



Guideline to inform Balancing Market offers

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1 Introduction

The Wholesale Electricity Market in the Western Australian South West Interconnected System operates under the *Electricity Industry Act 2004*, *Electricity Industry (Wholesale Electricity Market) Regulations 2004*, and *Wholesale Electricity Market Rules*¹.

Market generators² registered with the Australian Energy Market Operator make price and quantity offers into the Balancing Market, a component of the Wholesale Electricity Market, to supply electricity for each 30 minute trading interval. These offers are called balancing submissions. Market generators are primarily selected to supply electricity based on the price competitiveness of their balancing submissions.

The Market Rules require market generators to not price in excess of their short run marginal cost (SRMC), when such behaviour relates to market power. Clause 7A.2.17 of the Market Rules states:

7A.2.17 Subject to clauses 7A.2.3, 7A.2.9(c) and 7A.3.5, a Market Participant must not, for any Trading Interval, offer prices in its Balancing Submission in excess of the Market Participant's reasonable expectation of the short run marginal cost of generating the relevant electricity by the Balancing Facility, when such behaviour relates to market power.

1.1 Purpose of this Guideline

The Economic Regulation Authority (ERA) is responsible for monitoring compliance with, and investigating potential breaches of the Market Rules in the WEM³.

Some terms used in clause 7A.2.17 of the Market Rules are not defined and have not been judicially considered and are therefore, open to different interpretation.

The purpose of this Guideline is to explain how the ERA interprets the undefined terms in clause 7A.2.17 of the Market Rules, and which costs the ERA considers may reasonably form part of a market participant's SRMC.

This will support greater confidence in the market and promote more efficient market outcomes.

The Guideline is not binding on the ERA or on market participants. It is intended only to provide guidance to market participants on the ERA's current approach to monitoring compliance with clause 7A.2.17 of the Market Rules. The ERA encourages market participants to seek their own professional advice on their obligations and compliance with clause 7A.2.17 of the Market Rules.

Ultimately, any final decision and interpretation of the Market Rules can only be made by the relevant review body or court. For contraventions of the Market Rules, the relevant body is the Electricity Review Board.

¹ In this Guideline these are referred to as the 'Market Rules'.

² Terms in this Guideline are defined terms in the Market Rules and have the same meaning as in the Market Rules unless stated otherwise.

³ Rule 2.2A, *Wholesale Electricity Market Rules*.

2 Clause 7A.2.17 of the Market Rules

Clause 7A.2.17 of the Market Rules states:

Subject to clauses 7A.2.3, 7A.2.9(c) and 7A.3.5, a Market Participant must not, for any Trading Interval, offer prices in its Balancing Submission in excess of the Market Participant's reasonable expectation of the short run marginal cost of generating the relevant electricity by the Balancing Facility, when such behaviour relates to market power.

The terms 'reasonable expectation', 'short run marginal cost', 'relates to' and 'market power' are not defined in the Market Rules. This can create uncertainty when interpreting these terms.

The ERA considers that clause 7A.2.17 of the Market Rules should be read with regard to the WEM objectives. These objectives are contained in both Market Rule 1.2.1 and in section 122 of the *Electricity Industry Act 2004*.⁴

Rule 1.2.1 states:

1.2.1. The objectives of the market are:

- (a) to promote the economically efficient, safe and reliable production and supply of electricity and electricity related services in the South West interconnected system;
- (b) to encourage competition among generators and retailers in the South West interconnected system, including by facilitating efficient entry of new competitors;
- (c) to avoid discrimination in that market against particular energy options and technologies, including sustainable energy options and technologies such as those that make use of renewable resources or that reduce overall greenhouse gas emissions;
- (d) to minimise the long-term cost of electricity supplied to customers from the South West interconnected system; and
- (e) to encourage the taking of measures to manage the amount of electricity used and when it is used.

Clause 7A.2.17 of the Market Rules is in place to promote efficiency and to encourage competition among market participants, and should be read with this purpose in mind.

