

Australian Energy Market Commission

CONSULTATION PAPER

National Electricity Amendment (Five Minute Settlement) Rule 2016

19 May 2016

**RULE
CHANGE**

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About the AEMC

The AEMC reports to the Council of Australian Governments (COAG) through the COAG Energy Council. We have two functions. We make and amend the national electricity, gas and energy retail rules and conduct independent reviews for the COAG Energy Council.

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Summary

Sun Metals Pty Ltd proposes changes to the National Electricity Rules (NER) to address the mismatch between the time intervals for operational dispatch and financial settlement in the National Electricity Market (NEM). This consultation paper has been prepared to facilitate public consultation on the proposal.

Under the current arrangements, some generators and other wholesale market participants submit bids or offers to the market operator, signalling their willingness to generate, consume or transport electricity. The dispatch price is the bid of the most expensive generator that needs to be dispatched in order to balance demand and supply in each five minute period.

While a dispatch price is determined for each five minute dispatch interval, settlement - the transfer of money for electricity supplied to the market and consumed by end users - is calculated on a 30 minute basis. The settlement price is the time-weighted average of the six dispatch prices that occurred during any given 30 minute trading interval.

Sun Metals is of the view that the mismatch between the dispatch and settlement intervals leads to inefficiencies in the operation and generation mix of the market. It submits that this aspect of the market design provides incentives for generators to withdraw capacity to influence price outcomes and impedes some categories of participants from entering the market.

Sun Metals proposes a possible solution that involves compulsory five minute settlement for generators. Demand side participants in the wholesale market, including retailers and large consumers, could choose to be settled on either a five or 30 minute basis. The Commission is consulting on the components of the proposed solution, which are likely to form part of any possible solution.

In response to this rule change request, the Commission can make the proposed rule, make a rule that is different to the proposed rule, or not make a rule. The Commission will consider Sun Metals' proposal to assess whether the mismatch between the dispatch and settlement intervals creates a material problem that needs to be addressed. If the Commission establishes that there is a material problem, it will consider whether the possible solutions are likely to contribute to the achievement of the national electricity objective (NEO). This will include an analysis of the likely costs and benefits of making a change, and the likely transition to new arrangements.

Submissions on this consultation paper are due by no later than **16 June 2016**.

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1 Introduction

Sun Metals Pty Ltd proposes changes to the National Electricity Rules (NER) to address the mismatch between the time intervals for operational dispatch and financial settlement in the National Electricity Market (NEM). The proposal involves a five minute settlement regime which is compulsory for generators, scheduled loads and market network services providers (MNSPs), and optional for other wholesale market participants.

This consultation paper has been prepared to facilitate public consultation on the rule change proposal.

This paper sets out:

- a background to, and a summary of, the rule change request;
- an overview of the Commission's proposed assessment framework, and approach to assessing the rule change request;
- a number of issues and questions to facilitate the consultation on this rule change request; and
- the process for making submissions.

2 Background

This chapter provides:

- an explanation of the existing arrangements for dispatch and settlement;
- a brief overview of relevant work undertaken by the National Electricity Market Management Company (NEMMCO) between 1999 and 2003; and
- a summary of the Bidding in Good Faith rule change.

2.1 Current arrangements

The NEM is a gross pool market where all electricity supplied to the market and consumed by end users is transacted at the spot price. It is also an energy only market, meaning suppliers of electricity are only compensated for energy supplied to the central pool.¹ These features mean that spot prices must provide incentives for both operational and investment decisions, making the way in which prices are determined a critical element of the market design.

The Australian Energy Market Operator (AEMO) operates the market by balancing instantaneous supply and demand. Scheduled and semi-scheduled generators, scheduled loads and MNSPs² submit bids or offers to AEMO, signalling their willingness to generate, consume or transport electricity. For each trading day commencing 4:30am, these offers are due before 12:30pm on the day prior.

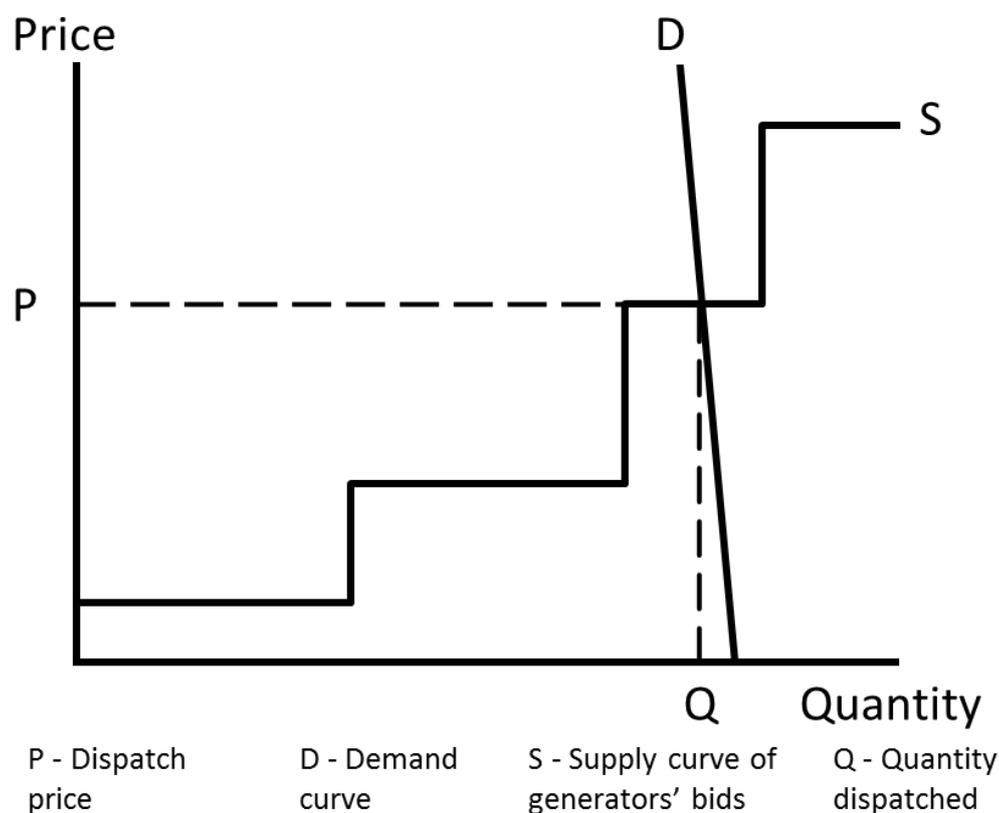
A generator may revise its offer up until the start of processing for the relevant dispatch interval through rebids that shift the quantities of electricity offered between the different price bands, while keeping the prices the same. Rebidding provides generators with the flexibility to adjust their position in response to changes in the market, including the actions of other generators.

