



29 May 2017

John Pierce
Chairman
Australian Energy Market Commission
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Submitted online: www.aemc.gov.au

Dear Mr Pierce

Five Minute Settlement – Directions Paper

Origin Energy Limited (Origin) welcomes the opportunity to provide comments on the Australian Energy Market Commission's (AEMC) Directions Paper on Five Minute Settlement.

The role of wholesale prices in the NEM is to inform short term operational decisions while also signalling future investment needs on both the supply and demand side. This requires a price setting process that is sufficiently transparent and robust such that market participants have confidence these signals are generally reflective of underlying supply and demand conditions. Origin agrees a shorter settlement interval would arguably lead to wholesale prices that more accurately reflect such conditions. As such, conceptually, the alignment of settlement and dispatch timeframes at five minutes represents a natural shift in the continuing evolution of the market.

However, as is often the case with significant reform, there are a number of trade-offs and it is crucial the AEMC adequately considers these when making its final decision. Origin's concern is that if implemented in three years as currently proposed, the alignment of settlement and dispatch will have a destabilising effect on the market at a time when the NEM is already undergoing a significant transformative period. Additionally, the timing and quantum of the purported benefits remain unclear and there is potential for pricing outcomes above those currently observed under 30 minute settlement.

Table 1 below highlights the case for alignment (which is contingent on a number of unknown factors), and the challenges that are likely to arise in the short to medium term that must have a bearing on how and when the change could be made.

Table 1: Case for aligning settlement and dispatch and key challenges

Case presented for alignment	Challenges and potential adverse impacts
<ul style="list-style-type: none">▪ Reduces incentive for strategic late rebidding, which limits the ability of market participants to respond to the price signal.▪ Theoretically allows for greater efficiency of dispatch by more closely aligning supply and demand.▪ Benefits of alignment will be realised where generation technologies have the capability of responding to five minute price signals.	<ul style="list-style-type: none">▪ The recent Bidding in Good Faith rule change has seemingly curtailed the impact of late rebidding.▪ Alternate generator operating strategies are sub-optimal given the difficulties associated with anticipating price spikes and the higher maintenance and operation costs that would be incurred (e.g. by more frequent operation at minimum generation).▪ The supply of cap contracts from the existing

Case presented for alignment	Challenges and potential adverse impacts
<ul style="list-style-type: none"> ▪ The existing fleet of peaking generation is unable to respond to five minute prices from rest. But there could be scope for existing plant to change their operating behaviour (e.g. operate at minimum generation more often in anticipation of price spikes). ▪ Realisation of the benefits of alignment is largely dependent on increased market entry of rapid response technologies such as aero derivatives, diesel and battery storage. But prospects of increased uptake of more responsive technologies are encouraging. ▪ The overall outcome will be a more efficient mix of generation assets and demand response technologies over time, leading to lower supply costs. This will benefit consumers as reduced wholesale electricity costs flow through to retail prices. ▪ The size of these benefits and the timing of when they will be realised is unclear. 	<p>generation fleet will reduce due to the inability of peaking generators to defend five minute caps where there is unexpected spot price volatility. Ramping limitations would also reduce the level of caps provided by base load plant. The total reduction in cap supply is expected to be greater than the 625 MW projected by Energy Edge given this excludes over the counter (OTC) contracts traded directly between participants and supply from base load generators.</p> <ul style="list-style-type: none"> ▪ The potential for new rapid response generators to supply hedging instruments to meet the supply deficit is unclear. While battery technology is evolving rapidly, large scale battery projects are still in their infancy around the world and reliant on substantial subsidies to be economic. ▪ The cost of hedging is expected to increase due to the reduction in cap supply and higher cap premiums brought on by the added risk of defending caps. This could translate into higher retail charges. There could also be negative implications for retail competition if some retailers face difficulty and additional cost in sourcing hedge cover. ▪ Market participants will face significant upfront costs in undertaking the necessary system and IT changes. Origin estimates it could cost approximately \$33-38 million to effect the necessary system changes to Origin's systems alone. ▪ The overall impact on spot market volatility and pricing is still unknown and no analysis has been undertaken to explore potential outcomes, including the extent to which five minute settlement would actually reduce wholesale electricity prices.

A potential path forward

We note the AEMC has highlighted the difficulties in using quantitative analysis to assist in determining the merits of the rule change. While Origin has some sympathy for this position, given the significance of the proposed change, further analysis is required. We suggest that in preparing its draft determination the AEMC should seek to better understand the magnitude and duration of the potentially disruptive/adverse impacts, as well as the timing and quantum of the expected benefits, if the rule is made. Specifically the AEMC should determine:

- the impact on hedging in the market brought on by the deficit in the supply of cap contracts;
- the implications for retail competition and the impact on energy consumers due to the disruption in the contract market;
- timelines around the expected market entry of new rapid response generation, including their costs and potential uptake;
- the natural sellers of new caps to replace the reduction in supply, and the timing of this supply;

- the potential for new hedging products to alleviate the shortfall in caps;
- an estimate of the system wide costs that will be incurred to undertake the necessary system, IT, and metering changes required to support the rule; and
- how to better understand the potential impact on wholesale spot prices and volatility (notwithstanding the inherent limitations of modelling these outcomes).

