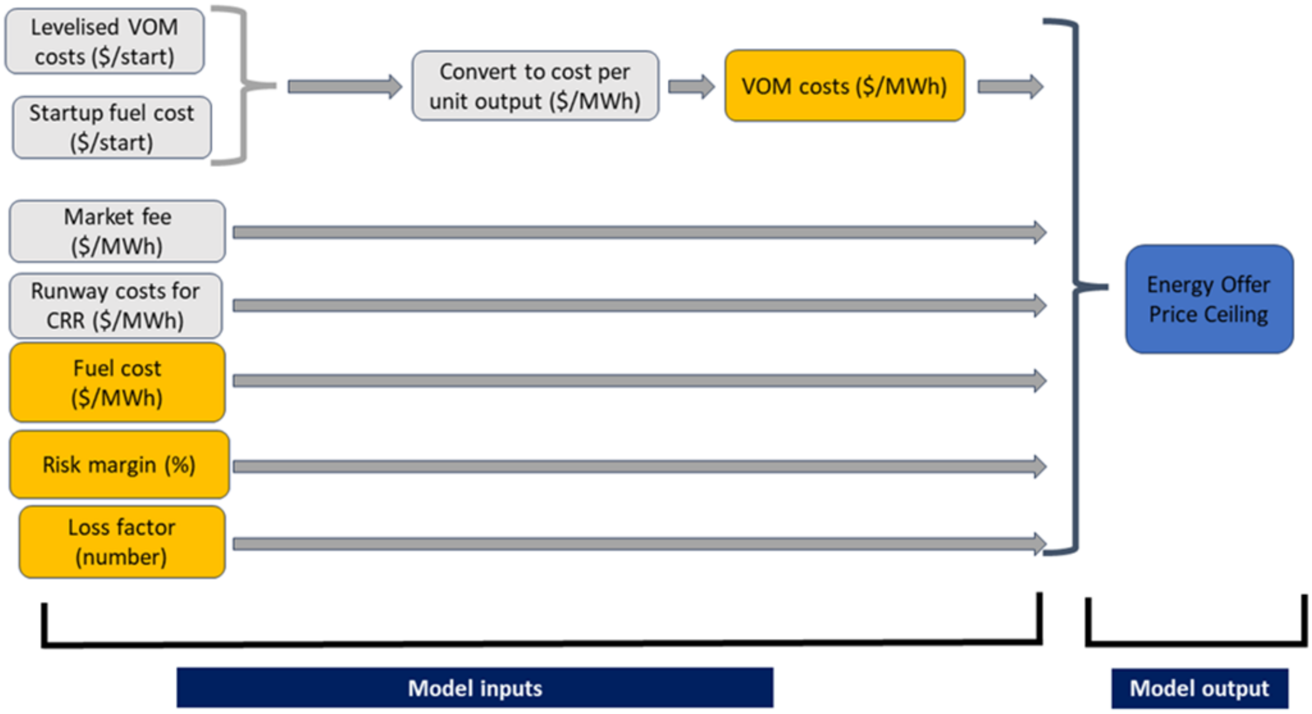
The method outlined in the WEM Rules makes explicit allowance for uncertainty in estimating such costs. There is no single supply cost for all operating conditions, so the Energy Offer Price Ceiling is set after considering a range of possible values.

The ERA has based its final determination on an operational scenario where the highest cost facility supplies energy for a short period of time at a low level of generation, 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 variable 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 market pre-1 October 2023. 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 determining the Energy Offer Price Ceiling is shown in Figure 2. The Energy Offer Price Ceiling is comprised of the following components:

- VOM costs, including 'levelised' VOM costs and start-up fuel costs (See section 2.2)[12]
- 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 in choosing the highest cost facility.

2.1 Selecting the highest cost facility

2.1.1 Choice of technology

The WEM Rules do not specify what generating technology should be considered as the highest cost facility when determining the Energy Offer Price Ceiling. As such, 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 distillate, renewable generators, and electric storage resources (batteries).

In selecting the appropriate technology type for setting the price ceiling, it is critical to base the assessment of generator cost on normal and credible operating conditions. This approach ensures that the analysis is grounded in scenarios that are reasonably expected to occur under typical system stress, without accounting for extreme, low probability events leading to extraordinary disruptions. By focusing on such normal and credible conditions, we aim to establish a price ceiling that is both, realistic and effective under high cost but plausible scenarios.

Coal generators are typically characterised by their relatively low marginal operating cost. This is so even though startup and VOM costs for coal facilities can be high, however these costs are amortised over a long period of operations. As a result, for this review, the ERA does not consider a coal facility to be the highest cost facility.