The central dispatch engine orders generators' offers from least to most expensive and determines which participants should be dispatched. In this way, the expected demand for electricity is supplied by the least-cost mix of generators, subject to network and other constraints. Generators that have their bid accepted are paid the price of the highest bidder that was dispatched for the interval. This process is depicted in Figure 2.1 below. The stepped supply curve represents the quantity of capacity that generators are willing to provide to the market at nominated prices.

¹ This is in contrast to an energy and capacity market where suppliers may also receive payments for being available.

² MNSPs are interconnectors that earn revenue based on the difference between the spot prices of the two regions which they connect.

Figure 2.1 Process of setting dispatch price



While a dispatch price is determined for each five minute dispatch interval, settlement - the transfer of money for electricity supplied to the market and consumed by end users - is calculated on a 30 minute basis (i.e. for each trading interval). The settlement price is the time-weighted average of the six dispatch prices that occurred during any given trading interval.³ Participants are settled on the basis of the half hourly settlement price and their aggregate production or consumption during the respective half hour.

These arrangements have been in place since the start of the NEM in December 1998.⁴ A five minute dispatch interval was chosen since, relative to a longer interval, it more closely matches the dynamic nature of the power system. A shorter interval reduces the potential for supply and demand to deviate from their expected levels within the dispatch interval, resulting in lower costs to keep the system in balance.

The 30 minute settlement interval reflects limitations in the technology available at the time. It was thought that a five minute settlement interval would require significant additional computational resources, and that metering equipment was not sophisticated enough to handle any finer detail than half hourly pricing.⁵

³ Where the dispatch price is represented by D1 for 12:05pm, D2 for 12:10pm, et cetera, and the settlement price for 12:30pm by S, $S = (D1+D2+D3+D4+D5+D6) / 6$.

⁴ NECA, *National Electricity Code*, version 1, 19 November 1998.

⁵ ACCC, *Applications for authorisation - National Electricity Code*, 10 December 1997, p60.

2.2 NEMMCO projects 1999-2003

Between 1999 and 2003, NEMMCO, now AEMO, undertook two investigations into the mismatch between dispatch and settlement. In September 1999, NEMMCO published a paper prepared by the NEMMCO-sponsored Dispatch and Pricing Reference Group.⁶ The paper identified issues arising from five minute dispatch and 30 minute settlement, and sought stakeholder views on alternative approaches. In response to stakeholder feedback, NEMMCO recommended that further work be undertaken.⁷

NEMMCO then formed a working group including representatives from the different sectors of the industry.⁸ The working group developed an issue definition and an options paper, which were both published in September 2001.⁹ It evaluated eight options, deciding upon two options which were then the subject of a cost benefit analysis. The two options were:

1. Five minute settlement that is compulsory for supply side participants and optional for others. This would be achieved by profiling existing 30 minute data into five minute intervals. This option forms the basis of Sun Metals' proposal.
2. Demand-weighted pricing. Supply side participants would install five minute metering and be paid a 30 minute volume-weighted price (i.e. dispatch prices weighted against their own five minute metered electricity). Demand side participants would also pay a volume-weighted price, but the volume would be the total system demand rather than their own.

The cost benefit analysis was undertaken by a consultant, using costs that were provided by members of the working group, and the consultant's modelling of the potential benefits.¹⁰ In the circumstances at the time, the consultant found that the costs of implementing either of the modelled options would exceed the efficiency benefits. NEMMCO therefore recommended that no changes be made to the dispatch and settlement arrangements.

2.3 Bidding in Good Faith rule change

In December 2013, the AEMC received a rule change request from the South Australian Minister for Mineral Resources and Energy proposing changes to the NER provisions that govern the manner in which generators offer electricity to the wholesale market.

⁶ NEMMCO, *Anomalies in the NEM Due to Five-Minute Dispatch and Thirty-Minute Settlement, Issues and Options paper*, 3 September 1999.

⁷ NEMMCO, *Anomalies in the NEM Due to Five-Minute Dispatch and Thirty-Minute Settlement, Draft Final Report*, 29 August 2000.

⁸ The working group included representatives from NEMMCO, generators, retailers, MNSPs, transmission network service providers (TNSPs) and end user groups.

⁹ NEMMCO, *Options for resolving the 5 minute dispatch and 30 minute settlement anomaly in the NEM*, September 2001.

¹⁰ MMA, *Benefits and Costs of Alternative Arrangements for Aligning Dispatch Prices and Settlement Payments*, final report, 22 May 2002.

The problem identified by the rule change request was the potential for participants to deliberately delay their rebids to withhold information from the market. The Commission took the view that delaying rebids to withhold information distorts wholesale price outcomes, decreasing confidence in the information provided to the market via contract prices and AEMO's pre-dispatch forecast.

The Commission made a rule in December 2015 to create a prohibition on false or misleading offers, and introduce a requirement that rebids be made as soon as practicable after a change in the material conditions and circumstances upon which the initial offer was based.¹¹ The rule also introduced new information recording requirements for rebids made close to dispatch. The Commission considers that this rule is likely to lead to more efficient wholesale price outcomes in the short term and create improved signals for investment that better reflect underlying supply and demand conditions. The rule will commence on 1 July 2016.

While there was some discussion about the mismatch between the dispatch and settlement intervals during the Bidding in Good Faith rule change process, this issue was outside of the scope of that process. However, the Commission did acknowledge in its final determination that the incentives on some generators to engage in strategic late rebidding were exacerbated by the mismatch between dispatch and settlement.