Origin believes a prudent approach is to align the implementation of five minute settlement with the period when market conditions indicate greater potential for the benefits of the reform to be realised. This could be achieved by making the rule change contingent on a periodic assessment of market conditions, the first of which could occur in four years from the AEMC's final determination. Any decision to proceed with the rule change could then be followed by a three year transitional period so businesses have sufficient time to undertake the required system changes described above.

If after completing the analysis suggested above, the AEMC concludes the rule change should be adopted now, (subject to some appropriate transitional period), at least six to seven years is required. This would better align with the timeframe proposed for the completion of metering changes in support of five minute settlement. Further, it is consistent with the time period proposed by Energy Edge to minimise the level of contractual disruption and will provide additional lead time for new investment in flexible plant to occur. With respect to the latter, in determining the overall length of the transitional period the AEMC should give detailed consideration to the key areas for investigation identified above.

More detailed views on aspects of the AEMC's directions paper are provided in Attachment A. These views should be considered alongside the supplementary report prepared by Seed Advisory on behalf of Origin Energy, which has been submitted as a separate item.

If you wish to discuss any aspect of this submission further, please contact Shaun Cole at shaun.cole@originenergy.com.au or on 03 8665 7366.

Yours Sincerely,



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Manager Wholesale Regulatory Policy

Five Minute Settlement in the NEM – Impact Assessment

1. Rationale for reform

Key point(s):

- Conceptually, alignment of dispatch and settlement periods provides a more efficient price signal to guide consumption and investment decisions. But the materiality of the underlying issue and efficiency benefits achievable are yet to be adequately explored or demonstrated.
 - Recent efforts to address the misalignment between settlement and dispatch timeframes in international electricity markets are unique and do not provide adequate justification for reforming the NEM.
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Materiality of the issue

A key feature of energy only markets is that spot prices provide incentives for both operational and investment decisions. For this to be achieved, it is important spot prices reflect the physical condition of the system and the continuous changes in the supply/demand balance. But the extent to which this can be achieved in practice is generally constrained to some degree by the physical, technical and economic cost of underlying market arrangements.

Consistent with this, a compromise was made between dispatch and settlement timeframes within the NEM. While the current market design places significant emphasis on the alignment of pricing and dispatch by optimising market operations across five minute periods, all electricity generation is ultimately settled on the basis of the 30 minute average dispatch price. The rationale here is that five minute dispatch reduces the level of ancillary services required to track fluctuations in the supply/demand balance, while 30 minute settlement ensures metering/settlement databases and process remain within practical limits.

This misalignment between settlement and dispatch has been the subject of discussion since the NEM's inception in 1998. Concerns have been raised that the averaging process, while useful to the extent it filters out some of the inherent volatility in a five minute dispatch cycle, can also create distortions and inefficiencies in the market.

Late rebidding

Sun Metals' original concern when submitting its rule change proposal was that the market design accentuates strategic late rebidding which impedes market entry for fast response generation and demand side response.

This specific issue has seemingly been addressed through the Bidding in Good Faith rule change, which placed more stringent rebidding obligations on market generators with a view to further limiting any perverse impacts. The AEMC analysis indicates there is a reduced prevalence of Dispatch Interval (DI) 6 price spikes, at least over the limited time period the rule has been in place.

Early price spikes under 30 minute settlement

The AEMC has also now identified DI 1 spikes as an issue that exemplifies the inherent inefficiency in the current market design, citing trading outcomes in the South Australian spot market on 21 March 2017 as a primary example of the perceived market distortion. Table 2 sets out the AEMC's key

assertions regarding these inefficiencies and our views on the validity of those claims. This table should be considered in conjunction with Table 3.1 of the Seed Advisory Report, which presents an assessment framework and further explores the trade-offs associated with aligning settlement and dispatch.

Table 2: Overview of AEMC assertions regarding the inefficiencies arising from early price spikes under 30 minute settlement

AEMC assertions	Comments
<ul style="list-style-type: none"> ▪ Early DI price spikes lead to the “piling in” phenomenon where large levels of generation are offered at a reduced price at a time when it is not necessarily valued by the market. Trading intervals can include both very high prices and potentially negative prices. To the extent that there is an increase in risk, this would also increase the cost of supply and retail prices. 	<ul style="list-style-type: none"> ▪ If the generation is not valued by the market it would not have been dispatched – clearly it is required to meet customer demand. ▪ Origin questions the categorisation of subsequent low dispatch prices as being inefficient. The low and sometimes negative prices observed after a high DI 1 price are most likely due to a generator defending its contracted position or a gentailer providing cover for its retail load by ensuring dispatch. Additionally, minimum run times for gas plant would mean that a low bid – e.g. below short run marginal cost (SRMC) – is in fact a prudent and rationale course of action following an initial spike in DI 1 given it would be more costly to switch off the generator. The market design makes allowances for such situations by enabling generator offers to be as low as -\$1,000/MWh, well below SRMC. In seeking to determine whether market outcomes are efficient or not, an observation of spot market outcomes in isolation is therefore unlikely to be sufficient.
<ul style="list-style-type: none"> ▪ It is from these price periods that generators typically receive a disproportionate amount of their annual spot market revenue. 	<ul style="list-style-type: none"> ▪ It is not clear what generators the AEMC is referring to in this instance or why this is viewed as a sign of inefficiency. For example, peaking generators have relatively low capacity factors and their business model is dependent on recovering long run costs at periods of high prices and volatility. In fact, scarcity pricing is an underlying feature of the energy only market and is critical to generators being able to recover fixed costs.
<ul style="list-style-type: none"> ▪ This bidding behaviour has the potential to significantly distort operational, usage and investment incentives, creating productive, allocative, and investment inefficiency. 	<ul style="list-style-type: none"> ▪ Again this is a broad statement with no evidence to verify the claim. It also gives no regard to the fact that the behaviour observed actually places downward pressure on wholesale electricity prices.
<ul style="list-style-type: none"> ▪ The current 30 minute settlement framework effectively makes operating flexible rapid response technologies for generation in the NEM more financially risky. By not providing appropriate rewards for more flexible technologies that can respond to the price spike, there is the potential for such resources to choose not to participate in the market at a time when the response is physically valued by the power system to balance supply and demand. Over any 30 minute trading interval this risks creating productive inefficiency through a sub-optimal and higher cost supply mix. 	<ul style="list-style-type: none"> ▪ No evidence has been presented to suggest the business model of rapid response technologies is undermined by the current arrangements, or that they preclude any increase in uptake. ▪ The statement implies there is an increased likelihood of unserved energy due to the current arrangements and that rapid response technologies are being prevented from entering the market to fill the deficit. This is clearly not the case. ▪ The AEMC has not demonstrated how 30 minute settlement results in a higher cost supply mix. One of the primary arguments used to argue for