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 Kwinana battery 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

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

these batteries track the energy market clearing price in their offers and are not the highest cost facility for the purpose of the Energy Offer Price Ceiling determination. This reduced the consideration set to thermal facilities that use coal, gas and/or distillate. As a result, for this review, the ERA does not consider a coal facility to be the highest cost facility.

As far as distillate and gas generators are concerned, the distillate price has tracked higher than the gas price historically (Figure 13). As the fuel cost tends to be the primary cost considered by generators when setting their offer prices, the ERA considers that a distillate-fuelled facility is the highest cost facility for the purposes of the Energy Offer Price Ceiling determination.[13]

2.1.2 Choice of facility

The ERA considered a list of facilities for which highest operating costs could exceed the current energy offer price ceiling if operated on distillate 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 of these facilities. Based on the analysis of the cost information provided and the operational profiles of these facilities until 30 September 2024, the ERA selected Merredin Power Station as the highest cost facility operating in the SWIS in both the first and second draft determinations.

Merredin Power Station remains the highest cost facility for this final 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 distillate. The power station is owned by Merredin Energy and operates to provide peaking power in the SWIS.

To establish Merredin Power Station 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 short-run efficient variable costs to provide energy to the SWIS.

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

2.2 Variable operational 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. As a facility has a distribution of potential VOM costs when considered as $/MWh, an average of that distribution is estimated.

Estimating 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 is generally comparable with the original equipment manufacturer's estimates and the estimated cost profiles of other similar facilities 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 fees and FCESS runway costs are outlined in Sections 2.2.5 and 2.2.6. Section 2.2.1 outlines the ERA's choice of analysis period 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 analysis period

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

Since October 2023, there have been changes in the dispatch profile of peaking generators, with the frequency of starts increasing compared to historical averages. Recognising this trend, the ERA amortised the VOM costs over an expected dispatch output based on Merredin's dispatch profile as observed between 1 January 2023 and 30 September 2024. Further analysis is provided in Appendix 6.

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]

[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.

The estimation of VOM costs relied 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 used information on number of starts, maintenance factors and maintenance triggers, inspection costs and a weighted average cost of capital to arrive at (a normal distribution of) levelised costs.

The discounted cost per start has been converted to a discounted cost per MWh of electricity generated based on the possible duration of short dispatch cycles.[15] 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 of energy generated reflects very high-cost operating conditions of the units. This process is explained in Appendix 5.

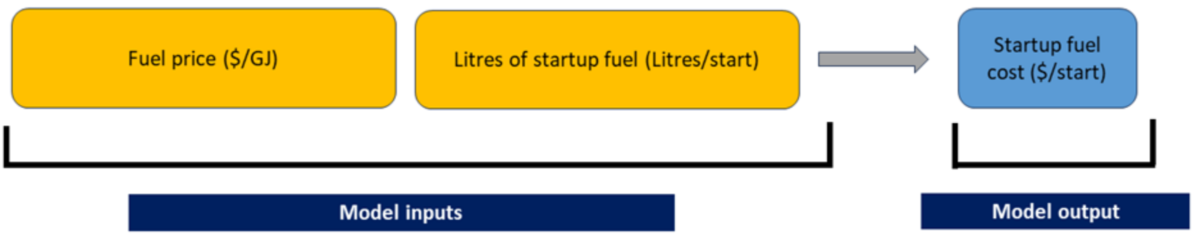
2.2.3 Estimation of startup and shutdown fuel costs

Fuel costs related to startup

Generators use fuel during startup in addition to the fuel used to generate electricity during a dispatch cycle. 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 were estimated using the analysis described in Section 2.4.2.

Figure 3: Model inputs and output for startup fuel cost



15 The assessment model considers short dispatch cycles as those between 5 minutes and 4 hours.

Fuel costs related to shut down

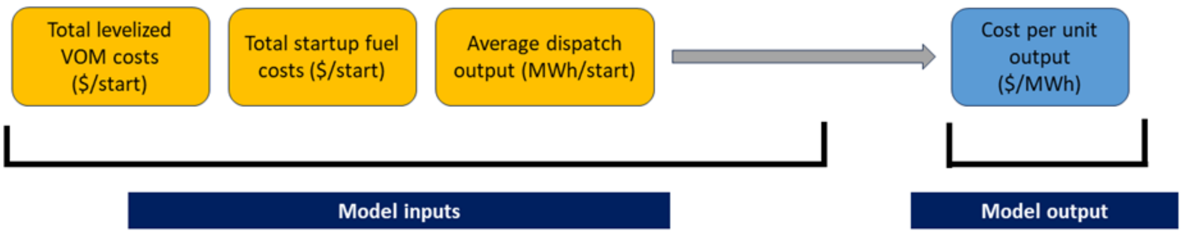
The Offer Construction Guideline allows for the inclusion of shutdown costs in energy offers. Shut down costs relate to fuel costs and additional maintenance costs incurred when shutting down a generator.[16]

The ERA's analysis of energy offers for generators similar to Merredin Power Station suggests shutdown costs were not included in energy offers. The ERA did not receive any feedback on exclusion of shutdown costs in response to its first or second draft determinations and these costs have been excluded from Energy Offer Price Ceiling calculation in the final 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. This is depicted in Figure 4.