¹¹ AEMC, *Bidding in Good Faith*, final determination, 10 December 2015.

3 Details of the rule change request

This chapter summarises the issues identified and solution proposed in the rule change request.

3.1 Issues

Sun Metals submits that the mismatch between the dispatch and settlement intervals leads to inefficiencies in the operation and generation mix of the market. Specifically, this aspect of the market design:

- accentuates strategic late rebidding, where generators have been observed to withdraw generation capacity in order to influence price outcomes; and
- impedes market entry for fast response generation and demand side response.

Sun Metals notes that batteries, some loads and some transmission systems are capable of responding in a single five minute dispatch interval. It submits that the capability of these technologies is not appropriately recompensed under the current arrangements and will therefore not be properly utilised.

Sun Metals provides two examples in support of its view that there is little incentive for fast response technologies to enter the market. These are summarised as follows:

1. A fast start generator being dispatched for one dispatch interval in response to a high five minute price. Through averaging, the 30 minute average price received by the generator would be less than the five minute price at the time that the generator was producing.
2. Loads, such as Sun Metals, having to restrict consumption over the whole 30 minute trading interval, to avoid high price events that may only last for a single five minute dispatch interval. This may be more disruptive for a load than a five minute response.

Sun Metals submits that the average price may not be sufficient for investment in fast start generation, or for the operation of existing generation capacity. It also considers that the requirement for it to reduce consumption for a full half hour is disproportionately disruptive to the production of zinc and its associated economic benefit.

3.2 Proposed solution

To address the issues identified, Sun Metals proposes a five minute settlement regime which is compulsory for generators,¹² scheduled loads and MNSPs, and optional for other wholesale market participants.

Generators, scheduled loads and MNSPs would be settled on a five minute basis using:

- existing five minute prices calculated by AEMO; and
- energy from existing revenue meters, allocated to the five minute periods within a half hour using operational data from supervisory control and data acquisition (SCADA) systems.

SCADA systems are used to monitor and control industrial process, such as power station generating units. The proposed use of SCADA data and the differences between SCADA and existing metering for revenue purposes are discussed in section 5.2.1.

Other wholesale market participants, including retailers and large consumers, could choose to be settled on either a five or 30 minute basis. All participants may choose, at their own cost, to install metering equipment capable of accurately measuring energy on a five minute basis.

As five minute settlement would be optional for the demand side of the market, AEMO would need to operate concurrent five and 30 minute settlement for different participants. This arrangement would create an imbalance between the money earned by supply side participants settled on a five minute basis and the money paid by demand side participants, who could be settled on either a five or 30 minute basis.

Sun Metals proposes a new mechanism to correct the imbalance. The imbalance amount, which could be positive or negative, would be recovered entirely from those demand side participants who continue to be settled on a 30 minute basis.

The rule change request does not include a proposed rule, but notes that changes to Chapter 3 of the NER would be necessary to implement the proposed solution.

¹² The five minute settlement regime would be compulsory for scheduled, semi-scheduled and non-scheduled market generators that sell electricity into the spot market at the spot price.

4 Assessment framework

The National Electricity Law (NEL) confers on the Commission the ability to take one of three potential actions in response to receiving a valid rule change request.¹³ It can make the proposed rule if it is satisfied that the rule is likely to contribute to the achievement of the national electricity objective (NEO). Alternatively, it can make a more preferable rule which is different to the proposed rule if it is satisfied that, having regard to the issues raised by the rule change request, the more preferable rule is likely to better contribute to the achievement of the NEO than the proposed rule. The third option is for the Commission to not make a rule.

Accordingly, the Commission's assessment of this rule change request will consider whether the proposed rule promotes the NEO, which is:

“to promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to:

- (a) price, quality, safety, reliability and security of supply of electricity;
and
- (b) the reliability, safety and security of the national electricity system.¹⁴”

The objective captures the three dimensions of efficiency: productive (efficient operation), allocative (efficient use of) and dynamic efficiency (efficient investment).¹⁵

Based on a preliminary assessment of this rule change request, the Commission considers that the relevant aspects of the NEO are the efficient investment in and use of electricity services with respect to the price of electricity.

The role of wholesale prices in the short term is to signal to generators to increase or decrease supply depending on whether this is valued by consumers, thereby promoting efficient outcomes. Consumers who accept full or partial exposure to wholesale market prices can similarly respond by increasing or decreasing their consumption.¹⁶ Wholesale prices also indicate how much it costs to produce

¹³ A valid rule change request is a request that the AEMC will act on under Division 3 of the NEL, having had regard to the matters set out in s. 94(1) of the NEL.

¹⁴ NGL, s. 7.

¹⁵ Productive efficiency means goods and services should be provided at lowest possible cost to consumers; allocative efficiency means that the price of goods and services should reflect the cost of providing them, and that only those products and services that consumers desire should be provided; dynamic efficiency means arrangements should promote investment and innovation in the production of goods and services so that allocative and productive efficiency can be sustained over time, taking into account changes in technologies and the needs and preferences of consumers.

¹⁶ This can be done either by becoming a wholesale market customer or through contractual agreements with retailers. Consumers may then undertake measures to manage their electricity use and limit this exposure, for example, they may engage with energy management experts.

electricity, providing generators and consumers with information that they can use when making decisions to invest in new generation capacity and load.

For this to occur, the price settling process should be sufficiently transparent and robust such that market participants have confidence that these signals are generally reflective of underlying supply and demand conditions. Further, prices should be sufficiently granular so to accurately reflect the value of electricity at different locations and different points in time. This rule change concerns the temporal granularity of the market price signal, which is discussed later in this paper.