⁴ *Electricity Industry Act 2004* (WA)

3 Bidding at short run marginal cost

3.1 Defining short run marginal cost

Short-run marginal cost (SRMC) is the increase in total cost that arises from a unit increase in output. The economic concept can be expressed as:

$$C'(Q) = \frac{\Delta C}{\Delta Q}, \quad Q \geq 0$$

where SRMC (denoted C') is a function of a plant's output (Q). That is, C' is the rate of change of cost (C) with respect to quantity (Q), for a small change in output. This Guideline uses this economic definition of SRMC.

Input costs for an electricity generator can be categorised into three broad types: variable costs, avoidable fixed costs and fixed costs.

The economic definition of SRMC only considers variable costs (such as fuel, water and other operating costs) and excludes both avoidable fixed costs and fixed costs.

Variable costs are costs that change with the level of production, and increase or decrease in a continuous or step-wise fashion. Average variable cost is the sum of all variable costs and avoidable fixed costs, averaged by the quantity of electricity generated over the number of trading intervals a generator is expected to run.⁵

A generator may sometimes incur avoidable fixed costs when it produces electricity, but these costs do not vary with production levels.⁶ An example in electricity generation is start-up costs, which are incurred to start a generator, but are the same whether production is at minimum or maximum generation levels.

Some generator components require overhaul at a faster rate than manufacturer recommendations depending on use. For example, generators operating in "fast start" mode or running at higher power can cause substantial wear on individual components. The replacement costs of these components can be characterised as variable costs and included in SRMC if they are incurred. That is, they must be true or actual costs incurred by the generator.

Fixed costs cannot reasonably be included in the calculation of a generator's SRMC or average variable costs. Examples of fixed costs (also called unavoidable fixed costs) that must not be included in the calculation include the capital cost of building a generator, fixed operating and maintenance costs for a generator and required upgrades to transmission facilities.

Table 1 below outlines valid cost components.

⁵ The averaging treatment of the different components of average variable costs are worked through in Example 3 of Section 5.

⁶ Economic Regulation Authority, Portfolio Short Run Marginal Cost of Electricity Supply in Half Hour Trading Intervals: Technical Paper, 11 January 2008, <http://www.era.gov.au/cproot/6317/2/20080111%20Short%20Run%20Marginal%20Cost%20-%20Technical%20Paper.pdf>, page 10

Table 1: Comparison of valid cost components

Input cost component	Is it a valid cost?	
	SRMC	AVC*
Variable costs (fuel, carbon)	Yes	Yes
Avoidable fixed costs (start-up costs)	No	Yes
Fixed costs (capital costs of building a generator)	No	No

*AVC = average variable cost

SRMC is a forward-looking concept. Costs that were previously incurred and are now unavoidable are considered sunk and not relevant to the generation decision. This means forecasting and judgement are required when a generator makes an estimate of its SRMC for each trading interval.

Average variable costs are also considered forward-looking, because some inputs need to be forecast (for example, the dispatch load and the number of trading intervals a generator is expected to run). Therefore, similar judgements are required to estimate a generator's average variable costs.

Forecasting errors are inevitable, and there are valid reasons for reasonable expectations to deviate from actual outcomes (see section 4.1 for a description of reasonable expectation).

Risk premiums are not valid cost components of SRMC and cannot be included in a generator's reasonable expectation of SRMC for any trading interval. The ERA considers the following are also not valid inclusions in a generator's SRMC:

- Earning a return on the initial capital investment
- Penalties imposed on generators for failing to comply with dispatch instructions that result in reserve capacity refunds.

3.2 Peculiarities of electricity generation and balancing submissions

The concept of a business pricing its products at the SRMC of production is well-established in economics. However, the adoption of the strict economic definition of SRMC to examine a Market Participant's behaviour under Rule 7A.2.17 may not be practical for a generator operating in the WEM, for several reasons.

First, a generator cannot increase production by 'one more unit' from zero generation⁷. Thermal generators have a minimum generation level, below which production is not stable. Hence, costs between zero and the minimum generation level must be averaged⁸.

Second, producers in most industries typically face U-shaped cost curves, where marginal costs fall initially, then increase as output increases, as shown in Figure 1 below.

