

Melbourne – National Electricity Market Review – Preliminary Report

15 December 2016

The National Electricity Market (NEM) Security Review, led by Australia's Chief Scientist Alan Finkel, will deliver its preliminary report in December. The Review was commissioned by the COAG Energy Council of federal, state and territory government energy ministers in the wake of recent events, including the September blackout in South Australia. The purpose of the Review is to develop a final report that will be a blueprint for national policy, legislative and rule changes required to maintain the security, reliability and affordability of the NEM in the light of the significant transition already taking place. Alan Finkel and a panel of experts discussed the preliminary report and likely policy implications at this Energy Futures seminar.

Introductions: Michael Brear, Director, Melbourne Energy Institute

Moderator: Tony Wood, Energy Program Director, Grattan Institute

Speakers: Dr Alan Finkel, Australia's Chief Scientist
Chloe Munro, Chair, Green Energy Regulator
Tennant Reed, Principal National Adviser – Public Policy, Australian Industry Group

MICHAEL BREAR: Good evening everyone. My name is Michael Brear, I'm the Director of the Melbourne Energy Institute and I have the good fortune of welcoming all of you here tonight. I also have the good fortune of welcoming our three distinguished speakers, but before I do so I would like to acknowledge the traditional owners of this land, the Wurundjeri people, and pay our respect to their elders past and present and their families. Tonight we're very lucky to have, as I said, three distinguished speakers. Our first speaker is Dr Alan Finkel, the Chief Scientist of this country, we're also very lucky to have Chloe Munro, the Chair of the Clean Energy Regulator, and Tennant Reed, from the Australian Industry Group. We'll be talking tonight about the Independent Review into the Future Security of the National Electricity Market, unsurprisingly called the Finkel Review to most of us. So, without further ado, would you please welcome Dr Finkel.

ALAN FINKEL: Thank you and welcome all. It's been a big two months for the members of the panel and the taskforce in the Independent Review into the Future Security of the National Electricity Market (NEM). Others can call it the Finkel Review I guess, but I'll refer to it by its full name or just "the review". We were only actually asked to even engage and start on this two months ago, on October 7th, after the South Australia blackout. There'd been a lot of pending interest for many years in looking into the NEM and we've been given the honour of taking a very broad review approach to its operation and ultimately to deliver a blueprint going forward. As I said, it wouldn't have been possible without a terrific panel, Chloe Munro, who's here tonight, Terry Effeneey, Mary O'Kane and Karen Moses.

I don't think that I've ever felt so prominent or even close to being prominent as I have in the last couple of weeks - you might have noticed there's been a bit of discussion about this review and various aspects around it - but the two months wasn't about the coverage, it was all about delivering a preliminary report to COAG, which we did last Friday. That was to the COAG leaders, we were asked

to do that by the COAG Energy Council, and here in Melbourne this morning there was a COAG Energy Council meeting where we did our final presentation of the preliminary report and had a discussion around some of the issues that come from that. So we presented it to COAG itself, which is chaired by the Prime Minister, and to the COAG Energy Council, which is chaired by the Federal Minister for the Environment & Energy, Josh Frydenberg. There was support not only for the preliminary report but there were some issues that came out of that, and we had a good discussion this morning about trying to get some efficiency into the next step by parallel processing.

What am I talking about? Well, as ideas come along for putting new technology into the grid to implement some of the services that the grid needs going forward, instead of waiting until everything's been worked out and all the rules have been brought forward and then starting to test those devices and see how they might work in the real world, we've got enthusiasm shown by the COAG Energy Council for authorising real world proof of concept trials on some of the technologies that I'll try and mention a little bit later. I thought that was good progress. But from tomorrow morning it's noses to the grindstone because we have to prepare the full report, which is the blueprint for the NEM going forward and that is due by mid-2017. So, as I said, there's been great interest in the press on some of the issues around emissions reduction, but the report isn't focused on that, the report is about many, many things and I'll take you through some of the highlights. There are seven chapters, an introduction, an important appendix on international best case comparisons, and the whole of the report needs to be taken into account. Most of the journalists haven't recognised that. There was an interesting article by Alan Kohler I think yesterday morning where he talked about the fact that the word "urgent" appears six times in our report and not once does it appear associated with the word "emissions". It's part of it, but it's not the focus of what we were doing.