The Commission uses an assessment framework to evaluate whether the proposed rule, if made, is likely to promote the NEO. The framework may be refined during the rule change process. At this stage the Commission is seeking stakeholder views on its proposed assessment framework, which includes the following factors:

- **Prices that reflect the marginal cost of supply and value of its use.** To promote efficient outcomes in the electricity market, spot prices should generally reflect the marginal cost of supply and value of consuming electricity. A shorter settlement interval would lead to prices that more accurately reflect the value of supplying or consuming electricity at different times. The Commission will consider the extent to which the proposed changes would improve price signals in the NEM, and whether this would lead to more efficient dispatch outcomes and investment decisions.
- **Price risk exposure.** All electricity generated and consumed in the NEM is transacted at the spot price. Participants can physically manage their exposure through their choice of generation technology (i.e. choosing generation technologies that provide necessary flexibility and control) and bidding (i.e. bidding at or above the cost of supply, so to avoid being dispatched if losses would be incurred). The mismatch between dispatch and settlement may create undue risks for participants, as the ability of participants to respond to changes in the market (via the dispatch process) is not well aligned with financial outcomes (settlement). The Commission will consider the impact of aligning dispatch and settlement on the ability of market participants to manage their price risk exposure.
- **Price risk allocation.** Participants can financially manage their exposure to spot prices by entering into contractual agreements that provide greater price certainty. These arrangements can involve the buyer of a contract paying the seller to take on some or all of the price risk to which the buyer is exposed. While these arrangements occur outside of the NEM, the Commission acknowledges that changes to the NEM market design may impact on the incentives for participants to buy and sell hedging contracts. The Commission will consider the potential impact of the proposed changes on contracting arrangements.
- **Supply and demand side competition.** A more accurate NEM spot price may provide better incentives for demand side participation, such as consumers deciding to curtail consumption, delay consumption, or install their own

generation capacity. These responses have the potential to reduce price spikes and average prices. More accurate spot prices may also encourage greater supply side competition with generators entering the market that are able to take advantage of spot price variability or existing participants investing in additional flexibility. The Commission will consider the extent to which this may occur if five minute settlement is implemented.

- **Regulatory and administrative burden.** The Commission will consider the potential regulatory and administrative burden on market participants that may arise if the proposed rule were to be implemented. Through this rule change process, the Commission seeks to understand the magnitude and distribution of the costs so that they can be compared against the likely benefits of making the change. The costs associated with the proposed changes would involve once-off costs associated with the transition as well as on-going costs associated with the new regime.

The Commission acknowledges that the assessment of the likely costs and benefits of the proposed changes will be an important component of the Commission's assessment of the rule change request. The proposed changes would likely result in costs and benefits accruing to most market participants, which would ultimately impact on the cost of electricity for end users. The costs and benefits will depend on the specific components of the solution, should this be needed. The components of a possible solution are discussed in Chapter 5.

5 Issues for consultation

Issues relevant to this rule change request are outlined below and have been provided for guidance. Stakeholders are encouraged to comment on these issues as well as any other aspect of the rule change request or this paper, including the proposed assessment framework.

5.1 Is there a problem?

The starting point for the Commission's consideration of this rule change request is to assess whether there is a material problem with the market design that needs to be addressed. This assessment of the issue and its materiality covers how the market is currently operating and whether the market design is sufficiently robust to accommodate potential future changes in technology and business models.

This section discusses the role of spot prices in energy only markets and then describes some situations that can occur due to the mismatch between the dispatch and settlement intervals in the NEM.

5.1.1 Role of spot prices in energy only markets

The NEM is an energy only market, where suppliers of electricity are only compensated for energy supplied to the pool.¹⁷ The significance of this is that participants must recover both their variable and fixed costs through the spot market. Separately, participants can manage the risks to which they are exposed by entering into contractual arrangements outside of the NEM that typically reference the spot price.

Due to the physical characteristics of the electricity system and the changing demand and supply conditions, spot prices need to vary to reflect changes in market conditions. As production must match consumption virtually instantaneously, the means through which electricity is delivered are constantly changing. When demand changes, a different set of generators may be called upon to operate. As parts of the network approach the limit of the amount of electricity that they can transport, electricity must instead flow via a different route, or be sourced from different generators.

An idealised cost reflective price would reflect the physical condition of the system and the continuous changes in the underlying supply and demand. Market participants would then face accurate prices on which to base their operational and investment decisions. For example, persistently high spot prices may indicate a need for new baseload generation capacity, whereas isolated high price events may provide an opportunity for new peaking plant or demand side response.

¹⁷ This is in contrast to an energy and capacity market, such as in Western Australian, where participants may also receive payments for being available.

In theory, there would be no formal limit to the spot price as consumers would have the ability and incentive to respond to spot prices. For this to occur, consumers would need to accept full or partial exposure to wholesale market prices. If consumers have the ability to curtail their usage, the spot price would be limited by the willingness to pay of the consumer who places the most value on receiving supply. This value would vary, depending on the needs of end users.

In practice, there are limits to spot price granularity. A shorter pricing interval increases the computational requirements for the market operator and participants. If prices were determined every few seconds, the number of data points would be several orders of magnitude higher than five or 30 minute pricing. The ideal granularity of the spot price is a function of efficiency gains from more accurate prices, the technical capabilities of participants and the power system, and the costs associated with recording and managing the increased volume of data.

5.1.2 Spot prices in the NEM

Under current arrangements, AEMO optimises the operation of the market on a five minute basis, providing dispatch instructions to generators, scheduled loads and MNSPs to meet by the end of each five minute interval. For each five minute dispatch interval, the regional spot price is taken to be equivalent to the bid price of the most expensive generator that needs to be dispatched to meet the expected demand for electricity. The settlement price is then calculated as the time-weighted average of the six dispatch prices that occurred during each 30 minute trading interval.

Dispatch prices are determined on an *ex ante* basis, before actual generation and demand are known to the market operator. Settlement prices are calculated *ex post* at the end of each trading interval, but do not account for deviations between expected and actual generation and demand.

Although the market is optimised on a five minute basis, the NEM does not currently provide a direct incentive for participants to respond to five minute changes in market conditions. All electricity generation and consumption is settled on the basis of the half hourly average price and participants' financial outcomes are not affected by the timing of generation or consumption within each half hour. When the six dispatch prices within a half hour are very close to the time-weighted average of those six prices (i.e. the settlement price), the incentives faced by participants are equivalent to if they had faced the five minute price (even though they are not settled on a five minute basis). However, when there are large variations in the six dispatch prices within a half hour period, the incentives for participants to efficiently respond to five minute changes in the market, and to maximise profits, may not be well aligned.

