Five minute settlement rule change request: Transcript of public forum

Sydney, 4 May 2017

The AEMC held a public forum and live webcast this month on a proposed fundamental change to the national electricity market's design – changing the settlement period for the wholesale electricity spot price from 30 minutes to five minutes.

Consideration of this important rule change proposal rests on the need for price signals that help drive investment in generation, not only using the technologies of today, but the technologies of the future. This forum was part of the project's consultation on evidence for and against moving to five minute settlement.

The request, from Queensland zinc refinery Sun Metals, would signal more accurately the value to consumers of fast response technologies, such as aggregating distributed storage, new generation gas peaker plants and rapid demand response, which are needed to support the increasing penetration of intermittent wind and solar generation in the sector.

The forum, which featured presentations by a diverse range of stakeholders, was an opportunity for stakeholders to provide feedback on the AEMC's recently released directions paper, in particular the Commission's views on:

- the costs and benefits of changing the settlement period for the electricity spot price from 30 minutes to five minutes
- a proposed three year transition period, if the change were to be made.

The Commission outlined its initial support for the rule change request based on the fact that five minute settlement would provide a more accurate, technology-neutral price signal that reflects consumer demand.

The AEMC aims for market and regulatory arrangements that adjust to whatever the future brings, and that enable consumer choices to drive the way the sector develops, the technologies that get deployed and the business models that succeed. Rules that are technology-specific risk being made irrelevant by the next leap in technology, and can be a barrier to innovation.

The AEMC has made around 220 changes to energy market rules since it was established. The rules can, and do, continue to evolve and accommodate changes in technology.

Stakeholder input, through public forums, submissions, meetings and other engagement with the AEMC is crucial in informing the Commission's analysis and rule changes. The AEMC will consider the views presented at the forum and comments from webcast participants. We also encourage submissions on the directions paper by 18 May 2017.

The draft determination is due to be published on 4 July 2017.

A transcript of the forum follows.

The ex-tempore character of this discussion has been preserved in the transcript taken at the event and from a recording of forum proceedings.

Australian Energy Market Commission - AEMC

Public Forum on Directions Paper:

Five-Minute Settlement

Held in Ballroom 3
Rydges, World Square
389 Pitt Street, Sydney

On Thursday, 4 May 2017 at 10.00am

MR PIERCE: Welcome, everybody, and thank you very much for your interest and engagement in this particular subject.

The quality, of course, of the decisions that the Commission can make is highly dependent on the engagement and the contributions that you make to the Commission's consideration of rule changes such as this. As Kris has already outlined, we don't actually keep records, I suppose, of the topics we deal with which generate the most interest, but this one would certainly be up there.

Because of that, we have taken the approach that we sometimes do of issuing a paper that outlines the Commission's, if you like, preferred position prior to publishing a draft determination, for a couple of reasons, but primarily to make sure that everybody that has a viewpoint, everybody that has a contribution to make, has an opportunity to express that and to be heard by the Commission and, just as importantly, particularly through forums such as today, that people have the opportunity to hear from others. The conversations that you have between yourselves and sharing of perspectives and viewpoints is just as important, or perhaps more important to these sorts of processes than everyone just talking at us.

I encourage you through today to take that opportunity, obviously through Kris's control of the process, to take every opportunity to engage with one another and to test, challenge and share ideas between yourselves.

The reason that is important is the Commission is very conscious of the fact that, in a sense, we don't do anything real. We make real determinations, but it's the market participants who have to take that away and make it work in the real world. Understanding of the rationale behind any particular rule change we make seems to us to be an important way of increasing the probability that the intent behind a rule change gets translated into reality on the ground.

Many years ago, in fact even before there was a NEM, New South Wales and Victoria separately ran trials on how a market could operate and throw up different types of market designs. In the case of New South Wales, at least, the question about what sort of time period, bids or offers,

and what we now call the spot market, the time period over which it would operate was an obvious first question that we'd have to deal with. To the power station managers and production engineers within New South Wales, at least, the answer to that was very obvious: it should be three months. The reason being, the coal contracts that sat behind the stations allowed variations in coal delivery volumes in three-month blocks. What they wanted to know was how much energy they were expected to produce over a three-month period so they could then plan their coal deliveries. So we said, "Okay, if that's what you need, let's run the market like that for a while, see what happens."

So, given a system demand forecast, they were asked to put in price offers, it was run through a dispatch process, and then they were fed back an energy volume for that period. When they got their volumes, we also gave them an opportunity, when they worked out what price times volumes meant for them, what their revenues would be, to resubmit bids. Then they got new volumes and they were given the opportunity to resubmit a third time, at which time the prices and volumes were locked in.

That is pretty typical in these sorts of situations. It takes about three rounds before people understand the relationship between their volume, and hence revenue, wasn't only dependent on their bids, it was dependent on everyone else's as well, which is very familiar for anyone that can recall the bar scene from the movie A Beautiful Mind, it's a similar idea.

So we ran the system, everyone was happy with three months, they had the price volume and revenue numbers that they thought they could live with and then reality hit. Demand ended up being different to what was expected, boiler tubes leaked, conveyor belts broke and both the volumes and the revenues that the generators ended up with wasn't what they expected and wasn't what they were happy with.

In the review process afterwards, they suggested that the time period should be shortened so that we have, essentially, something very similar to what we have today, a set of bids, but over half-hour periods for the next day. The response was outrage - how could you run a power system based on a system like that - to the extent that at one

point I feared for my life in this room full of engineers, until one of them, one of our own, who is one of our speakers today, in fact, reminded them of a control period they'd learnt in their engineering degrees, that the more often you can make changes in a system, the more stable the overall system is.

That sort of quietened them down and we ran the trials and people discovered they could make it work. It seems to me that there are similar sorts of issues in the context of a five-minute, 30-minute rule change. It's about the time periods over which adjustments can be made and people can adjust their positions - obviously on a completely different scale, but still the same principle, the underlying principle being if demand varies continuously, then you would want supply and price as close as the speed of light will allow you to, to also be able to vary continuously.

Now, that might be a nice principle but, again, we have some realities. There are some realities in relation to the costs associated with changes in systems, metering and the like, IT systems, but I think more fundamentally from the Commission's viewpoint, we have these things called hedge markets, and sometimes I think the Commission feels that we are one of the few people that has to continuously remind people of the important role they play in underpinning the reliability of supply and the effect of a change such as this on the ability of those hedge markets to operate and be effective, as a risk management mechanism within our market. It is a key question in the Commission's mind in considering this rule change. Those sorts of issues, I think, are well articulated in the paper that I'm presuming you've all read and that's why you're here today.

We are looking forward to hearing from not just our presenters, but all of those who are here today, online, around those sorts of issues, in order to help the Commission come to a view about what's in the best long-term interests for consumers. Thank you.

DR FUNSTON: Thanks, John. I'd now like to invite Kathy Danaher, from Sun Metals, the proponent of the rule change, to come up and do a presentation.

MS DANAHER: First of all, I also want to start by

thanking the AEMC, and also for the opportunity to speak at this forum. As a alluded to a moment ago, Sun Metals initiated this rule change because basically it saw a fundamental distortion in the market, where participants made decisions to buy in the wholesale market based on a five-minute price, but the settlement price could be one hundred times different because it was based on a 30-minute period.

This happened on many occasions and Sun Metals saw this distortion as producing poor investment decisions for SMC and for other loads. Sun Metals strongly supports the directions paper produced by the AEMC. There are a couple of areas where we believe they may have been overly conservative but, on the whole, we endorse their position.

Just to think about it, there are really three key elements of discussion that we need to take into account: firstly, it's logical and commonsense that ideally the settlement price should reflect the dispatch price; secondly, it's understandable that the current major wholesale participants would resist change because they are comfortable with the current process. They know how to make money in the current system and they do not see the value in the cost, particularly IT changes that will be required.

Finally, the future is about more diversity of supply and quite different technical and commercial solutions. The current arrangement favours conventional supply and retail arrangements. However, the wholesale market should not favour one group of participants, existing large participants, over another. This means the current arrangement should change.

Sun Metals believes that all parties agree that the alignment of settlements and despatch price is logical and consistent with good economic principles for efficiency of market outcomes for both supply and the use of electricity. Sun Metals believes it is fundamentally wrong that purchasers in the wholesale market should choose to take wholesale supply for a five-minute period at one price, and find the prices change when it comes to settlements 20 minutes later. This is important to those like Sun Metals who manage their price exposure through a combination of hedge and load management.

The effectiveness of load management is completely undermined when we choose to operate at 100 megawatts demand because the dispatch price is $50 a megawatt hour, but ends up having to pay $2,000 a megawatt hour for that energy because of despatch in the settlement period.

Through this real change process Sun Metals has also come to recognise the importance of aligning the dispatch and settlement price for generation if the market is to operate efficiently. There has been some strong negative reaction to the adoption of the five minute process. This option has led to the major existing players of the wholesale market and it seems to be mainly on the cost implementation basis perceived in contracts markets, particularly caps. Sun Metals is concerned that this approach is influenced by a desire of the existing large market participants to protect their current position.

The current generators and vertically integrated market participants have learnt how to extract value from the current discrepancy between the dispatch price and the settlement price. In recent years this has been particularly evident in Queensland as evidenced by the concerns of dispatch prices in the last two dispatch periods.

The market is failing if the structure does not provide true cost signals for the use of any energy based on efficient operation and use of plant, nor does the current dispatch settlement discrepancy provide clear allocation of value to generators, particularly those who operate in part of the settlement period. The settlement process must align the allocation of value between participants and reflects the alignment of demand, supply, cost and prices.

The current misalignment of dispatch and settlement prices seems to be used to create an inefficient value transfer by some current participants. This distortion negatively impacts some energy users as well as some generators. The current market structure favours the large conventional base load or intermittent generators and hence, is not technology neutral and will result in market inefficiencies.

The AMC direction paper clearly demonstrates the historic availability of five minute dispatch capacity from

existing generators, including existing thermal and baseload plants. This highlights the potential for competition for five minute dispatch changes based on five minute settlements. This should remove any concern from participants about a reduction in capacity in the market.

Sun Metals agrees that there are ample resources currently in the NEM and that new investment will occur, irrespective of the outcome of this rule change, that can physically respond to five minute prices. There has been significant discussion in the rule change process about the impact on the contracts and hedge markets, particularly the caps.

Sun Metals' experience is that the liquidity of the contracts market has reduced significantly over the last seven to eight years. Sun Metals believes this reflects a concentration of power through the vertical integration and concentration of ownership of major supply assets. This reduction in liquidity is encouraged by the misalignment of dispatch and settlement prices.

Sun Metals understands that there may be a reduction in caps while other technologies are introduced and operating models of existing plants are adjusted to support the risk management role of the caps and other hedges. Currently, the providers of physical support for caps are exposed to the differential between the dispatch price, the settlement price and their capacity to respond.

These existing participants manage this lack of alignment and hence, it is reasonable to assume that existing providers will also be able to manage the reduced misalignment and hence, deals will reduce this uncertainty in the market. Emerging technologies will also enhance this offering. Sun Metals believes that the financial market will establish other tools to manage these risks if there is a legitimate demand for them.

It is important that consideration of this rule change be forward looking to respond to emerging changes in both supply-side technology and operations, as well as demand-side economics and market participation. The data produced by the AEMC in the direction paper highlights the level of distortion between what price the supply-side was prepared to dispatch and the price they received.

This distortion is obvious in all regions at different times, but is dominant in Queensland and South Australia and lesser distortions in other regions. There is an argument that in an underlying physical supply side arrangement dominated by conventional thermal generation, the distortion may not be material. However, the materiality is increasing significantly with the change in supply-side technology and economics.

The direction paper highlights the existence and emerging technologies in terms of batteries and quick-start generation and combined generation and storage that will respond to five minute prices most effectively. Sun Metals believes that the rules should be neutral to technology, but that neutrality must be based on logical rules consistent with efficient economic principles. The mismatch of dispatch price and settlement price is neither logical nor consistent with good economic design.

The five minute settlement process will remove this distortion and improve market efficiencies, but will not necessarily deal with the wider market issues in Queensland, South Australia and emerging in Victoria. Sun Metals contends that improving wider market performance will be easier with supply-side price distortions removed.

In conclusion, Sun Metals strongly supports the AEMC directions paper and that the position of the settlement price should be aligned to the dispatch price. Sun Metals is concerned that the existing market participants are likely to overestimate the cost of implementations because of their stated and understandable reluctance to see value in changing the existing settlement and dispatch distortion.

Sun Metals does believe that the AEMC is being conservative in establishing the transition period proposed in the directions paper. Sun Metals does support the stage approach, but Sun Metals would ask the AEMC to look at the duration of Stage A program to ensure that we are not unnecessarily delaying implementation. The AEMC has not endorsed Sun Metals' proposal to adopt five minute settlement discretionarily on demand-side participants in the wholesale market.

Sun Metals endorses AEMC's position that it is more effective to include all participants in the five minute

settlement, but Sun Metals is concerned that the current participants will be incentivised to maximise the cost of changes in settlements that may be necessary to address the estimated by making it optional for retail and market customers, so there may be a transition period where it is optional.

Finally, and for me most importantly, Sun Metals wants to publicly endorse the work and the efforts of the AEMC of this rule change process and urge all participants to look to establish a long-term sustainable wholesale market operation by supporting the alignment of dispatch prices with settlement prices. Thank you for your time.

DR FUNSTON: Thanks, Kathy. Before I kick off the first session on materiality, could I just invite all the speakers to come up the front. I also understand that there are people having some issues with their browser who are audio-casting this, so if you are having issues, the advice is it to reload the browser and hopefully that will fix it, but if you're having further problems, please let us know and we'll look to rectify them.

I think I have 10 minutes to talk about this, but given that I'm actually talking about what are the contents of the directions paper, I'm going to try to keep this short so that we can use the full amount of time to hear from the speakers that have been invited, but also to hear the views of the general public.

Just in relation to the materiality of the problem, in terms of our assessment of the proposed rule change that was put forward to us, we need to assess that in line with the National Electricity Objective, and so in assessing that we need to see whether or not the rule change is in the long-term interests of consumers. To do this one of the things that we assess is whether or not there is a material problem with the existing rule and whether or not, therefore, there will be benefits associated with the rule change.

This is really what this session is about, whether or not there is a material problem that exists with the existing misalignment of dispatch and settlement at five minutes and 30 minutes, and then whether or not there are benefits, therefore, from moving to five minute minutes.

Just in terms of the key findings of the directions paper - and this is really just by way of a reminder - the Commission highlighted that we believed there was a material problem with the existing 30 minute settlement. We highlighted that we believed that in principle there were benefits from aligning dispatch and settlement and improving the price signal and the alignment of dispatch and settlement should be in the shortest time practicable, which we believe is that five minutes.

We also looked at evidence in terms of data from existing arrangements within the NEM and the wholesale pricing outcomes and what we found is that there was evidence that showed that the 30 minute settlement does appear to be distorting price signals and there seemed to be some behavioural evidence of the incentives that we were suggesting could arise actually occurring.

We also looked, in assessing the materiality, at the NEM design and the current market conditions. We believe that based on the NEM design and current market conditions, that there were actually benefits of an improved price signal and that the price signal was increasing over time. We also believe that there were better re-bidding incentives with regards to the five minute settlement.

Just in terms of the in-principle benefits, the way we assessed this in the directions paper was we looked in particular at what was the issue when there were price spikes within a 30 minute settlement period. Obviously, if you have a five minute dispatch price but then if you have a 30 minute settlement period, there is a question as to whether or not people are actually responding and participants are actually responding to an effective 30 minute price rather than a five minute price.

One of the things that we looked at is what incentives does that create? We looked at the incentive at the end of the period where there was potentially this incentive to increase the price in the last period. We also noted, though, that this is something that is being dealt with through the bidding in good faith rule change process which was put in place and implemented as of 1 July 2016.

We also highlighted though, that there was a potential issue with a price spike occurring within the first period. We noted there were incentives for piling

in, in particular at a time when that generation was not actually physically valued by the power system. There was a potential disincentive for fast and flexible response technologies as they weren't getting the full reward in terms of responding to that particular spike in the first pricing interval, and there was a question about, given the bidding behaviour where those sort of technologies, those technology generators that were able to respond within the 30 minute period but not within a five minute period, because of their behaviour, there appeared to be some form of artificial variation occurring which didn't necessarily reflect the underlying market risk.

We believe there was the potential for an improved price signal as a result of this behaviour. We also saw that aside from the 30 minute period, if this was to actually occur over the longer term, there was a potential for a distortion of the generation mix over the longer term and potentially a misalignment of the lowest cost technologies and the social incentive in terms of the lowest cost to society in terms of the generation mix, with the private incentive mix in terms of what would be invested in. We thought that that created some potential inefficiencies in the longer term and was unlikely to promote dynamic efficiency.

As I mentioned, we did look at the existing distortions in the NEM. One of the things we also highlighted in the directions paper was, we have seen a move, at least in Queensland and South Australia, where since the bidding-in-good-faith rule change has been put in place, we have seen this spike actually in the first dispatch interval and yes, it has been removed from the sixth one, but we're seeing it now in the first interval. We're seeing some evidence of the incentives that we looked at actually occurring within the NEM.

The other point we highlighted was one particular example where we highlighted this incentive to pile in and we highlighted there was one particular example of this in South Australia where what you can see here is the differential between the 30 minute settlement price and the five minute dispatch price.

In relation to design and market conditions, we looked at the benefits of alignment being recognised actually internationally. At the moment, in the US there's a FERC

order from 2016 which has looked at the alignment of dispatch and settlement at five minutes, and we've made the point that while there are obviously benefits that the US regulators have highlighted and people internationally have highlighted, we believe some of those benefits are likely to be greater in Australia because of the more important role of price signal here for places not only for the ongoing operation within any period, but also for longer-term investment because of how the wholesale price is reflected then in terms of the hedge and contracts market and how the contracts market is, effectively, that market for generation capacity.

We also believe that there are increasingly signals needed for flexible and fast response and this is to support the increased penetration of intermittent generation. One of the things that has come from discussions in the course of stakeholder working groups and bilateral conversations is a general recognition that we are moving towards more generation which is likely to be intermittent over time and so with that, there is this need for a price signal to actually ensure that we do get the right investment in flexible and fast response to actually support that increased penetration.

Finally, one of the things we noted is that given the life of the existing assets, I think, in particular, the thermal generation assets, it will be noted that around 45 per cent within a decade will be at least 40 years old within the NEM. There was a view that there needs to be the right price signals, so this improvement in the price signals that occurs from aligning dispatch and settlement at five minutes is likely to have this longer-term benefit.

As mentioned, we also highlighted that we believe there are still issues that exist with re-bidding which were highlighted in the previous slide.

Just in terms of the questions, I will leave this up because these are the questions we are really interested in and we highlighted this in the directions paper. We are interested in understanding how material are the price signal inefficiencies under 30 minute settlement? To what extent would five minute settlement address the inefficiency in price signals from 30 minute settlement. How does aging generation, evolving technology and intermittent generation actually affect this assessment?

Are there greater material benefits or not? What type of generation bidding would emerge under a five versus a 30 minute settlement. Thank you.

MR SKELTON: Thank you. Firstly, I'd just like to correct a potential misunderstanding and that is that the work I've done and I will be presenting from was done for the Australian Energy Council and that is not a generator perspective. The Australian Energy Council actually represents all of the big retailers in Australia, so I think they would be a bit irritated if they thought I was only speaking on behalf of generators, although that's where I've spent most of my life.

What I would like to do is just go quickly through the potential benefits that we think might be there and just comment on them. The first one, obviously, which both John and Kris have spoken about, is moving the market closer to the ideal. Our view is that whether the five minute settlement is closer to the ideal or not is essentially an irrelevant question, because that's a sunk choice. That was a decision made a long time ago and whether we have a difference between what theoretically would be best compared to what we have is a bit irrelevant.

The question is whether the benefits of shifting from what we have to five minute would substantially exceed the costs and the risks associated with that. I think that's the question we need to focus on, not whether what we have is less than ideal in the current world.

The engineer that John talked about who advocated moving to 30 minute settlements, that was me. I'm sure John is not trying to make me feel bad about resisting at this point.

MR PIERCE: Emotional blackmail isn't something I'd resort to, Russell.

MR SKELTON: Never, but I think the question still remains. The question is what is the magnitude of the benefits versus the magnitude of the costs, which is essentially a quantitative question, not a philosophical question.

The next benefit is the potential benefit of improving the ability of customers, like Sun Metals, to make

production decisions with some confidence that they're not going to get whacked with a substantial retrospective price increase. Kathy has put that proposition very well and I think that is a real potential benefit associated with going to five minute settlements, but the question I think is whether the rule change that is introduced that Kris referred to has actually made that circumstance better and whilst we acknowledge it's early days, the early indications are that the sort of incidents that you had of lots of price spikes occurring in dispatch interval 6 in Queensland has largely gone away and the incidence of price spikes versus dispatch interval seems to be much more even than it was previously to that.

I am not saying that that's not a good benefit but the question is whether that problem has already been solved and that's a question of analysis really.

The next one is whether it will create incentives that will reduce the cost of production or productive efficiency and the view is that there are three ways it could improve that efficiency. One is by incentivising incumbents to produce during dispatch intervals with high prices, or on the other side of that, incentivising and not to produce with low prices and incentivising new entrants that can respond more quickly and produce during dispatch intervals with higher prices, like very fast start generation.

I think it is generally acknowledged that this is a very difficult question to answer. Forming a view on whether five minute settlement would achieve a material shift in these incentives and create a material advantage is fairly problematic, particularly trying to attempt to quantify the magnitude of the benefit in dollars.