Figure 1: Cost curve of a theoretical producer

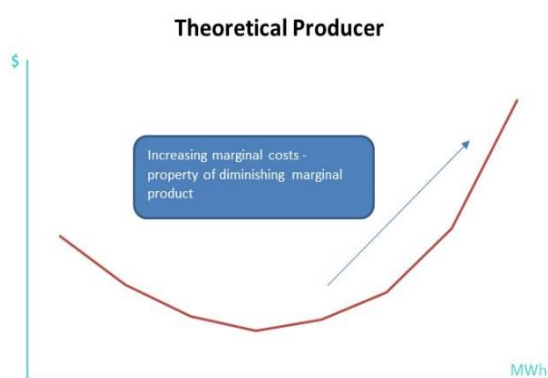
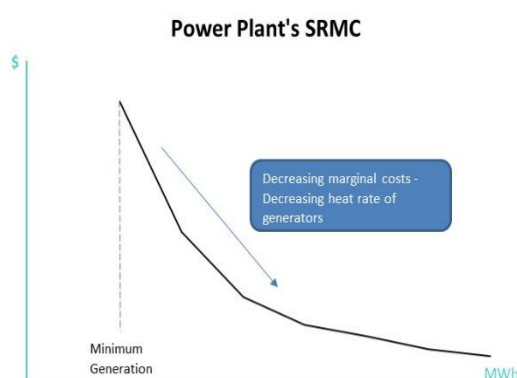


Figure 2: Power plant's SRMC



Electricity generators typically become more efficient as they increase production from minimum generation to optimal generation (beyond which stability and efficiency are compromised, so production beyond this point is generally not considered)⁹ (Figure 2). This is a result of the decreasing heat rates of generators. A generator's average heat rate is the amount of fuel required to generate one unit of electricity, and a lower heat rate means lower fuel costs.

Differentiation between average heat rate and marginal heat rate is important when determining balancing market price and quantity offers. The marginal heat rate is relevant for the calculation of SRMC, while average heat rates are used to calculate average variable costs (average heat rates are used to determine marginal heat rates as shown in the examples to follow).

As many other costs in electricity generation are relatively linear, the actual SRMC of the generator falls as production increases. A generator's SRMC will be less than its average variable cost across much, and possibly all, production levels.

⁷ Here 'one more unit' is not necessarily 1MW. For example, one more unit could be the difference in output from starting up and going to minimum generation, in which case a generator can include start-up costs in the SRMC calculation.

⁸ SRMC and average variable costs are considered the same up to the point of minimum generation.

⁹ The path to maximum generation is not necessarily continuously variable due to factors that may affect stability and efficiency.

A generator will lose money supplying electricity, unless the balancing price received equals or exceeds the generator's average variable costs.

Strict pricing at a generator's SRMC can lead to a generator making a loss in the Balancing Market, which is not sustainable in the long term. This affects whether optimal investment in the WEM can be achieved.

For these reasons, the ERA considers that pricing at average variable cost is a valid approach in the context of clause 7A.2.17 of the Market Rules. It is likely that the offered prices would reflect the generator's reasonable expectation of the costs of generation and would prevent it from making short-run losses.

Further, a generator cannot offer prices equal to the SRMC for each production level, because it must offer prices in a monotonically upwards manner (that is, each successive tranche bid into the market must be at a higher price than the last), otherwise notionally higher-output tranches will be dispatched first.

Due to these peculiarities of electricity generation, when a generator offers prices above its reasonable expectation of its SRMC, but does not exceed its average variable cost, the ERA considers that the behaviour may not be related to market power.

4 Interpretation of undefined terms in clause 7A.2.17 of the Market Rules

This section provides guidance on the ERA's interpretation of undefined terms in clause 7A.2.17 of the Market Rules. As a general principle of interpretation, words should be given their ordinary meaning within the context in which they appear in the Market Rules.

4.1 Reasonable expectation

An expectation is a belief that something will be the case or is likely to happen in the future. It could also be a forecast. For an expectation to be reasonable, the expectation must have some basis above guessing or speculating. It may also be viewed in the context of the information available to the generator. A market generator should be better informed than someone not familiar with the market. Therefore, a market generator is expected to have a good understanding of its costs, and of the market more broadly, including the Market Rules.