Figure 4: Model inputs and output for cost per unit



A more detailed analysis of estimating costs in terms of $/MWh is provided in Appendix 5.

2.2.5 Market fees

The Offer Construction Guidelines allow 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 2024/2025 value, published by the AEMO, is $2.94/MWh.[17]

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 Control Service 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.

The ERA estimated runway costs using AEMO's settlement data. The runway costs for Merredin Power Station from 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.

16 ERA, Offer Construction Guideline, pp. 10-11, (online).

17 AEMO, WA Budget and Fees 2024-25, p. 5, (online).

2.3 Results for the variable cost component

Table 2 below outlines the components included in estimating VOM costs. They have been estimated as $[redacted]MWh.

Table 2: Estimate of variable costs for Merredin Power Station

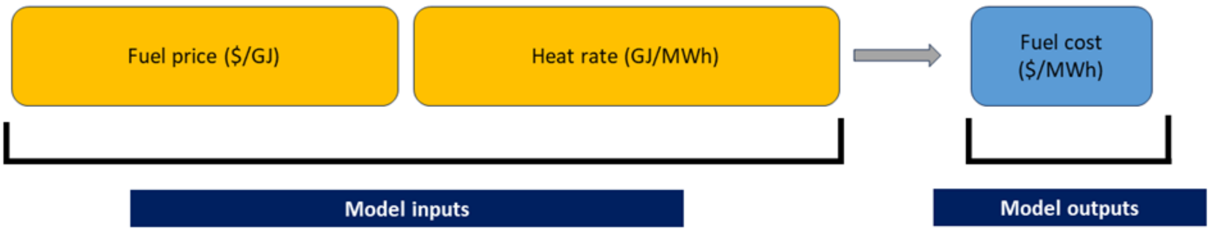
Item	Unit	Cost
Maintenance costs	$/start	[redacted]
Average duration of dispatch per start	Hours	[redacted]
Startup fuel consumption	$/start	[redacted]
Estimated mean output per start (short dispatch)	MWh/start	[redacted]
Amortised maintenance costs	**$/MWh**	[redacted]
Amortised startup costs	**$/MWh**	[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: Totals may not sum due to rounding.

2.4 Fuel costs

The WEM Rules require estimation of fuel costs incurred during energy dispatch as the product of the mean heat rate at the minimum stable loading level output 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

To determine the final Energy Offer Price Ceiling, the ERA has used the mean heat rate at the minimum stable loading level based on the ERA's assessment of available information. This is in keeping with the current WEM Rules.

However, prior to 20 November 2024, the WEM Rules stated that the fuel cost component was to be determined using the minimum dispatchable loading level as specified in AEMO's Standing Data.

As a result, in the first draft determination, the ERA stated that the minimum dispatchable loading level specified in AEMO's Standing Data was [redacted] MW, which is 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. This resulted in high fuel cost and an Energy Offer Price Ceiling of $1500/MWh.

Following changes to the WEM Rules, the ERA released a second draft determination in which it evaluated the heat rate at minimum stable loading levels, based on ERA's assessment of available information.

We have continued this method to determine the final Energy Offer Price Ceiling.

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:[18]

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

As a result, the ERA finds 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 instructions at this level of output for a sustained period. The heat rate of the facility at 6MW is [redacted] GJ/MWh.

[18] Registration Technical Data Guide version 4.2, AEMO, published May 2024 (online).

2.4.2 Fuel price

Merredin Power Station runs exclusively on distillate fuel.

Consistent with previous reviews, the price of distillate is sourced from the Perth Terminal Gas Price (TGP) (net of goods and services tax and excise).[19] The TGP includes shipping costs and therefore considers variations in these costs due to factors such as exchange rate changes.

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

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

- Derive the average daily Perth TGP over the preceding three months (August 2024 to November 2024).[20]
- Remove GST (10 per cent) and distillate excise ($0.506/L) that would not be paid by local generators.[21]
- Add a transportation cost of 1.2c/L.[22]
- Convert the cost of distillate from Australian cents per litre to $/GJ based on the estimated calorific content of distillate.[23]

The outputs are shown in Table 3 below. For its final determination, the ERA has relied on a reference distillate price of $25.22/GJ.