Our view is that it would be possible to model this, but it would be difficult, it would be very time consuming and expensive, but in our view, considering the materiality of the costs that would be incurred by participants to shift to five minute settlement, we believe it is imperative that that analysis be undertaken.

What we did as an alternative to that was examine historical behaviour during price spikes and seek to form a view on how five minute settlement may shift those incentives. It is speculative to some degree, but it is a sort of a view based on what we'd be seeing and will five

minutes shift that. In our view, a key component of that was examining how generators reacted to price spikes that occurred in dispatch intervals 5 and 6, because in a sense that is not dissimilar to the incentives they would be exposed to under five minute settlements, in that one of the difficulties with 30 minute settlements is if there is a price spike early in the trading interval and you respond later in the trading interval, you get the benefit of something that occurred earlier.

If you increase your output after that trading interval has occurred, you derive no benefit from the price spike that occurred in that previous trading interval. If people are turning up after that trading interval where the price spike occurred, that would make you think well, maybe that's a similar circumstance of what would be occurring if generators saw price spikes that only lasted for five minutes.

We looked at a sample of data. To do this exhaustively was beyond our time and capability and my analyst ran out of space in his spreadsheet, I suspect, that's what he normally does, and what we observed is three things. Firstly, that some generators - we're not sure how or why - seem to be able to anticipate the price spike and actually they start to increase their output in the previous trading interval and turn up and they're there when the price spike occurs and then they persist and then they go away. Some generators see a price spike early in the trading interval, increase their output towards the end of the trading interval and derive the benefit from doing that.

We also saw examples of generators responding to price spikes occurring late in the trading interval in dispatch intervals 5 and 6 and so the increase in output that transpired only occurred in the next trading interval, so they derived no immediate benefit in terms of the trading interval price.

It is hard to form strong conclusions, but the conclusions we came to were some of this behaviour may be inefficient, but some of the behaviour is clearly generators responding appropriately to price spikes from a risk management perspective, which is efficient behaviour, that's what you want them to do. That is clearly the case for price spikes that occur in dispatch intervals 5 and 6.

From our perspective, there's no real basis to conclude that any of the behaviour is inefficient because you have three different sorts of behaviour emerging, some of which is potentially inefficient, but you also see other behaviour which is not inefficient, and it is hard to impute the motives of the generators, what they're doing, you can only observe what you observe and our conclusion is that there really is potentially no confidence that there's a problem that needs to be solved of any materiality.

The next question is whether it is going to stop new entrants that are very fast-start turn up and I think that means there are two questions. One is, do the rules limit the entry to fast-start generation, such as batteries, and then the next question is - because both questions need to be answered in the positive - if that generation is not turning up, does that mean that the market is paying more for its electricity than it otherwise would?

It is going to be interesting what Dean says later on, but I am just quoting him, I didn't know you were going to be here, Dean, and Dean is very proud of the rate at which they're investing in batteries and that's under 30 minute settlement, and I note also that Dean's colleague, when putting a submission to the Senate about what they ought to do to make life more conducive for batteries, was silent on the need for five minute settlements.

I can understand why they would prefer five minute settlements, that means they make money faster and easier and I'm a huge fan of that, as are all generators, but that doesn't necessarily mean that you've got to create an environment just to help one particular asset class make money faster, particularly when, in the process of doing that, you make it harder for another asset class to make money.

I am not sure that I accept the view that the five minute makes things technologically neutral
. Whatever you do, if your 30 minutes gives certain people an advantage compared to others, you go to five, you give other people an advantage compared to others, and so I don't think there's such a thing as a technology neutral choice of the settlement period.

Our conclusions are pretty simple. Without a comprehensive modelling exercise, in our view, it is very

difficult to estimate the magnitude of the benefits of five minute. On our analysis, we conclude that the potential benefit is likely to be small, non-existent or even negative potentially, and, in our view, it is important that before the AEMC commits the industry to spending a substantial sum of money, that they ought to get someone or a number of people to attempt to quantify the magnitude of the benefits before proceeding. I am done, thank you.

I have one more slide and John will like it. That is a quote that I love from a Nobel Laureate winning economist, he won it some years ago, John, but I think his comments are still the same, and that is, "The curious task of economics is to demonstrate to men how little they really know about what they manage they can design."

Here is my story about John. As he said, he and also Brian and another colleague of theirs were involved in this internal market, which was very interesting and amusing and a lot of fun and we learnt a lot of things. My abiding memory is that the ability of the rule makers, which was John and Brian and Paul Smith, to make rules that would elicit the behaviour that they thought was desirable. My view was that John acknowledged failure one day when he dragged us all down to Sydney and he said, "I need to introduce you to the idea of moral persuasion. I want you to behave", because he couldn't find a rule that would compel us to behave the way he wanted.

My view is that that's just a word of caution for humility on behalf of those of us who think we can predict how people respond to something we do to change the rules of what we're operating in. Now I'm really done, thank you.

DR FUNSTON: Thank you for offering that perspective. I note that John is chairing the session today, he will have the right of reply at some stage to that. If I can invite Dean Spaccavento, the CEO from Reposit Power, to provide the new technology perspective on the issue of materiality. Thank you.

MR SPACCAVENTO: Good morning, everyone, just a quick thank you to the AEMC for holding a forum like this, it is very important to get everybody's views, especially the little guys, of which I am one.

I am the CEO of the company Reposit Power. I have been in the demand side of new technology space since about 2007, so that's pushing 10 years now. I was thinner and I had less grey hair then, but I have been asked to speak about materiality. I will try to keep my scope very, very tight to materiality, for what I can talk about authoritatively, and that is Reposit.

Reposit is a control system that is used to make batteries make more money. That's its job. In this room, I'm happy to admit that Reposit was actually set up as a Trojan horse to get storage into the grid. Based upon my background in finance, I realised a profit motive is what's required to have people make an investment in a technology, and that's why we have a thing called grid credit. Grid credits are money you get from the grid for having your battery participate to solve the issues that it resolves. It is a system which provides good pricing levels most of the time, and those pricing levels deliver investments decisions, and those investment decisions solve problems and that's what the system is supposed to do.

We are independent. We are not aligned to a retailer, we are not aligned to a battery manufacturer. We integrate with people who believe that the customer is king and that the delivery of value for the investment decision-maker, i.e. the customer, is paramount. We are interested in customers feeling that they are the ones that are being paid attention to, because then they open their wallets and make an investment in the kind of generation that the NEM needs.

NEM is calling for fast response. It's most clearly seen in the rise of FCAS prices. But we are not talking about FCAS here, we are talking about wholesale. You can see it in the instability that we have got. You can see it in what generators are getting retired, you can see it in which generators get fired up when gas prices drop. It is a movement that is clearly delivered by intermittent generation becoming more and more prolific in the market and with increases in that intermittent generation, electricity storage is absolutely required or "very fast start, I don't care what".

The problem is that that pricing of "very fast start, I don't care what" is being muffled by a 30-minute settlement, because the prices delivered in a five-minute

period are smudged across the 30-minute period. That means that you don't end up with a clear signal that investment in a five-minute responding, or sub five-minute responding resource is the right thing to do. Hence you won't get as much investment.

In terms of materiality, I want to talk about numbers. I picked this date of 21 March in South Australia. This is a very, very standard early bidding piling in late thing. It's in South Australia, which is one of our favourite places. What you can see is some behaviour that is characterised by an early very high price. That's the $10,000 a megawatt hour line. Then this negative price - or not negative prices, much lower prices, but you see it goes negative quite a lot. There's the zero line.

What that means is that that looks like a happy day for us, "This will be very interesting if you had batteries". Actually when you did the numbers on the 30-minute settlement, it was a bit, "Yeah, it was all right". Exactly that kind of response from my trading desk is what, when I tweeted it out to the world, I got through everybody else. "It would be really cool if we had a five-minute settlement, I'd definitely be interested in doing something like that". So I went, "Okay, let's see what the actual difference is". There's the numbers. Everyone can see exactly how this is being done, a trading interval by trading interval and there's all the settlement prices down there. You can see the early bid price is in red and then you can see the pile in. Those minus prices are people jumping into the market. The generation wasn't required, they just decided, "We better get some money, turn on the generator".

You can see what the calculations are. You look at about 30 per cent, 40 per cent increase in value, no difference in trading other than the fact that you could respond to a five-minute price rather than a 30-minute price.

So, in some of the intervals it is actually zero and there is no benefit, and that would be the second one and the last one, but you can see what the benefit is beyond that - 30 per cent, 40 per cent. I'll make it easier. On the assumption that this is a 5 kilowatt LG Chem battery, it is basically state-of-the-art, it doesn't deteriorate under high power usage, it doesn't deteriorate very heavily

under bad temperatures. It's a 5 kilowatt machine, it's pretty much what everybody is buying at the moment.

We assumed perfect dispatch prices, which never happens, for lots of reasons, but for this we presumed that the control system knew what the five-minute price was going to be coming up, and there was battery capacity available. The analysis basically said you need 7 kilowatt hours of backwards and forwards to be able to execute what this has executed. This is not how the battery actually traded. The battery in South Australia traded on the 30-minute market - in fact all the batteries, 170 of them, traded on the 30-minute market. We didn't turn them on for five minutes, because why would we.

This is pure price response, which means we don't do any sort of predictions of this or that; just here is the price, this is what I'm going to do. No trickery, no derivatives trading, nothing, straight merchant price response. I also, at least in this one here, in the grid credits calculation line, did not include the value associated with the resale of the kilowatt hour that you would get at buying negative. Then they get to sell it later on in an arbitrage.

So I did a calculation. What did I come up with? I'm happy to share this spreadsheet with everybody. An increase in grid credits, 22 per cent. That's 22 per cent value increase in the money that a customer would have got from their battery in a five-minute market, versus a 30-minute market, in the real world, on 21 March in South Australia. That's 21 per cent, 22 per cent. That's material. 22 per cent is a fifth. On a 10-year battery lifetime, that's two years off the life of it. Everybody in batteries and solar speaks about pay-back periods. So if you want to get that continuously, you have to go from a 10-year payback to an eight-year payback. Actually batteries are looking in South Australia like a six or seven-year payback. So you're coming down to within 4/5. That's clear mainstream adoption time. So just this is basically stopping lots and lots of batteries going to the market. Yes, I did say we were doing 200 batteries a month. It's actually more than that now, but that's not enough. That's nowhere near enough. That's only 12 million a year. 12 million a year doesn't the touch the sides of anything.

If you add in the resale price of the kilowatt hours you get from negative prices, it is goes to 30 per cent materiality. 30 per cent. So now a 10-year payback period becomes a seven-year payback period, and on a six-year payback period, you're getting on to four. Again, material. People will make investment decisions on fast capacity because they are getting paid for it and in fact they are getting 30 per cent more, which means that you'll get an increased uptake.

That's what the grid credits is for. It's the Trojan horse. It is the profit motive. It delivers a palatable financial return for mums and dads and punters in the world who don't need to know about wholesale markets and FCAS and network support, and all the clever things that we do, but they are interested in seeing their electricity bills being lower in a way that is understandable.

More grid credits means more storage in the NEM. That's what it means. When we do our research, it's disproportionate because people go, "Oh, look, I got grid credits", and they hold it up with their friends' at BBQs on Saturday afternoons - we actually monitor when the app gets used, Saturday afternoons, public holidays, because they show their friends. It's viral. They want to say, "Look how clever I am, I'm getting paid. My house is so clever". It's good for us, but it's also good for the NEM because people think, "Maybe I should get that". If they are going to buy a battery, they get a battery which is in the system rather than a battery that hides behind a meter, a battery that helps us rather than a battery that sits there and is not coordinated at all.

So any battery that starts providing grid credits is balancing the system and it's helping us out, and that is good because it means we can do other things like, for example, sell financial derivatives to slow generators. Why shouldn't we? Everything that was set up in our technology is built to sell financial contracts because we understand that merchant is one thing, but a much more important and interesting part of the market for us is the derivatives market, particularly when you need to capture all of the value associated with a piece of technology and being fast, but not being able to last for very long, which is what batteries do, means that there are certain places and times you can make money, and it's at the beginning.

So where there are a generators that cannot deal with fast start, I'm happy to sell a contract to. No worries. I'll fill in the gap, and then you can keep on generating for the rest of the day if you need to because I can't do it. This is the diversity that's important. We'll do it, because we'll get more grid credits for our customers which will send an increased price signal for customers to buy batteries and put them into the market.

Around we go. This is how we go from 12 MW a year to maybe a GW a year. This is the virtuous cycle that is enabled by allowing a clear price signal to go to people who make investment decisions, and they householders and small business owners.

Just to show you that in terms of materiality it's not just about volume, but also about reality, it's not science fiction, on Monday we turned on the full swap pass-through for customers. Customers now get full swap pass-through on their solar, they get full swap pass-through on their batteries, and the control system manages it accordingly. Already we are seeing a dampening of the response from the control system from the 30-minute signal. We haven't even had any nice prices. They are crazy prices in the market at the moment, but they are not heavy, heavy volatility prices.

The customers are already asking, "How come you didn't respond in this interval?" "Because we did the predictions that basically it looked like this wasn't going to be a good interval on settlement". "Oh, how does that work?" We said, "That's what this five-minute and 30-minute thing is about. You should come to the public forum".

This is going to be technology that will be available to everyone who buys a Reposit controller or Reposit compatible batteries later in the year. It's not going to be some of them; there are going to be a lot of them. Everybody we showed this to wants it. It is a good thing to have, and it helps put storage into the system, but the pricing is being dulled by the 30-minute settlement. I'm going to stop banging on about that now.

Thank you very much for your time. I look forward to your questions.

DR FUNSTON: Finally, I'd like to invite David Havyatt,

senior economist with Energy Consumers Australia, and he'll be providing the consumer perspective.

MR HAVYATT: Thank you, Kris. Let me first start by acknowledging the traditional owners of the land on which we meet, the Gadigal people of the Eora nation, and pay my respects to their elders past and present.

I'd like to acknowledge and thank the AEMC for the decision to proceed through a directions paper on this rule change. The Commission is to be commended on the fact that generally their final decisions are closely aligned to their draft, so when the draft is likely to be something significant and maybe a surprise for some in the market, the idea of going through a directions paper to show the Commission's thinking is greatly welcomed.

Let me just start by reminding everyone who Energy Consumers Australia is, because not everyone always knows. We are a creation of the COAG Energy Council, and our role is to ensure the voice of small consumers is heard and reflected in market outcomes.

We have analysed the objective of promoting the LTIC and promoting economic efficiency in our little research paper available on our website. In the end, they both equate to ensuring that current and future customers pay no more than is necessary for electricity services. There is no such thing as an efficient outcome in which consumers pay more than they did in the non-efficient outcome. It is really quite simple when you do the allocative and productive efficiency analysis. The efficient one is where consumers pay less.

I want to thank Kathy for what was a stunning analysis of issues in the market materiality. I think she covered that field extremely well, but I want to focus a little bit more on just the household consumers.

This is a chart we never tire of showing, which is the bad news, that electricity prices have been increasing in real terms at unsustainable rates, almost double in some places. This is the simple, real price from the ABS data.

You might argue about the methodology the ABS uses, whether they are using the standing market offers versus market offers, but that really gets washed away when you

are looking at the fact that it is a trend line.

The bad news is there are not just one or two causes of this. Lots of people want to say it's this, that or the other, but the fact of life is if we want to make a difference to consumers, we have to make sure we are focusing on every aspect of the market, every aspect of the price back, that leads to those end consumer prices.

Unfortunately, consumers are noticing. We go out to talk to consumers a lot. This quote comes from our latest round of any energy consumer survey, and it's not something we want. We are not an advocate, a campaign organisation. We are not running around the world trying to get consumers angry; we are just reflecting what we are hearing from consumers and want everyone to focus every day on the fact that this is the position that we collectively need to be addressing. The wholesale market is one of those places where we need to address these issues.

That brings us to the materiality question, and I think the easiest way to talk about the materiality question is just to talk about the variability between the five and 30-minute prices and the fact that it has been growing. So this is a trend. This is something that's different. It's not just a question about whether it is or isn't worth having a consequence; it's the fact that this feature is going. One of the concerns we have is that part of what happens in the market, what retailers do is, they are not actually retailers, and the benchmark for a retailer isn't David Jones, retailers are a billing engine, they have a book of customers, where fundamentally their business is managing risk. So every time we have got volatility in the marketplace, that ultimately is something retailers wind up having to manage, and managing that always costs money.

I'm the first to acknowledge that if we change the market structure here in the wholesale market, we'll actually add some short-term uncertainty, because people won't quite know how to deal with that in that current market. But, in the long-run, we actually remove disruption, which I'll talk about a bit further.

The second thing I want to talk about, there are people who want to, as Russell said, imply that this is all about gaming by generators. I am not sure that's a helpful

or productive way of framing the question, and it may well be, as Russell's argued, that behaviour we see is efficient. It probably is in the context of the existing rule, but that doesn't mean that it's efficient in the universe of all possible rules. That is the analysis frame, not the current rule, and that is the reason why we have got to really seriously think about what this market looks like going forward.

As I said, everyone talks about response to the price spikes we see, but the issue is in the five-five world, those price spikes that we see at the start of 30-minute periods probably don't actually exist. When you change the behaviour and as I'll say later, the change in fleet, the outcome you would expect to see is in fact less of that behaviour.

The really hard part about all of this is the fact that building this market has already been a long journey, and the market for the next 40 years is another long journey. We have got to keep on taking the steps we need to take day by day to make that journey. You don't make the journey by not walking forward.

Let me then turn to the question about materiality. I have had a number of conversations with people over the last few days, and a lot of people have used this language of "cost benefit analysis", so I thought I'd go back to the Act and remind myself of what the AEMC's criteria for making a rule is. The AEMC may only make a rule if it is satisfied that the rule will or is likely to contribute to the achievement of the national electricity objective. Secondly, in doing so, the AEMC may give such weight to any aspect of the national electricity objective as it considers appropriate in all the circumstances. So it isn't required to do anything that remotely looks like a cost benefit analysis but, if it were, it will be looking at the costs and benefits across the entire market.

It certainly isn't, as Russell suggested, required to demonstrate that the benefits would substantially exceed the costs. That isn't the task of the Commission. So anyone in the room who thinks that's the task of the Commission, I suggest you go back and rethink what we are dealing with here. One of the things you can notice, though, is that the benefits which fall from any change in this way are going to be ongoing, and they are going to

increase over time, whereas all the costs I have heard about so far have been identified as one-off initial costs. That makes the hurdle, even if you are going to start to talk about costs and benefits, a significantly difficult arrangement.

The AEMC's directions paper has identified that the scope it is looking at is the LTIC in the context of efficiency with respect to price. I agree with the Commission's emphasis on that, but I want to talk about the definition of efficiency and that pesky word "efficient". Efficiency has two fundamental dimensions to it. There's the static concept that we are all familiar with, about productive and allocative efficiency, and the second component that we often don't talk about much, dynamic efficiency. If you are interested, you can read my longer writings about this in the latest issue of the ACCC's network where I talk about what I called the "Hilmer trilogy", that efficiency has three components and three components only comes from.

When you actually go and deconstruct all of that, what you realise is that the really significantly important part in the efficiency calculation is the importance of dynamic efficiency, the importance of change and innovation in markets.

There are two barriers that occur to innovation. The first barrier of innovation is that regulatory structures by their nature perpetuate existing processes. That's what they do. They are sets of rules designed to make an existing market work. So you always have to be careful and say, "Do our rules impede innovation?"

The second one is behavioural biases. Behavioural biases are, in this case, the bound of rationality of corporate actors. I put the cover of this book here because this is a hilarious read in its introduction about industrial organisation and bounded rationality, because the author starts off by saying that bounded rationality is only something that applies to consumers, because, of course, corporations always are making the right decisions to maximize profit, ignoring, of course, the term bounded rationality itself was introduced by Herbert Simon to describe the fact that corporations don't actually behave that way. This is really going to the point that Kathy made: participants are comfortable with the existing

arrangement. That doesn't mean the existing arrangements are right.

Russell tried to argue that the 5/30 rule is a sunk decision, because it was made at the start of the system. That's not true, because the energy system we are looking at today, tomorrow and over the next 20 years, is a very different energy system to the one that Brian and John and Russell and others were building a market around 20 years ago. That was a system that existed and consisted of big coal-fired generators and basically nothing else. That is not the system we are designing rules for now. This is not a sunk decision, this is what does the rule need to look like for the market we are looking at going forward.

I thought John's description was very good, very informative about the engineer's view that a three-month market was right. Going back and analysing some of the other things, the interesting thing is some of the comments people were making about whether there are things that can respond in five minutes or not. Well, the bottom line is the coal fire generators couldn't really respond in 30 minutes, but we still went with a 30-minute settlement market.

I think John's point was one of the best when he made this point, that if demand varies continuously, you expect prices to be able to move continuously. It's really important to remember what's going on here is that the demand curve itself is shifting. How much people are wanting at what price points is changing continually. So in the perfect world you'd see the prices change.

The last one I want to talk about is the development of the financial markets. I just want to re-emphasise that the financial markets evolved to support the market structure. The bottom line is that pigs weren't designed to create a market in pork belly futures. We are not designing the energy market to create the contracts market. We need to have a contracts market that can support the market, and what we heard Dean talk about was in fact how you can have different kinds of contracts in a five-five world.

There is a strong in principle efficiency argument that's already been made. The current arrangements create incentives for generators to bid below marginal costs, the

generator is not physically valued, and we behave in a way that creates artificial volatility and risk. That's the summary of the conclusion of the AEMC paper. I don't see there is any disagreement with that.

Ultimately, the mismatch between dispatch and settlement can be expected to stifle the operation of fast response technologies that can respond over a dispatch interval. I think those are accepted grounds, maybe not, but I haven't really heard an argument that they are not.