Let me tell you a little bit about the preliminary report. First of all, what it's not. The preliminary report, which I hope that many of you have had a chance to look at, is not a draft of the blueprint. When we realised we had two months to do a preliminary report, after a couple of days of thinking, "Oh my gosh, how do we tackle such a big task and get something meaningful into a draft?" with the support of those who asked us to do the report we decided to make it not a draft of the blueprint nor would we put in recommendations or findings, instead we developed an issues paper. So really what you've got there is a series of observations and questions that will drive a consultation process. The process is now open for submissions from the public either in writing or, in some cases, we'll try to organise to do some face-to-face meetings where you're invited to answer the questions that are in that issues paper, because we want to be informed, we want all the players in this process to have an opportunity to share their ideas with us so that we can do the best possible job on the blueprint, and all of this has to be done in the context of a rapidly-changing world of electricity. It's quite extraordinary what we're seeing not only here in Australia, but in every developed country in the world. It's actually the first time in nearly 120 years that the fundamentals of electricity generation have changed.

So what I'm talking about is that for 120 years, since the mid-1880s until, say, the mid or early 2000s, all electricity was fundamentally generated the same way. It didn't matter whether the primary energy source was water cascading down a hill driving a shaft to turn a turbine, called a synchronous generator, or coal burning in a furnace to make steam to turn the shaft and drive a synchronous generator; effectively from the point of view of the utility of those electrons you could say all electrons were created equally. But now there's a massive change happening and we're seeing very different kinds of sources. We're seeing an influx of largescale centralised wind-generated electricity; we're seeing around the world, less so here but it's happening here, solar farms generating large quantities

of electricity from individual centralised sources; and then we're seeing the distributed rooftop solar - Australia's got 1.5 million rooftop solar installations, it makes us close to being the highest per capita in the world. And they're different. They're different. The synchronous generators have with them attributes that contribute inherently to a stable system, to grid strength, to frequency control, they have inertia, all these wonderful characteristics, and the wind and the solar, the variable renewable energies, don't. That doesn't mean they can't be valuably integrated into the system, and I'll talk more about that soon, it's just a challenge that we have to take on.

The other significant thing to note in terms of the context of change out there is falling prices. The prices around the world now for largescale solar and wind are becoming comparable to the levelised cost of electricity for installing new coal, because no-one's going to install subcritical coal, they're going to installed ultra-supercritical coal and the prices are actually not that much different. Another thing that's different is that consumers are driving change, I'll come back to that soon, and you see things such as the internet of things which will enable neighbour-to-neighbour sales of electricity, otherwise called peer-to-peer trading, and aggregated demand management. A lot of change and then, of course, on top of all of that, never to be forgotten, are the three most important things, which are batteries, batteries and batteries. As I said, our report is a series of observations and questions so let me share with you some of the high level observations. The first is technical. We couldn't avoid identifying that the security, the reliability of the system is not as inherently strong today as it was in the past and that's something that absolutely has to be addressed. It's the key reason why we've been asked to do this report, to look at the security and reliability of the electricity supply in Australia.

Now, as I mentioned, we recognise that wind and solar-generated electricity are different. That's okay because there are solutions that enable us to very effectively integrate solar and wind into the grid, but the worst thing we can do is just to tack them on. There's got to be a deliberate strategy for how they're integrated into the system. It's as if we have to send them off to finishing school so that they come back and they've got the perfect etiquette, etiquette to know how to use knives and forks such as intelligent wind turbine controllers, these are devices that go on the wind turbines to give them synthetic inertia, just the good characteristics that you want, and the ability to work with batteries not so much for energy storage, but batteries for controlling electronics that can synthesise things such as fast frequency control. If we bring them along properly they'll dance co-operatively with synchronous motors, which are big spinning machines that don't do anything, they're just sitting there on the grid but when a transient occurs they very co-operatively and effectively help the system to ride through those transients. With these kinds of solutions we can make a difference. They'll start small but, through their numbers and through the appropriate application of these around the grid, they'll start to have a significant impact.