Table 3: Reference distillate price

Item	Cents per litre	$/GJ
Perth TGP	161.42	
TGP less GST	146.75	
TGP less GST and excise plus transport	97.35	25.22

The price of distillate will vary due to fluctuations in world oil prices and refining margins. The ERA will use average daily TGP over the preceding three months to index the Energy Offer Price Ceiling every month. Indexation is explained in Section 3.1.

[19] Australian Institute of Petroleum, Historical ULP and Diesel TGP Data, (online).

[20] This is consistent with the previous energy price limits which considered prices over the three preceding months.

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

[22] Marsden Jacob report produced for AEMO, *2019-2020 Energy Price Limits Review – Final Report (Public)*, p.36, (online).

[23] Department of Climate Change, Energy, the Environment and Water, *Australian national greenhouse accounts factors*, 2024, p.20, (online). Department of Climate Change, Energy, the Environment and Water, *Australian national greenhouse accounts factors*, 20243, p.210, (online).

2.4.3 Results of fuel costs

For its final determination, the ERA finds that the fuel cost for Merredin Power Station is $[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. [24]

In the previous energy price limit reviews, the ERA generated distributions of the variable parameters used in the energy 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 energy 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 Energy Offer 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 offer 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.[25] For this review, the risk margin has been 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.

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.

24 Wholesale Electricity Market Rules, 20 November 2024, 2.26.2(a)i, (online).

25 This was the 80th percentile of the average variable cost distribution in the previous reviews. ERA, Energy Price Limits, 2022, p. 8, (online).

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.[26]

[26] Western Power, 2024/25 Loss Factor Report, p. 6, (online).

3. Final determination

The Energy Offer Price Ceiling calculated under the new WEM Rules is $1000/MWh. It will apply from 1 January 2025 and is subject to review within 3 years (January 2028).

This value is greater than the current transitional Energy Offer Price Ceiling of $738/MWh, but lower than the $1500/MWh proposed by the ERA in the first draft determination, released in April 2024, and the $1100/MWh proposed in the second draft determination, released in November 2024. The decrease in the Energy Offer Price Ceiling since the second draft determination is the result of falling distillate fuel prices.

An Energy Offer Price Ceiling of $1000/MWh is based on a heat rate being evaluated at Merredin Power Station's minimum stable loading level of 6 MW, as determined by the 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 levels 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 final 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 a duration of between 45 minutes and 3 hours 55 minutes. Additionally, whilst the Merredin Power Station has been dispatched with more frequency since October 2023, there has been a reduction in VOM costs from $[redacted] MWh to $[redacted] MWh. This is due to a reduction in costs to the fuel component of start-up costs, a major factor of Merredin's VOM costs.

Table 4: Calculation of Energy Offer Price Ceiling

Component	Unit	Final value
Mean heat rate at minimum capacity	GJ/MWh	[redacted]
Mean fuel cost	$/GJ	25.22
Fuel cost	$/MWh	[redacted]
Mean variable O&M cost	$/MWh	[redacted]
Loss factor	-	0.9498
Average variable cost distribution - Mean	$/MWh	911.43
Average variable cost distribution – 85th percentile	$/MWh	948.13
Risk margin	%	4.03%
Energy Offer Price Ceiling (without round up factor)	$/MWh	948.13
Energy Offer Price Ceiling	**$/MWh**	1000

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.[27]

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 three-yearly 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).[28]

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

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

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 distillate price for the monthly indexation process:

- Derive the average daily TGP preceding three months.[29]
- Remove GST (10 per cent) and distillate excise ($0.506/L) that would not be paid by local generators.[30]
- Add a transportation cost of 1.2c/L.
- Convert the cost of distillate from Australian cents per litre to $/GJ based on the estimated calorific content of distillate.[31]

27 Wholesale Electricity Market Rules, 20 November 2024, clause 2.26.2F (c), (online).

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

29 This is consistent with the previous energy price limits which considered prices over the three preceding months.

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

31 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:

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

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

Indexed Energy Offer Price Ceiling

Indexation will apply to the Energy Offer Price Ceiling prior to rounding up to the nearest $100/MWh. Loss factor changes will also be included when updated by Western Power.

Appendix 1 – List of Tables

Appendix 2 – List of Figures

Appendix 3 – Submissions received in response to the second draft determination

The ERA received two submissions in response to the second draft determination, with a summary provided in Table 5 below.

Feedback is also discussed within the body of the determination, against the relevant topics.