We got a changing energy market. We have a changing energy fleet and changing demand. It is unrealistic to expect market rules to remain unchanged through a transition. There seems to be no doubt we need to change.

Going back to that last point, we've talked about batteries and what Reposit is doing. We are already starting to see these moves for big batteries being installed in the NEM, partly through government action, but South Australia I think has 93 respondents for its proposal. Then you've got the announcement by the Lion group about its large solar. You've got the announcement yesterday from the clean energy regulator that we are getting a lot more investment coming through again. Now there's a lot more solar. So this market is just going to continue changing. There seems to be no doubt that there's a benefit in aligning dispatch and settlement in the industry.

There doesn't seem to be any logic behind not having aligned dispatch and settlement. It doesn't make sense, I suggest, that somehow or other you don't actually know the price of the energy you're buying because you have responded to a five-minute price quote, but you are paying on something that was outside that five minutes. It's just illogical. It seems the right way to solve that is to have a shorter settlement period. Maybe some will argue that 30-30 is the right rule change to make, but I think not changing the rule isn't the option. That gets me to the conclusion that the question isn't if to make a rule change, it's when and how. The materiality threshold is crossed.

The last point is simply that the case is we have got to focus on dynamic efficiency, we have to focus on the market change. Quite possibly, if we could have done

five-five at the start it would have been a better decision. That would have been potentially the right time to plant the tree. I don't want us to be in five years time sitting here saying, "Geez, wouldn't it have been great if we'd moved to five-five settlement five years ago when we had the chance". How about we make a decision now and focus on how to do it, not if. Thanks.

DR FUNSTON: I'd now invite our chair, who is going to facilitate a general discussion on these issues. We also have a couple of people with roving mics, so if there are any questions from the floor, we can also take those.

THE PEARCE: Thank you very much, each of you, for outlining the issues in the way in which you have. This is really an opportunity for you to raise issues, ask questions of people who made the presentations, or indeed us.

One of the main advantages of today, I think, is the opportunity that you have to share perspectives with the ones that accord with your own, or perhaps more interestingly differ somewhat from your own.

First of all, if I can remind people to state who they are and where they are from.

MR GUIVER: David Guiver from ERM Power. It's a two-step questions, so I will give you both upfront.

From, say, AEMC's perspective, should they expect technology like Reposit not to respond because of the low price, but probably shortage of supply?

The second one is large users, large industrials, maybe won't be able to benefit from the same kind of scale battery that yourself provides, so should they be anticipating more frequent high-price spikes that your technology piles in for that five minutes, which in some ways may drive prices up for large users who won't be able to have the same scale of battery?

MR SPACCAVENTO: Whilst Kathy is going to the mic, the first one, if the price is low then no, we won't discharge people's batteries; that's the simplistic way to do it, really, it co-optimises six or seven different things, but if the price is low, the market isn't calling for energy,

so giving energy makes no sense and, in fact, I'd rather hold that energy for when the market does need it and then provide it in, or increase my FCAS bid, or deliver my energy to the network.

A low price for us is just we use it as a proxy as, "Everything is fine, guys, we don't need help at the moment." So yes, we will what the market expects. On the second part of it, our technology is agnostic to any type of storage you want. We have hot water under control at the moment as well. We do residential first as a marketing decision and it's because residences make decisions based upon "feeling good" and "cool tech" and "I want the nice things", et cetera, et cetera, and they're typically homogenous.

Our control system is already in control of a market generator, CESF1, but we just don't market that because it took us a long time to commission that thing because you have to talk to 38 different parties.

We will move the controller into small to medium and then, if we choose, we will move the controller into centralised batteries. It is a marketing decision to not go for the big ones at the moment, that's it; it's the same gear. Kathy?

MS DANAHER: Large users - we will retrofit a battery storage process to get to the higher prices just like the user. There is no difference in the economics from a small to a large, it's the cost curve as it comes down. Do not be deterred, we will invest as well into batteries if it makes economic sense. We will respond to the short periods to capture that value and we will probably be capturing quite a bit of value given our sites.

DR FUNSTON: Just a reminder - could you speak into the microphone? We had a bit of a microphone issue there. I think a number of people who were online just noted that they didn't quite hear that question. Thanks.

MR LY: My name is Kevin Ly from Snowy Hydro. I've got a question for David and Kathy. We have seen a lot of slides that questioned the materiality issue, but really only look at the spot market outcomes. As John Pierce indicated in his opening address, there is an integral part to play in the contracts market to allow generators and particularly

second-tier retailers to manage their load risk.

My question is how can one ascertain the materiality threshold has been reached by only looking at spot market outcomes and not examining the integration of both spot market outcomes and contract outcomes? The reason why I say that is we've seen price spikes in the first dispatch period and we've seen generators come in to generate. The reason why we've seen that is generators who have sold cap contracts, or swaps, have come in to hedge that contract position.

In the absence of that contract position they wouldn't do that, so the prices for dispatch periods 2, 3, 4, 5, 6 may remain high. My question is have the proponents who advocate this rule looked at both spot and contract and looked at them from an integrated perspective? Thank you.

MR PIERCE: I think that was directed to David and to Dean; is that right?

MR LY: Yes.

MR SPACCAVENTO: Yes, we have put it up on the slide. Clearly, I want to sell you slow generators fast caps, that's what I want to do, that's right, and we have looked at the opportunity for being able to use the speed of the battery in a fast market to increase reliability and to reduce risk and make profit, and we again deliver our customers with grid credits; so yes, we have. I'm not privy to all the bilateral contracts that have been made in the market, unfortunately, so I can't do a full analysis as to who are going to be the winners and who are going to be the losers. What I can do is look at it from the benefit of my customers and I can see that delivering grid credits at low energy high power for short periods of time, right, low energy, high power, is beneficial for them and I would like very much an opportunity to do that to capitalise on the benefits and the advantages of the tech where the market is calling for those benefits and advantages and that is speed and power modulation.

MR HAVYATT: And my answer was also on my slide, which is yes, there is a physical market and there is a derivatives market. If you change the physicals market, clearly, the derivatives market needs to change. Do I have faith in the endless capacity of financial markets to innovate and adapt

to a change in physical market? Well, I am not sure that the financial community - they're normally quite keen to talk about how good they are at adapting and innovating. So I think talking about how the existing derivatives market is affected is to put the cart before the horse. The horse is the physical market. The derivatives market is something that comes after that. As I said, we didn't design the pig to create the pork belly's futures market.

MS DANAHER: From our point of view of being market participants, we obviously see what happens in the markets every day and yes, we manage a mixture of spot and term as part of that process. We're talking about the market now and the market in the future. If we look at the market now and we see the people that sell the caps and if you see their actions in the market, especially in Queensland, we'll see what the price is going to be the next day, we'll see high volatility, we will see high prices, we'll see the fast generators starting the day before they're needed. So they're in the market when they know there's high volatility and then we see them stay in the market a little bit longer when it leaves.

They are responding not to a 30 minute price, they are responding because to protect a cap it's best not to have the spike at all because you have sold the revenue as a single stream at the start of the period and the start of the term.

MR PIERCE: Yes. It is actually something I have to continuously remind people when they are looking at the spot market outcomes, that a lot of the behaviour they hypothesise about may actually have more to do with people's contract positions rather than hypotheses about evil intent.

Could I suggest perhaps the issue - I don't know if it was explicitly being raised, but one that is perhaps a follow-up is the effect on, particularly, second-tier retailers and their ability to get themselves set on the wholesale side so they can compete on the retail side, with the consequential effect on industry structure and retail competition.

Perhaps I could invite people to offer a view about the effect on the nature of this retail market and its structure and the effectiveness of competition in the

retail side that this rule change and its consequences on hedge markets and the nature of those hedge markets is really something we've been getting people's views on.

MR SPACCAVENTO: You will notice that Reposit doesn't have contracts with Energy Australia, AGL or Origin. We have contracts and partnerships with small retailers, some would say, simply, isn't that small, but they're smaller, second and third tiers. The reason why that is, is because we can deliver small chunks of cover that grows with customer base to those retailers so that they have an alternative, a physical counterparty for the risk that they have in the market.

The batteries that are on those retailers are used as an alternative to a financial contract, but you don't have to buy them in megawatt chunks, you buy them every time you get a new customer. Every time you get a new customer that customer self-covers. What that means is that the competitive disadvantages that currently exist in the market due to great big vertical integration are being eroded and that is good for competition in the market because it tries to unstrangle the 90 per cent market share that the big three have.

We do it on purpose. The big guys won't talk to us anyway, they're kind of stuck, they're trying to entrench a business model. The second-tier guys need oxygen and we are part of that oxygen for them and you will see the market free up as a result.

MR PIERCE: Anybody else?

MR HAVYATT: The first is that maybe the right answer to solving the problem for second-tier retailers is to put the genie back in the bottle, but unfortunately the courts made the decision that AGL could buy Loy Yang and it has all been downhill since then. The bottom line is the best solution to levelling the playing field is to get rid of the vertical integration.

MR PIERCE: I thought you were going to talk about Torrens Island.

MR HAVYATT: The second part of the answer is a bit more realistic, which is one of the things that you observe in the retail marketplace is, in fact, that retailers are very

non-innovative. The fundamental market offers made by the large retailers are, "Here is a price and here is a price you can have if you happen to pay on time. Oh, by the way, you're meant to do that anyway by the contract, but I'm going to give you a 20 per cent discount", as in the example of EA which was the one I was looking at yesterday.

Now, if it was the reverse, if you were saying to somebody, "I'm going to charge you a 20 per cent penalty for not paying on time", you'd be seeing the ACCC in court, but somehow or other we've got a marketplace where that's occurring.

On the flipside, are there any offers in the marketplace that encourage a consumer to make their behaviour reflect the costs that the retailers are actually facing? No. This is a bizarre outcome. We've still got controlled load in terms of off-peak hot water systems, but off-peak hot water systems were introduced in the days of the vertically integrated generators to create the baseload for the coal-fired power plants to keep generating at night and also utilise the network as well, but it was as much the generating fleet as it is network, but we've got nothing more innovative than that in the marketplace.

I continue to come to the answer that says the more emphasis we put on the realities of the wholesale price stack for the retailers, the more chance we've got that some of them will wake up one day and say, "Hey, I could actually make more money because if I could save this customer $30 on their bill" - sorry, "If I do something with this customer so it saves me $30 but I only need to pay them $15 to elicit that behaviour, then I make $15." That is actually the whole theory of dynamic efficiency, that's the theory of the way that it's meant to play out, that you actually make short-term profit because of your innovation, but we don't see that.

MR PIERCE: Russell, did you want to say anything about that?

MR SKELTON: One of the things I think we need to think about is the current cap market is supported by who it's currently supported by, which is largely gas-fired peaking generators and I just think that before we get too excited about the alternative that may replace them over time, that the rate at which Dean has batteries turning up is

megawatts per month, or what was it, 24 per year or something like that?

MR SPACCAVENTO: One GW installed by 2020 is the report.

MR SKELTON: Yes. I think we just need to be cognisant that if you create a circumstance where you limit the capability of the existing providers of risk management products to have the willingness and the enthusiasm to do that, at least initially, they may discover other ways of managing that risk, then you might create a gap in the ability of people to manage their risk and second-tier retailers, who don't have the benefits of some vertical integration, may have a hard time of it. When they have a hard time of it, customers have a hard time of it. I think we just need to be a bit cautious about getting all excited about rushing into this without thinking about the --

DR SPALDING: So is that the transition question?

MR SKELTON: It may be, but I think all of these things will take time to happen and I'm not sure that if you said, as of today, you've got five minute settlements, a whole bunch of people who currently provide risk management products and back them with the existing assets are going to struggle, there's a problem. Whether a transition period will solve that, in my view, is an open question and I just think we need to be careful about that.

MR GRZINIC: Paul Grzinic from Aurora Energy. A question for Dean, and I suppose Russell for a second component, is that you put up some modelling earlier around - this is not necessarily directed at yourself - the general tone that there is an element of gaming in the latter two intervals in the 20 minutes to maximise the price outcomes for large generators. In that context, you put up some modelling, Dean, that illustrated the benefits to a battery should they receive those five minute prices. That assumes the basic assumption that those prices would have prevailed in a new five minute market.

Do you think that those prices would have actually prevailed in context that if we believe those generators have enough power to gain those prices, do you think they would continue to offer those high spot prices in a five minute market versus a 30 minute market, and hence, dilute that ability to dispatch as per David's comment earlier?

MR SPACCAVENTO: I actually don't care about the gaming. I am not building a business based upon the gaming behaviours, be they there or not, of other participants. I am building a business based upon what the system is asking for and the system is asking for fast responding generation. Now, do I think that those things would have occurred in a five minute market? No. Do I care? No, I don't care.

What I do think is that there are other things - that true physical state of the system of the demand, supply and balance, will be better communicated with the price signal and we will make our batteries follow those and there's going to be plenty of value because we've got a whole bunch of renewables and intermittent generation coming in.

MR GRZINIC: In context to, I suppose, materiality, this is what we are addressing, it appears to me that the materiality is based on the assessment of outcomes from a 30 minute market as opposed to what those likely five minute full-price outcomes are in a five minute market.

MR SKELTON: As I said, I think the huge difficulty in assessing the materiality is that someone has to have a crystal ball that works pretty blooming well in order to predict what happens to the incentives that you create for all of the players that play in the market when you change from 30 to 5, and as I said in my smart-arsed comment to John, one thing that I'm very sure of is that none of us really know what will happen and I think to sort of make assertions that things will get better and things will change for the better is pretty brave because we simply don't know and we haven't attempted to try to understand it other than to make assertions that this will make things better.

I think given the risks in materiality and the costs associated with this, and potentially for customers, there's a real risk that this could end up - you could think of scenarios where peak-end generators say, "Stuff it, I'm not going to bother responding to any price signal because I simply fry money", so the price spike persists for a number of trading intervals at $14,000, and Dean's batteries then run out of puff and then the price persists.

I don't know whether that is what will happen or not.

All I can say is that we don't really know with confidence and I think it's pretty brave to say this will make things better because I think we have no way of knowing that they'll make things better.

MR SPACCAVENTO: Can I respond to that? I don't think the market can be structured around making things better for one person or another or anything like that. The market is a financial overlay on a physical system and the physical system has a demand/supply imbalance that must be met instantaneously, that's what this system is about. The financial overlay is about finding a way to find the most efficient way of having demand and supply be balanced instantaneously across long and short time scales.

Being able to have a market that is granular enough to be able to find the most efficient outcome for that demand supply imbalance is what you're looking for. If you go back to that fundamental of the market, then all you need to be able to do is recognise that faster response is required to meet the demand/supply imbalance, price signals need to be delivered for investment for fast response, let's get out of way of that, end of story.

MR PIERCE: If I may, this session could go on for a lot longer. We have a number of other things to go through. I am very aware that people had a number of other questions to go through, but I am going to have to move on to the next topic and encourage you to corner people who you want to talk, as we need to just have a wee break. I do want to make two comments, though, one to my mate here. That quote that he is seeking to use against me is certainly one that I tend to use when dealing with people who think that the answer to any problem is for greater centralised control and one of the things that people would be, I think, aware of in the way in which the Commission goes about its work, not just in this area, but elsewhere, one of the questions in our mind always is related to the impossibility of really knowing what's going to happen in the future, and hence, in the way in which we design the rules and the way in which we think about the market, the objective, it's not always possible, but certainly the direction we're going is what sort of system can we create so that it can self-adjust and correct whatever happens in the future in respect of technologies and demand and gas prices and other input costs.

It is the way in which the system adjusts to those different futures and understanding that process of adjustment and its effect on consumers which is a central tenet of virtually everything the Commission does when it is looking at a particular issue.

Secondly, I think David made this point, and I'm really only going to harp on it because it is a more general one that in recent times I've heard a lot of people talk about, which was to say, he rightly said, the system of the future will be different to the one in the past and in saying that he's obviously referring to the nature of the technologies that make up the system and the way in which the business models that operate within it are constructed and either survive or not.

The jump is then often made that the way in which the rules are designed is a reflection of the technologies that existed when the market was established. The technologies have changed, always have changed, they change in different directions in different parts of the system, changing of technologies is not new. The mere fact of it is not new.

The laws of physics, economics and finance, however, tend not to change. It doesn't matter what the technologies do or what individual costs do in the future, we'll still need to have a secure power system, or be able to operate a secure power system, and we will still need to be able to observe and to identify what are, effectively, the market demand and supply curves.

The processes around the rules and the things that are really central to the way in which the rules were constructed, are constructed and will be, I suggest, constructed are around those two particular tenets and those two particular needs. We don't have a NEM design or a rule design that is dependent on any particular groups of technologies.

Them changing over time, that's life. I mean, I'm a lot greyer now than I used to be and that's just what happens. We had better have a short break and then we'll go back on to the next topic which will be chaired by a different Commissioner.

DR FUNSTON: Thank you. 10 minutes, so could you be back in the room just after 11.50, thanks.

SHORT ADJOURNMENT

MR HENDERSON: I am chairing this session. Welcome back.

I notice that people love putting up a quotation. I found one from a learned economist as well: the difficulty lies not so much in developing new ideas, as in escaping from old ones. I thought that was quite interesting. That was actually John Maynard Keynes from the 30s.

I'll now hand over to Ben Noone, who will go through and introduce the next part of the session.

MR NOONE: This next session relates to chapter 4 of the directions paper, and it concerns two things: the first being the ability of different technologies to provide a supply or demand side response to five-minute prices; and the second, whether the rule change would provide workable risk management outcomes in the contract market, which we did touch on just before in the Q&A, which is clearly a focus point for this project.

Clearly, the significance of these two things is that for there to be a benefit from making the rule, there need to be some changes in the behaviour of participants in the physical market and, as I think is understood, the changes in the physical market would flow through to consumers, through the contractual arrangements of wholesale participants.

To start with, I'm presenting analysis that we prepared on the ramping capability of existing generators. The first analysis at the top was of the start profiles of peaking generators which in the NEM include gas, hydro and diesel generation. So what this showed was that among the scheduled fast start generators, there is actually very little capability in the observable data for these generators to provide a response within a five-minute period.

In South Australia shown here, and also in Queensland, we observed that in aggregate there's around 100 to 150 megawatts that could theoretically be delivered within a five-minute period, whereas in New South Wales and Victoria, there was actually no fast start generation that

could be provided within five minutes. The next analysis shown in the bottom chart looked at how much power could have historically been delivered by generators that were already running, which may include the fast start generators if they were online at a particular time.

So here it is expressed as the average of each five-minute period in a day of the amount of megawatts that could be provided from these generators. What we found was that, on average, there are hundreds of megawatts in each region that can be provided within five minutes. What this suggests to us is that the challenge of moving to five-minute settlement is not necessarily a physical capability issue, as there is this sizeable ramping capability currently available.

Next, we looked at the flexibility of potential new investment technologies that I imagine everyone in this room is familiar with. We acknowledge that there are various energy storage technologies that can provide a very fast, flexible response. The sorts of applications emerging involve co-location with generation assets, be they existing thermal plant or wind and solar projects, utility scale batteries that operate independently of existing assets, or the aggregation of smaller batteries, as we heard about earlier. Another option is modern gas turbines, which can ramp from rest to full load within a five-minute period.

Further options include faster demand response applications, which we see as becoming increasingly cost effective due to technology improvements and greater availability of data through internet-of-things connected devices.

There are examples in overseas markets, including this one from New Zealand, and Alberta, where we observed that hundreds of megawatts of load can be curtailed in less than one second. We suggest there is scope for this to occur in the NEM, if the right price signals were to be provided.

The fourth new investment option that we have identified is diesel generation, which can ramp from rest to full load in a couple of minutes. The summary point here is that technology is enabling faster, more flexible responses, while also enabling more active participation

from smaller customers - again, as we heard about before.

A further thing that I'd like to emphasise is that while the rule change has been characterised by some as gas generators versus batteries, there is a range of technology here, and in a five-minute settlement we would expect there to be increased competition between all of these to provide a level of flexibility that is indicated by the market price signal.

Having looked at the technical potential at different of flexible technologies, we next considered the impact that five-minute settlement may have on the level of investment in these technologies. Our observations here are that five-minute settlements would more accurately reflect the value of flexibility, whereas 30-minute settlement favours less flexible technologies, at the expense of more flexible alternatives.

Under a five-minute settlement, we'd expect to see marginal changes in the investments being made. For example, we would expect to see more investment in energy storage and more aggregation of distributed generation because of an improved value proposition. In five-minute versus 30-minute settlement, it may lead to a choice of a more flexible gas turbine if a replacement project was being considered. Similarly, it may make the difference between a manual and a faster automated demand response.

Our view, as articulated in earlier presentations, is that in the absence of these changes in investment, over time the generation mix will be less efficient resulting in consumers paying more than they otherwise would have.

Having said that, we acknowledge the changes in the NEM physical market flow through to consumers by the contractual arrangements between participants. We have some concerns about the impacts that the rule change could have on these contracts. I'll let Josh from Energy Edge cover this in more detail, but the point that I'd like to make here is that we accept that some of the existing strategies would be less effective under a five-minute settlement, which would impact on the volume and price of some contracts.

Our concern is that if there is a reduction in the volume of contracts on offer, participants may be unable to

adequately hedge their exposure to spot prices which, as identified in earlier questions, could result in prices being higher and more volatile than they would have otherwise and could ultimately damage competition in the retail market if smaller retailers are no longer able to hedge their risks.

We have thought about some of the potential responses to this reduction in the volume of cap contracts that may occur. Firstly, we note that existing assets could be operated slightly differently. They could operate at low load so that they have the potential to respond faster when price spikes are anticipated. There may be scope to engage in more sophisticated forecasting of price and demand, and rely more on those forecasts in commitment decisions. There may also be potential for existing generators to sell different financial products that better reflect the physical capability that they can provide.