Another observation: prices are high. There's no way you can get around that. In about a five year period starting from 2008 in inflation-adjusted terms residential prices across Australia went up nearly 50%; a big increase. Why? We don't actually fully understand all the reasons yet, but the big contributor is the buildout of the poles and wires which was regarded as being necessary and now has to be paid for and, of course, that appears on all consumers' bills, residential, industrial and commercial. Another reason which is starting to be felt and is affecting the prices of the forward contracts for electricity is that natural gas is expensive, increasingly so, and supplies are limited, and natural gas of course is a key complement to the variable renewable energy, such as solar and wind, because you can ramp it up quickly and it's relatively low emissions. So you're seeing those forward contract price increases, especially in South Australia, where there's more need for the gas which is

expensive and constrained in supply. Another observation that we've had is that the rate of change of the rules and the market operation are slow in the context of the change that is out there. Innovation is rampant in the world of electricity technologies. As I've mentioned, you've got batteries, solar panels and peer-to-peer trading, on industrial sites you have co-generation and tri-generation being increasingly used, and these changes are happening more rapidly than anybody anticipated. You're seeing with residential customers, not all but many of them expect to be in control of their bills and their electricity usage and they want to be part of the solution and they're voting with their wallets. They're going out there and they're buying solar panels and now they're buying batteries because they can do the economic analysis and work out if they've got a battery then they can store the excess during the day and avoid having to buy a bit more expensive electricity than they can get by selling electricity into the grid. They do the economics and realise that batteries make sense.

Now, talking about how consumers are voting with their wallets and making a difference does raise a concern. There are vulnerable consumers out there that don't have the opportunity to do that, so we have to be very careful as we plan the future blueprint for the NEM that we have them uppermost in our mind all the time. The speed of change that we're talking about does bring risks to system security and reliability, and so we need to make sure that the rule changes can be brought forward to keep up with the incredible rate of change of technology and, if anything, the rate of change of technology is accelerating, it's not slowing down. Another observation is attitude, there's broad enthusiasm for change there. No-one feels that this is something that's going to be imposed on them. Whether they're participants in the NEM by being generators or transmission line operators or retailers or distribution operators, or whether they're the consumers, industrial, commercial and residential, everybody feels that it's time for change because of all the externalities that can't be avoided. And there's enormous goodwill; everybody wants to help the panel to do its job, we get offers all the time, it's much appreciated and we'll get more of that through the consultation process.

Another observation, I'd say that without exception everybody we spoke to, and we spoke to about 30 groups, about 150 people ranging from large and small consumer groups, representative groups of industries and for transmission line and distribution operators, all expressed a desire for a co-ordinated national approach to integrating energy policy and emissions reduction policy. There's a clear recognition out there that we have a national commitment under the Paris Accord to lowering emissions and that will impact the electricity sector, and equivalently there's a clear recognition that the electricity sector has to play its part in helping Australia to meet those international obligations. But everybody's aware, as we are deeply aware, that while doing that we have to be focused on security and reliability. You can't trade security and reliability and ultimately affordability to achieve those goals, so it's a tough challenge for us. It's a so-called trilemma of security and reliability, affordability and driving towards lower emissions, so we're all looking for new approaches to achieve this and we discuss various approaches in our report. We didn't make any recommendations in our report on anything, including the ways to best integrate these policies, and I have to say personally and on behalf of the panel we look forward to taking submissions from the broader community on how that can be most effectively done. Our job is to listen to the ideas and then effectively integrate them for the best outcome.