The remainder of this section sets out two scenarios that are possible under the current market arrangements where there are large variations in dispatch prices within a single half hour period.

The first example is a price spike that occurs towards the beginning of a trading interval. In such instances, participants may have an incentive to improve their

settlement outcomes even though the market condition causing the price spike may have passed. Generators may seek to increase their output, while large consumers may continue to reduce consumption. As noted by Sun Metals in the rule change request, loads have to provide a response for a full half hour in order to avoid a price spike, which may have only been for a single five minute dispatch interval.¹⁸

Alternately, if a spike is not high enough, or sustained for multiple intervals, peaking generators may not respond to an early price spike if the expected 30 minute price is insufficient to recover their costs.

Another example is the case of a price spike occurring towards the end of a trading interval. In such instances, few, if any, participants are able to respond. This may create risks for some categories of participants if they have not anticipated the high price event. If a load consumes during the first 25 minutes of the trading interval in the expectation that the price for the half hour would be moderate, it would be disadvantaged as all their consumption for the half hour would be charged at the higher average price. The potential for this to occur may be a disincentive for loads to accept spot price exposure. Peaking generators may also be disadvantaged under certain contractual arrangements.

Issue 1	Is there a problem?
1.	To what extent does the mismatch between the dispatch and settlement intervals create risks for market participants? What is the materiality of these risks and under what circumstances are they most acute?
2.	What types of supply and demand side participants are capable of responding within a five minute period? Under what circumstances can these responses occur?
3.	Would the wholesale market operate more or less efficiently if supply side participants were settled on a five minute basis?
4.	Compared to the current arrangements, would settlement on a five minute basis be more conducive to demand side participation? How would demand side participants respond and what impact would this have on market efficiency?

5.2 Possible solutions

In response to this rule change request, the Commission can make the proposed rule, make a rule that is different to the proposed rule, or not make a rule. The Commission will only make a rule if it finds that there is a problem with the current arrangements, and there is a solution that it considers will, or is likely to, contribute to the

¹⁸ A response could be in the form of restricting consumption or using a battery to offset consumption from the grid for a short amount of time.

achievement of the NEO. As part its assessment, the Commission will consider the likely costs and benefits of any solution.

The following sections discuss the components of Sun Metals' proposed solution, which includes a new source of five minute data and a mechanism to manage the settlement imbalances between the money paid by consumers and the money owed to generators. Some potential impacts on contracting arrangements are also discussed, as are other possible solutions to the issues raised by Sun Metals.

5.2.1 Five minute data

When settling the market, AEMO currently takes account of the 30 minute price and the aggregate production or consumption of individual participants during each half hour. The latter is provided by metering equipment, which is installed at the connection points of individual participants. Consistent with the 30 minute settlement interval, metering data is provided to AEMO for each 30 minute period.

Five minute settlement would require a new data source to supplement or replace the existing 30 minute data from meters. Sun Metals' proposal involves AEMO using operational data from SCADA systems to allocate, or 'profile', the 30 minute metered energy to the 5 minute periods within the half hour. Sun Metals considers that using SCADA data will reduce implementation costs by avoiding the need to replace existing meters.

SCADA systems are used by AEMO and asset owners to monitor and control the power system in real time. The differences between existing metering for revenue purposes and SCADA measurement are summarised below.

Table 5.1 Revenue metering versus SCADA

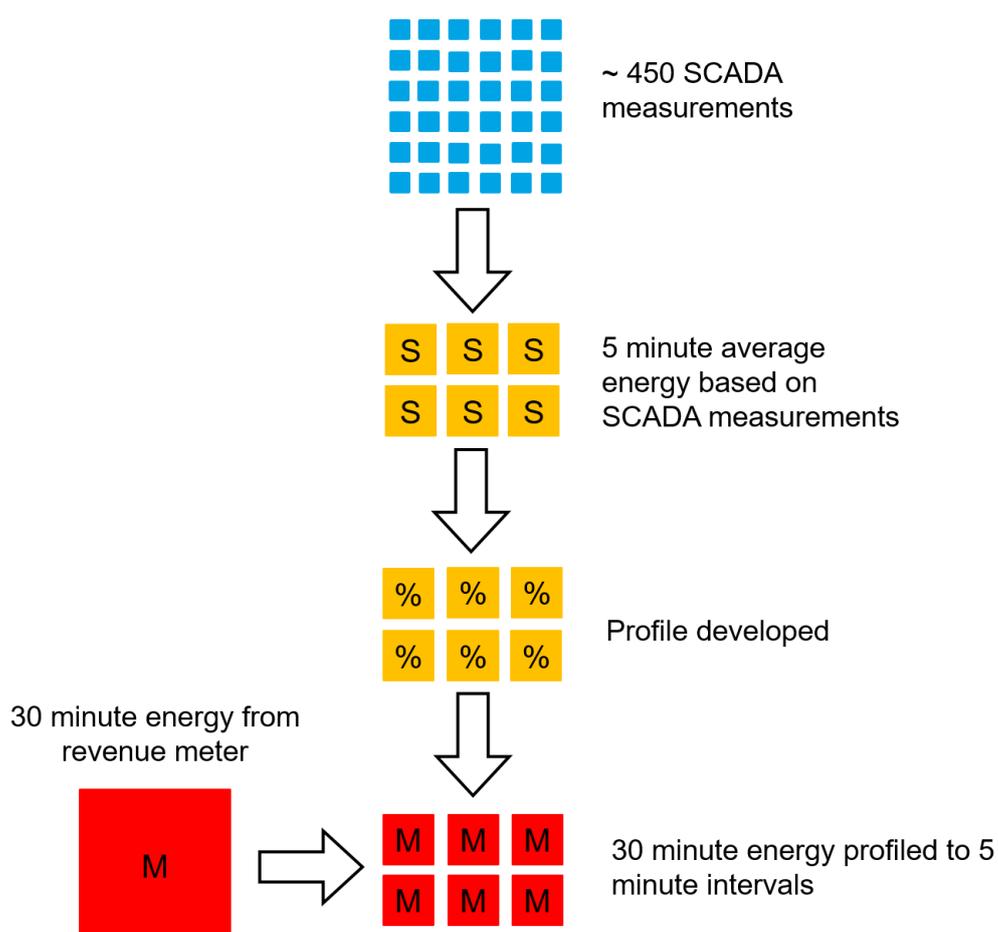
Point of comparison	Revenue meter	SCADA
Current application	To measure electricity consumption or production for the purpose of financial settlement	To monitor and control the power system in real time
Unit of measurement	Energy (e.g. MWh)	Power (e.g. MW)
Typical measurement interval	30 minutes	4 seconds
Accuracy standard	Specified by Australian Standard	No common accuracy standard
Typical accuracy	0.5 to 1% (for scheduled generating units)	2 to 4%
Procedures for missing data	Defined by AEMO Procedures	State estimation or manual techniques

Note: State estimation is an optimisation method involving the collection of basic power system variables that are then used to calculate other variables.