A second source of caps could be sale from existing baseload generators, and, thirdly, caps could be sold by new entrants, which could include batteries and new thermal plant.

We see technical potential in these options, but it is unclear if they could make up for the full reduction in the cap volume that is forecast to occur, which is one reason why we see that five-minute settlement could not be implemented overnight, and a transition period would clearly be required for assets to adapt and new sources of contracts to emerge.

Finally, when we get to the discussion, and also in submissions, there are some questions that we'd like to see covered. This is how operation and investment may differ in a five-minute settlement. Is your view consistent with the view that we have put forward? How successful would the alternative strategies that we have listed be for existing generators and what volume, if any, if caps could be offered by battery operators? Thank you.

MR PIERCE: Josh is going to get into the analysis of financial markets from Energy Edge's perspective.

Welcome, Josh.

MR STABLER: Thank you. I'm Josh Stabler, the managing

director of the integrated energy advisory business, Energy Edge.

We have provided a 90-odd page document so far which is on the website, which took a look into, as an independent expert, the impacts of contractual markets. We'll keep this fairly short, given the time, and in ten slides we only cover so much of that document, so we do recommend people read that.

Energy Edge's role here has been as an independent advisor and we have had a very clear and specific scope, which is to take a look at the implications on the financial contract market of the potential rule change to five-minute settlements. So it is taking a look at the individual implications as opposed to any other wider issues.

When we take a look at the financial contract market, we see there is an implication between a five-minute and a 30-minute settlement period, specifically when there are different volumes for each of the five-minute periods and different prices for each of the different five-minute periods. So, therefore, if the volume stays the same, there is no implication. If the price stays the same, there is no implication. This is important because when we start taking a look at the individual contracts that we want to do analysis on, we see different outcomes.

Specifically, we take a look at the swap contract first. These are the primary financial market contracts, the primary way people use to manage their risk, their price risk, in the market at the moment. A swap is where you choose to enter into an arrangement with a counterparty to fix the price instead of taking the underlying floating price. That is swap. The rationale there is that the counterparties have a decision there that they want to remove the risk, get rid of the price ambiguity for generators, the natural sellers of swaps. They want to manage their price for all of their volume that they are selling, specifically flat as against high capacity factors, and you've got other ones, peak and other swaps, which you might use for other different levels of capacity.

For the retail side or industrial customers, you want to do it to manage your baseload consumption. What we are seeing here is that swaps are unaffected. The volumes stay

the same; therefore there is no change. There might be change to the way that somebody behaves in terms of defending that position, but the actual contracts themselves don't change. The CFD remains the same.

If we take a look at the cap market - they are commonly known as caps, but they are actually 30-minute automatically exercising call options with associated call premiums and $300 strike prices. That is the standard product that runs in the market. Being an automatically exercising product, it finds out whether or not a price is in excess of the strike. If it's $301, that is an exercised contract. If it's $1,300, it's an exercised contract. That is on the half hourly average price that is done for that particular contract at the moment.

The rationale for this type of contract is that you might do it for a high price, therefore it's got low volume, therefore you might align it with an asset that has low volume or a retail book that has a sharp demand flex to it that you are trying to align your price to.

So, therefore, because caps have a price dependency, because they change their volume depending on what the underlying price is, by changing it from a 30-minute settlement price to a five-minute settlement price they are affected.

The conversion across - what we anticipate is that a current 30-minute cap market would move across to a five-minute automatically exercising market, otherwise you introduce basis risk. Selling a contract in Queensland and having a power station in New South Wales is a basis risk. Having a 30-minute settlement of your contractual arrangement with a five-minute revenue is a basis risk. Therefore, we anticipate it would shift across to a five-minute cap.

Using an example of the implications of this different change, we have shown two graphics here. The top shows a $1,300 price for the first dispatch interval. In a five-minute exercising cap, that is $1,000 above $300, but if the rest of the half-hour period ends up being 50, 50, 50, 50 and 50, the average price over that two-hour period is $258. That's less than $300, therefore there is no cap pay out.

This is where we are seeing a fundamental difference between the actual contracts and why they would cause a different payout. If it exceeds all six dispatch intervals, then the trading outcomes for a 30-minute and a five-minute are the same. Therefore, this is showing the implications of why we have a difference between the two behaviours. This is just purely looking at the actual payout of the contract. This isn't looking at any of the physical backing or anything.

What we can then do is we can decide to bring physics to the party. That seems like a really good plan, given my experience with physicists. What we find here is that the physical availability of the assets to defend their position changes between a five-minute market and a 30-minute market. So, following on from some of the graphics Ben showed, what we see here on the top is taking a look at an open-cycle gas turbine from rest. Not every single price spike happens with open-cycle gas turbines all sitting at zero, but in the cases where they are, and you have a price spike, this is the way that they could respond.

In this particular case, it shows the different regions there, so we have got all the different colours for different regions showing them as they rise. Now, in the first dispatch interval, all of them are at zero, but over a 30-minute period, they end up with 50 per cent. So, 50 per cent of their volume ends up being dispatched during a half-hour period where there is high price spike in the first five minutes. It's different when you start introducing different points, but this is just showing it from the first period.

Now, pumped storage, which is one of the fastest responsive units in Australia, or in the world - its ability to ramp up to full capacity is almost unparalleled. It still only managed to get around about 33 per cent capacity in the first five minutes, but it ends up getting about 89 per cent by end of the period.

This is just using the T1, T2, T3, T4s of the assets in Queensland. This is using what they are physically showing, but what that shows is that they are very effective at 30 minutes, and only somewhat effective at five minutes. This is where the difference is. It's not that everyone is unable to respond, it's just that over a

30-minute period you have a very long time in order to respond to underlying price signal.

So what that means is that in each of the different regions we have different levels of who provides the caps into them. Queensland and South Australia are dominated by gas turbines, OCGTs; New South Wales and Victoria are dominated by the hydros from Snowy Hydro in terms of being able to physically provide volumes into the market. So this is us looking at their physical capability and their physical capability to respond to price and how they actually have responded to price.

The white section is the implications of changing from 30 to five, which is around about a 23 per cent drop across the market. We have calculated the underlying trade volumes at around about 2,650, which means 23 per cent of that is a 625 megawatt reduction in the number of caps that will be made into the market.

Now, is it exactly 625? Well, no, but the relatively, the representation of that number, is correct. That is something we were confident with, that the percentages and the amounts that we are looking at here are representative of the volumes.

I guess, having heard some conversations in the first part, we haven't really gone too deeply into modelling all of the behavioural changes. One of the main reasons is there are 200-odd units, there are 155,200 dispatch intervals every year. The game theory response of that 20 million-odd responses every single period is impossible to predict, and I guess you are making very large leaps of faith when you go down that path.

The final point is this 23 per cent drop in liquidity here in the cap markets. Liquidity is something which needs to be nurtured. It is a fragile thing. If you end up in a position where you have no liquidity, it's a difficult place to come back from and it's important to take that as a consideration.

Thank you.

MR PIERCE: Thanks very much, Josh. Now we have a presentation from a generator's perspective, David Guiver, executive GM trading at ERM Power.

MR GUIVER: Probably the perspective of the market participant might be a bit of a fairer story if you are having someone from ERM Power talking about the market, so thanks, John and team, for the opportunity today to have a chat to you, who are we, what are we all about.

We are probably the third or fourth largest seller of electricity to end use customers in Australia at the moment. Maybe not everybody has heard of us. We only sell to the business end of market. So I probably can't buy Dean's products yet, but I will be able to in the future in that space, so we'll be switching business cards later on.

We have about 18.5 terawatt hours this year under contract. We have a very small amount of generation available in our business, so we rely on the financial markets quite heavily to go and procure those contracts. I think if you look at our peer organisations, a lot of them do have some large baseload-type generations. So we could arguably be the biggest buyer of hedge products in the financial market at the moment.

We are also the owner of a generator. We have some generation in Queensland, in the NEM, peaking generation, gas-fired, about 300 megawatts, and we have also got a similar type of asset located in the Western Australian market, so we participate over there.

We also retail in the USA. We acquired a business over there and we have grown that quite rapidly. We have a customer book, a kind of customer lifetime contract over 14 terawatt hours of load under the contract. We are quite interested in regulations of other markets and some of the observations that are being made there. There's some exposure to five-minute markets.

Interestingly, David, we have a huge demand response program. I think possibly the largest. We write big cheques to customers every year to buy their demand response capacity, so we have some pretty strong views around the effectiveness of those types of products and the important role they play in managing risk for retailers.

We also used to be to be a pretty active developer of generation assets. We built about 2,500 megawatts of peaking generation gas in Australia, maybe the previous

decade will be the best time to describe that. On the whole, we are probably just a really large retailer and a pretty, I guess, big representative of the large industrial and business customer base.

Where do we think five-minute markets are? I guess we are not at the moment strong advocates for what's proposed. We put that on the table from the start. We are actually not against the idea; it's really about how the policy unfolds in relation to other policy activities on the table and what other things are implemented.

I guess, you know, we see a market, it is inevitable, it becomes lower carbon market, we are fine with that. Security supply - you know, ultimately it is an engineering solution and the financial markets come in behind it. So that's obviously got to be a key. We are one of the most affordable, so when we make large transitions we really do need to think about the cost of doing things quickly, or gradually, and how that plays out. Because, as we all know, the end user is the one that will ultimately foot the bill. It is kind of a closed system. If someone wins, someone has to pay for the other side of that, which is fine.

We recognise that, particularly with renewables in the market, it is under transition, so it is game on. It is a changing market now. We have seen incredible price changes, we can see the vulnerability to the system when we lose a couple of large baseload generation assets. It is kind of our last one. The most recent one seems to have really hurt us, or the most recent two have really hurt us. Also, we do need to think about the financial markets, and if you just take out one or two, you know, do we actually have the liquid active markets that Kathy mentioned, and are they effective for us.

We are a little concerned about the concept of how quickly we transition and whether this policy alone is the right way to transition. We look at other international markets. We don't see them foraging down five-minute market only without some other security supply type activities wrapped around those. I think we need to take that into consideration when we go through this policy change.

One big broader observation we'll make is that Finkel

review is underway, and we would like to see that play out. This proposed rule change does, I would say, potentially fundamentally change the market. It is quite wide-reaching. I'm not going to go into billing systems, and all of the downstream type of activities that are going to flow through, because there will be plenty of others to talk on that over time, but I do think we really need to see that Finkel review play out, to see if we do get NEM 2.0, or wherever we are heading, and then pick up our thoughts around more broadly is it a five-minute with a few other regulatory rule changes along the way. I guess I'd appeal to the AEMC to consider that Finkel is underway and I understand it's going to be a pretty wide-reaching review.

I think I would like to really focus on wholesale market, or liquidity. That's my role at ERM Power, I'm responsible for the economics of our power stations, I'm responsible for hedging the risks associated with our customer load, so that kind of thing keeps me awake the most, thinking about those markets, and where they are going.

Josh gave a good intro. Hedge products are vital for generators, retailers and end use customers. They provide some kind of price certainty, a good healthy liquid financial market in electricity derivatives I believe is good for all spectrums of the market. New technologies that come into the market see that that's where they want to get to, essentially dealing in those products, which is great to hear.

Josh, as he mentioned, has done a bottom-up look at some reduction in liquidity around the cap market, 625 megawatts. I think it's a good piece of work, Josh. I think it does actually go a little bit beyond just losing 600-odd megawatts of cap liquidity. I do think about behaviour. I'm thinking already about what we do with our assets. Do we hedge them? What are the implications if we price customers out into that three-year horizon where customers are now looking for pricing?

We have seen in both Queensland and South Australia, which got a little bit of coverage today - maybe we'll refer to them as the two more likely volatile states - gas generators in both locations have elected to, what I understand, sell their gas because it's been a more

profitable strategy than it had been to dispatch energy into the national market, or sell risk products against those assets.

Gas prices are up. I don't think it's a huge stretch of the imagination to think now owners of gas generation would be literally thinking, "Hey, is there certainty for my asset, is there a return on that asset, selling that gas contract at the moment?" People want those gas contracts, so those are the behaviours that are going to be hard to work out and we are never going to know those answers. But I think we have had a few clues of what's happened in those states where companies have taken those decisions and we have seen a great example in South Australia where there's an incredible price signal, but the asset had sold its gas. So, you know, it wasn't there for the market. We are thinking about liquidity of financial markets, but also flowing that down to security of supply.

Ironically, renewables are coming in. Gas is a little bit more efficient on carbon than traditional baseload generations. As we transition to more of a renewables market, I think we need an environment which encourages gas generation, and doesn't maybe shuffle it back in the queue a little bit further. I think that's something we need to think about, not just from a liquidity purpose, but from a security of supply.

We also think you take out a few more caps than the 600 megawatts, we also think a few swaps come out of the market, so it was good to get a quick explanation of swaps. If a large baseload generator trips mid-half hour now, they can ramp in extra generation and cover that outage so they can mitigate the potential loss of exposure to the pool price, if they have sold risk against that generation, or maybe fully cover it if they can ramp up in time.

I would suspect, and I'm not responsible for dispatching baseload generation, they would be inclined to sell less hedges because I think it would be an increased risk to them in a five-minute market to hedge up to their current levels. I could be wrong. Again, it's a behavioural outcome that we'll see unfold.

I do think we do lose liquidity in swaps, and I think we do lose liquidity in caps. Thinking about how to hedge that large retail business I was talking about earlier, I'm

not going to get any smoothing of that half hour. So the load I have to hedge doesn't get smoothed out by the ups an downs of that half hour.

When we hedge, we are going to need to think about do we need to hedge up to a higher level. Is it to the probability of X situations that we need to be at the five-minute exposure level rather than a half hour level. Maybe we will, maybe we won't. I guess there's potential that there will be also increased demand for derivatives, so we could have declining supply and increase in demand. Simple economics: the price goes up. I don't think there's a lot of dispute around short-term, that if we did transition quickly, we would see quite a sharp increase in the derivative market.

Whether the spot market follows with that, I'm not too sure, but I think there will be a natural higher demand for a more scarce product. I think that does go to time and how we transition, or what other things we wrap around the transition.

I think just one other thing to think about is in three years time, probably the next baseload generator does leave us. I think that's quite publicly spoken about, large generation in New South Wales probably comes out around about the three-year mark. I think we have got another kind of liquidity test on the market just at the same time that we are moving into this potential brave new world, so I think we do need to think a little bit down the track. Let's not rush. Let's get it right, or let's get some other rules around this change.

More broadly, we do need to think about those security supply issues. We do need synchronous generation. I have no doubt that we'll have a proliferation of batteries. A lot of people do talk in how many megawatts and how many gigawatts of batteries will come in, but from a security of supply issue, we do need to think about megawatt hours and gigawatt hours, so there will be periods where we do have more of our traditional generation assets unavailable and we will need assets available with the right economic signal to come in and provide energy for sustained time periods. Again, I think that is in the mix of the conversation.

Broadly, ERM Power would say this is going to happen,

it is a matter of time, but let's just make sure we think about what the actual full policy environment is. Let's let Finkel play out first, let's see what the outcomes are and then let's focus on the next round of rule changes. Thank you.

MR HENDERSON: Thanks very much, David. Now, another perspective from Emma Fagan from Tesla Energy and Dominic Adams from Mojo Power, giving their new technologies perspective. We will have Emma first, obviously.

MS FAGAN: Thanks to the AEMC for having me and being able to be one of the faces of new technology for today. I will just jump into a brief disclaimer to start with. I will just be presenting today on the technology perspectives, so response times, ability to be deployed, and speak more generally about case studies around the world where Tesla is already participating in similar markets. If anyone has any queries about our position on the rule change more broadly, we're happy to discuss that at lunch. I will also throw over to Dom to discuss the broader markets implications once I have finished with the technology.

A bit of an overview of Tesla and Tesla's position in Australia. We have been operating in Australia since 2014 officially. I am sure most of you in the room are pretty familiar with the motor side of the business. We make electric cars. From an energy storage perspective, we've got two key products, the power, which is our home energy system which is 7 kilowatts, 13 kilowatt hours, and the utility scale or commercial and industrial scale, our power pack which is 100 kilowatt hours plus, so that's what I'll be focusing on today. I see around the world - David, you will be happy with this because we're speaking in megawatt hours, not in megawatts. We have 300 megawatt hours of deployed storage already in 15 countries around the world. I was on Bloomberg New Energy Finance last night just to look at what the total installed capacity - unfortunately, it is power capacity - around the world is at the moment and it's tracking at just over 4,400 across all battery storage installed around the world, according to Bloomberg's systems. Battery storage is well and truly being rolled out and the vast majority of this has been installed over the last couple of years.

One of the key points and one of the key things that

we want to touch on is the ease of battery storage in terms of how it can integrate with the existing grid systems in Australia. From Tesla's perspective, our power pack is fully integrated, power pack by directional inverter, so you can dispatch and absorb power within very short time frames. It is in-built with integrated software so you can manage the load and demand and remote monitoring so you can manage real-time monitoring and control.

From an actual integration perspective, we've got full power discharge within one second and sub 15 milliseconds for fast frequency response, so we're well and truly able to participate in five minute markets and respond to five minute pricing bills. Full power can be maintained for the full five minute dispatch period, and for longer, so that's easily managed as well.

I suppose one of the key queries as well is how well it does integrate within the existing grid system, so again, the way we operate is through SCADA software which can be linked either locally or remotely to our site master controller, which gives accurate power feedback through dispatch, so at any time if we're looking to dispatch 100 megawatt hours, we will dispatch 100 megawatt hours, there's no lost load there.

This is basically how it works, in effect. You've got your inverter, your power pack, your site master controller which is located on site. That's linked remotely to Tesla's servers and then it's also linked directly to the SCADA or the external controller which is integrated into the existing market.

In terms of response to price signals, the demand signals, we've got a response time of less than 1,000 milliseconds from direct command, that's for our utility scale systems. For aggregated systems, if we're looking to aggregate a number of power walls, either working through the Mojos or Reposits of the world, you're looking at two to three seconds for response time from a demand signal.

I suppose one of the key things that I really wanted to touch on as well is that this is happening around the world already, so one of the key projects that we'll discuss today is the Southern California Edison Project, which some of you might be aware of. This project was

launched by the California Public Utilities Commission last year on the basis of a gas leak in Aliso Canyon following a State of Emergency which was declared by the Californian Governor.

On the back of that they launched immediate energy storage procurement mandates to replace gas peaking capacity in California and managed demand through the winter. This one was deployed in three months from contract signature through to full operation and this is a 20 megawatt, 80 megawatt hour system as well. It is part of a broader system that was launched in California to manage its demand issue. Again, fully grid integrated, it has been operating in the wholesale market since it has been deployed.

This is just a bit of an overview of what it looks like, in effect, so 48 inverters, 396 power packs, all of our systems are fully scaleable. Basically, if you do need additional power to be deployed, it is just a matter of adding in additional inverters, additional power packs, it's plug and play technology. There is very little site works that need to be done, it is basically laying a slab of concrete and putting the power packs and inverters on top of it. This one is a stand-alone system.

Ben touched on a few different applications of energy storage, energy storage of the utility scale. Before also being either collocated with existing renewable energy or operating independently, this one was plugged into the Mira Loma substation and just operates independently in the wholesale market.

This is another example. This one is collocated with 30 MW of Solar PV in Hawaii. The Kauai Island Utility Cooperative wanted to maintain energy independence, basically, and to do that they wanted to install energy storage to manage their peak demand during the evenings, so it's 30 megawatt, 52 megawatt hours.

This one operates through a long-term PPA, but again it includes a customised control system that was built for KIUC that integrates with the existing grid control system - platforms deployed with dynamic control capabilities that monitor the real-time grid conditions and make continuous adjustment so they can be dispatched as required.

Just touching on a few of the changing market conditions in Australia as well, one of the key points that I wanted to make was that this is happening around the world. The software already exists, it's very easily integrated into existing grid systems and with the announcements from the SA Government and the Victorian Government, I think we'll see that battery storage will be participating in wholesale markets in Australia with relative ease hopefully within the next six to nine months. I am going to throw over to Dom now to touch on actual market implications.

MR ADAMS: Thanks Emma for the technology side. I am just going to talk a bit about Mojo's experience, particularly its relevance to the rule change and the liquidity of caps issue. I've only got one slide, so I'll just pop that up and that's the key points and just talk to that.

Mojo's core strategy is to build a retail energy business that's resilient to and takes advantage of a distributed energy future. The first phase of this is to build a retail business that provides energy services, not just electrons, and we're doing this through a subscription fee business model. We make money from the subscription fee, not from the electrons that we provide to customers, so then we can focus a bit more on servicing customers rather than providing a commodity.

For us this includes helping our customers reduce their energy costs by managing their grid consumption more intelligently with solar batteries and other controllable devices, the technology that Emma has been speaking to. Phase 2 of the business is about building and controlling a fleet of distributed energy assets and the aim is to build a fleet, generate value through controlling the fleet, and share a chunk of that value back with our customers. Reposit's model is quite similar but they sit outside of being a market customer in the market and that's where we have a point of differentiation.

We are now conducting fleet management trials to underpin that phase of the business. There's quite a bit to it, as Dean and Emma know, but the technical issues are solvable and it has been demonstrated both overseas and in Australia before.

Controlling distributed assets remotely provides access to lots of different bits of the value chain, but key for this rule change is the value in balancing supply and demand in the wholesale market. As the retailer Mojo is financially responsible for the consumption that occurs at the customer's meter and is exposed to spot prices for that consumption. We currently manage this risk through hedging contracts, caps, swaps and so on.