AEMC assertions	Comments
	alignment is that lower dispatch prices following a DI 1 price spike is inefficient and that it disadvantages rapid response technologies that are in fact currently more expensive than other generation in the market. This raises the prospect for a more productive inefficient outcome (at least in the short term) if more costly rapid response technologies are deployed ahead of lower cost generation.
<ul style="list-style-type: none"> ▪ A worst case scenario of the existing framework would be where the misalignment of dispatch and settlement creates incentives to invest in slower response technologies in the future that are not only less valued by consumers in a particular five minute interval, but also involve a higher cost of supply. For example, this could arise due to the higher ancillary service requirements associated with operating the market with relatively inflexible plant. 	<ul style="list-style-type: none"> ▪ The overall impact of mass deployment of more responsive plant on the NEM (e.g. on system frequency) is unknown and could potentially give rise to additional costs that would need to be considered when considering such investment. This issue was recently raised by the Australian Energy Market Operator (AEMO) with respect to the potential deployment of batteries in SA, who noted the ability of inverter based technology to ramp very quickly could cause power system problems (e.g. frequency disturbances) and ultimately lead to contingency type events.¹

AEMC stylised example – impact of 30 minute settlement

Generally our view is that the usefulness of the stylised example is limited. In the example, the AEMC seeks to replicate the bidding strategy under 30 minute settlement for a rapid response generator (e.g. a battery) and a fast response plant (e.g. gas peaker). After observing the price at the end of the settlement period the AEMC compares this to the dispatch (settled) prices if the generators were settled on a five minute basis. However, there is no adjustment in the original bidding strategy, which would be expected given the new settlement arrangements. The conclusion seems to be that generators would bid (and ultimately be settled) at their SRMC allowing for an efficient outcome. This seems overly simplistic, as explored in Table 3 below.

Table 3: Assessment of the AEMC’s conclusions regarding the stylised trading example

AEMC conclusion		Comments
<ul style="list-style-type: none"> ▪ With an early price spike under 30 minute settlement, generation that cannot respond immediately, but can generate within the 30 minute period has an incentive to: 	1. manage risk by bidding at a price that is below the cost of generation;	<ul style="list-style-type: none"> ▪ Bidding below or above SRMC in an energy only market is not necessarily a sign of inefficiency, as previously discussed.
	2. operate the plant in such a way they dispatch at a time when their generation is not physically valued by the power system; and	<ul style="list-style-type: none"> ▪ If the plant is not physically valued by the power system why then would it have been dispatched? The AEMC’s reasoning here suggests the generation is not needed and there is oversupply.
	3. behave in a way that creates artificial volatility, uncertainty and risk for wholesale market	<ul style="list-style-type: none"> ▪ The AEMC has not explained how lower prices in subsequent dispatch periods results in added risks for market

¹ Australian Energy Market Operator, ESCOSA – Inquiry into the Licensing Arrangements for Generators in SA, Workshop Presentation, 16 May 2017.

AEMC conclusion		Comments
	participants.	participants and the market overall.
<ul style="list-style-type: none"> ▪ For generation that can respond within a five minute dispatch interval to early price spikes, there is incentive to: 	1. manage risk of price uncertainty inherent in after-the-event 30 minute settlement by, bidding at a price that is above the marginal cost of generation;	<ul style="list-style-type: none"> ▪ At times of scarcity, bids above SRMC are not unusual.
	2. avoid being dispatched, even though the dispatch price highlights that their generation is physically valued by the power system in their interval; and	<ul style="list-style-type: none"> ▪ This is known as market risk – fast start generators face this problem every time they turn on given minimum run times. ▪ At times of scarcity, the settled price is likely to be well above the SRMC of a rapid response generator, so it is not clear why they would seek to avoid being dispatched.
	3. potentially creates risk for the ongoing operation and financial viability of flexible and fast response technologies.	<ul style="list-style-type: none"> ▪ This has not been explained and suggests that business case for rapid response technologies is being undermined by the current arrangements.