Another observation is the importance of natural gas in this transition that's being driven from the outside through the introduction of new technologies and the drive towards lower emissions. Natural gas is critical for the transition especially in the short and medium term. Now when I say short and medium term I don't mean next year and two years from now, I mean one, two or three decades. The

electricity market is big, the technology is across the country, it's the longest continuous electricity grid in the world at 5,000km from end to end, and anywhere in the world as well as in Australia it takes a long time to make substantial change. We have to recognise that, and when something takes a long time the most important thing to do is start straight away because it's going to take a long time from whenever you start. Gas is going to be an important part of that transition, otherwise we run the risk of bifurcating wind and solar supported by coal and that's not going to achieve people's goals. Tight supplies and high prices of gas are driving up our electricity supply. If we had more gas it would make it easy for the Australian energy market operator to manage the system to achieve security and stability. Why? Because gas-fired electricity, first of all, can ramp up and down very quickly to fill the gaps when the variable supplies drop out or ramp up and, secondly, because gas is a traditional generator with synchronous generation it adds to the system voltage strength, the security and the reliability.

So what are the opportunities that we see already to reform the NEM? One would be the introduction of additional markets beyond energy. The NEM has from its inception focused on trading energy, but as we transition into new kinds of generation we have to think about trading other things, such as inertia, which is one of the characteristics that adds stability to the electricity system. We have to focus on active integration of solar and wind rather than passive integration, and that can be done really effectively using recent and emerging technologies, so it's an important thing to do. I think there's a need for a bit more systems engineering and power control engineering to guide the planning for the future growth of the NEM. As I mentioned right at the beginning, we have to think about doing proof of concept testing early so that we've got the ability to effectively bring in these new technologies knowing that they'll work and as quickly as possible, because we've been doing the proof of concept work in advance of the new rules. I'd like to see more transparency in the system. It's a complex system, it's really hard to work out what's going on, and one of the challenges we've got is to map out that system so that we thoroughly, thoroughly understand it. So more transparency would help all, it would help the operators, it would help the policymakers and it would certainly help us. There's a need for more underlying high speed data that measures the performance of the system in real time to inform the operator so the operator can manage it more effectively. There's a need for more high level system statistics, descriptors that tell the policymakers what's happening. Yes, they're there, but they're hard to get your hands on, so we need to eliminate the obscurity of lack of high level statistics visibility. And there'll be more, there'll be a full spectrum of approaches that will emerge during the development of the blueprint, I don't have any doubt about that at all.

So what's our status? As I said, we delivered the issues paper to COAG last Friday and to the COAG Energy Council this morning here in Melbourne. Now we're seeking responses to our questions and we're looking for those by February 21st. Let me just quickly summarise the big items: we're in a period of transition and the change is happening very, very quickly, it's accelerating, it's happening across the developed world, and it's now driven by investors to a large extent because the price of wind and solar is coming down to be comparable to new traditional sources; we have to deeply integrate solar and wind into the grid, we can't just leave it to a natural approach, it's got to be planned; the market rules and regulations, their development needs to respond more quickly to externally driven change; and the last thing I'll mention is that investors and the industry are looking for a co-ordinated national approach to our energy and emissions reduction policy. So let me say thank you and I look forward to engaging further with you on the panel tonight.

MICHAEL BREAR: We'll now have Chloe Munro from the Clean Energy Regulator.