Being able to physically control the consumption experience that the customers meter by controlling assets behind the meter can either reduce our need to call on the caps and other hedging contracts we have in the market, or allow us to withdraw those caps altogether and save money there. That is money saved directly on our balance sheet and that's where the value we see initially is. That is just the wholesale market part of the value stack and not the other bits. Put another way, we save money because we don't have to pay to contractually manage our exposure to the five to 10 hours a year that equates to around 10 per cent of our wholesale costs.

Moving to align dispatch and settlement at five minutes is pretty critical for this model because it reduces the inherent risks associated with physically managing wholesale price exposure under the current arrangements. Currently, algorithms designed to hit the spot price peaks can only really make a well-educated guess at what the 30 minute price outcome is going to be and then respond accordingly. This includes responding within trading intervals to lots of false positives and lots of false negatives and that's the blunting of the price signal that Dean was talking to earlier.

Basically, it is very hard to use your asset really efficiently under the current system and moving to a five minute settlement world would allow us to respond much more to actual price signals rather than our forecasts of what might happen in a particular 30 minute period. That would give us a lot more confidence to start pulling down the contractual hedging from the market and making the money.

The point is that the technology is there to be able to reduce the demand for caps on a move to five minute settlement by physically managing wholesale risk behind the meter, but this is all only really relevant to the decision on moving to five minute settlement if this sort of a model

can be scaleable and replicated and if so it could have a reasonable impact on the level of demand for caps under five minute settlement. I will make a few comments on scale now.

There is a wide range of estimates for uptake of residential batteries, from not very many at all through to a few hundred thousand by the early 2020s. At the high end of the range, assuming about a 5 kilowatt of output capacity for each battery, that's equivalent to about a Hazelwood or up to five gas peakers, but, as we all know, these are numbers and just modelled estimates based on assumptions which are pretty much always wrong. Even the high estimates could be wrong on the low side, as was basically always the case when estimating where PV roll-out would get to and customer behaviour of course is a very difficult variable to predict, but at the coalface we're certainly seeing a lot of interest in batteries.

Physically managing spot price risk also requires batteries that you can control, that you can speak to, cloud to cloud, like Emma was talking about, and most residential battery systems now are starting to come with this capability as standard, which wasn't the case at the very beginning of the market, including all the Tesla power wall 2s, Dean's Reposit box enables that, and other battery providers are often controlled through things like Dean's Reposit box, but a lot of that technology is being eaten up into the inverters themselves as well more and more. Often the inverter just requires a remote firmware update to enable us to speak to it.

The story is not just about batteries but also other demand management behind the meter. We conducted an interesting trial on that really hot Friday of 10 February where we texted 500 of our smart-meter customers in New South Wales and asked them to opt in to the program and turn down their appliances between 4 and 6pm and they'd receive a $25 credit on their bill. 40 per cent participated, which we thought was quite staggering, 40 per cent is quite a lot, and the top 10 per cent of responders dropped their load, their whole load, around 10 kilowatts on average.

This is a fairly blunt instrument and obviously can't respond within a five-minute period, but it does tell us that there is a big demand from customers for services that

help them to better manage their energy use and the business models that develop to fulfil this need or this demand are probably more likely to use controllable devices that can respond within a five minute settlement period, like circuit-level control and those sorts of things.

It appears likely that there's going to be lots of batteries out there, to us and to Dean and to others, and also other demand management assets in the near future and lots of those will have the capability to be remotely controlled to manage spot price exposure, but the other main variable is whether the business models to do this can develop and we'll be able to get to scale.

I can only really speak from Mojo's perspective on this, which is that we find through our analysis that the value in managing our risk in this way is very compelling and that with retail competition and competition in energy services and so on developing, that more and more of these products and services will be developed to share the value back to customers, particularly customers who have spent a lot of money on their very expensive toys, they're very engaged and they look around for the best products and services.

I would also like to touch on another Mojo experience. We have been involved in recent tenders for grid-scale batteries in South Australia and Victoria. There's 90 and 100 responses to those respectively, so it appears like there's no real shortage of interest from equity and debt looking to invest in those sorts of projects.

A key part of the financial modelling underpinning those projects is the ability and the value in selling caps through those assets. Given this, I think it appears there's a fairly strong potential for grid-scale batteries to provide some of the liquidity on the supply side for caps, and I think also that it would be really helpful and interesting to hear a lot more from the developers and operators in the grid-scale battery space. We have heard from Emma, which is great, but there's a lot more out there, so it would be interesting to get them a bit more involved in this rule change. That's pretty much all I had.

MR HENDERSON: Thanks very much, Dominic. Brian Morris, who is President of the Energy Users Association, will give

a customer perspective.

MR MORRIS: Thanks, Neville, for the opportunity to speak today and I guess I'm really here wearing two hats. As Neville mentioned, I chair the Energy Users Association which represents large energy users, so not the smaller users really that we've heard a lot about today, and also in my day job as leading the energy and sustainability team at Schneider Electric, I work with a lot of large end users managing their energy procurement and making sure their data is correct and all available for their sustainability reporting and also to find opportunities where they can be more efficient and control their costs.

I was asked to speak on two topics today. The first one is the views of the Energy Users Association's membership and the second one was just the trends in commercial and industrial energy users energy management practices, to do a quick overview of that. The Energy Users Association is a very diverse group of members, ranging from large industrial users, manufacturing and commercial users and that's just a few of our member organisations.

There were some big names there and some of Australia's largest energy users, so corralling those can be a little bit of a challenge, there's a wide and diverse range of views and groups and interests there, but I thought I would just share the backdrop, really, that all large users are facing in Australia and small users are starting to see as well. We are really coming from a position at the moment of record high energy electricity prices and gas prices, for that matter. Users are concerned about system security and we've seen the recent blackouts in South Australia and some curtailment events in New South Wales also, so, above price, really consumers are concerned about “Do I have a stable supply?”.

Because of that they're questioning their viability in Australia. Where once energy was our competitive advantage, it has quickly moved to being a disadvantage in Australia now and to run business in Australia, so particularly for those users that are very, very energy intensive, a lot of questions going on, people are lining up their businesses to the end of electricity and gas contracts where they'll make another decision.

Just recently, a couple of weeks ago, was really the first user that I'd heard that had actually made a direct decision to make a business decision to close a part of their business in relation to electricity prices and it was a bowling alley. They were about to sign a new lease on a premises and they got their annual electricity contract and said, "If that's the price, I'm not going to renew that lease on that bowling alley, I will close it."

That is only a small impact, no-one will notice that probably, apart from the people in that suburb where the bowling alley was, but I think it is the start of the things to come over the next few years.

Large users are also questioning the structure of the NEM. The NEM has delivered for us well over many years since it was set up and I think it continues to deliver well in many ways, but certainly there are some questions. Is the current market and policy working? End users are really hurting and looking for change.

The views of the energy user members - I emphasise that I talk to them - I can really boil it down to probably four groups. The first group is "Don't know, haven't looked at it", "Don't really care", "Someone else can take care of it for me, thank you". The second group is probably more the large industrials, I would say. They've got a bit of a view, "It's not good for me as I can't curtail within five minutes". So when they look inside their business, they're saying, "Look, there's no real benefit here. I can't respond to it".

The third group is probably the more innovative end and maybe more the commercial guys and manufacturing, but they're really saying, "Yes, I'm supportive of it because we're investing and exploring new technologies. We want to be at the leading edge. I think I'll get a direct benefit out of it, so I'm in."

Then there's a fourth group. This is probably a bit of a combination between 2 and 3. There's a group that would say, "Look, I support it because even though I can't curtail within five minutes and there's no direct benefit on my organisation, there's an indirect benefit that I think this will bring through the introduction of new technologies."

Landing on a position from an energy users perspective was difficult, there's a wide range of views due to that diverse member base, but I'd have to say when you sit down, probably that first group, when you start to talk to them about some of the benefits that the five minutes will bring and actually how the market works, they sort of get to point number 4. Even the second group, they probably would say, when you really dig in, they haven't done enough thinking about what it means when they look outside their fence. They start to drift toward number 4 as well.

In general, I would say from an energy users perspective there's certainly an interest for change and the five minute settlement rule is seen as probably a step in the right direction, I would say, to get some change and better outcomes for the future because the current state is not palatable for anybody.

The next thing I wanted to look at was the C&I energy market trends. This is something from my day job and from Schneider Electric's perspective we see as a global adviser to large energy consumers. We are certainly seeing a push to end users being asked to be more sustainable. Their customers, they're lenders, they're owners and governments are all pushing for more sustainable development and transparency.

Energy costs globally are becoming more volatile. Gone are the days when you could sign up for a long-term stable agreement and sit there and not take any notice. Globally we're seeing that trend and certainly that's something that's in Australia as well. We all know data is exploding. 99 per cent of the data that is out there is not used, that's a commonly known statistic; the same in the energy world. One thing it does do in Australia, it creates lots and lots of data. Obviously, the trend is to distributed energy resources and this is not just about being renewables or being more energy efficient, but it is also about security of supply. I have heard a lot of customers recently saying, "I'm interested in installing generation on-site", whether it's renewables supported by batteries or whether it's diesel-fired peakers just for that system security.

Really, this all boils down to customers or consumers are being forced to become more knowledgeable, interested and active and really they don't want to be. They would

just love to use electricity and gas as something that just turns up, they don't have to really care about, just as another input, but I think that all these global trends that we're seeing are forcing them to become more active. They'd love to just get on with their business, whatever that may be, and have electricity input that's just delivered to them at a reasonable price and reliably.

One of the things I would like to share is when it boils down, what is possible in the customer world. Schneider Electric is also a reasonably large energy user and we own Clipsal. We have a manufacturing facility in South Australia. Our energy price over there or cost has increased like many other consumers has in Australia, so I guess we're lucky enough to be at the forefront of technologies and be able to do something about it and improve our position and also give some learning.

We set down this path of improving the performance of our plant. We had four program objectives. One, and probably foremost, was to lower energy costs. For most customers I would see in Australia that's their primary driver. The second is to reduce emissions, the third is we're looking for operational efficiencies, and the other one is to be a thought leader. We want to be at the pointy end of that space and I think this is a general trend. We are seeing many customers starting to look at it and saying, "How do I do this and what's possible?" With current higher prices everybody is interested in alternative solutions.

What does it really look like? We are, like most other users in Australia, like Kathy's organisation, probably one of a handful of customers in Australia that is actually a market customer and buys electricity on that short-term basis and still the bulk of energy users buy through a retailer and a few of those will access the spot market via the retailer, but most of them are still under peak/off-peak contracts.

So we really had three themes to our solution: the first one was to minimise energy use; the second one was to shift or control and shift demand; and the third was to get some supply from renewable sources.

First of all we'll do an energy audit to really identify what's possible and quantify that. We have done

some back-of-the-envelopes, but certainly we need to do an audit to get it to the next stage. A lot of large customers now are investing in energy audits to understand what they can do.

We are expanding a range of solutions on site. That looks like - solar, that's sort of a no-brainer. We'll probably install batteries. We will control our loads. We have heard a lot of talk about batteries today. Dominic started to touch on controlling customer loads. I guess in general there's a lot of talk about the supply side, meeting the needs of the market, but I think the massive untapped potential is really in the demand side and changing the size of problem that needs to be served by the supply side, as a starting point. When electric vehicles become more mainstream, we'll have charging stations on site.

There's a little logo there, DSO, demand side operations, that's a controller that we have for commercial sites that actually can optimise and control all the batteries and the solar and I guess the loads on site to drive any outcome that you throw at it.

There is only so much we can do on site. For large users, they generally have large loads and a smaller amount roof space. So we'll also look to grid connected solutions. We'll also enter into probably solar, but a grid connected power purchase agreement, whether that be solar and wind. We are out in the market talking to some people about that right now.

Really, we think this is quite an innovative solution. None of the pieces in its own right is super innovative, but bringing them all together and controlling it is the point, and we look forward to demonstrating that to some of our customers quite soon.

We will also keep the solution open to other alternatives as they come along. Implementing this solution will require us to renegotiate our electricity retail contract. Kathy spoke about how they buy in the five-minute market, and some others do as well, but really most consumers in Australia buy energy on a peak and off-peak basis. They don't care. I don't care at home whether I use energy on the hottest day in summer when the market's screaming out for supply, or a mild day in April when there is plenty.

I think, fundamentally, consumers are getting smarter. They need these new technologies and rule changes to allow the technologies to be implemented and for them to, I guess, participate in that market and work in sympathy with the needs of the market to lower the overall costs for all.

That was all I had to say, thank you.

MR HENDERSON: Now I open up the floor for questions.

I'll just refresh, if you like, the things the Commission are interested in getting feedback on: how operation and investment may differ under a five-minute settlement; how successful would alternative strategies be for existing generators; and what's going to be the impact on caps and swaps in the market.

I better ask John first, seeing he's the boss.

MR PIERCE: I have two questions, one for David and one for Emma.

David, you referred to other policy mechanisms to go hand in hand with a five-minute settlement. I was wondering whether you might give us a hint as to what you think those other things might be. Secondly, to Emma, the examples you used, if I understood them correctly, the counterparties to your contracts were some central authority, i.e. investment wasn't made on what we'd refer to as being market-driven, they were made on the basis of what some extra authority thought was required for consumers, rather than consumers deciding for themselves. To what extent does the deployment of the sorts of technologies you're talking about depend upon there being an omnipresent planning God that does things for people as distinct from it being driven by a market?

MR GUIVER: We observed in Texas where they are a five-minute market energy only, but they do have a mechanism that makes assets like fast response gas generation available. So there is, I guess, an incentive payment to make sure they stay in the system.

In our response in Finkel, I guess we are not thinking about the five-minute marker, per se, but thinking about the transition to renewables, we could see the same logic

around how we make sure that capacity sticks around for the transition. That will be an example.

MS FAGAN: You are right, John. The two examples that I gave, one was driven by a state of energy emergency that was declared in California and the other one was really driven by the island looking to maintain energy independence. I would say that the vast majority of projects that have been considered do have an economic component, more than anything else. So any market changes that are going to impact revenue for battery storage will certainly be considered favourably.

MR ADAMS: I might add to that point, during the Mike Cannon-Brooks, Elon Musk, Malcolm Turnbull Twitter storm, Lyon Solar came out and announced that even without government support, they are going to be putting in about 100 megawatts of batteries to support a large scale solar plant, so I assume that that's based on looking at the market, rather than looking for support.

MR HAVYATT: Look, it was just a follow-up question to David, because I actually went and looked at your Finkel submission, and your Finkel submission said that you wanted to see a capacity market for fast start generators in conjunction with a five-minute rule change, if there was a five-minute rule change.

My question comes down to isn't that something that the contracts market could solve. In other words, couldn't there be a market for people saying, "We need these generators to be turned on." You don't need a rule change to make that market occur. Someone just needs to be prepared to pay them for it, and that can happen in a financial market irrespective of what happens inside the NEM rules. Am I wrong?

MR GUIVER: You are not wrong. The question is who pays, because if one person pays, everyone gets the benefit, and generally society doesn't go for those structures. They need a market to pay, or they need a cost distributed across the market.

MR HAVYATT: Subsidiary behind the actual cap, the cap's only available because you've made the --

MR HEADBERRY: David Headberry from Major Energy Users.

One of the things that's concerning me is that we are talking about the market as it might be in a Utopian world. We are not looking at what the cost is going to be to introduce all of these new technologies, lots and lots of batteries. Even at the current price of batteries, we are still looking at something like $800 to $1,000 a day per megawatt hour to be available.

That's a big cost, and that's just to be available. You're going to have to drive the offer price quite significantly high. We are also looking at getting new fast start generators. It's a wonderful idea, we'll get the new LM6000 right across the fleet, but someone has to pay for all of these things. We have not done any analysis to see whether all of these you beaut ideas are going to increase the price of electricity and, as Brian so succinctly put it now, big users are having a lot of trouble with the current electricity prices, let alone having more and more added into it.

As well as those price impacts we are going to see, I then start to see that if we move to a five-minute settlement, are we going to change or reduce even further the amount of competition that we need? At the moment we need more competition in the market. We are actually seeing a contraction of competition right across the market. If we change to a five-minute settlement, are we going to change or reduce the amount of competition? Are we going to increase it? I don't know the answer. Nobody's looked at this, yet fundamentally the market objective is about being the most efficient in the long-term interests of consumers. Competition is fundamental to that. That was what Hilmer started off with way back when dinosaurs roamed, back in the 80s and early 90s, when Neville Henderson was trying to write up the new rules.

What I'm concerned about is we are going off on this wonderful excursion, saying, "These are you beaut things, we can do that", but we are not looking at whether we are going to increase cost as a direct result of this. We have not done that and we have not looked at whether we are going to increase competition, which is what is essential to minimise the cost for consumers.

MR HENDERSON: If I could answer part of that. Part of

this exercise, obviously, when we look at what are the outcomes of a five-minute settlement process, and I go to any of the rule changes we looked at, the key aspect of that - we do look at the impact of competition. We'd be interested in people's views as to whether they are going to increase or decrease.

I think the only thing we have heard so far is that there is potentially a lot of other technologies looking to come into the market, that can fill a niche in certain areas, which would increase competition.

Coming back to your question, where are we going with this? What we are not about is picking technologies. We try to be technologically neutral. It's up to investors to make the decision as to whether or not they want to invest and then the rate of return. We have to make the environment such that can make those investment decisions to the best of their ability.

When we look at this rule change, we are looking at the issue, and Russell's raised it and others have raised it, that there are costs involved in moving away from where we currently are. We are very interested in that. From a pure economic point of view you say, "Yes, there are benefits if you match real time demand with real time pricing". Yes, a nice position to get to, but what we have to look at are what are the costs and what are the benefits in actually getting there?

MR VAN BOECKEL: Luke Van Boeckel from Stanwell. I was interested in some of the information about the battery roll-outs and particularly the Tesla examples. To what extent will this rule change, change the amount of that which rolls out? So there's been a lot of discussion about batteries are coming, Dean's going to put in a gigawatt, Mojo's going to put in some and Tesla is going to put in some as well. How much? Is there a percentage, a kind of metric, a threshold, that this rule change, in particular, is going to impact that investment, or can we just leave it and get all of that good stuff anyway?

MR HENDERSON: Who would like to answer from a battery's perspective.

MR SPACCAVENTO: When you have 30 per cent, which was the

number I put up on the slide - that was the number. 20 to 30 per cent increases payback period by a fifth or a third.

MR VAN BOECKEL: That's the potential benefit to one installation under a specific scenario, not the net benefit of adding more installations which are doing the same thing at the same time.

MR SPACCAVENTO: Yes, that is the benefit of a single installation, but that benefit is scaleable. It's not just related to my mum's house. Everyone gets that who has the same control system, the same battery, in the same region. The benefit is an economic reflection of the value delivered. It's not made up money. It doesn't come from the sky. As a result, it is a zero sum gain. 20 or 30 per cent is the reflection of the benefit that's delivered. I'm not reaching into my back pocket and topping up.

MR STABLER: Are you saying that increased volume does not impact price?

MR SPACCAVENTO: Arbitrages will close with volume, that's true. That's a fundamental of the market and that's what we expect. But we are a long way from that. You've said 625 megawatts of liquidity is about to disappear under this. That's great. I'd love to fill 625 megawatts of liquidity with storage-backed caps.

MR STABLER: The cap volumes are not just two hours worth of requirement, which is where you do run into issues regarding trying to do a 1 megawatt versus 1 megawatt. As David mentioned, this is to do with megawatt hours. It is important to make sure that we are talking about the same things when we are doing our comparisons, because it's very easy in this argument to have issues to do with megawatts and megawatts hours.

MY LY: Kevin Ly from Snowy Hydro. I have a question to Josh. I appreciate your analysis in the Energy Edge paper. I'd just like to highlight that Snowy Hydro is the largest provider of cap contracts in New South Wales. We have over 3,000 megawatts of feed-in capacity. It was highlighted that generators and participants as a whole are very good at taking a set of rules and then using it to maximize their revenue. We are a commercial entity and if this rule change goes ahead, we will do the same. My

concern is volatility.

As I pointed out, and as you pointed out, our response time from rest is at least two minutes. There is no way we'll be able to sell the same level of caps under the current five-minute settlement, under the 30-minute settlement versus the five-minute settlement. If we can't sell the same level of caps, we'll have more spot market exposure.

Now, my background, as a trader, as an engineer, tells me that volatility would go up. As soon as you have spot market disclosure, there is no incentive to hedge a contract position. So I'd just like to get your insight, as a modeller, on your views on what you believe what would happen to volatility as a whole for the market.

MR STABLER: All of our analysis was based on the direct implications of moving from a 30-minute settlement, where you have time in order to recover your volume, even if you missed the initial price signal itself. At the moment, I guess what happens in the market is you have a price spike that comes along. That is either a positive or a false positive.

At the moment with the fact that people pile in, you have a whole lot of people responding to that market signal as if it is a positive result. If it turns out that that was actually not a result and it was incorrect, they still come on line and they are still ready. That changes the way that some people would behave if they were in a five-minute market where they now make a decision between whether or not it is a positive or a false positive, and that changes whether or not they would ramp up.

If you increase a pool exposure of any player to the market, they are incentivised to be able to withdraw capacity in order to make a gross margin benefit. That happens regularly and it happens across the market. That happens not only for one portfolio, but across multiple portfolios. If multiple portfolios all receive the same behavioural response, which is to reduce the hedge limit, then you have a larger amount of market exposure that is exposed, and therefore the market would have a better, I guess in the game theory's response, opportunity to be able to, through competition, withdraw capacity. That's our fundamental response.

The problem is there are 115,000 periods per annum. There are new generators who are going to come on and cause implications there. That brings on new supply. Is there an implication of having new supply? Yes. You'd say new supply would cause price to go lower, but eventually that causes exit which causes other changes as well.