Table 5: Summary of submissions received and ERA responses

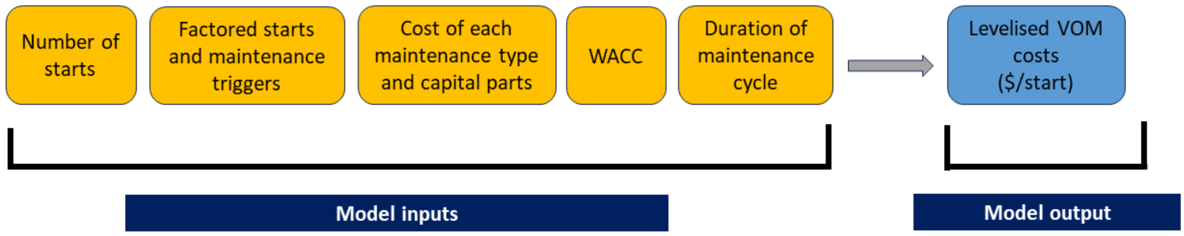
Stakeholder	Feedback
Alinta Energy	
Alinta Energy maintains that the dispatch profile used to determine the EOPC should reflect the maximum duration of a cycle under a fast start inflexibility profile. Under WEM Rules 7.4.45, the maximum length of a fast start inflexibility profile cycle is 60 minutes. Alinta Energy considers this to be a more transparent approach and a better reflection of the minimum duration for which a peaking generator should be prepared to run. Alinta states that this will allow generators to recover all efficient variable costs. Alinta Energy supports the indexation methodology.	The ERA acknowledges Alinta Energy's suggestion that a shorter dispatch cycle reflecting maximum duration under a fast start inflexibility profile could be considered as a part of the approach to determining the value of the EOPC. However, as part of this determination, the ERA has considered the historical runs and typical operating conditions of Merredin and other high-cost facilities on the SWIS. Consistent with the Energy Price Limits review in January 2023, the ERA has determined that utilising a maximum run cycle of four hours will result in an EOPC that is more reflective of the costs that are typically incurred by a facility. The ERA notes that the risk margin, as well as the requirement to round up to the nearest \$100/MWh, serve to mitigate the risk of a facility under-recovering their costs for shorter run times.
Synergy	
Synergy notes that the WEM (FCESS Cost Review) Rules that commenced on 20 November 2024 are likely to result in the EOPC being reached less frequently. However, it also comments that the proposed new EOPC still represents an increase on the current price and as such will have an impact on wholesale market participants and customers. Going forward, Synergy believes that the introduction of new battery storage systems will reduce the dispatch frequency of the current highest cost facility. If this occurs, assumptions relating to the number of starts of the highest cost facility will require re-assessment to adequately reflect operational and maintenance costs. Synergy believes that if material changes eventuate, a review of the EOPC should be undertaken prior to the next review date of January 2028.	The ERA acknowledges Synergy's comment that a higher EOPC than is currently in place may impact on market participants and customers. However, it notes that the increase is due to a change in methodology in assessing market price limits since the introduction of the new market. Under the WEM Rules (2.26.2N and 2.26.2NA) a market participant may seek a review of market price limits if they believe there has been a material change in circumstances. Such a request must not be made until at least 6 months after the finalisation of the preceding review and the ERA may consider this request under 2.26.2Q. Alternatively, under WEM Rule 2.26.1, the ERA is required to undertake a review no later than every 3 years.

Stakeholder	Feedback
Synergy supports the change to estimating fuel costs of the highest cost facility in the SWIS by evaluating its heat rate at its minimum stable loading level.	

Appendix 4 – 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 1 October 2016 to 30 September 2024.

A large range of plausible values for starts per year was then sampled from the distribution to model how many maintenance events would 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 have been 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.[32] The ERA's analysis has assumed that variable maintenance expenditure will remain 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.[33] 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).[34]

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 6.

Table 6: [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:

32 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).

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

34 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.[35]

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 that 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.

35 General Electric, 2021, *Heavy-Duty Gas Turbine Operating and Maintenance Considerations*, GER-3620P (01/21), p. 31, (online). 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.[36] For clarity, the calculation of the price limits in this final determination uses estimates of maintenance expenditures as provided by Merredin Energy. These differ from the values used in the stylised example below.

The Merredin Power Station has a maintenance schedule as listed in Table 7 below.

Table 7: 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 8.[37] 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 8: 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.

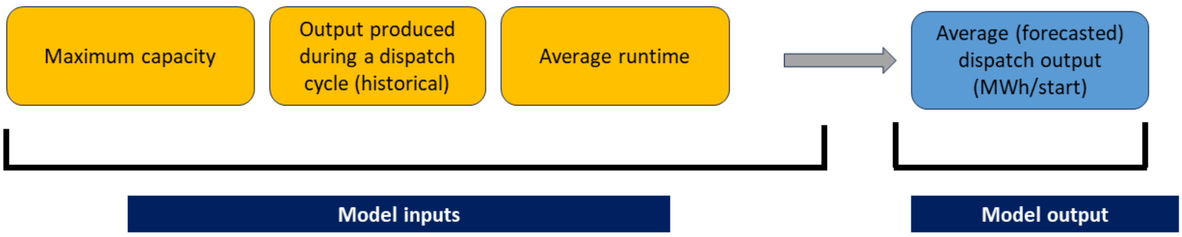
[36] Jacobs, 2015, *Energy price limits for the Wholesale Electricity Market in Western Australia – Final report*, Tables 3-4, (online).