CHLOE MUNRO: Thank you Michael and thank you for the invitation to speak here briefly this evening. I should make a quick disclaimer, I was appointed as part of the panel that's supported Alan and his work not ex officio in our role as the Clean Energy Regulator, but more broadly because I'm a person who feels as though I've been around the NEM forever, certainly at least 20 years. I hope that I bring a pretty broad perspective both from the policy side and also from the large customer side and of course now from the work I do at the Clean Energy Regulator. I do feel I've got a lot of skin in the game and I really am very hopeful and very optimistic that the work that we do can really move us forward a long way in terms of the optimal management of the electricity system. I have to say, it's been really refreshing working with Alan because, unlike me, he came to this project without, I think, great prior knowledge of the NEM and not a lot of preconceptions, he just hasn't accepted conventional wisdom and has really sort out the evidence. As he said, he's spoken to a huge number of people and drawn together a great deal of material in a very short period of time in order to produce a report which includes a lot of observations and asks a lot of questions, and we're really looking forward to the responses we get to that because I think if we draw on that material we'll be able to do some very solid work in terms of advising governments on a blueprint for reform of the market. It's really been a great privilege to witness such a brilliant mind in action and it's been quite astonishing to see the pace at which Alan's worked.

I want to talk for a minute about my own perceptions of the NEM and things that I think I brought to the panel. The first one is that it's certainly true that I've been concerned for some time that the institutions of the NEM haven't been sufficiently responsive to the pace of change or indeed to the opportunities that are presented, particularly by the digitisation of the economy. Maybe I've seen that from my time working in particularly telecommunications. So from the COAG Energy Council down there's really a challenge to them I think to keep pace with the change and, again, I think the process that we're going through gives an opportunity to map out what those changes might be; that's why we've got a chapter on governance. Also I think that, despite the language of the National Electricity Objective which talks about the long term interest of consumers, the focus of the NEM and the way it works is very much on the supply side. I've been quite disappointed over the last two decades at how little demand-side management has actually practise come forward in the market and how long, for example, it's taken for the smart grid concept or smart meters, which have been around for a long time, to be deployed in a way that's actually in the interests of consumers; again, we have a chapter that talks about consumers. I really do believe that if those technological opportunities are seized and those consumer preferences are liberated it can be good for affordability, it can help and protect the security and reliability of supply, and will be beneficial for emissions reductions. So what I see about the trilemma is that it is actually possible to have it all. I know that it's always talked about in terms of trade-offs, but they can actually be mutually supportive.

Now, absent any overt co-ordination through the instruments of the NEM, as Alan observed, consumers really are driving transformation through their own investment decisions and that is making the task of managing the system more complicated, although I think there are also solutions for that. Some of these consumer decisions are incentivised by climate change policy, there's no doubt about that, however we shouldn't forget that, even with the benefit of subsidies, consumers have covered a lot of the capital cost upfront out of their own pockets, and it's very interesting to look at on what basis are people making these investment decisions, this is households and business. So that really takes me to my own experience of administering the climate change policies, the marketplace mechanism. I've had experience now of quite a range of them, the so-called Carbon Tax which included a certain amount of emissions trading, the Renewable Energy Target (RET), and now

the Emissions Reduction Fund, which includes purchasing through reverse auctions and also the safeguard mechanism. My observation is quite simple, which is that people in businesses really do respond to incentives and markets really do help reduce prices through competitive process, but you don't always get the response that you want or you expect and the reason is because there are lots of other forces at play that affect how investment decisions are made. So the wider economic and political context and the context when we're talking about electricity - gas is part of that wider context, as Alan has outlined - are very, very important.

So just looking at the Emissions Reduction Fund, for example, we know that business investment is low despite interest rates being very low. Business investment in Australia is quite subdued at the moment so it's not surprising if manufacturers aren't rushing out to make big capital investments to take advantage of the industrial energy and fuel efficiency method under the Emissions Reduction Fund. On the other hand, the land sector always owns the large capital item which is land, so land use change through human-induced regeneration, for example, is more accessible and that's where we're finding the lowest cost abatement at the moment. We've seen how investment under the RET has waxed and waned, particularly with the loss of bipartisanship around that policy, so the political environment is obviously very important too and it's important because investors are always looking forward to what will policy be in the future. So the way that I look at it as the administrator of these schemes is that the debate about the relative merits of different individual policies to me isn't very interesting. What is interesting is how can we make this policy work in the overall context, and that's really my job as a regulator, in a way it's a luxury, whatever the law is I administer that. But I am interested in the circumstances that will allow our climate change policies to be most effective and that means that they have to work in concert with the electricity system because the electricity industry is such a large emitter, and it has to be durable, sufficiently durable to enable investment to occur and that investment has to occur without large risk premiums being built-in because of policy uncertainty, otherwise you're not going to get lowest cost results. So they all interact and without all of that then we won't get the system security that we want, we won't get the affordability that we want, and we certainly won't get the emissions reductions that we want.