The process of using SCADA measurements to profile 30 minute metered energy is depicted in Figure 5.1 below. It first involves taking the SCADA measurements of instantaneous power and averaging these over each five minutes during a half hour period. For clarity, these power averages are then converted to energy.¹⁹ The five minute averages are the basis for a profile, where the percentage value for each five minute period is the five minute energy divided by the total energy from the whole half hour. The profile is then applied to the 30 minute metered energy to allocate the energy to each five minute interval.

¹⁹ Energy is power multiplied by time, which is in this instance expressed in hours. Hence, the conversion of power to energy involves dividing power by 12, as five minutes is one twelfth of an hour.

Figure 5.1 Process to develop SCADA profile



There are several issues with the use of SCADA data that may need to be addressed if the proposed rule is to be implemented:

- Accuracy and reliability. As noted in Table 5.1 above, SCADA measurement equipment is typically less accurate than revenue metering equipment and the processes for dealing with missing data are less regimented. More robust processes and accuracy standards may be required if SCADA measurements are to be used for profiling data in the settlement process.
- Basis for measurement. SCADA systems can be installed at different locations within each power station. For example, SCADA measurements may exist for any or all of the following: power at each individual generating unit, power for the whole power station and power consumed internally to run the power station. This may lead to differences in the basis for measurement between individual power stations.
- Dividing by zero. As the total energy for a half hour approaches zero, the values of the SCADA profile approach positive or negative infinity.²⁰ This could occur

²⁰ This is because the profile would be calculated by dividing five minute energy from SCADA measurements by 30 minute energy, also from SCADA. As the denominator approached to zero, the result will approach positive or negative infinity for a non-zero numerator.

due to measurement errors or bi-directional flows, such as in the case of a generator that consumes electricity as it starts up, or a bi-directional interconnector.

A further consideration is whether using SCADA measurements in this way would comply with the National Measurement Act.²¹ In accordance with s.7.3.4 and Schedule 7.2 of the NER, metering installations must comply with the National Measurement Act and applicable specifications or guidelines specified by the National Measurement Institute. Under the Act, it is an offence to use a revenue meter in such a way that it gives an inaccurate measurement, or tamper with a revenue meter, causing it to give inaccurate information.

The proposed use of SCADA data would not appear to convene this provision of the National Measurement Act since the accuracy of revenue meters would be unchanged. Metering data would continue to be collected by metering data providers and provided to AEMO and other market participants. However, the proposed changes would also involve AEMO modifying metering data before it is used in the settlement process - an arrangement which may be of concern to some stakeholders.

The Commission seeks stakeholders' views on whether SCADA measurements would be suitable for the purpose proposed in the rule change request.

Issue 2	SCADA
5.	Is using SCADA measurements a viable alternative to replacing existing metering equipment in order to implement five minute settlement?
6.	What changes would be required so that SCADA measurements could be used for profiling energy in the settlement process?

Another component of Sun Metals' proposal is that participants can choose to install five minute metering instead of being profiled using SCADA measurements. Five minute metering would be necessary for demand side participants who choose to participate in five minute settlement, if they do not have a suitable SCADA system. Supply side participants may also opt to install five minute metering instead of being profiled by AEMO.

Many modern interval meters are already capable of measuring energy at intervals shorter than 30 minutes. It may be possible for existing meters to be reconfigured to a five minute measurement interval, so long as they still have enough memory to locally store 35 days' worth of data.²² Sun Metals suggests that the Commission consider whether this requirement for 35 days of data is necessary, or if a shorter storage period would be appropriate.

²¹ National Measurement Act 1960 (Cth)

²² This is required under rule 7.3.1 (a)(10) of the NER.

Sun Metals also observes that a new metering data format would be required to cater for five minute data. The Commission understands that changing the metering data format in this way would have impacts for metering data providers and the businesses with which they interact, including retailers, generators, AEMO, and network business. It would also necessitate changes to the settlement interfaces between AEMO and generators, and AEMO and retailers.

The Commission is interested in stakeholders' views on the likely changes that would be required, including direct changes to participants' systems as well as consequential changes to other market arrangements.

Issue 3	Five minute metering and other options
7.	What changes would be required to metering infrastructure so that five minute metering data could be used in the proposed five minute settlement regime?
8.	What changes to participants' systems would be required to accommodate a five minute data format?
9.	Could five minute settlement be implemented without changing the existing data format?
10.	Are there any other data sources, such as dispatch targets, that would be preferable to SCADA profiling or five minute metering?