Market participants are not required to have perfect foresight to form a reasonable expectation. A market participant's reasonable expectation of its SRMC at the time of making its balancing submission for a particular trading interval may differ from the eventual SRMC for a number of reasons, including that information was not available at the time the forecast was made. The important factor is that the market participant's forecast was reasonable.

Essentially, the test is what a reasonable market generator would have expected under the circumstances known (or that ought to have been known) to that generator at the time it made the balancing submission.

The ERA does not intend to take action against a market generator for making an error in its forecasting, as long as the balancing offer represents a reasonable expectation of this generator's SRMC of generating the relevant electricity. The ERA needs only to be satisfied the market participant has acted in a reasonable way.

The ERA would investigate offers that did not appear to represent a reasonable expectation of the SRMC of generating the relevant electricity in a given trading interval.

4.2 Market power

Market power can be defined as the ability to influence prices and to benefit financially from this ability. An entity with market power can usually operate with limited constraints from competitors, suppliers, customers or new entry into the market.

Decisions on quantity may also indicate market power, for example, where a market participant withholds energy from the market. This is because withholding can affect the balancing price¹⁰. Withholding can be either physical (by taking a generator offline), or economic (by raising the price at which it offers some or all of its output above its SRMC and up to the market price cap). In many short-term electricity markets, demand is

¹⁰ Biggar, D, The Theory and Practice of the Exercise of Market Power in the Australian NEM <https://www.aer.gov.au/system/files/AER%20Attachment%201%20-%20Darryl%20Biggar%20paper%20-%20The%20theory%20and%20practice%20of%20the%20exercise%20of%20market%20power%20in%20the%20Australian%20NEM%20-%2026%20April%20%202011.pdf>

completely inelastic over the relevant trading interval. In this situation, withholding usually results in an increase in price without a reduction in consumed quantity.

Some market participants have the ability and incentive to influence market outcomes through withholding. The ERA is primarily focused on economic withholding, as this allows a firm with market power to earn a relatively higher price on its cleared capacity than it would have, had it offered its entire supply at competitive levels. In addition to specific exemptions in clause 7A.2.17 of the Market Rules, there are instances where withholding may not be related to market power and the ERA has to be satisfied that any intention for withholding is reasonable.

Several elements of clause 7A.2.17 of the Market Rules affect the interpretation of market power:

- (a) There is no express requirement that market power be significant or sustained.
- (b) The provision is capable of being mobilised for “any trading interval”, in connection with the generation of the “relevant electricity”.
- (c) There is a link between market power and a generator’s reasonable expectation of its SRMC.

Element (a) above indicates that **any** market power is of concern under clause 7A.2.17 of the Market Rules.

In energy-only markets, such as the National Electricity Market, some degree of temporary market power may be necessary or desirable for generators, as it signals the need for new capital investment in the market and allows peaking plants to cover costs when they do generate. This is because there is no separate capacity market providing capacity payments.

Prices in Western Australia’s capacity market provide the signal on the adequacy of generation capacity and the need for new investment, and allow peaking plants to cover costs even if they seldom generate electricity.

Whether or not market power exists in the context of clause 7A.2.17 of the Market Rules, the timeframe over which the assessment is made should be no longer than is necessary for trading to take place. In the WEM, this is a single trading interval.¹¹ Pricing above a generator’s reasonable expectation of SRMC for a single trading interval can be enough to trigger a breach of clause 7A.2.17 of the Market Rules where the behaviour is related to market power.

4.3 When pricing ‘relates to’ market power

A causal link needs to be made between a market participant’s market power and its pricing behaviour before determining whether that market participant’s behaviour is related to market power.

In assessing the existence of this causal link, the ERA would consider whether or not a market participant would have offered the same prices during a given time period both with and without market power. The pricing behaviour may relate to market power, where the prices offered in a balancing submission:

¹¹ For any trading interval or a collection of intervals, pricing should reflect the reasonable expectation of SRMC.

- (a) Differ from the market participant's standard pricing behaviour¹² when it did not have market power.
- (b) Increase the market participant's profits when it has market power relative to its standard pricing behaviour without market power.¹³

Standard pricing may include, but is not limited to, trends in bidding behaviour or bands within which offers typically fall.