International experiences

The AEMC has noted a range of overseas markets, where regulators and market bodies are either in the process of aligning dispatch and settlement timeframes or at least recognise the merit in doing so. While this may be true, it does not provide adequate justification for pursuing such a reform in the NEM, particularly when you consider the rationale for reform is heavily influenced by the characteristics unique to each market. A summary of Seed Advisory's key observations in relation to the international markets cited by the AEMC is provided below.

New Zealand

The New Zealand Electricity Authority is currently investigating the potential for implementing five minute dispatch and 30 minute settlement with a view to delivering more efficient pricing signals for market participants. Final prices are currently published with a two day lag and a variety of forecasts of final prices are relied on by market participants to estimate and manage their positions. While a real-time pricing option based on five minute settlement and dispatch was considered, the Electricity Authority noted this would require extensive metering changes and upgrades to settlement and reconciliation systems, the cost of which is not appropriate at this time.

United States Federal Energy Regulatory Commission

In September 2016 the United States Federal Energy Regulatory Commission (FERC) ruled that all six system operators under its jurisdiction must settle energy in their real-time markets at the same interval that those markets are dispatched (i.e. five minute settlement). As it is currently structured, three of the six regions already operate with five minute dispatch and settlement, while the remaining three combine five minute dispatch with hourly average pricing.

FERC's decision relates primarily to the need to improve the alignment of dispatch and settlement across the various markets (including ancillary markets) rather than align settlement and dispatch timeframes per se. The recent entry of more flexible gas fired generators into some of the US markets has led to an increase in uplift and ancillary payments as those generation technologies interact with

the requirements of energy, transmission and other ancillary service markets. In some of the markets governed by FERC, the costs incurred as a result of this misalignment and associated poor compliance with dispatch instructions are so large that if they were eliminated, this would offset the costs of implementing the reform.

It is also worth noting a number of US electricity markets, including those with five minute dispatch and settlement, have some form of capacity market or regulated capacity requirement in place. In these circumstances, the role of spot markets is primarily to guide near term operational decisions rather than incentivise investment in generation capacity. This is in contrast to the NEM, where the energy-only market provides signals for efficient dispatch of plant and incentives to contract to undertake efficient investment. As suggested by the AEMC, this may mean alignment of dispatch and settlement is even more relevant in the context of the NEM. But it also serves to highlight that the short to medium term disruptive impacts from alignment in the NEM will be amplified if the ability of a significant proportion of the existing generation fleet to participate and derive revenue from the wholesale market is compromised, without the added safety net of capacity payments.

Alberta Electric System Operator

In the Alberta electricity market dispatch prices are currently determined in real time one minute intervals and the settlement price is based on a 60 minute time weighted average. In 2005 consideration was given to aligning dispatch and settlement intervals with a view to improving the efficiency of dispatch over the long-term. Further reviews conducted between 2006 and 2015 resulted in the alternate reform proposal based on one minute dispatch and 15 minute settlement periods. But by 2015, the market operator “*noted that dispatch and settlement period alignment is not currently considered a high priority when compared to other market initiatives such as Transmission Constraints Management, Interties Restoration and Market Systems Replacement*”.

2. Market implications

Key point(s):

- Technical limits will significantly impede the ability of the existing generation fleet (including base load generators) to offer cap contracts to manage pricing risk in the wholesale market.
 - The 625 MW reduction in cap contracts forecast by Energy Edge is significantly understated, given it does not capture OTC contracts traded directly between participants or the impact on base-load generation.
 - There is a high likelihood five minute settlement would increase overall energy prices for consumers, particularly in the event new investment does not offset the expected reduction in cap contracts.
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A five minute market will better incentivise investment in more responsive/flexible technology. At the same time it will change the economics of operational and investment decisions regarding generators with slower ramp rates. This includes a significant proportion of peaking generation plant within the NEM that would be incapable of responding to five minute price signals, since start-up times generally exceed this timeframe and minimum run times can extend for as long as two hours.

This has significant implications for financial contracting and the ability of market participants to manage the risks associated with participating in the market as well as the overall cost to consumers. These issues are explored in further detail below.

Financial market impacts – liquidity and pricing

Financial contracts play a critical role in enabling market participants to manage risk and underwrite investment in generation capacity and long term fuel arrangements. As such, any significant change to one market will have consequences for the other. Given the nature of the proposed rule, the main financial product that will be impacted is half hourly settled caps. But there are broader implications for other financial instruments that must also be considered.

Cap contracts

Caps are used by buyers such as retailers to manage retail load flex and extreme price events and help sellers such as gas fired generators to underwrite new generation capacity and long term fuel arrangements. Caps are predominantly sold by fast start and base load generators who look to gain income certainty from the sale of the caps, and then generate at times of high prices to physically support the payout required under the financial product.

According to Energy Edge, the inability of most fast start plant to respond to unexpected price spikes from rest or minimum load within five minutes will lead to a reduction in contracting volumes in the order of 625 MW. They also note the net effect of the change could be even higher, given the ability to use generators as cap-like natural hedges will also be diminished and increase demand for caps. While this analysis is generally sound, Origin believes the actual volume of impacted caps could be significantly higher for two key reasons.

1. OTC cap contract impacts are understated: The 625 MW (23 per cent) reduction in caps is based on an initial estimate of total traded volumes of 2,650 MW. This includes OTC volumes traded through brokering platforms, but not volumes traded directly between participants. To provide perspective, a large majority of the total cap contracts traded by Origin are traded directly with other market participants.
2. The role of base-load generators is not considered: Base-load generators are one of the largest sellers of caps in the market. While the AEMC believes these generators will not be impacted by the rule change, ramping limitations could ultimately reduce the volume of caps they are able to physically underwrite and sell.