[37] 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), pp. 35-36, (online).

Appendix 5 – 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 such as 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 1 January 2023 to 30 September 2024 is provided in this section as well.

Average output

During 1 January 2023 to 30 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 1 January 2023 to 30 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.

Stakeholder feedback

Alinta's submission raised concerns relating to the dispatch profile used to determine the Energy Offer Price Ceiling. Alinta believes that the dispatch profile should reflect the maximum duration of a cycle under a fast start inflexibility profile. Under WEM Rules 7.4.45, the maximum length of a fast start inflexibility cycle is 60 minutes. The ERA's calculations were based on a mean runtime of short duration (less than 4 hours), in keeping with the Energy Price Limit Review published in January 2023.[38]

The ERA notes that this would result in a higher Energy Offer Price Ceiling due to a shift away from the average cost of the highest cost generating facility in the SWIS.

Indeed, consideration of all runs of a facility less than four hours is likely to be more reflective of the variable supply costs that a peaking facility such as Merredin would experience. In comparison to only considering runs of 60 minutes, the model considers the full range of runs, from as short as 5 minutes up to 4 hours.

No changes to the methodology applied have been made.

[38] ERA, Energy Price Limits – Final Determination, pp. 16-18, (online).

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 1 January 2023 to 30 September 2024.[39]

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 dispatch cycle. The average capacity factor of short dispatch cycles is [redacted] 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.[40]

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.[41]

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.

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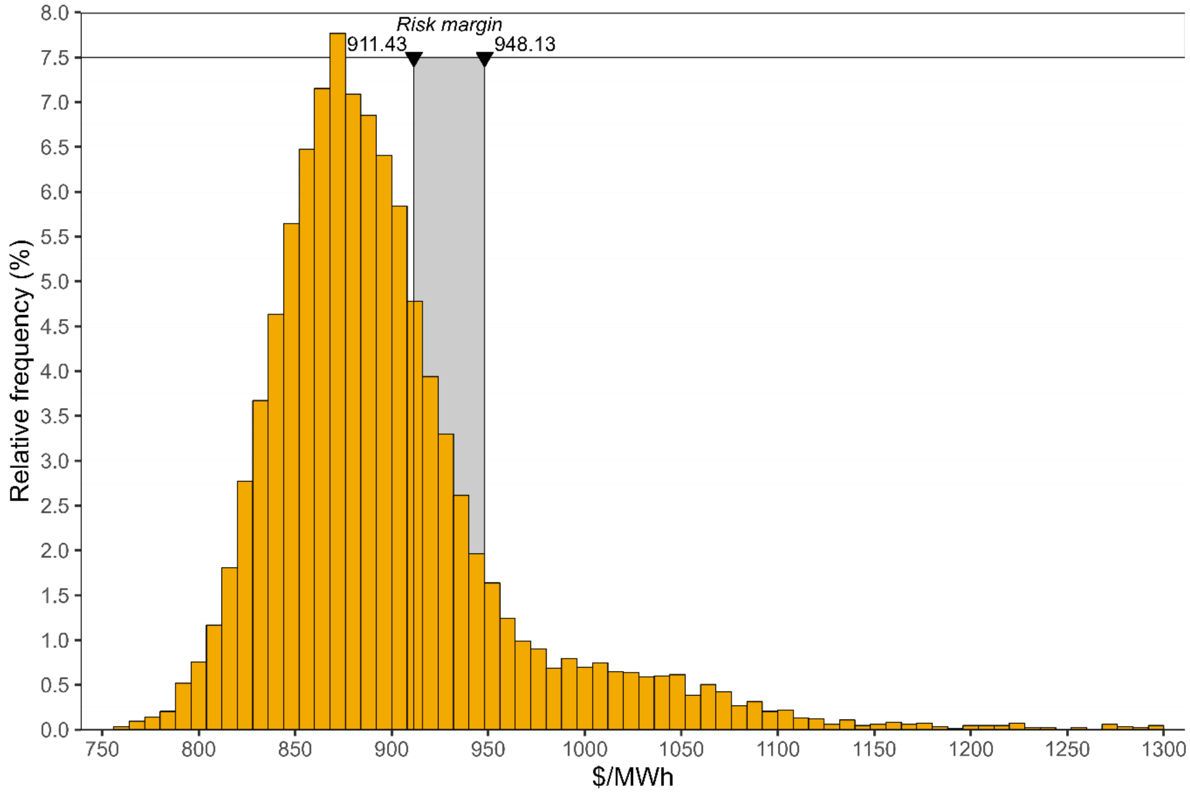
39 This is consistent with ERA's previous Energy Price Limits reviews, (online).