Ultimately, whether a market participant has market power and whether its behaviour relates to that market power will be a question of fact and determined by considering all relevant circumstances.

¹² Clause 7A2.18 (a) of the Market Rules allows the ERA to take into consideration a market participant's "historical Balancing Submissions, including changes made to Balancing Submissions, in which a pattern of behaviour may indicate an intention to create a false impression in the Balancing Market;"

¹³ There could be circumstances in which a generator would make exactly the same profits. It could be indifferent being dispatched or not if its capital costs are covered in the capacity market and its bids into the market at its average variable costs.

5 Worked examples

The ERA has prepared three examples to help market participants' understand its interpretation of clause 7A.2.17 of the Market Rules. In each example the ERA has assumed that the generator has market power.

5.1 Example 1

Assume a coal generator with a minimum generation output level of 20MW. It is running and has heat rates, cost and input variables to produce 40MW¹⁴ as shown in Tables 2 and 3 below. Whether the input is considered part of SRMC or average variable cost is also included:

Table 2: Input cost components

Input cost components	Cost \$/MWh @ 40MW SRMC (AVC)	SRMC	AVC
Operations and maintenance ¹⁵	9.00	N	Y
Ancillary expenses ¹⁶	2.00	N	Y
Shared services ¹⁵	1.00	N	Y
Mill maintenance ¹⁵	3.00	N	Y
Fuel cost at coal price of \$3/GJ	43.50 (54.00)	Y	Y
Incremental operation and maintenance	5.00	Y	N
SRMC (AVC)	48.50 (69.00)		

Table 3: Output range and average heat rates

Output (MW)	Average heat rate ¹⁶
20	19.00
35	18.50
40	18.00

¹⁴ This is equivalent to 20MWh in a half hour trading interval. In the marginal heat rate (MHR) equation, a factor of 0.5 works its way out to give the same result. In the other examples (2 and 3), average variable cost calculations are in MWh and hence a factor of 0.5 is applied to convert figures from MW to MWh.

¹⁵ For this example we assume these costs are incurred when generating the relevant electricity, but they do not change with production levels and are, therefore, considered avoidable fixed costs.

¹⁶ As these are simplified examples, heat rates at other increments are not presented. In practice, smaller heat rate bands on either side of 40MW would be used.

To calculate the fuel cost for SRMC, multiply the marginal heat rate at 40MW (14.5GJ/MWh – details in Box 1 below) by the coal price of \$3/GJ, which gives a fuel cost of \$43.50/MWh.

Box 1

The generator's marginal heat rate is calculated as follows:

$$MHR = \frac{(40MW * HR(40MW) - 35MW * HR(35MW))}{(40MW - 35MW)}$$

$$= \frac{(40MW * 18GJ/MWh - 35MW * 18.5GJ/MWh)}{(5MW)}$$

$$= \frac{(720GJ - 647.5GJ)}{(5MW)}$$

$$= 14.5GJ/MWh$$

The only other allowable variable cost, which can be added to fuel cost to arrive at the SRMC in Table 2 above, is the incremental operations and maintenance cost of \$5/MWh, resulting in a SRMC of \$48.50/MWh.

Avoidable fixed costs form part of the average variable cost. In practice, these components are calculated differently from the SRMC figures as they are averaged, or spread over total generation (from minimum generation to the production level), as opposed to using the SRMC equivalent, which is determined at the margin for a small output change. Also note the differentiation of marginal and average heat rates. In the calculation of SRMC above, average heat rates were used to calculate the marginal heat rate at production of 40MW.

To calculate the fuel cost as part of the average variable costs, multiply the average heat rate at 40MW (18GJ/MWh) by the coal price of \$3/GJ, which gives fuel cost of \$54/MWh.

In this Example 1, the allowable input cost components from Table 2 are added to the fuel cost to calculate the total average variable cost of \$69/MWh and include operations and maintenance (\$9/MWh), ancillary expenses (\$2/MWh), shared services (\$1/MWh), and mill maintenance (\$3/MWh).

In this Example 1, the generator would make a loss if it bid at SRMC of \$48.50/MWh and the balancing price was below its average variable costs, as a generator's breakeven price is its average variable cost.