In the short to medium term, the expected reduction in the supply of cap contracts and added risk many generators will face in defending five minute caps will likely result in increased cap premiums. This would impact retailers looking to hedge their spot price exposure, the cost of which will be borne by energy consumers.

Again, while we agree with the underlying premise that ultimately the alignment of settlement and dispatch could allow for more efficient market outcomes in the long run, it is critical to examine the shorter term impacts, particularly given the NEM is already undergoing a transformative period. In preparing its draft determination, the AEMC should therefore seek to better understand the magnitude and duration of the potentially disruptive and adverse short term impacts that could arise if the rule is made. These include:

- the impact on hedging brought on by the deficit in the supply of cap contracts;
- the impact on energy consumers due to the disruption in the contract market;
- the natural sellers of new caps to replace the reduction in supply, and the timing of this supply;
- the potential for new hedging products to alleviate the shortfall in caps; and

- the potential impact on spot market prices more broadly.

Swaps and futures

Liquidity in financial markets is contingent on a range of factors, including the willingness of buyers and sellers to enter into long-term arrangements. This willingness is heavily influenced by uncertainty relating to future market outcomes, with the retrospective carbon tax repeal in 2014 providing an example of how heightened uncertainty can severely impact liquidity in electricity derivatives.

To this end, the decision to implement five minute settlement would similarly introduce significant uncertainty with respect to the forward pricing of electricity. While Origin agrees with Energy Edge's assessment that 30 minute swaps and five minute swaps are mathematically equivalent, the rule change would result in different participant behaviour in the wholesale market and hence create different five minute prices than those currently observed. This could result in lower levels of liquidity in swaps and futures markets at least in the near term. The interaction of swap and cap contracts also means that any increase in cap premiums will also be reflected (at least in part) in swap contracts.

Alternate operational and investment strategies

On the basis that existing strategies to manage the risk of participating in the market would be less effective under the proposed rule, the AEMC has given consideration to a range of alternate risk management options that could be pursued. The merits of these are discussed below.

Operation of existing plant

The AEMC notes there is scope for existing generation, particularly fast start plant, to change their operating behaviour in response to the new market dynamics. For example, a peaking plant could operate at minimum generation more often in anticipation of price spikes. However, price spikes are inherently difficult to predict, with Energy Edge identifying that a significant proportion of high price events are unanticipated. Operators of fast start plant currently try to optimise their usage to capture as many of these events as possible in a cost-effective manner. A new strategy of running more often at minimum generation is unlikely to be sustainable or efficient given generators would incur additional operating and maintenance costs.

A more likely outcome is that the capacity factor of peaking plant would actually reduce, with peaking generators simply forgoing the opportunity to access price spikes that are unlikely to be sustained. This is consistent with the fact that such plant will have less incentive to operate in the market when they are not required to defend caps and could lead to higher overall electricity costs for consumers. This is also at odds with what is required in a market with an increasing proportion of intermittent generation.

The Discussion paper also notes that "*hundreds of megawatts of power can be provided from generators that are already running*". The extent to which this statement holds true in reality requires further consideration. In Origin's view, if this volume of ramping capacity was actually available the level of volatility observed in the market would be materially lower and base load generation would actually be setting the market price during those volatile periods. The fact this isn't the case suggests base load generation doesn't have enough ramping capacity to actually cap the price during volatile periods. As such, these generators will also face challenges in responding to unpredictable price spikes within five minutes.

Alternate hedging strategies

Origin agrees that ultimately we would expect the Australian Stock Exchange (ASX) to develop new standardised futures and options products to assist with hedging risk under five minute settlement. But

as discussed earlier, the extent to which these products would fully capture the additional market risk is unclear. It will also take time for liquidity in these products to develop.

With regard to the potential for fast-start generators to sell non-firm caps as a way of reducing the risk of not being able to capture as high a percentage of price spikes, this would still likely result in reduced earnings for those generators due to the lower premium associated with the product. Such a product may also not be attractive for retailers as a risk management measure due to its reduced firmness.

Investment in new plant

The benefits of the rule change are largely contingent on a view that investment in new, more responsive technology will occur. Potential options include: aero derivatives / industrial (frame) open cycle gas turbines (OCGT); diesel generating units; and energy storage. But there are relevant factors that must be considered when assessing the investment case for each of these options.

- OCGT plant: The new OCGT plant identified (including aero derivatives) are unable to respond in five minutes from rest. As such, they would face similar challenges to the existing fleet of peaking plant, albeit to a lesser extent.
- Diesel plant: The investment case for diesel generators is uncertain, given the current shift toward lower emissions thermal plant and renewables. To this end, Origin believes it would be a perverse outcome if this rule change undermined the investment case for new and existing gas-fired generation while simultaneously encouraging the entry of more emissive and higher cost plant.
- Battery storage: The outlook for widespread deployment for battery storage remains uncertain. While technology is evolving rapidly, large scale battery projects are still in their infancy around the world and reliant on substantial subsidies to be economic. According to Energy Edge, while some large scale battery projects may be installed in the short to medium term, they will be a long way from addressing the estimated shortfall in caps.