So to conclude, I'm really excited to have the opportunity to be part of this review. It really is a great privilege. It's going to be tough, we're going to get huge amount of input to distil, but we will land on some recommendations and I think this concept of having a blueprint that can take a really integrated, holistic approach, a system-wide approach really is our best bet to get the outcomes that we're looking for and to solve that energy trilemma and optimise across the three corners of security, affordability and emissions reduction to the benefit of consumers, who sit absolutely at the heart of this problem. Thank you.

MICHAEL BREAR: Finally, our third guest speaker is Tennant Reed from the Australian Industry Group.

TENNANT REED: Well I didn't have any part in the preparation of the interim report, but can I congratulate you all, it's an excellent read. Everybody in the room should read it; it's a bit of a cracker. What I want to talk about is what the rest of us do now, because we have a period until the 21st February when we can all input into the process, then potentially a blueprint might be handed over, we'll see how that goes, and then there will be a longer period as the vision that is outlined in that report is implemented or not and we're all going to have responsibilities to engage with that process

and try and get the best outcome that we can. So I want to talk a little bit about how we do that and give some thoughts about how we engage with what is in the report.

First, we need to keep in mind throughout the process why it matters. The answer is going to be different for all of us, but we're going to need to remember that because every one of the solutions that is proposed is going to have somebody that doesn't like it and potentially lots of people who don't like it and there will be a great deal of confusion about different ways of getting at the same technical potential for flexibility on the demand side or supply side or whatever else. So in all of that nitty-gritty we need to remember why we're doing this and, for us, it's things like a member of AI Group who's based in South Australia whose clever and dedicated engineers have eked out considerable energy savings on their site over the last five or ten years as part of the continuous struggle to stay competitive. The value of all of those savings has been wiped out by the changes that have taken place in the SA market over the past couple of years. Now if they hadn't done those savings they would be in an even worse position, but head office and the supply chains are looking at them going, "Are you viable? Why should we continue to have you as part of the business?" There are lots of stories like that. For others it's going to be a household question or it's going to be an emissions question, but we need to keep the priorities straight as we go into the detail.

The second thing I want to say is that, as part of this energy security and reliability, affordability and emissions trilemma discussion, we need to not get too caught up in the debate about what is the mechanism that should drive emissions reduction because we will have plenty of time for that debate, that will go on. What we are short of is time for talking about how we make the energy system we're going to wind up with work. So whether we wind up with some form of national carbon pricing or some form of state-led scheme or regulation, or RET on steroids, or whatever, the result is probably going to be that we wind up with a heck of a lot of renewables in the system and whatever the mechanism is that drives it, it will not solve of itself any of the problems that the review is confronting around integrating those volumes of renewables into the system. We've spent a decade or more in this country having further debates about is carbon pricing the devil or the saviour; we need time for some other debates as well as that very entertaining one that I enjoy considerably myself. Having said we should think a bit more about stuff other than carbon pricing, I do also want to say that we should think about the implications of net zero emissions. The review has quite properly directed itself towards how we're going to achieve the 2030 target that Australia has committed to of 26-28% below 2005 levels. That's very important, how are we going to deliver those? But in the longer term there is a conversation about net zero and any energy system that we consciously design has got to be thought about in that context: is it capable of delivering that or the energy systems portion of that? That's a pretty tough ask, but it's something we've got to confront.