The ERA considers that in Example 1 the generator could make price and quantity offers up to \$69/MWh without contravening clause 7A.2.17 of the Market Rules.

5.2 Example 2

Assume a gas powered unit is running and forecasts to run at 250MW with the following input costs (Table 5) and (average) heat rates (Table 4):

Table 4: Output and heat rates

Output (MW)	Heat rate (GJ/MWh)
105	8.310
135	7.883
200	7.680
250	7.625
270	7.779
300	7.897

Table 5: Input cost components

Input cost components	Value
Variable operating and maintenance	\$5/MWh
Start-up costs	\$2,000
Other avoidable fixed costs	\$100/hr
Gas price	\$6/GJ

The average variable cost is calculated by multiplying the heat rate at 250MW by the fuel price of \$6/GJ, and by adding the operating and maintenance costs and average avoidable fixed costs per MW. Start-up costs are not included, as the plant is already running. The avoidable fixed cost figure is converted to a per MW figure by dividing it by the generator's power output:

$$AVC = 7.625 * 6 + 5 + 100/250$$

$$AVC = \$51.15/MWh$$

In this Example 2, this figure would be considered the upper limit of this generator's Balancing Submission bids.

To calculate SRMC, it is necessary to convert the average heat rates to marginal heat rates using the formula as in Example 1:

$$\begin{aligned}
 MHR &= \frac{(250MW * HR(250MW) - 200MW * HR(200MW))}{(250MW - 200MW)} \\
 &= \frac{(250MW * 7.625GJ/MWh - 200MW * 7.68GJ/MWh)}{(50MW)} \\
 &= \frac{(1,906.25GJ - 1,536.00GJ)}{(50MW)} \\
 &= 7.41GJ/MWh
 \end{aligned}$$

As in Example 1, the fuel cost is calculated by multiplying the marginal heat rate by the gas price, which equals \$44.43/MWh.

Adding the variable operating and maintenance costs of \$5/MWh gives a SRMC of \$49.43/MWh.

In this Example 2, the generator would make a loss if it bid at its SRMC of \$49.43/MWh and the balancing price was below its average variable costs, as a generator's breakeven price is its average variable cost.

Accordingly, the ERA considers that in this Example 2 the generator could make price and quantity offers up to its average variable cost of \$51.15/MWh without contravening clause 7A.2.17 of the Market Rules.

5.3 Example 3

This Example 3 is based on the plant with the same costs and heat rates as in Example 2 above, but which is not currently generating. The plant is expected to start up and run for 12 trading intervals at 200MW.

At 200MW, the average heat rate is 7.68GJ/MWh, which can be used to calculate the marginal heat rate as follows:

$$\begin{aligned}
 MHR &= \frac{(200MW * HR(200MW) - 105MW * HR(105MW))}{(200MW - 105MW)} \\
 &= \frac{(200MW * 7.68GJ/MWh - 105MW * 8.31GJ/MWh)}{(95MW)} \\
 &= \frac{(1,536.00GJ - 872.55GJ)}{(95MW)} \\
 &= 6.98GJ/MWh
 \end{aligned}$$

Note the average heat rate at the minimum generation level of 105MW is used, as the generator is starting up from zero.

Multiplying the marginal heat rate by the gas price (6.98*\$6/GJ) produces a fuel cost of \$41.90/MWh. SRMC is then calculated by adding variable operation and maintenance costs of \$5/MWh, resulting in SRMC of \$46.90/MWh.

As start-up costs do not form part of SRMC, this generator would make a loss, unless the balancing price was equal to its average variable cost, which includes start-up costs and other avoidable fixed costs. Start-up costs are averaged over an output factor taken to be the expected generation level (200MW in this case) multiplied by the 12 expected trading intervals (multiplied by 0.5 to convert to hours). Avoidable fixed costs are averaged over the expected generation level. This gives an average variable cost of:

$$AVC = 7.68 * 6 + 5 + \frac{100}{200} + \frac{2,000}{12 * 0.5 * 200}$$

$$AVC = \$53.25/MWh$$

The ERA considers that in this Example 3 the generator could submit bids in the Balancing Market up to its average variable costs of \$53.25/MWh without contravening clause 7A.2.17 of the Market Rules.