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

41 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.

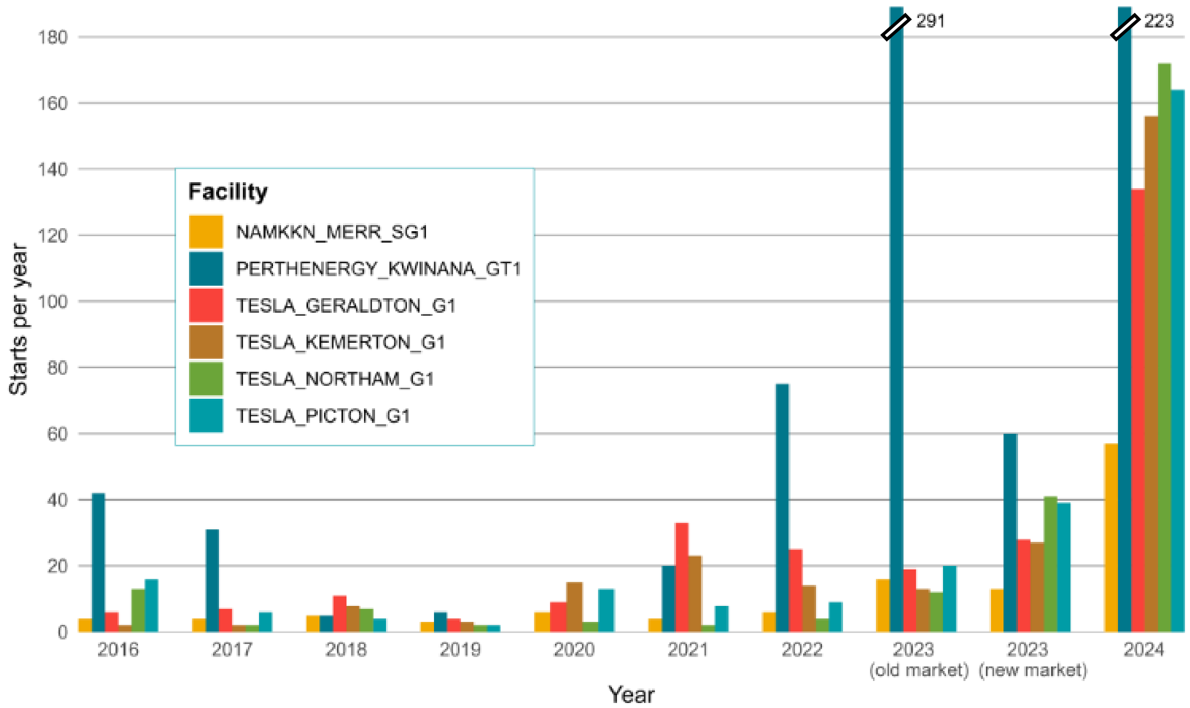
Appendix 6 – Choice of period of analysis

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: Distillate generator starts per year