MR HENDERSON: We'll take one more and then have lunch. Russell, you had your hand up.

MR SKELTON: My question is for Dominic. Am I right to hear that one of the benefits you see in five-minute settlements is improving your ability to predict correctly a price spike?

MR ADAMS: Yes, that's right, because you are actually reacting to what the market actually is, rather than what you expect the financial outcome to be over the 30-minute period. So your algorithm is not trying to guess whether or not in the end of the trading interval there's a price spike or not; you are looking at the market and reacting much more just to what it's doing.

MR SKELTON: For the half hour the price is forecast, but it's just not as big a number.

MR ADAMS: For the half hour the price is forecast, but often that doesn't eventuate.

MR SKELTON: If AEMO was able to improve the reliability of their five-minute pre-dispatch forecast, which is not very great at this point in time, would that help as an alternative?

MR ADAMS: We don't know what the price for the half hour will be until into the last five minutes of that half hour.

MR SKELTON: That's true.

MR ADAMS: Which is the problem.

MR SKELTON: My question still is one of the concerns we have is that AEMO's five-minute pre-dispatch forecast which they run for at least an hour or two hours, is not highly reliable.

MR ADAMS: If it was perfect, that would be great.

MR SKELTON: Would that solve your problem?

MR ADAMS: It would solve our problem if - well, not really, because of some of the economics that Dean put up on the board around using your asset more efficiently. Because if you just have to respond in a five-minute period and you just want to hit that five-minute period and value that flexibility, you have to use your asset for the other 25 minutes when it's not needed.

MR HENDERSON: We are running behind time, so we'll have a lunch break now and I'll ask you to be back by 1.45. Thank you.

LUNCH BREAK

DR SPALDING: Could I have your attention, please. We are about to start the third session. Thank you, that's much better. The third session is very much focused on operational and metering type issues. In a sense no-one has raised the subject of metering yet, so you have constrained your discussion to align with our design of the agenda, so thank you for that, but now we're going to have only just the AEMC speaker, Ben Noone, who is going to take us through this issue, so I'll just pass straight over to Ben and then we'll have some question time at the end. Thank you.

MR NOONE: Thanks, Brian. As mentioned, I am the only person presenting in this session, so hopefully we can get through this reasonably quickly and then hear from the audience.

I am speaking about what we see as the most feasible implementation of five minute settlement and the purpose of this is to present a framework to participants so that they can work out how they would be affected by this rule change. Ultimately, what we're interested in understanding is whether you agree with the position that we've come to and what this would cost.

There are two questions as part of this part of the day. The first relating to optionality, the question is should five minute settlement be optional or compulsory for demand-side participants. You would probably be familiar

that the rule change request has proposed compulsory five minute settlement for generators, market network service providers and scheduled loads and that it would be optional for other participants on the demand side.

The thing to be clear about here is that when we're talking about optionality, the option would be afforded to market customers. That is mostly retailers and then a handful of the largest end users in the market. Another thing to note is that even if a retailer is settled on a five minute basis, the billing of customers is still at the discretion of that retailer. Clearly now retailers are settled on a 30 minute basis, but most customers are on flat or peak/off-peak tariffs and billed monthly or quarterly, so we don't see the implementation that we're proposing as having a direct impact on those arrangements.

A key concept in talking about optionality is the settlement residue. Optionality whereby some of the demand-side participants are still settled only a 30 minute basis would result in regional imbalances in the money that is earned by generators versus the money that is paid by those loads that are settled on a 30 minute basis. This occurs at any time, as Josh mentioned, that there's a variation of price or demand or supply within a half hour period. There are differences between the 30 minute and the settlement and the five minute settlement outcomes can arise. In this stylised example here, both changes in volume and price occur at the same time.

Looking back at the historical data, over longer periods of time AEMO would generally be in deficit if generators were set on a five minute basis while loads were on 30, so there would be a shortfall of the money that would be owed to generators. Over the period of 2000 to 2016 the difference in the deficit was in the order of 0.1 per cent which is really quite small, but that is not to say that 30 and five minute settlement are very similar. It is the time element and who those payments accrue to that are important in thinking about that.

In terms of optionality, the decision tree here represents the process that we've gone through. The fundamental question is whether it should be optional or not. If it is not then there's no residue, but clearly there's a much larger implementation effort. If there is optionality for the demand side, and we would assume that

some proportion of loads would continue to be settled on a 30 minute basis, then there is that residue that occurs and then there's the question of what's the best mechanism to deal with that.

The two options that we have looked at - I imagine there probably are many more - these are the two high-level options that we've considered. One would be a recovery based on a causer pays principle which would require identifying who the consumers, retailers, loads are that are still set at a 30 minute basis and then somehow recovering or compensating those participants to the amount of the residue.

Then option B would just allow the sums of money to merge with the existing residues, specifically the intra-regional settlement residues which are largely due to differences between marginal loss factors and actual losses on the transmission network.

In terms of the pros and cons of having this optionality, the obvious pro is the much lower implementation costs, but the key point there is even though the costs would be lower, the end result would be very different. In terms of the cons identified by many in the earlier consultation, there would be a less efficient price signal for those remaining on the 30 minute settlement. Earlier in the day we put forward our views of why we think a five minute price would lead to more efficient operation and investment decisions. We think that the same largely holds for the demand side, acknowledging that not many loads are directly exposed to spot prices, but the price signal does filter through, be it through pass through arrangements or retailer offerings.

Another drawback of optionality is that there would be extra complexity for AEMO participants potentially in managing the alternative arrangements, and then we also see additional risk for buyers and sellers of particularly cap and floor contracts, given the basis risk that could exist with the counterparties to the contract being settled on a different reference price.

The position that we got to with this, as articulated in the directions paper, was that if 5 minute settlement is to be implemented then there's a clear preference for all market participants being settled on the same basis. What

this would achieve is that there would be more accurate price signals both to invest in flexible demand-side technologies and to operate flexible technologies that we expect to enter the market, irrespective of this rule, to be operated in ways that better align with the physical requirement of the power system, which was what Dean from Reposit was referring to earlier.

We also see, having this consistent settlement, as being more conducive to existing and new entrants selling cap contracts because it would avoid situations of basis risk, as I mentioned on the previous slide. Clearly, the implementation costs would be higher, but we considered that this implementation would be more likely to produce a net benefit than under a scenario in which optionality is provided.

We also put forward the position that if there is a transition period where not all consumers are able to be settled on the 30 minute basis, that it would be most appropriate for those sums of money, which are relatively small both compared to the existing residues and incredibly small compared to the total value of settlements in the market, to merge those with the existing residues because the mechanism would be disproportionate to the benefit that could be achieved.

Moving on to metering, the question here is what the data source should be if all market participants are to be settled on a five minute basis. The options we've considered here is the option whereby five minute settlement is implemented by AEMO using SCADA or telemetry data from generators, and then the other option would be the revenue meter implementation.

As mentioned, the telemetry implementation, AEMO is using existing data that's collected for operational purposes to profile the 30 minute data to five minute periods to be used in settlement. The metering implementation involves existing revenue metering that currently provide 30 minute data being reconfigured or replaced so the five minute data can be available.

Similarly to the optionality implementation, the SCADA implementation would have a lower cost, but the end result would perhaps be less satisfactory. In terms of the drawbacks of using the SCADA, I think it has been

identified by many participants that the SCADA is of lesser quality and that would need to be taken into account. There are also differences in the basis for measurement, so this is differences in SCADA being either for the sent out energy of the power station or the as generated energy at the terminals of each unit, and some preliminary analysis has suggested that the percentage of generators that may have this mismatch whereby the revenue meter is for the sent out energy but the SCADA is at the unit level, is for around 75 per cent of generators in the NEM.

Our position on SCADA is that it would be unacceptable if the absolute values were used in settlement, but it is likely adequate for profiling. The other thing to note there is that SCADA profiling is common in US markets where five minute settlement has been implemented in the real-time markets. We see this implementation as likely being workable for generator settlement.

The issue really arises with the SCADA implementation for which participants this data is available. Under the rules, SCADA systems are required for generators that are larger than 30 megawatts, market and network service providers and scheduled loads. What is missing from that equation is the 100 or so generators that are less than 30 megawatts, which is around one gigawatt of capacity, and all the non-scheduled loads, as aside from perhaps a very small number of the largest industrial customers, AEMO doesn't have real-time visibility over how those loads are operated.

The options for dealing with the generators that are below this 30 megawatt threshold and the 3.2 million customers or so that have interval metering, would either be to install some sort of telemetry device or to reconfigure or replace existing meters for five minute recording.

I think it is quite clear that option (b) would be preferred for customer settlement because the telemetry option seems overly complicated, would perhaps duplicate existing processes and also presents opportunities for gaming because the ability of AEMO to validate the data is not the same as it is for generator SCADA. Also, it seems to be the case that a large proportion of interval meters could likely be remotely reconfigured to record 5 minute data, so that works in favour of that implementation.

In thinking about this, it is useful to put some numbers around how many meters there actually are in the market. Things to note here, Types 1 to 5 are the interval meters but only Types 1 to 4 are remotely read. Type 6, the accumulation meters, and manually read, most households in states aside from Victoria have these. And another thing - these numbers for Type 5, include the 2.8 million Type 5 meters in Victoria and they're actually remotely read despite their classification otherwise.

I will speak to the implementation first in terms of the interval meters and then the Type 6 accumulation meters. To implement the five minute settlement would require the reconfiguration, replacement or an exemption from providing five minute data for all interval meters in the NEM. This would clearly be a very significant logistical challenge given the number of meters involved, around 700 Generation, 2000 network and 3.2 consumer meters, of which 2.8 are the Victorian AMI. The challenge also comes from there being six times more data, or three times if you're going from 15 minute recording which does exist in some cases. The requirements under the rules is for the Types 1 to 4 meters to store 35 days worth of data internally and 200 days for Type 5 meters, so if you're increasing that by a factor of six, there are questions of whether there's enough internal memory to meet those requirements.

There is the potential to address that by relaxing the 35 day requirement or exempting some categories of meters from providing five minute data and the options chosen in this implementation would depend on how many meters are affected by those constraints. The questions that we really have are perhaps not possible to answer today, but for those who work in the space, in written submissions, would be around the proportion of meters that can be remotely reconfigured and whether the internal memory is sufficient to meet those 35 or 200 day requirements.

If we then go on to the accumulation meters, of which there are close to 10 million of those, they're read quarterly but they're settled only a 30 minute basis using a net system load profile. I won't go into that in the interests of time, although I will say that the process requires interval meter data from all the transmission connection points, most of the transmission connection

points, and all interval meters in the Types 1 to 5 categories.

Having the net system load profiles at a five minute resolution would avoid changes to a large number of Type 6 metres, but in doing so requires five minute data from all those Type 1 to 5 and most of the transmission network metering that contribute to the net system load profile.

We see that given the challenges involved, if this was to be implemented there would need to be a transition period for interval meters to be reconfigured or replaced. What we've put forward in our directions paper is a period of three years for Types 1 to 3 metering, which includes around 18,000 meters, which would be aligned with the testing inspection regime under the rules which involves meters being visited every so often as part of a routine maintenance, which may go some way to reducing but not eliminating the marginal cost at the equipment level of a change like this.

We have then suggested a longer period, I think it was five years, for Types 4 and 5 metering, given the much larger number of meters involved, and what we're proposing is that five minute settlement could potentially commence so long as the bulk of energy transfers are captured.

Our indicative analysis that AEMO helped us with is set out in this last point and it showed that for quite a small test case that Types 1 to 3 meters generally capture around 85 to 90 per cent of the generation and transmission power flows, but only 22 per cent of consumer load. If you add in the 26 per cent or so that would be accounted for out of profiling Type 6 meters with Types 1 to 3 meters, you're looking at capturing close to 50 per cent of customer load.

To summarise on what we're proposing as an implementation, we see that for the larger generators the SCADA implementation is feasible but there appears to be limited appetite to do this and it brings into question whether this facility would be used. In terms of the generation that's smaller and all loads, we see that a metering implementation would be more appropriate.

In terms of the requirements for five minute data, this would involve all generators, Basslink and scheduled

loads in the consumer space. Again, in an ideal scenario you would have all Types 1 to 5 meters because, firstly, they're needed to settle their respective financial participant, but also because they're used to calculate the net system load profile.

There would be no changes required to Type 6 meters if that five minute profile is available. And then in terms of transition network metering, yes, there would be five minute data required to the 90 per cent or so that contribute to the net system load profile, but that may not be required in Victoria since if all the AMI meters are recorded at a five minute interval, there would be little need for anything beyond that.

I have a series of questions here that, again, I am happy for people to provide perspectives on this today or otherwise in written submissions. This is around, essentially, whether you agree with the positions that we've come up with and then some specific questions around the capability of metering and whether in particular cases exemptions should be required if it is considered that the costs of replacement or reconfiguring is considered prohibitively expensive. Thank you.

DR SPALDING: Can you leave that last slide up. Thank you, Ben. Clearly, the metering aspects of this rule change are not trivial. Metering is not often an area that people like to focus on, but it is an important area, particularly if we are to seriously consider this rule change.

As Ben quite clearly pointed out and I appreciate the way that he went through it very promptly too because we're short of time, is that the rule proponent actually proposed in their rule change that the customer side of the settlement process down to five minutes would be optional; in other words, there would be a choice whether it was done at the five minute basis or a 30 minute basis.

As Ben pointed out, quite clearly that creates settlement issues because the settlement doesn't balance and so you have to then work out what to do with a shortfall or an excess of funds and that's not trivial.

The directions paper that you've seen goes into a fair bit of detail on what we're proposing in this space. As

Ben has pointed out, primarily, we didn't suggest looking at the optionality, we actually think we should go to five minute settlement both sides, to the extent that you can, and that also was that we wouldn't pick up the SCADA option, but we would actually go to trying to put in five minute metering where it can be reconfigured, and I'm advised that there are a large number of meters that can be reconfigured into the five minute space and for those that are currently the accumulation meter and are currently profiled to go to 30 minutes, they would then be profiled to go to five minutes, so the processes would be similar, obviously, but with a larger number of data; so that's what we've put in place.

The last issue that I just wanted to raise and then we'll open this for discussion is that we talked about transition, if we were to go for this rule change, due to contract market issues. I would suggest that the metering side also requires a transition and, as Ben pointed out, we proposed a two-stage transition, a period of up to three years to get the interval meter operating at five minutes and then another couple of years to allow the final proportion of that to be put in place.

Are we kidding ourselves in that space? There are a few people here I know that do have a metering technology background. I would be interested in your comments as to whether our assumptions and proposals are credible or not or are there other issues. Any questions or comments that people would like to make in this area of optionality and metering?

MR GUIVER: David from ERM Power again. I am just wondering if AEMC has any thoughts on how a retailer would deal with having half our meters under one arrangement and the other half under another through a transition process in regard to running billing systems, settlement systems and the likes.

DR SPALDING: David, I will just restate what I think you said. If you had an optional process where some people were optionally done under half hour and some under five minutes, how would a retailer manage that, and by implication, and I think Ben pointed out as well, that obviously would add to complexity because you would have to have two systems, or a system that can accommodate both aspects of it and we do recognise that as being a cost and

that's one of the reasons why we perhaps weren't so keen on optionality. Do you want to comment on it that, Ben?

MR NOONE: Does that answer your question, David?

MR GUIVER: I think it does indicate that you may have to run duplicate systems for an extended period of time.

MR NOONE: Were you referring to the three and five-year thresholds or I could complete, sort of, an optional scenario, because yes, I think we do acknowledge that in a scenario in which some customers are at five and some are at 30 indefinitely, then that does add complexity and potential duplication.

MR HAVYATT: Look, Ben, I must admit I haven't turned my mind to this part of it yet. There seem to be two issues. The first is to note the fact that if you've got a five minute meter in place, and some people already do, the system happily just receives the file and converts it to 30 minutes because of the way it is structured. It is a question about whether we actually need - even if we're going to make it sort of mandatory, whether you can't actually layer a secondary version of net system load profile to the half hours to profile the half hours to the five minutes, because it seems to be a big ask, especially given where Victoria is currently on meters, to think that we're going to replace the Victorian meters with five minute meters, and given that we're in the world of in fact retailers being in control under, effectively, metering contestability from 1 December this year, they're then the ones in the position to decide whether they want a five minute meter or not. I am getting a shake of the head from here.

DR SPALDING: Can I just make a point of clarification there? It is our understanding - and this is where I'm happy for people to correct us if we're wrong - is that almost all of the Victorian meters would be able to be reconfigured and not have to be replaced. In other words, the metering elements already reading 5 minutes, you configure it to be able read into five minute segments. The only issue that we're aware of is that the data storage in those meters may be an issue. Anybody? Martin, do you have a view on that?

MR GILL: Because it's actually done in the Silver Springs

card that's got megabytes of storage and so it's not actually a meter limitation down in Victoria, so they could be remotely done and they would be able to store it quite easily.

MR BANNISTER: Hugh Bannister, IES. I think my question overlaps a bit with the question that was just asked. I'm a bit confused as to why the original proposal, which was focused on the wholesale market, indeed those at SCADA really, I can understand the logic for extending that to all wholesale market participants, but now we've made a leap from probably a few thousand measuring points to 600,000 and I'm not quite sure what the logic of that is.

I know there's some sort of benefit in consumers participating, but to imagine that 600,000 are going to participate on day one or in any foreseeable period, I would have thought that would be much more gradual and that's where optionality really makes some sense. I am not quite sure of the leap between the wholesale into the retail. Is there some reason that I'm missing, something to do with your settlement systems, or something like that?

DR SPALDING: There would clearly be a period of optionality as you transition. If you were to transition to a complete five minute settlement process then the main reason for that is to remove this residue issue that you get if you try and settle one group on the basis of 30 minutes and another group on the basis of five minutes.

MR BANISTER: The residue issue is driving this conversion of 600,000 --

MR HENDERSON: You need to recognise that to settle a wholesale market transaction, you are talking about the retail. What is the retailer's wholesale transaction? A lot of it now is the sum of their customers' loads. To get the retailer load, you need to have the customer load. It's not like the old days where you had the retailer slow the distributor, so the retailer slowed what was going through the distribution-transmission connection points. To get to the wholesale load, you need to sum up all of their customer loads.

MR BANNISTER: You couldn't envisage an interface there at that wholesale level --

DR SPALDING: Are there any other questions?

MR VAN BOECKEL: Luke from Stanwell again. I was wondering if you had investigated and to what extent you investigated optionality on both sides of the market, rather than just on retail side of the market, on the load side of the market?

DR SPALDING: Yes, we did consider that. Ben, did you want to comment on those?

MR NOONE: This is one exercise we had thought about, and what that might look like, but I think given the arguments that we have made in favour a more efficient price signal, both the supply and demand side, I'm not sure if we'd really achieve very much by making a change in which a five-minute settlement was optional for everybody. It may not actually be desirable, really, if that was to be the case.

If the large thermal generators continued to operate in the way that they do now, but then some increasing share of battery operators are allowed to operate on a five-minute basis, I think it would be very hard to predict at all what would happen. I'm not sure if that would be desirable for participants, although some small operators could clearly make a lot of money out of it, at least for some potentially short period of time.

MR GRZINIC: As a retailer hedging, in regard to some of the comments made earlier here, the roll-out between the wholesale and retail sides, being five and five or five and 30, any misalignment between those creates a very real risk, or increases the risk in managing our hedge portfolio, likely to reduce the availability of some products that are able to manage that risk. That runs the risk of, I suppose, some generators offering some products at five-minute and some at 30-minutes, and further reducing the liquidity in the market, is one risk.

Secondly, I suppose is a comment, is around managing mega data, the pure quantums of that, in retail systems. We are going to obviously meet any competition changes, as we speak now, moving to 30-minute data. Going to five-minute would only exacerbate those costs and I think there was a comment made earlier that this cost is a total amount of energy in the market, or relatively small. On

the retail side of the business, these are quite high fixed costs, and whilst they are large revenue businesses, they are very small retail margin businesses, and these costs material in that context.

DR SPALDING: For me, just to summarise what you said then, I'm hearing that you first of all said that to have optionality would be difficult to manage.

MR GRZINIC: Yes, it would be difficult. It's likely to increase the risk profile for retailers, and is therefore likely not be a great encourager of competition in the retail side of the market. So whilst this may facilitate more wholesale competition, it may affect a more consolidated retail market.

DR SPALDING: The second point you made was about going to five-minute data would add a cost to you.

MR GRZINIC: That's exactly right. Whilst that cost is not big in the scheme of settled load in the market, for retail margins which generally are quite thin --

DR SPALDING: We'd be very interested in any stats, any information you could provide us on that, because that will help us as we consider the options forward.

DR SPALDING: David?

MR HEADBERRY: One of the issues that I have regarding the metering, I'm not sure how it would work, but most small generators less than 30 megawatts are usually part of another process. They are integrated as a co-generator or a tri-generator, and I'm not sure how you would go about that, or what your proposal is for metering. Do you meter the generator independently of the site load or do you actually sum the two, or what? I'm not sure whether you have thought about that and what your solution is.

DR SPALDING: Can I answer that one, just before you move on to the second one. At the moment, they would be both metered on a half hour. The load and the generator, they are operated together. What we are proposing is they both go to five minutes.

MR HEADBURY: Even if they are behind the main revenue meter?

DR SPALDING: Is the generator going to be trading outside of the customer connection point?

MR HEADBERRY: Sometimes it exports; sometimes there's an import into the site because it's behind the meter.

DR SPALDING: At the wholesale level it would have to be a five-minute meter, is what we are saying.

MR HEADBERRY: My second question is has anybody started to put any numbers around the sort of costs we'd be up for? Again, that is going to be a very heavy impost on all consumers.