With respect to small scale battery deployment (i.e. behind the meter), it is clear investment is continuing to grow and current market arrangements are not an impediment to uptake. But the extent to which small scale battery storage can supplement or contribute to the supply of cap contracts is unproven. The overall impact of mass deployment of battery storage on the NEM (e.g. on system frequency) is also unknown and could potentially give rise to additional costs that would need to be considered when considering such investment. This issue was recently raised by AEMO in the context of SA, who noted the ability of inverter based technology to ramp very quickly could cause power system problems (e.g. frequency disturbances) and ultimately lead to contingency type events.²

When evaluating the costs and benefits of energy storage for a single application, storage technologies can be prohibitively expensive compared to the alternatives. But storage technologies differ from other systems across the grid in that they can efficiently provide multiple services, thereby improving their economic viability. As such, the uptake of energy storage technologies is not only heavily contingent on further capital cost reductions, but also the ability of storage proponents to access additional revenue streams beyond simply shifting energy in the wholesale market (i.e. while the benefit/cost ratio for a single application may not be favourable, an amalgamation of applications provides multiple revenue streams for the same investment).

² Australian Energy Market Operator, *ESCOSA – Inquiry into the Licensing Arrangements for Generators in SA*, Workshop Presentation, 16 May 2017.

Developing a business case for investing in any of these technologies will also require an assessment of expected market volatility. Even if there are, or there will be as a result of the growing penetration of renewable generation, sufficient and sufficiently high transitory price signals to signal the requirement for new investment, these conditions may not be sufficient for new investment to occur. Opportunities to profitably generate will also depend on the rapid response plant's position in the merit order. If more expensive than existing generators, the new entrant can be undercut by the existing generation fleet on any occasion where the new entrant is not the marginal generator.

Potential market outcomes

Origin agrees it is difficult to quantify potential market outcomes under five minute settlement. Nonetheless, the magnitude of the intervention warrants further analysis beyond simply exploring the theoretical efficiency benefits that may be achievable, particularly given any real benefits will largely be contingent on participants' behaviour once five minute settlement is implemented.

Based on the above discussion, Origin is not satisfied the proposed rule will actually reduce overall electricity costs for consumers, even if new investment occurs. In fact, should the rule change precede any significant investment in more responsive plant, it is likely consumers would face higher electricity costs in the short to medium term. This could also have implications for competition in the retail sector, with smaller market participants potentially exposed to wholesale market risks they can no longer effectively manage.

The AEMC's preliminary view appears to be that sufficient investment will occur over the proposed three year transitional period to offset the initial impact of the rule change on the existing generation fleet. But the extent to which this assumption ultimately holds true is contingent on a range of highly uncertain factors, as noted below.

- Overall new capacity requirements: The question of the gap that may emerge and the potential for new technologies to fill the gap without material consequences for customer prices and retailer solvency requires further analysis. Even if you assume the rapid growth trajectory predicted by potential new entrants actually materialised, under the AEMC's proposed transitional period, 2020-21 is likely to be a critical year in providing substitutes for existing risk management products. Unanticipated developments in the commitment of existing generators providing these products could significantly increase market risk and investment requirements. In this regard, Energy Edge notes that five minute settlement has the potential to bring on the exit of gas-fired power generation due to the diminished ability of such assets to capture value.
- First mover advantage: There is no guarantee the short-term response to the gap in the market will minimise the cost of supply over time. Effective first mover responses may discourage further market entrants by reducing or eliminating the price signal from shorter settlement periods. Further, given rapidly changing market dynamics and heightened uncertainty, the willingness of market participants to undertake significant investments may be lower than usual.
- Visibility of new capacity: If investment in flexible generation capacity is not visible to the market operator (i.e. scheduled), it will not change the wholesale market spot price. The extent to which this generation could also be relied upon to address pricing risk in the market (e.g. as a substitute for caps) is therefore highly uncertain.
- Type of new capacity: It is important to distinguish between energy and capacity requirements. Both pumped storage and batteries are net energy users and do not address energy constraints. As such, it is not a one for one substitution when considering the need to replace existing thermal capacity, particularly when you consider overall system security needs.

The risks associated with the change and heightened level of uncertainty underpinning the key factors that will ultimately determine its success are such that it is not reasonable to simply assume the theoretical benefits of the reform will be realised over time. A more prudent approach would be to implement five minute settlement only when there is certainty that sufficient investment has actually occurred. This would minimise the level of the market disruption and likely deliver more efficient pricing outcomes for consumers. This view is supported by Energy Edge, who recommend that “... such assets are in place prior to the implementation of the proposed rule change to ensure that the market is not left with a shortage of cap contracts that will result in retailers potentially having to manage their load flex with instruments that either increase price or increase risk.”