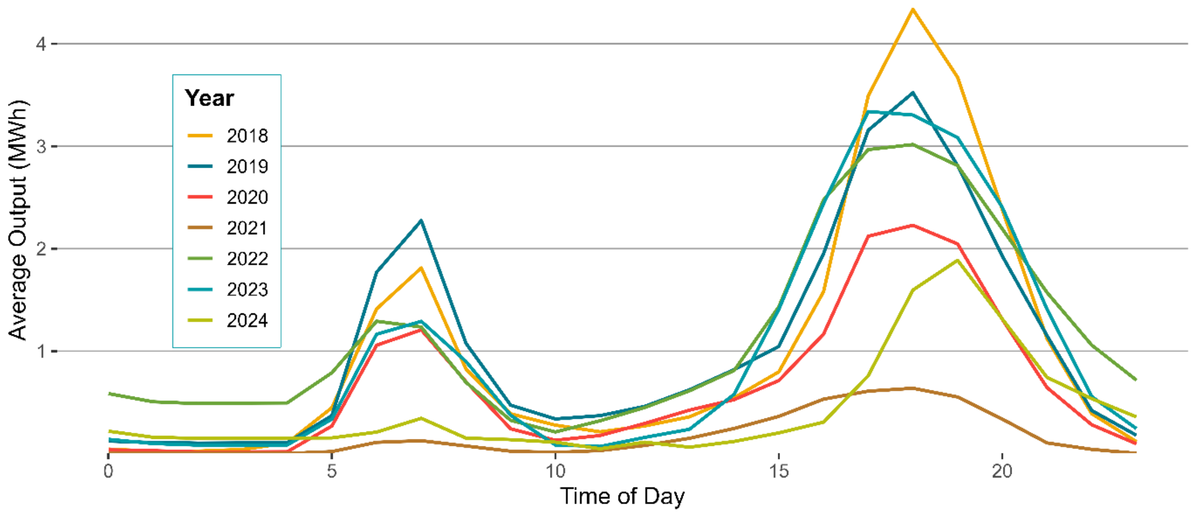


Source: ERA analysis based on public data published by AEMO
Note: 2024 figures are until 31st October 2024

- 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.[42]
- 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.

42 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.

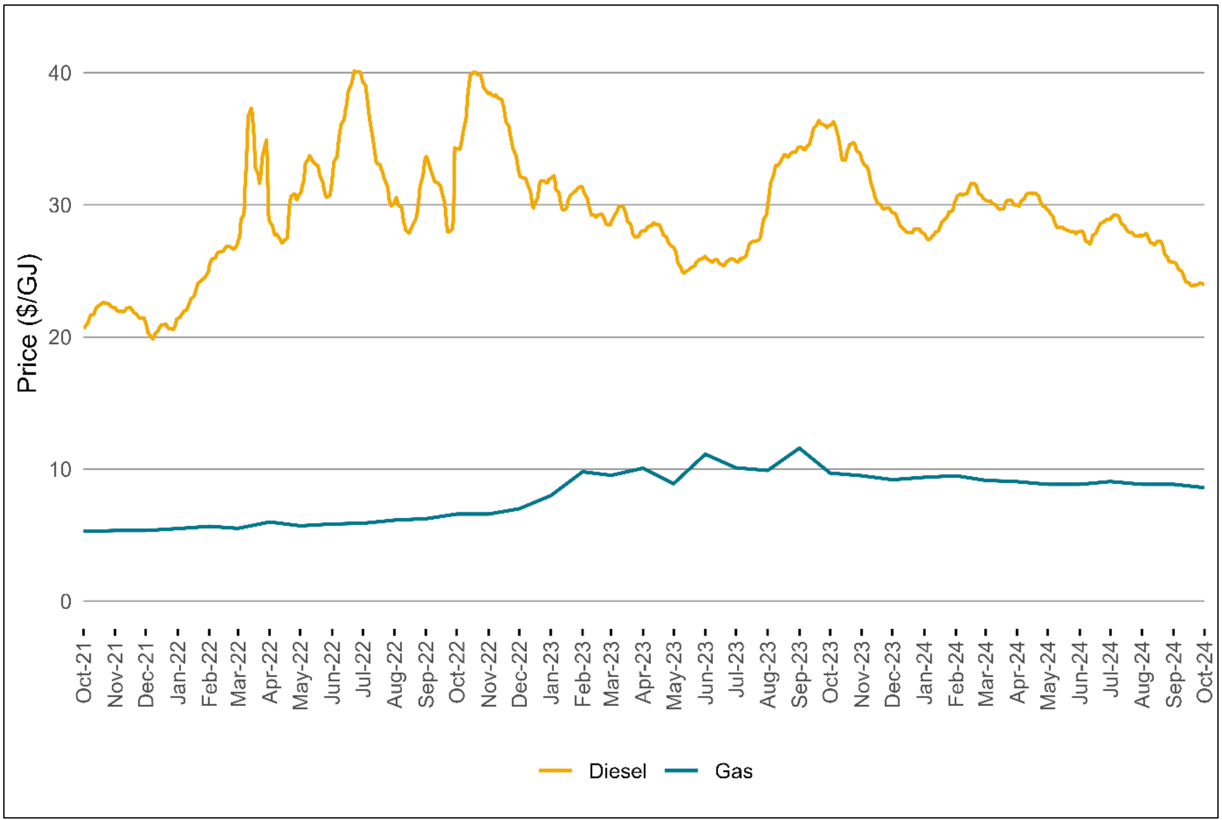
Levelised VOM costs have been amortised over average output Merredin Power Station generates over short dispatch cycles, that is dispatch cycles with a duration of less than or equal to four hours.

The stack of generators has 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 7 - Fuel price comparison

Figure 13: Comparison of gas and distillate prices over the previous 3 years



Source: Distillate prices are calculated from the daily average terminal gate price, less GST and excise, then converted to $/GJ.[43,44,45]
Gas prices are the monthly maximum prices on the gas trading spot market.[46]

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

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

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

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