DR SPALDING: As far as we understand it, a large number but not all of the meters would be reconfigurable. So it's not changing hardware, you're just changing the software. If anybody did have costs and issues associated with that, we'd be interested to know.

MR HEADBERRY: There will be costs.

DR SPALDING: Of course there will be costs, that's right.

One of the reasons for the directions paper is that people are saying to us, "How can we give you information on costs or activities when we don't know the model that you're most likely to go towards?" That's what the direction paper is setting out.

We put a stake in the ground as what we think we believe we are heading towards. You tell us what the costs are in association with that proposal - costs or benefits, both sides.

I think we might wrap up metering at that point and move on to the last session.

MS BRODIE: I'm Emily Brodie. I have been working with Kris and Ben on the five-minute settlement program.

This presentation really follows on from the conversation we have just been having. It's about the costs and the transition and bringing together some of the aspects of the rule change proposal we have been talking about today.

30-minute settlement has been in place for almost 20 years, and contract market transactions, metering and IT systems are all designed on this basis. So a change to a five-minute settlement would therefore create major implementation costs for the sector.

To make the proposed rule change, the Commission must expect that the enduring benefits of a five-minute settlement would outweigh the costs. The main categories of costs will relate to contract market disruption, which we have talked about in sessions one and two, and metering upgrades and IT system upgrades. Ben has spoken to metering upgrades just now. However, there is potential for cost for implementation to be reduced or mitigated through an appropriate transition period.

The discussion paper presented the Commission's initial views on five-minute settlement design features, costs and a staged transition period for implementation. These views were based on our own analysis and evidence provided to us by stakeholders. An important purpose of the directions paper, as Brian has just spoken about, is to seek more evidence from stakeholders. This session sets out the key findings of chapter 7 in the directions paper which talks about costs and transitions.

In the discussion paper that's been alluded to, the Commission proposed a staged transition to five-minute settlement. This approach was developed assuming that there wouldn't be demand side optionality, and that revenue metering data would be preferred to SCADA profiling. This approach attempts to balance the benefits of introducing five-minute settlement, while reducing the transitional costs and risks.

As you can see on the slide here, the first part of it is stage A. During this time we expect most legacy contracts to have expired and rolled off, new contracts to have been executed prior to five-minute settlement starting.

As Ben talked about, during this time, types 1 to 3 high voltage meters will be upgraded, IT system upgrades would occur, and NSLP profiling will be adapted to five-minute settlement.

Stage C relates to the type 4 and 5 meters. A longer

implementation is required because there are several hundred thousand of these meters.

The following slide steps through how we arrived at the proposed implementation. As discussed throughout the forum, the Commission sees the role of contract markets as extremely important, because they reduce the price uncertainty for generators and consumers.

Moving to five-minute settlement would disrupt contract market operations and would create two categories of costs. Firstly, one-off costs. These would be incurred in renegotiating, terminating or replacing existing contracts that endure beyond the date when the five-minute settlement would be implemented.

A transition period would allow for most of the contracts to expire and, therefore, reduce implementation costs. Our analysis during the development of the discussion paper has shown that 18 months to four years is required for the expiry of most existing contracts that would be affected by five-minute settlement.

The second are the potential ongoing costs in contracting. Again, we have had some good discussion on that this morning, in particular in session two, where we covered how a move to a five-minute settlement would potentially result in an initial reduction in cap contracts, which would affect wholesale and retail markets. So a transition period would also likely provide the opportunity for the cap contract markets to adapt.

I might just get through this fairly quickly because Ben has done a good job of summarising it. Essentially, to implement a five-minute settlement we need five-minute settlement data. The discussion paper recognises that there are large practical challenges and costs in implementing a five-minute settlement because of the sheer number of existing meters and their different capabilities and characteristics.

We have talked about how some meters can be updated remotely, whereas some other meters may need labour intensive replacement, all incurring cost. We have also discussed how some meters would not need to be replaced as we could use NSLP data profiling on a five-minute basis.

Ben referred to the inspection and testing regime under the national electricity rules. This sets out what those maximum times are between test and inspection, and shows you how the transition period that was designed relates somewhat to those times between test and inspections.

The final category of costs that I'd like to talk about today is IT systems. Moving to five-minute resolution data will require significant system and process changes for most market participants. This relates to having to upgrade systems to be capable of handling five-minute resolution metering data. Two examples are given there, one for metering data providers and another example for retailers. The next slide will also give you an idea of how other market participants are affected.

The features of the costs for IT systems is they are large and they are one-off. Again, we view an appropriate transition timeframe may allow for these costs to be mitigated, particularly if the changes to the systems were incorporated into regular, wider IT system upgrades that happen from time to time.

This slide is one of my favourite slides. It shows the complexity in upgrading IT systems to five-minute capability. It shows the huge numbers of complex information flows, bearing in mind there's going to be six time more data. It also shows how the IT systems need to integrate with multiple other systems. In turn, this indicates the scale and cost of necessary upgrades to accommodate five-minute settlement. So it demonstrates why businesses need sufficient time to implement the changes.

We have seen from earlier slides an optimal transition period would be short enough to capture the benefits of five-minute settlement as early as possible, but long enough to reduce the implementation costs associated with contract market disruptions, metering changes and IT system upgrades.

In the discussion paper the Commission proposed a transition period in the order of three years, and this was based around the contract and metering implementation issues that we are aware of. So we are open to receive feedback on any issues that you think we have missed that would

warrant a different transition period if the rule change were to be made.

One way to think about this is that this is the Commission's direction in the absence of us finding any further information, or in the absence of any further information being provided to us. So if you have any concerns with this direction, we are seeking new evidence from stakeholders around the costs and benefits of introducing five-minute settlement and evidence as to why longer or shorter transition periods might be appropriate. Making a submission on the directions paper is a good way to provide us with clear evidence on your position and submissions are due in two weeks time on Thursday, 18 May. We look forward to hearing from you.

MR PIERCE: I do have two other speakers, Russell and Chris.

MR SKELTON: Emily has made my job fairly easy. In the work we did we identified four areas of costs: renegotiating contracts, changes to the businesses, the costs to AEMO and third parties. There are a lot of people who provide services to the market who will have to change things, and a brief comment on cost to customers.

What I did is I spoke to a bunch of market participants as part of me putting together my report and, based on those discussions, estimated a number of contracts with terms greater than three years on the assumption that the transition would be about three years. The interesting thing is most of those that were greater than three years were actually greater than ten years, so essentially a transition period, unless you want a transition period of ten years, means that these costs are unavoidable, if you do introduce it.

Just to help think about it, we categorised those contracts into three types: one was the standard ISDA contracts using essentially - the standard ISDA recommended terms and conditions and the only things that are specified are prices and quantities. The other one is with some change to that, some bespoke terms and conditions, which would probably require some renegotiation, and large contracts with a lot of specific terms and conditions, which would require major renegotiation.

Two observations: one is these contracts will all have to be renegotiated or adjusted. Inevitably, particularly bigger contracts, one of the parties at the time that happens will hate the contract, and the other will love it. That means that the one that hates it says, "We'll agree to the changes subject to" some mitigation of the things they hate.

On that basis, we have estimated - and I used the services of a lawyer that have I've used for many years, who has lived through a lot of these processes, some of them with me- the costs per contract. You'll see the table there. The standard ones are pretty easy. The big cost would be the collective discussion with AFMA, to sort out what the standard changes would be and then it's a fairly simple process of executing those. The bespoke ones generally are modest costs, and the large ones are a lot more.

I would expect that in the $300,000 for the larger ones, a lot of them would probably be that or less, but there would be one or two, I guarantee you, that will cost a million bucks - a knock them down, drag them out brawl, that's the way it would work. In our view the total cost with the transition period of the contract negotiations is about $8 million.

The other change is to do with business systems. In talking to the businesses I spoke to, there are generally three areas of business systems. One is the wholesale market trading systems, the systems that provide information and the ability to traders and the ability to execute contracts and trade on screens. They would need to be upgraded. Retailers would obviously have major changes to retail management systems. The other one is risk management and reporting systems.

Most of those risk management and reporting systems are all home brewed. They are all created on a combination of properly developed code with lots of spreadsheets, lots of linkages. My bitter experience is that means something changes, some small change, and the whole thing falls in a screaming heap. So the view was that the risk management trading reporting systems would have to be replaced in their entirety, because no-one would know what you needed to change to fix them, and the other systems would require major upgrades.

The view I got from talking to people was that the IT service providers would see this coming, they would not include that in any of their sort of maintenance type upgrades, so the costs would be material. Most of the businesses did have a fairly fuzzy view on what these cost estimates were. Some were fairly clear. So what I've done is taken the range of cost estimates provided by all of the participants I spoke to, which was a lot, and applied those estimates. You can see there is quite a range. I then added up total costs, so the cost was about $150 million for the changes to IT systems.

The other thing is that there was a view that there would be an ongoing cost increase in terms of the support for those new systems. That's the way things tend to work. So the present value of those costs, about 5 per cent, which would be about $200 million. So that's a material cost. The view I got was that I don't think seeing a transition period coming necessarily makes that cost much different.

In addition to those, AEMO is going to have to spend some money, we guessed at $10 million. Third party service providers like consultants who provide market modelling and predictions, they'd obviously feel compelled to change their models. ASX would have to change their systems and contracts. Businesses that provide information services will have to change things. They would all add up to one-off costs that they would have to incur if this was introduced.

Our view is that somewhere around $250 million, plus or minus, a fairly big percentage, would probably be the sort of costs created by this change. There's one thing I can guarantee you about that number, it's wrong, so don't quote me, but the conclusion is that it's a big number.

The other thing is price impacts. The static analysis that the AEMC did and we also did, and got exactly the same number, essentially, means that if nothing else changes and we go to five-minute settlement, prices will increase a little bit, but a little bit is $17 million a year. The theory is that at least initially cap premiums will shift up. The analysis previously presented explained why that happens.

The other thing I think will happen is the spot price volatility will increase, at least in the short run, and the latter two things all resolved in pricing increases, at least in the short run, to customers, which I think means that in considering this the AEMC needs to think about where the benefits are and the magnitude of those benefits to make this worth doing.

MR PIERCE: Thank you. Chris?

MR DEAGUE: Thank you, everyone. I'm about to give a presentation that probably requires 30 minutes to do properly, but I see the agenda gives me five minutes, so you're about to see a real-time demonstration of the difficulties of transitioning from 30 minutes to five.

My job's made a little bit easier by the fact that quite a number of points I was about to make have already been made. So I will rush through the first few slides which really just summarise what the AEMC direction paper says about transition. As we have just heard, the key challenges that the directions paper notes are disruption to the contracts market and the costs associated with metering and IT changes. I won't dwell on those points any longer.

The AEMC's paper then goes on to propose the key things that the transition period should seek to address, and, as I say, I'll skip over those now, given that they have already been covered, in the interests of time.

As we have heard, the AEMC have come up with a two-stage transmission proposal, a total of five years. What I'd like to focus on in this presentation is the challenges that I think need to be contemplated during that transition period. We have heard a lot of discussion this morning and this afternoon about what this change might mean, but in this presentation I'm focusing on the transition period itself.

Given that we are talking about a long transition period here, five years or possibly even longer, what I'd suggest is the AEMC's deliberations not only need to consider the merits of the change with regard to the NEO, but for that transition period as well, if we are talking a five-year transition period, that's a substantial period of time, so we really need to consider the attributes of the

change and its impact on the NEO for that period.

In other words, I don't think it would be reasonable to say to consumers, "Look, you're going to have increased costs and other implications from a security perspective for five years, but if you can endure that, you'll come out the other end with some benefits".

The other point is that the discussion on how long the transition period should be has talked about contracts. One type of contract that doesn't seem to have been mentioned a great deal is a power purchase agreement, typically used to support solar and wind generation. These typically go out to the year 2030 when the current renewable energy target period expires. They are a much longer term contract. If you were to try and consider accommodating those kinds of contracts we'd perhaps end up with an even longer transition period.

What I want to get on to, as I said, is consideration of the actual transition itself. I have mentioned the NEO. The other way of looking at this is to consider the energy trilemma which is becoming something we are all focusing on. It gets mentioned in the Finkel report. Of course, the way I look at the energy trilemma, where we are dealing with the challenges of ensuring affordability of energy and energy services for consumers, maintaining secure and reliable supply of electricity, and the third limb being the need to transition towards lower carbon emissions.

The way I view that is the NEO really deals with the affordability and the security aspect of that. It doesn't specifically deal with the emissions transition, but clearly that's an important thing that we all should be contemplating.

I'll be using those three parameters to very quickly consider how effective I think the transition or the things that the transition should be assessed against. If we firstly turn our mind affordability, again, this diagram has already been put up. I also thought it was a good diagram. It clearly shows just how complicated this beast is that we are dealing with. Remember, that diagram, as well as showing two dimensions, has a third dimension of depth. Most of the boxes are multiple parties so there are a lot of lines that link the entities together.

When you consider how complex that is, it gives you a good appreciation of where the potential costs come from. Russell has outlined potential sizes of those costs. So those costs are real, and those costs inevitably will get transferred on to consumers.

From an affordability point of view, it's difficult to conclude that for the transition period. Remember, we are talking about a five or five-plus-year period, the consumers are going to see increase in costs.

Strike one on the first parameter, I think. The second and frankly, from my personal point of view, most important limb that I don't think has had anywhere near enough consideration in the discussion today is energy security. Energy security, we all know how important it is in the NEM and there has been a lot of focus over recent years, particularly in South Australia but more generally as well, on the need to maintain energy security given the challenges of intermittency and transitions to new technologies.

The Energy Edge report I think made some very interesting findings in relation to potential impact on open cycle gas turbines. Some of the key points that I found of interest in the Energy Edge report were that in looking at the challenges that open cycle gas turbines would face under a five minute settlement regime, that it notes that the majority of the price spikes, the five minute price spikes that we've seen in the last two years, have been isolated. In other words, there's one five minute price spike and then it's gone. So there's a challenge then if you're not able to meet that and respond within that five minute period, which most of the OCGTs cannot, as we've seen.

The other interesting thing that Energy Edge noticed is the difficulty in forecasting five minute price spikes and it looked at the accuracy of the AEMO five minute pre-dispatch and observed, as most of us have in the past, that it is not very easy to predict these things; in fact, most of them are not predicted.

If we were to move to a five minute settlement regime, the OCGTs would not typically respond unless they had an expectation that the price was going to remain for more than five minutes and, as we've heard, the conclusion would

be that there's a likelihood of up to 625 megawatts of caps withdrawing from the market and that also the Energy Edge report notes that a large proportion of that would be in South Australia where there are a lot of concerns around security right now.

Also, the 625 megawatt figure, it's only an estimate of course, that represents the size of the caps that would be withdrawn, potentially. The physical plant that you need to underpin that is greater because if you've got, say, 1 megawatt physical plant you can maybe cover perhaps 75 per cent of that with a cap. If it's 625 megawatts of caps, that equals about 830 megawatts of physical plant. The report goes on to say that that's likely to be a conservative estimate, it could be materially higher than that. That's a lot of plant that's potentially having the rug pulled out from its business model.

Remember that this is gas plant too that's already suffering a lot of pressure from increased gas prices. It is pretty close to a tipping point already. If we contemplate that, these open cycle gas turbines are going to have a great deal of difficulty defending those caps and will struggle to survive. There is a suggestion in the directions paper that plant of this kind can perhaps look at making some sort of improvements or new operating regimes. As the owner of a company that manages a lot of this plant in South Australia, we're talking about very old plant here. I don't think it's terribly realistic to just conceive of ways that it can suddenly be made to respond within a five minute period. In fact, even new open cycle gas turbine plant that's available on the market now would have trouble with this.

New technology absolutely will be the answer in the longer term and we as a company don't wish to be standing in the way of new technology, in fact, we're looking to invest ourselves, but I just caution that if we're so eager to move to this brave new world, that we don't undermine the world that we live in today and in doing so undermine power system security. I think this is a really important point that perhaps hasn't had enough consideration not only for the transition but also perhaps for the longer term.

Finally, and just very quickly, on the transition to lower carbon emissions, obviously gas has been talked about a lot as the transition fuel towards lower emissions and I

think most of us would agree with that approach, but if what I've just said is true, that if we are entering into an arrangement which would make it more difficult for a lot of that gas plant to survive, or at least to even operate, then the likely outcome of that is that we'll see a greater reliance on existing coal fired generation, so the transition therefore to lower emissions, at least in my mind, is being undermined. Strike 3.

In summary, when considering the transition, as I said, it is a long period of time, we really have to be able to justify it during the transition period as well as at the end. I think it is going to be potentially detrimental to all three limbs, to the affordability, to the security and to the emissions of the energy trilemma, but otherwise I think it's fine.

MR PIERCE: Thank you, Russell and Chris, for being clear and brief. Over to you - questions? Issues? David?

DR OUTHRED: I would just like to start by congratulating both Russell and Chris for very imaginative presentations. I am not so sure about the logic, though. I will come back to a specific question, but just to explore this issue of logic I would just like to go off on a slight tangent first.

In a sense, we haven't really discussed fully what the purpose of the spot and derivative markets are in an electricity industry and while, of course, we would like to see players in the market who are usefully operating in a way that was physically useful, we would like to see them profitable. We can't just turn that around and say we're here, therefore, we should be profitable, which is essentially the way the argument was put and Chris at the end indicated that, in fact, his CTs were a bit long in the tooth, a bit like I am, and maybe it was time they were retired anyway.

If we're going to go back to why have we got this, the purpose is because we're trying to operate a physical system and we're trying to operate it as well as we possibly can and to do that if we're going to use a competitive structure, we have to start off by looking at what the physical industry does, which is a flow, and then we have to say how can we translate the physics, the issues about getting that to go where you want and managing the

risks, how we can translate into a commercial framework so that we can, in fact, use guys like you to solve the physical problem?

To do that we need to make the spot market exhibit as much of the short-term risk we can and that's why we have five minute pricing, because we want to exhibit as much of the short-term physical risk as we can. As soon as we lengthen that, or particularly, if we have a hybrid of five and 30 minute design, we're really smearing that information so that physical issues are not being translated. If that's the case then you can't argue that your competitive industry is efficient. It is only a question of in which way is it inefficient.

The second thing that we haven't addressed is what are the derivative markets for. The derivative market are there to allow the translation of short-term commercial risk, which is in the spot market, to long-term commercial risk, which in turn then can be translated back into physical assets, like investments in your combustion turbines; so you need to close the loop in that way.

One of the problems we've got here is that we've separated out the question of five minute pricing from the question of derivative market design and a lot of what I have been hearing here is actually more to do with failings in the derivative market than it is in the question of whether we should have five minute pricing or not.

Finally, I would just make this point and then I'll come to my question for you guys. Unless you guys are good at walking on water, you're not going to stop this relentless process that we now have of rolling out PV and with the help of Dean down the road, lots of batteries. If you're going to argue that we shouldn't do this then what are you going to tell Malcolm about how poor old Malcolm is going to manage this new future which is coming ready or not and how are you going to demonstrate that what you're doing is supporting what Malcolm loves, which is innovation into a brave new world. Over to you.

MR SKELTON: I don't feel any obligation to help Malcolm.

MR DEAGUE: Firstly, I don't think anybody was arguing that we should stand in the way of that development, Hugh.

I certainly don't --

DR OUTHRED: So what do we do instead? If we don't do this, what do we do.

MR DEAGUE: I would just like to finish my point. Certainly, nothing that I said or anything that Russell has said should be taken as being seen as we are trying to put up barriers to new technology. On the contrary, the company I work for is seeking to invest in new technology. We're looking actively at doing that right now as we speak. Nor are we seeking to prop up old technology for the sake of it. You talked about efficiency, I am all in favour of efficiency, but I think we also need to bear in mind effectiveness. I think what I was saying was the current arrangement may not be the most efficient, but it has been effective. We have a set of arrangements that are effective in giving reasonable affordability and good security. I am just saying those are things we need to be sure that if we are turning our back on those things, we need to do that with our eyes open; that's all I'm saying.

DR OUTHRED: Is that how you said that to the Premier of South Australia?

MR DEAGUE: I haven't said that personally, but we had numerous conversations with the South Australian Government, as you would expect as one of the major generators in South Australia.

MR SKELTON: This presentation was just answering a question that the AEMC I think understands they need to contemplate and that is how big a cost are we looking at here for the transition and I think that's a matter, because someone is going to have to pay for that and the way the world works that I've observed is that's either the shareholders of the businesses who have got to do it and all the customers, and the businesses will try to make sure it is the customers as much as they can.

I think in contemplating the change to the rules, all we're saying is that the AEMC needs to think about the benefit of five minutes versus 30 minutes in terms of facilitating that new world and I'm still a bit puzzled as to what that clear benefit is and particularly puzzled about what the quantum of that benefit would be to compare to the costs associated with doing it, that's all I'm

saying. I am not saying let's resist PVs and batteries. If people want to spend the money and do that, they can go for it, it's a free country, I thought, last time I looked, but I think AEMC needs to think about benefits and costs and what does the five minute settlement do to the changing investment environment and what are the benefits that derive from it. I don't think it is an issue associated with trying to do a King Canute and stop the tide coming in. I think it's still a question, in my mind, as to how much of a difference the five minute settlement makes to the investment turning up. Clearly, it will make it turn up faster but how much faster and how much does that matter? They're questions I think that need to be contemplated because we're going to spend a fair bit of money to make it happen, that's all I'm saying.

DR OUTHRED: A lot of what we were talking about, Russell, was players who have old IT systems and who for some reason didn't realise that sooner or later five minute pricing would be an issue and now somehow society should pay them for fixing up their old systems so they can work with five minute pricing. That seemed to me a lot of what you were talking about.