3. Implementation costs

Key point(s):

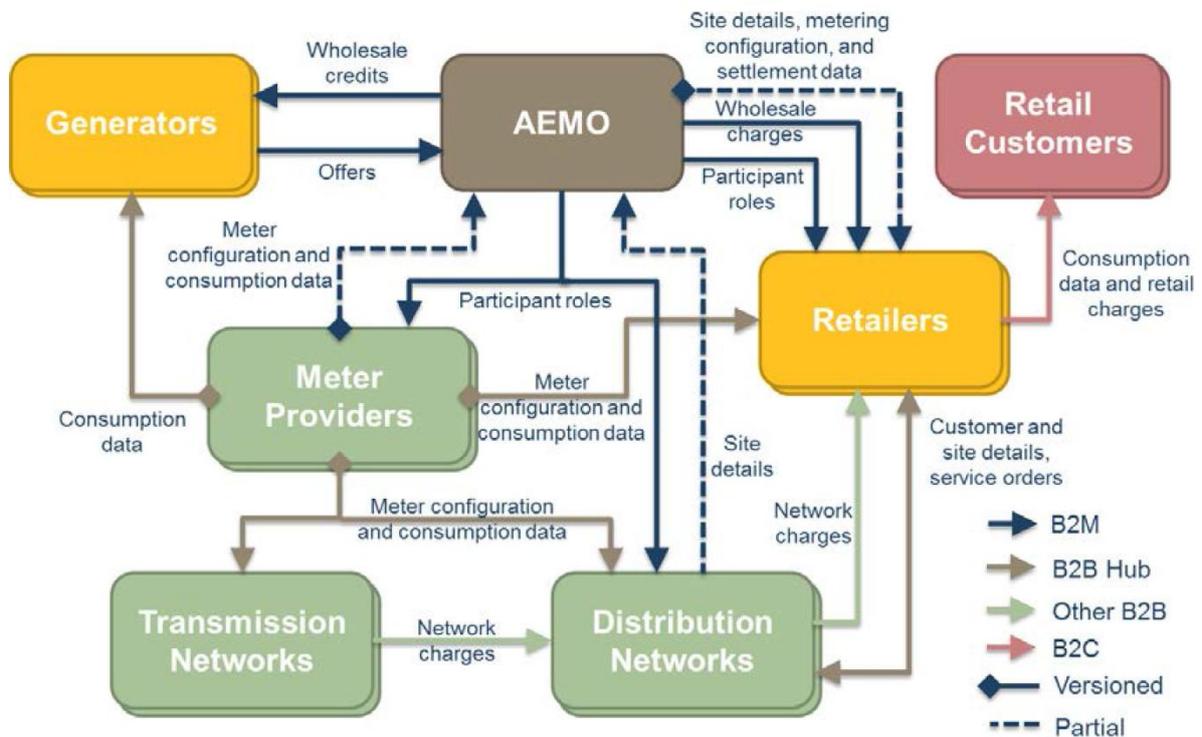
- Implementing five minute settlement would necessitate fundamental changes to internal systems and processes, the costs of which are estimated to be in the order of \$33-38 million for Origin Energy.
 - The AEMC's proposed transitional period would still result in significant contractual disruption. Analysis undertaken on behalf of the industry suggests contract renegotiations costs could be in the order of \$8.3 million.
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Origin is supportive of the AEMC's preliminary position that if implemented, five minute settlement should be compulsory for both the retail and demand sides and underlying five minute data should be derived from revenue meters rather than supervisory control and acquisition (SCADA) data. The costs associated with accommodating these changes are explored in further detail below.

Internal system/process changes

Implementing five minute settlement would necessitate fundamental changes to internal systems and processes that are currently incapable of accommodating five minute settlement data. As identified by the AEMC (and illustrated in Chart 1 below), information flows between AEMO, metering data providers, generators and retailers are highly complex and integrated. One simple change to the underlying data set has ramifications across all systems.

Chart 1: NEM information flows



Origin has provided a breakdown of impacted systems and estimated upgrade costs in Attachment B, which has been provided confidentially as a separate attachment. Estimated upgrade costs total \$33-38 million, which is significantly higher than the proponent’s original estimate of upfront costs to generators of \$2.78 million based on figures originally reported by NEMMCO. These costs are outside of the ongoing costs associated with additional data processing and analysis, or any resultant costs to support the change (e.g. increased prudential requirements, ongoing data management etc.).

Contractual implications

Exposing generators and demand side participants to different reference prices (i.e. five minute settlement prices compared with 30 minute settlement prices) would have a significant impact on financial contracting in the NEM. Where existing contracts are in place, Origin agrees with the AEMC’s assertion that the change in pricing would likely constitute a market disruption event and provide grounds for termination or renegotiation of those contracts. This is not only relevant to financial hedge products such as cap contracts, but also power purchase agreements (PPAs) and Settlement Residue Auction (SRA) contracts, each of which reference 30 minute settlement prices in the NEM.

According to the AEMC, a three year transitional period would allow a significant proportion of ASX traded caps to lapse prior to the rule change taking effect and minimise the resultant level of disruption. This is based on analysis that demonstrates the more liquid end of the trading curve is up to three years forward – in some regions futures contracts have traded three and a half years forward, and cap contracts three years forward.

But ASX and broker traded OTC contracts provide only a small part of the picture. Based on Origin’s view of OTC caps traded directly between participants, a number of long term contracts are in place that span well beyond the proposed transitional period. This is acknowledged by Energy Edge, who state that long term caps sold as part of bank financing arrangements typically span 10-15 years. While a number of these arrangements may be more than half way through, the reopening of these

may possibly involve some form of refinancing exercise particularly for those assets that will have reduced effectiveness of capturing five minute price spikes. Energy Edge suggests that a transitional period of at least five years would be required to minimise the overall impact on these contracts.

The AEMC also notes long term PPA's and swaps are unlikely to be materially impacted, with changes mainly relating to the reference price. But the change in pricing would still likely constitute a market disruption event and provide grounds for termination or renegotiation of those contracts, including terms and conditions. The impact on PPA's and swaps should therefore not be discounted.