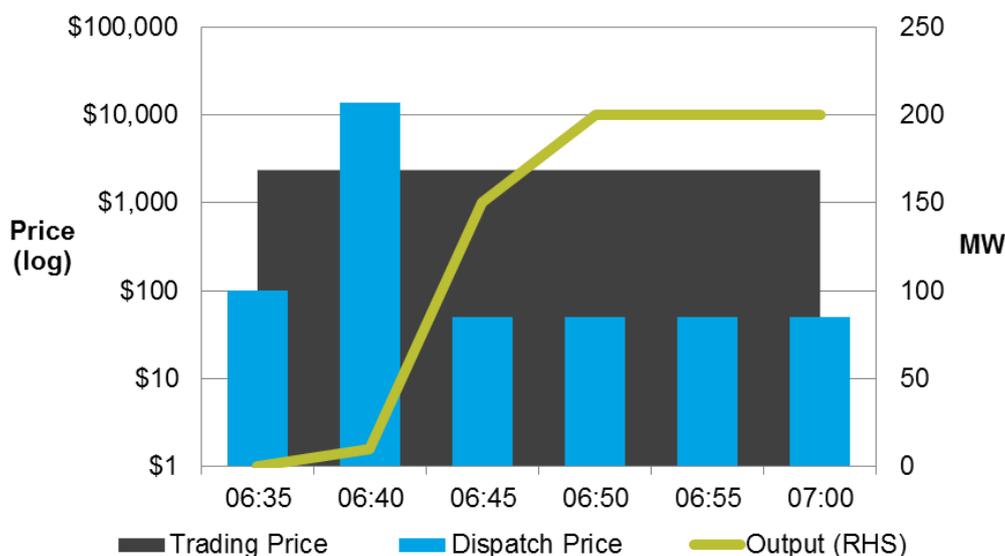
5.2.2 Managing the settlement residue

Sun Metals proposes that five minute settlement would be compulsory for generators, scheduled loads and MNSPs, and optional for other participants. Under such a proposal it is likely that some portion of the demand side of the market will choose to remain on 30 minute settlement.

The benefit of five minute settlement being optional for the demand side of the market is that five minute data would not be required from demand side participants who do not opt in, avoiding the need for meters to be reconfigured or replaced. However, this arrangement would result in a discrepancy between the money paid by consumers and the money owed to generators, which would need to be managed by AEMO. This discrepancy, or settlement residue, would only arise as part of a solution where it is optional for demand side participants to be settled on a five minute basis.

Figure 5.2 below provides an example of how a settlement residue may occur if some participants are settled on a five minute basis and others on a 30 minute basis. It shows the response of a gas peaking generator to a high price event, which occurs in the second five minutes of the half hour trading interval. The peaking plant ramps up to maximise its output over the half hour period.

Figure 5.2 Peaking plant response to early price spike



In this example, the dispatch price is \$100 per MWh in the first five minutes, \$13,800 per MWh in the second, and \$50 per MWh for the remainder of the half hour. The trading price for the half hour is therefore \$2,350 per MWh. The generator would receive just under \$149,000 for this trading interval under the existing arrangements, but only \$15,000 if it was settled on a five minute basis. This 90 per cent reduction in revenue under five minute settlement occurs because it was not generating at full capacity during the five minutes when the price was high.

Similarly, a large load that is able to anticipate and respond to a high five minute price would pay less under five minute settlement.

The example above shows the different settlement outcomes that can occur depending on whether settlement is on the basis of five or 30 minute energy. If a load consumed the same amount of energy in a half hour as the peaking generator supplied in Figure 5.2, it would be required to pay \$149,000 if it was settled on a 30 minute basis. On the other hand, if the generator was settled on a five minute basis it would only receive \$15,000. The outcome in this closed system with only the peaking generator and load is a settlement residue of \$134,000.

Notwithstanding the examples above, over periods of weeks and months it is expected that the money paid by electricity consumers will usually be less than the money earned by generators in the spot market. This is because high prices tend to correspond with periods of high demand - when generators are likely to be running close to full capacity. Generators that supply proportionally more electricity during the high price events would receive greater spot market revenue as a result.

In the rule change request, Sun Metals observed that if consumers were settled on a 30 minute basis and generators on a five minute basis, the discrepancy between the money paid by consumers and the money owed to generators in Queensland in January 2015 would be less than 0.3 per cent of total settlements. This is based on the

assumption that all generator bidding and load consumption would be unchanged under five minute settlement.

Sun Metals proposes that the settlement residue be recovered from demand side participants who continue to be settled on a 30 minute basis. Hence, consumers who opt into five minute settlement would be exempt from this payment. Each consumer would pay a share of the residue proportional to the amount of energy that they consumed during the period for which the residue is calculated.

Sun Metals suggests that the new residues be combined with the existing *intra*-regional settlement residues, which, it argues, would require no changes to retailers' systems. These are existing imbalances in the settlement transactions within each region resulting from differences between loss factors and actual losses on the transmission network, and metering errors.

Intra-regional settlement residues are distributed to, or recovered from, the transmission network service provider (TNSP) responsible for the region in which the residue occurred. TNSPs pass on the residues to customers in the form of higher or lower transmission use of system charges. A point of difference between these arrangements and Sun Metals' proposal is that the new settlement residues would be allocated to a subset of customers (i.e. those settled on a 30 minute basis). New processes would be required to identify consumers settled on a 30 minute basis so that the residues can be correctly allocated.

The Commission notes that there are a range of other mechanisms in the NEM whereby sums of money, including settlement residues, are allocated. These include the Settlement Residue Auctions for the allocation of *inter*-regional settlement imbalances, the recovery of some ancillary service costs and NEM participation fees. Elements of these mechanisms may be useful when considering the design of a mechanism to manage the residue arising from optional five minute settlement, should this be needed. In general, a mechanism to manage settlement residues is likely to add complexity to the market design.

The Commission seeks stakeholders' views on the impacts of five minute settlement being optional for demand side participants and how the resulting settlement residue could be managed.

Issue 4 Settlement residue

- 11. Should the full value of the settlement residue be recovered from demand side participants remaining on 30 minute settlement?**
- 12. Would it be feasible to merge the new residues with existing *intra*-regional settlement residues? Are there any alternative mechanisms that would be preferable?**
- 13. Should five minute settlement instead be compulsory for all demand side participants? If so, what threshold would be appropriate for compulsory demand side participation?**

5.2.3 Contracting

As the NEM is a gross pool market, participants do not trade electricity directly with one another - all electricity must be bought and sold through the central pool at the half hourly settlement price. Participants can then enter into contractual arrangements via over-the-counter and exchange-traded markets to fix the price of electricity, or provide greater price certainty. Through these arrangements, participants manage the risks associated with volatile wholesale prices, which in the NEM can fluctuate between positive \$13,800 and negative \$1,000 per MWh.²³

A five minute settlement regime that is optional for demand side participants is likely to involve some participants being settled on a five minute basis, and others on a 30 minute basis. These respective groups of market participants would be exposed to different reference prices and, therefore, different risks. Where contractual arrangements already exist, a change to the reference price may constitute a market disruption event under these contracts and provide grounds to terminate or renegotiate the contract.²⁴

A move to five minute settlement may impact on the incentives to buy and sell certain types of contracts. Under the current arrangements, generators and consumers in the same market region are well suited to contract with each other since, for a fixed volume of energy, the costs incurred by consumers are inversely related to the returns to generators. A consumer and a generator may enter into a contract in order to:

- fix the price of a specified volume of energy; or
- limit the price to which the consumer can be exposed.