MR SKELTON: No. What I am saying is that if the AEMC says we are going to five minute settlements, that will create a cost and that cost will have to be borne by someone and that's a cost that the economy has got to be able to cope with, that's all I'm saying, yes.

MR PIERCE: Hugh, would you mind just articulating, perhaps, you referred to failings in the hedge market. What were you referring to in that case?

DR OUTHRED: Yes, the issue of hedging market is this, that if you actually look at the pricing theory, you'll find that integral to it is the combination of a spot market and a highly efficient derivative market. This was partially reflected in the original version of the National Electricity Code, you'll recall, which had the one day head and two day head short-term derivative markets, and the reason why you need something like that is because the derivative market needs to expose both price and volume trajectories and at the moment, with the arrangements we've got, there's absolutely no public information about volumes and this is one reason why AEMO is in all sorts of strife trying to do its forecasting not only for, if you like, the

base case, but the risk profile around that.

One of the problems we've got with the National Electricity Rules is they say virtually nothing about derivative markets, nor do they speak about the importance of derivative markets. That is the point I was making. Before we go to this short-term pricing the more critical that issue becomes.

MR PIERCE: Could I take that as a reference to, or you would see that issue being addressed through transparency around those derivative markets, as distinct from them being run by or ruled by the AEMC?

DR OUTHRED: Yes, I really don't mind too much what you call it. The critical thing is we need and are going to need even more a much clearer view about what volumes look like going forward, particularly over the next couple of days, if you like, the weather forecasting horizon, and that needs to expose not only, if you like, the most likely case, but also the risk profile to round that.

The other thing that we can see already happening, and it's going to happen more, is that even the so-called go-slow generators will be less able to offer swaps because of their own volumetric uncertainty and so we need to see the structure of the derivative market moving much more towards caps with a number of strike prices.

There is really a whole lot of work that needs to be done there and, quite frankly, if I was setting up this process, I would have tried to integrate some of that into the question of the spot market shift to the five minute design, because the two things are really quite closely related and a lot of the discussion we have been hearing today really, as I said, reflects problems about managing the short-term risks as well as the problem about transiting from old structures to new ones.

MR PIERCE: You might file that under the reference that was made earlier to other - I think it was referred to as policy, I'm not sure it's policy, but other things that would need to be put in place to support a five minute settlement period. I think Mark was going to be next.

MR HENLEY: Thanks very much, John. I think most of you know that I'm Mark Henley from Uniting Communities and

obviously coming very much from a customer and consumer perspective. One thing we know about the energy market is that no matter what happens when we are talking about costs, the end customer pays. Based on what we've just heard, roughly $250 million of costs over say five years, my question is simply about how lumpy those costs are likely to be and what sort of incidence there will be on different customer classes, particularly lower income households?

MR SKELTON: I can answer the former and not the latter. The two categories - the contracts will be negotiated over a time, but I suspect that most of the costs will occur leading up to the transition to five minutes because --

MR HENLEY: Year 1?

MR SKELTON: I would say if the transition ends in year 3, that most of those costs would occur in years 2 and 3, because people are procrastinators, and the IT costs I think would occur over a period of a couple of years leading up to the transition as well because I think they would be pretty significant material. What retailers choose to do with that in terms of how they reflect that to customers, that's a matter that they would contemplate. I wouldn't have an idea about how they would do that.

MR PIERCE: I wondered whether anybody had a response or a view - let me get the slide back perhaps - on Russell's estimates about around the renegotiation of contracts and the costs associated with those. Does anyone have a view on that?

MS FETCHET: Jacqui Fetchet from Norton Rose Fulbright. I am just interested how much thought has gone through into the PPAs. I can't remember who - maybe it was the first or second slide that mentioned long-term PPAs as part of this sort of transition and whether or not they would be perhaps more advantageous and perhaps that would be something that could be worked into PPAs as they're currently being entered, or whether there is something that needs to be taken into account, or just how PPA contracts, particularly as retailers are increasingly entering quite sizeable long-term PPAs as off-takers for large-scale renewable energy projects, what sort of impact this might have on the negotiation or the terms of those sorts of contracts?

MR SKELTON: I would assume that people who are well advised, who have been entering contracts, long-term PPAs, which often is the base, by the way, in the last year or two, I'm sure they would have had some clauses in there saying, "In the event of the AEMC doing this", you know, "this is what will happen", but in talking to the businesses, and Chris made the same comment, that the contracts that are greater than 10 years, most of those are long-term off-take agreements associated with renewable projects and the like and so they were included in those cost estimates and most of those would be in the bespoke type where there's particular terms and conditions that are specific to the fact that it's a PPA and some of them, if they're bigger ones, would be in the big category which would be fairly expensive to navigate.

MR PIERCE: I am just wondering whether Emily or Kris would like to comment on looking at the change of law provisions.

MR STABLER: Can I add something? So long as the price remains the same, as we were mentioning earlier, with the ways that the contracts actually change, if you have a similar pricing in all the different five minute periods then the settlement outcomes between the five and the 30 shouldn't actually change in those outcomes. It will change the revenue outcomes of the underlying asset, but the actual settlement of the period, so long as the prices are the same or the volumes are the same, that will actually equalise out.

MR PIERCE: I understood Russell to be raising the issue, though, that a change in something like this would automatically trigger the ability of somebody to open up the contract and as soon as they opened it up on one reason, then everything is on the table. It is rather like trying to get something through the Senate; you never know what's going to come out the other side.

MR SKELTON: Yes. The advice I've got is that question number 1, which we got some legal advice on, is will the introduction of five minute settlement trigger the standard market disruption or price source disruptions contained in most standard contracts? Answer: Yes. Then the question is what happens next and most of them will probably be sorted out fairly amicably and easily, but as they become more valuable and more complex, I think what you're

describing, John, would happen. Someone who doesn't like what they've got which five years ago they loved, they'll use that as an opportunity to try to renegotiate all sorts of terms and conditions.

MR HENDERSON: I would just like to understand your comment about PPAs put in place would have to be renegotiated. Some time ago I was associated with quite a number of PPAs putting in place and to my understanding of this contract, this wouldn't affect anything. Effectively, if you take PPAs that supply to a local retailer, it's just the metered energy that goes out, nothing to do whether it's five minute settlement or half hour settlement, it is purely on meter of the energy that goes in to the system. I am not quite understanding the extent of PPAs that you're talking about.

MR DEAGUE: I think perhaps there are a few different types. I know some PPAs have a pool exposure associated with them, so that's what I was referring to.

MR HENDERSON: And others that don't --

MR DEAGUE: If they don't have a full exposure then that's right.

MR SKELTON: The number I estimated was based on discussions with market participants and lawyers that have been involved negotiating those and they were of the view that that's the sort of numbers of contracts that were affected.

MR HAVYATT: Three quick questions, one to the AEMC folks. The guys doing cost-reflective network pricing are all building demand tariffs built around the 30 minute peak. If you move to five minute metering they may want to have a conversation, so you might need to have a chat about that.

The second one was surely with the PPAs wouldn't it be true that the longer we delay, if we're going to ever make the change, we're just going to wind up with more contracts that were negotiated before we had the change so, in fact, the AEMC moving quickly to start the transition will improve the ability of contracts to reflect the transition.

The third one was to Chris. You talked about the scenario that says how the change to five minute settlement

might drive OCGT out of the system, but on the flipside we've got a risk that there's a point that says gas was a good transition fuel that we started talking about 10 years ago; it's not necessarily such a great transition fuel now. You even admitted the idea that says that maybe OCGT's time is up. So if we went to the other counterfactual which is actually, OCGT is going to disappear anyway, does your answer about the five minute settlement change or not in the sense that, actually, we're losing the contract market because there's no longer gas generators.

MR SKELTON: I don't think it matters how quickly AEMC undertakes this because, as I said, I would expect that most lawyers who advise our clients in this space would be telling them, "You need a provision in the contract to deal with what happens if they introduce five minute settlements and here is what will happen." That would be already happening, would be my expectation. It happened more than once with carbon pricing.

MR HAVYATT: It has happened for two years already.

MR SKELTON: Well, maybe.

MR DEAGUE: Yes, David, we perhaps can envisage a world in the future where OCGT is not part of that world and that may very well be the case. I suppose I'm not really wanting to focus just on OCGT. Really, the general point I'm making is if we move to five minute dispatch and settlement, we need to recognise that we are really making it very difficult for any technology solution that can't dispatch significantly in that five minute period and if that's what we want to do, fine, but it's not a technology neutrality question, but you really are, in effect, saying no to a whole bunch of existing technology and maybe even future technology that can't dispatch within five minutes. If that's what we want to do we need to be very clear that we've got our eyes wide open because, to my mind, it has a number of implications for pricing and security.

MR PIERCE: But can't that just be reduced to; in making changes like this you need to be cognisant of or be able to articulate what the expected effects are on security, reliability and price?

MR HAVYATT: Yes.

MR PIERCE: It just comes down to that, doesn't it?

MR HAVYATT: Yes.

DR FUNSTON: We just have a question from one of the online listeners.

MR Noone: This is a question from Dylan McConnell of the University of Melbourne. It is a question for Chris. It is in two parts. Chris, you mentioned that OCGTs wouldn't be able to respond to one-off five minute price spikes. If this is the case, why should you be remunerated for a service you cannot provide?

And two, some new OCGTs come with 10 to 15 minutes of battery storage to cover the ramp-up period. What is preventing existing OGCTs from doing the same and covering their cap contracts with a relatively small amount of battery storage collocated or otherwise?

MR DEAGUE: Well, as to the first point, obviously under the current arrangements we get payment through the five minute/30 minute arrangement and that's understood and I accept that we could change that and my point is simply that if you move to a five minute arrangement, that kind of technology is going to have difficulty in being dispatched in time and therefore making a return. I am not saying don't do that, I'm just saying be aware that that will be the implication, that kind of technology, generally speaking, won't be able to respond.

Sure, it could do things like put batteries in or, as was being suggested this morning, we, as a seller, as an OCGT generator, mainly our business right now is selling cap contracts and I think the suggestion was made that if we have difficulty selling cap contracts under a five minute regime then we could perhaps purchase a cap from a battery or somebody else who could provide that initial response in a few minutes and then we could back that up with the following five or 10 minutes.

I guess that's technically possible, although it just strikes me as making the world very complicated if we are saying there's a need for caps, but in this five-minute world there's no entity that can do the cap on its own, it has to be a cocktail of a fast-acting battery that can come in quickly but can't hang around, a GT that can hang around

but can't come in quickly. If we put the two together in a clever way, I guess we have a solution. Again, that sounds to me quite complicated. We can do that, there will be costs and questions about reliability, and so forth. Again, I'm not saying no, I'm just saying be very aware and think very carefully about how effective that is likely to be. It's maybe not the most efficient; my concern is effectiveness.

MR PIERCE: I think somebody else earlier today commented, in answering my three questions, we need to be cognisant of not just things called megawatts, but also megawatt hours as well. The meaning of life is not found by just looking at a five-minute interval.

MS TARR: Jennifer Tarr from Stanwell.

AEMC has expressed their concerns on the impacts on the contract market, yet the transition period in relation to the contract market just seems to be about how long it is until the current ASX contracts have - the longest traded contract in that market. What about the 23 per cent reduction in cap liquidity in the contract market and the idea that assets that can't currently provide, or who are going to reduce their cap output, will need to make changes to their assets, or new technologies will need to develop, or become cheap enough to install, and even new financial contracts will need to develop? What about a transition period for that? Have you considered how long that will take?

MR PIERCE: I will let the troops say something in a minute. I know one way we have been thinking about this is - I mean, let's just take it as a given for a moment that if you do get the withdrawal of the sort of quantities that Energy Edge was talking about, then in order to get back to square one, in a sense, you need to have a view about physically what other bits of kit are going to get put on the ground and what sort of contracts are they going to be able to offer. Hence, part of what we are trying to solicit through the directions paper and through these sorts of discussions is indeed views about, in effect, what is the rate of new investment in different types of technologies and their ability to, if not exactly the same sort of contract, at least offer contracts that serve the same sort of purpose, because I'm not sure that that purpose is ever going to go away, as a way of helping with

a judgment about whether it should be in the event that the rule change is made, whether the transition period is appropriate at three years, or two years, or four years, or five years. There will not be an empirical basis where you can run through a model to determine what the optimal number is. That's why the views of people within this audience and people participating in this process are so important to us.

MR NOONE: If I could just add to that. There have been some questions around where the three years came from, so it might be helpful to provide a bit more detail on that.

If we look at the three areas where we are looking at material challenges in transitioning to five-minute settlement, there is the metering aspect, the system costs and then the contract market impacts as well.

If you look at each of those, with contracts, we observed that the bulk of most contracts are accounted for within that sort of two to three-year period. If implementation goes beyond that timeframe, then the volume of contracts that would be affected would be reduced. Clearly there are still some that exist beyond that time, so there is some threshold that needs to be considered. If we then look at IT system changes, it seems that less than a year, depending on the scale of the project, may be appropriate.

The other thing with the contracts is that if we are talking about changing assets, investing in new things, the lead time of different technologies is something that we have considered. You could put in utility scale batteries for a few months, if necessary, diesel is maybe a year. You're looking at major changes or new gas turbines for several years. So the three years was arrived at with that in mind.

Then the third thing around the metering, as I observed with the test and inspection regime there is some sort of routine inspections that are occurring within that three-year period with the high volume meters. So there may be some sort of marginal benefits in aligning with that.

Again, it's a number that's been chosen with a range of variables in mind, but we are very open to people

suggesting why a longer period may be required for any reasons that you have.

MR CAMROUX: Simon Camroux from AGL. I'm just wondering what the fallback position is if we get a three-year period and we find out we just don't have what we need to manage or mitigate our exposure to volatility in the market?

MR PIERCE: I expect somebody would put in another rule change.

MR SKELTON: And you would take another three years to consider it.

MR PIERCE: I admit that was trite, but I was just trying to make the point that the ability to change what happens in the sector very much rests in the hands of the people that are participating in it. We can't initiate rule changes. We are relying on others to do it, as in this case.

In some respects this is a legal question. Normally I suspect in any sort of project management sense you wold say, "I'm going to undertake this activity on the condition that these things have been satisfied beforehand". Ideas about how that sort of thing can be incorporated into a set of rules, we'd be very open to.

MR SKELTON: I do remember a rule change that was introduced once, and I spent the weekend talking to Brian about the lousy outcomes as a consequence, and then the answer was, "Well, put in a rule change and we'll sort it". I think something like that would be very helpful.

MR PIERCE: The issue is how. That has been causing significant problems in different contexts in the past.

MR CAMROUX: From my perspective, and we are a fairly major player in the market, I think we are capable as a large entity in transitioning within a three-year period, but I would be really, really frustrated if what we saw was a diminution of competition in the retail space which actually led to increase regulation to address price rises that were caused by the implementation of this rule change.

I think that we could get somewhere, possibly, with five-minute settlement, and we are transitioning and

looking at VPPs and battery storage capabilities, et cetera, but I would really love for us to be cautious, be wise, and to really make sure that we don't possibly blow up the retail market which could possibly lead to further regulation.

MR PIERCE: Again, I think you have raised two issues. If you remember, I think it was the IT system diagram that Emily put up, and the associated metering issues, one of the things that strikes me about that sort of diagram is not just the complexity but, rather, the number of people who have their fingers in different parts of that pie, and all the bits that connect the number of people that have to, in effect, deliver their part on time. So that coordination issue would be a significant thing for us to be aware of. This is generally the case, but particularly the case in this rule change.

In the pursuit of an objective through a fairly narrow mechanism, in the scheme of the world, this is what this is, the risk of consequences which then trigger further regulatory interventions on another part of the system is something that we have tried to be as sensitive to as possible. The one that you're referring to is just one of a number that I can think of that we would need to be not just aware of, but confident that the risks of those triggers in other areas of the system for increased regulation being either able to be managed through our processes, and sometimes those things are not within the control of our processes. There is some judgment involved in assessing those as well.

MS HENDRIKS: Mary Hendriks from the Australian Energy Storage Alliance. I just have a comment. With a lot of the rest of the world moving to the five-minute interval, and already on that settlement interval, isn't there a risk with not doing it as well?

MR PIERCE: Absolutely. That's part of it. If I can go through the list of, if you like, other regulatory interventions that may be triggered through this process, there are certainly some which come if you do make the rule change, but there are also some which come if you don't. Very much so. I was alluding to some of those with some of the people I was sitting around the table having lunch with.

DR FUNSTON: I'm conscious of time, because we have a hard deadline to get out of here by 4 o'clock. If we could make this the last question and then Brian can wrap up. Thank you.

MR CAMROUX: There have been a couple of comments today about the importance of transparency and visibility of market activity, noting that the large user representative, and the technology representatives, have mostly suggested that distributed storage and/or generation is likely to be the major beneficiary or potentially take the place of some of the existing supplies of peaking capacity.

Under current rules, most of that is not required to make itself visible to the market, or even to the market operator, which has to come up with the pre-dispatch forecasts. So I was keen to understand anyone's views, really, the Commission's or the proponents, of whether there is any barrier or reason why we shouldn't ensure that we get that greater visibility.

Helpfully, the Commission has two rule change processes already on its books that look to address some of these things. I'd be pretty keen to understand if there is any circumstance in which the Commission will go ahead with this rule change and not process a version of those rule changes to bring that visibility in.

MR PIERCE: Before other people here address that, particularly in submissions, and we don't usually do this, but there is a high degree of linkage between this rule change around the thresholds for effectively being a schedule generator, and having that lowered. One of the questions, I suppose, that goes along with this rule change is the willingness and the ability of some of these new technologies and new businesses to be scheduled and dispatched.

If your battery is big enough, should we be lowering the threshold to caption more of them in that dispatch process?

MS DANAHER: Can I also answer that. We have already just discussed in the rule change that there's only metering five and six, it's is not going to be five minutes, so AEMO

are going to have a hell of a lot more transparency at the level higher of what's happening in the market and will be able to make better forecasts, because they will have the data to be able to do that now. Obviously there are other technologies for that, but for this aim it will improve AEMO's transparency completely of the market.

MR PIERCE: We had better stop, otherwise we are going to keep going around the room before Brian gets to finish. Thank you.

DR SPALDING: Thank you, John, and thank you for all the speakers. We appreciate the time and effort that you have put into the presentations today. I know it's your own time and you've made a significant contribution.

Not only am I appreciative of the contributions that the presenters have made, I also appreciate the way in which the audience has interacted, and particularly the professional way you've expressed your views. They don't obviously align with each other, but you've done it in a very professional and respectful way and we value that, as well as the actual points that you make.

We have had quite interesting sessions, starting off back in session one on materiality, but before that, Kathy from Sun Metals gave us a very good explanation of why they put the rule change in, in particular their desire to remove distortions in the market, as they perceived them, although they did express some concerns over the transition time.

Russell then gave us some concerns about the potential benefits, and I guess questioned what the benefits were of moving to five-minute settlements. He also suggested that really more analysis needs to be done on the modelling of the outcomes in order to try to understand that answer to that question.

Dean from Reposit gave us quite a good explanation of battery technology and the control of that technology and he pointed out that the NEM is calling for fast response and he gave an example of a system where some 30 per cent, or 20 to 30 per cent benefit would be accrued for that particular operator on five-minute settlements. He also indicated that batteries will support financial instruments.

David from ECA talked about the variability of five-minute and 30-minute prices as growing in the market now, but that benefits from changing to five-minute settlements would be ongoing.

We then had a good session of discussion, looking particularly about the contract in the spot market.

In the second session on responsiveness and contract market, Josh from Energy Edge gave us a good analysis of the impact on the contracting of the contracts, both caps and swaps, and basically pointed out that swaps is generally not an issue, but caps definitely will be affected and we have had quite a bit of discussion on that, and pointed out potential for about 20-odd per cent drop in liquidity in the caps market.

David from ERM gave us some good explanations and considered that the cost of transition, and whether this change alone is appropriate, or whether it should be combined with other factors, and I think we honed that down to perhaps having a capacity mechanism would be appropriate from his perspective, if you were to change to the five-minute settlements. He also, I guess, cautioned about rushing into this and to be somewhat cautious in the approach of going to this rule change.

Then we Emma from Tesla and Dominic from Mojo talking a bit about the technology. Dominic pointed out that the five-minute settlement is crucial to their business model.

Then we heard from Brian, from the energy end-user association and talked about that end-users are hurting at the moment and are looking for change. He also showed that there was a range of views from his members, I guess most leaning towards support but not certainly unanimous.

We had a session on metering, which I won't go into because there was no external speakers there.

Then we had the last session on costs and transition and we heard from Russell and Chris. I guess, Russell, we appreciate the detailed analysis you've done to indicate a cost of $250 million, or something thereabouts. Chris, we appreciate the appropriate you took about trying to address the NEO, in particularly the trilemma, in the transition

period and the issues that came through.

All of that discussion, as I said before, has been recorded. There will be a transcript of it as well. That will be available on our website within a relatively short period for those who want to follow this up. We certainly will be taking it on board.

We are very keen to make sure that all of our stakeholders understand why we make decisions, and that will be clear in any determination that we make, but you also should recognise the value that we place on listening to you and interacting with you. Today has certainly been one of those sessions.

Please provide your feedback on the discussion paper. We certainly welcome those by Thursday 18 May, if possible, for us to keep the pressure on moving this rule change along.

A feedback form has also been handed out. If you'd like to give us some views as to how we can improve these processes, or issues you have got, we would value that information as well.

Thank you very much for your attendance. We appreciate that and look forward to continuing interaction on this and many other subjects.

AT 3.49PM THE CONFERENCE WAS CONCLUDED ACCORDINGLY