Based on the above, the AEMC's proposed transitional period appears inadequate and would still result in significant contractual disruption. While it is difficult to quantify the overall financial impact, analysis undertaken on behalf of the industry suggests contract renegotiations costs could be in the order of \$8.3 million.³

Metering

Origin agrees revenue metering upgrades are necessary to implement five minute settlement in the NEM given the limitations associated with relying on SCADA data for settlement purposes. As noted by the AEMC, SCADA measurement equipment is typically less accurate than revenue metering equipment, with accuracy falling within the 2-4 per cent range relative to 0.5-1 per cent respectively. While it is recognised the SCADA data would only be used for profiling purposes, this increased level of inaccuracy can still distort revenue outcomes, particularly in instances where generation output and prices vary significantly over the settlement period. The location of SCADA systems within a power system can also lead to differences in the basis for measurement between individual power stations.

To minimise the costs associated with implementing metering changes, it has been proposed that all revenue meters apart from Type 6 accumulation meters should be replaced/reconfigured within five years. Under this approach, AEMO could continue to use the Net System Load Profile to create five minute resolution data for the majority of small customers still reliant on accumulation metering rather than interval metering. But it should be noted this broad implementation proposal would actually require a large number of Type 4/5 meters that are not capable of being reconfigured to be replaced, principally due to the data storage limitations.

This would be a perverse outcome given accumulation metering would remain unchanged. It would also give rise to significant costs in addition to those outlined in Attachment B. While the AEMC notes there may be scope to relax local memory data storage requirements for metering to around 35 days, this would effectively mean there is no redundancy built into the system if any issues arise (e.g. a sim card fails and cannot be replaced immediately). As such, Origin's preference is that existing Type 4/5 meters are also exempted from providing five minute resolution data and effectively grandfathered if the rule is made.

4. A potential path forward

Key point(s):

- The extent to which five minute settlement would deliver net market benefits and ultimately lower energy supply costs for consumers is contingent on a range of highly uncertain factors.
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³ Russ Skelton & Associates, AEMC Public Forum – Five Minute Settlement, Workshop Presentation on Costs & Price Impacts, 4 May 2017.

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- A prudent approach is to align the implementation of five minute settlement with the period when market conditions indicate greater potential for the benefits of the reform to be realised.
 - In the event the periodic review mechanism isn't implemented, a longer overall transitional period in the order of six to seven years is required. This will provide additional lead time for new investment in flexible plant to occur and assist with minimising the level of contractual disruption.
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Ensuring wholesale electricity markets provide price signals and incentives to be responsive to demand over the shortest timeframe practicable is important from a market efficiency perspective. To this end, Origin agrees there are theoretical benefits that could be achieved from addressing the current misalignment between five minute dispatch and 30 minute settlement timeframes in the NEM. But the extent to which such a fundamental reform would deliver net market benefits and ultimately lower energy supply costs for consumers is contingent on a range of key factors, including:

- the level of new investment required – the forecast shortfall in caps of 625 MW is understated, given it excludes OTC contracts traded directly between participants as well as the potential impact on base load generators (i.e. a reduced ability to underwrite caps due to ramping limitations);
- the economic viability and suitability of new investment – it is not clear whether sufficient investment in new, more responsive plant such as battery storage will materialise over the transitional period to offset the expected reduction in caps and also alleviate any security/reliability of supply concerns that may emerge;
- the impact on wholesale energy costs – increased premiums associated with financial derivatives and the introduction of higher marginal cost plant into the supply mix will place upward pressure on wholesale energy costs, at least over the short to medium term;
- the level of contractual interruption – a transitional period of at least five years would be required to minimise disruption to long-term caps, with a three year transitional period leading to overall contract renegotiation costs in the order of \$8.3 million; and
- total system upgrade costs – the cost of upgrading Origin's energy trading and retail systems alone is in the order of \$33-38 million.

Given the above, Origin believes a prudent approach is to align the implementation of five minute settlement with the period when market conditions indicate greater potential for the benefits of the reform to be realised. This could be achieved by making the rule change contingent on a periodic assessment of the market, the first of which could occur in four years from the AEMC's final determination. Any decision to proceed with the rule change could then be followed by a three year transitional period so businesses have sufficient time to undertake the significant system changes described above.

In the event the periodic review mechanism isn't implemented, a longer overall transitional period in the order of six to seven years is required. This would better align with the timeframe proposed for the completion of metering changes in support of five minute settlement. Further, it is consistent with the time period proposed by Energy Edge to minimise the level of contractual disruption and will provide additional lead time for new investment in flexible plant to occur. With respect to the latter, in determining the overall length of the transitional period the AEMC should give more detailed consideration to:

- the impact on hedging in the market brought on by the deficit in the supply of cap contracts;

- the implications for retail competition and the impact on energy consumers due to the disruption in the contract market;
- timelines around the expected market entry of new rapid response generation, including their costs and potential uptake;
- the natural sellers of new caps to replace the reduction in supply, and the timing of this supply;
- the potential for new hedging products to alleviate the shortfall in caps;
- an estimate of the system wide costs that will be incurred to undertake the necessary system, IT, and metering changes required to support the rule; and
- how to better understand the potential impact on wholesale spot prices and volatility (notwithstanding the inherent limitations of modelling these outcomes).