²³ From 1 July 2016, the market price cap will be \$14,000. See: AEMC, *Schedule of Reliability Settings (MPC and CPT for 2016-17)*, 16 February 2016, Sydney.

²⁴ Transactions using the International Swaps and Derivatives Association (ISDA) framework may contain provisions that apply if there is a market disruption event, such as a material change in the formula for or the method of calculating the relevant commodity reference price.

If the generator and consumer instead face different reference prices under an optional five minute settlement regime, these contractual arrangements may be less effective.

Issue 5	Contracting
14.	How would the proposed move to five minute settlement affect existing contractual arrangements?
15.	Would the proposed optionality for demand side participants affect the ability of participants to contract with each other? Would a generator settled on a five minute basis be able to contract with a consumer settled on a 30 minute basis?
16.	What impact would a move to five minute settlement have on contract market liquidity?

5.2.4 Other solutions

The existing arrangements for dispatch and settlement have been in place since the start of the NEM in December 1998. As discussed in section 2.2 above, the mismatch between the dispatch and settlement intervals has been considered on several occasions before and after the start of the market. The issue was also considered by the Australian Competition and Consumer Commission (ACCC) in its determination on the Application for Authorisation for the National Electricity Code in 1997.²⁵

The following summary of other possible solutions is provided for completeness. The Commission notes that there have been many changes in the energy industry since the earlier investigations and that if a problem is found to be present during this rule change process, it is not limited to other possible solutions that have been previously identified.

In both the NEMMCO and ACCC processes, various options to address the mismatch were considered. Most of the proposed options fit into the following two categories:

- aligning the dispatch and settlement intervals; and
- changing the price calculation.

The most logical options for an aligned dispatch and settlement interval are five, fifteen or 30 minutes.²⁶ Alignment at 30 minutes would involve an increase in the dispatch interval while the settlement interval would remain the same. Alignment at fifteen minutes would involve changing both intervals. The Commission understands that the significant majority of interval meters installed in the market are capable of fifteen

²⁵ ACCC, *op. cit.*

²⁶ Two further variations on this option are five minute dispatch combined with fifteen minute settlement (i.e. 5/15) or fifteen minute dispatch and 30 minute settlement (i.e. 15/30).

minute metering. Hence, such a change may be less disruptive than a move to five minute metering.

Potential changes to the price calculation considered by NEMMCO involved the calculation of a demand weighted price, where the weighting is based on aggregate demand for each market region. Variations of this option include both supply and demand side participants paying the regional demand weighted price, or regional demand weighted pricing in conjunction with five minute settlement, where those not settled on a five minute basis would pay the regional demand weighted price.²⁷

Further alternatives to the price calculation include settling the market on the basis of either the maximum or minimum dispatch price in each half hour. In the ACCC's determination, it observed that some participants supported these options, and that the average, which was ultimately adopted, had been suggested as a compromise.²⁸ The settlement price could also be calculated as the median or the mode of the six dispatch prices.

A final option which does not fit into the above categories is compulsory demand side bidding. This option would leave the dispatch and settlement intervals unchanged. The rationale for this option was that demand side bidding may counter the volatility produced by the five minute dispatch cycle.²⁹

More information on all of these options can be found in the original source documents.

The Commission has not considered these options in detail. It does, however, note the following in relation to the potential alternative options:

- Increasing the dispatch interval, such as to fifteen or 30 minutes, would increase the potential for supply and demand to deviate from their expected level within each dispatch interval. This would result in higher costs to keep the system in balance.
- In isolation, changing the price calculation would not enable participants to benefit from responding to five minute price spikes as they would still be settled at the same price for all electricity generated or consumed during a half hour. Hence, these options would be unlikely to address the issues raised by Sun Metals in the rule change request.

²⁷ NEMMCO, *Options for resolving the 5 minute dispatch and 30 minute settlement anomaly in the NEM*, September 2001.

²⁸ ACCC, *op. cit.* pp58-60.

²⁹ NEMMCO, *Anomalies in the NEM Due to Five-Minute Dispatch and Thirty-Minute Settlement*, Issues and Options paper, 3 September 1999, p9.

Issue 6**Other solutions**

17. Having regard to the issues raised in the rule change request and in the event that there is a problem found to be present, do you consider there to be any alternative solutions that are preferable to the proposed solution?

6 Lodging a submission

The Commission invites written submission on this rule change proposal by 16 June 2016. Submissions are to be lodged online via the Commission's website, www.aemc.gov.au, or by mail to:

Australian Energy Market Commission
PO Box A2449
Sydney South NSW 1235

Alternatively, submissions may be sent by fax to (02) 8296 7899.

Where practicable, submissions should be prepared in accordance with the Commission's guidelines for making written submissions on rule change requests.³⁰ The Commission publishes all submissions on its website subject to a claim of confidentiality.

Those who make a confidentiality claim should clearly identify the part or parts of the submission to which the claim relates, and give reasons why the Commission should accept the claim. Where the Commission decides that the claim is justified, it may publish the submission with the confidential information omitted.³¹

All enquiries on this project should be addressed to Ben Noone on (02) 8296 7852.

³⁰ This guideline is available on the Commission's website.

³¹ See section 108 of the NEL.

Abbreviations

ACCC	Australian Competition and Consumer Commission
AEMO	Australian Energy Market Operator
MNSP	market network services provider
NEL	National Electricity Law
NEM	National Electricity Market
NEMMCO	National Electricity Market Management Company
NEO	national electricity objective
NER	National Electricity Rules
SCADA	supervisory control and data acquisition
TNSP	transmission network service provider