I'd also like to say something about technology neutrality. It's a very important concept in this space, but it's something that we probably misapply at times. We need to be careful about putting too much weight on the projections or the models or the expectations that we have at any given point in time. Seven years ago a bunch of people thought that right now we would be seeing a vast wave of investment in hot dry rocks geothermal energy in Australia, and there were a bunch of models that spat out the result that you'd get heaps of that because they were fed with inputs that looked kind of plausible either at the time that was done or in the few years leading up to that modelling when the relevant studies were done, and they didn't turn out to be on the money. So we need market designs and policy structures that are robust to surprises on the technology side. In talking about technology neutrality, that's not the same as passivity. There are a bunch of standards, pieces of infrastructure,

legal frameworks and more that are needed for any given energy technology to compete to supply the services that we require. So we do need to do a bit more than just wait and see what happens, but also, for all that neutrality, we do need to pay attention to what has been happening and it can be often very hard to get past expectations about what ought to have happened to see what really did happen. What has been happening is that variable renewable energy has been playing a bigger and bigger role in our energy system and the market is changing quite dramatically as a result and we can, with due caution, extrapolate out a bit from that to see a market where a big chunk of the demand for energy, that has traditionally been serviced by generators that from one perspective you can call baseload and from another you can call inflexible, will evaporate or will be met by generators that have a short run supply cost of zero. That's a market that is incredibly uncomfortable for inflexible generation to operate in and unless we have a radically different energy market design, that probably would be very expensive to consumers. We really, really need to grapple with the questions that are very properly and thoroughly raised for all of you to input in the review about how we manage that variability given that inflexibility will not meet our needs either.

I'd just like to make one final point which is that there's something that's very important in this space that reviews have a great deal of difficulty engaging with, and that is not policy but politics, which is very difficult. A luminously reasonable set of views from the experts in the field can help, but it can only do so much. We've had a lot of luminously reasonable reports on energy and climate policy in the past decade, so it really does come down to the rest of us to take that information and not accept it as wholly writ, to engage with it critically, but to be serious and dedicated in trying to get good reform, good outcomes and people on all sides of politics and all levels of government seeing that they have no alternative but to do likewise. I might leave my remarks there.

TONY WOOD: My name's Tony Wood and I'm going to be moderating the next part of this conversation tonight. I'm the Energy Program Director at Grattan and the *Future Energy* series is the one that we run in conjunction with the Melbourne Energy Institute. We don't often get a crowd as big as this; that obviously is down to the quality of the panel, Dr Finkel, Chloe Munro and Tennant Reed.

All three of the speakers this evening used the word "trilemma". When I was putting up a couple of notes preparing for this evening my spellchecker threw the word out, I assume it's because I have an American spellchecker on my computer or something. It's interesting to me that often we talk about this trilemma, and the Minister, Josh Frydenberg, has referred to it as well, as though it was something that's more or less going to be in balance as an equilateral triangle when usually what happens in the energy market is one or other of these corners of the triangle is more important than another. People are absolutely worried about price. Today the Australian Energy Market Commission report talks about price increases potentially coming, mostly in Victoria, as a result of the closure of Hazelwood, so price is really important. If you live in South Australia you had a blackout on the 28th September and you think security and reliability of electricity is really important, and if you've been following this conversation over the last couple of decades, maybe more for some people, you think overarching all of this is climate change. The trick is that I think at the moment we're at a point where all three of them are actually in quite a difficult position. We don't often see a situation in which within a short space of time we've had such a vitriolic conversation about climate policy, such a conversation about energy security, the first state-wide blackout that most people can remember, and such a conversation about price increases. It's becoming very challenging to think about how this is going to be resolved, but fortunately Alan and his panel are going to solve it and they're going to cure all known disease in the second half of next year and that won't be a problem.

Of course, there is a context in which this conversation is taking place and the Finkel Review's preliminary report and final report is unfolding, and that is one in which the parameters have been set by, whether you accept them or not, perceived challenges to security of supply. There's nothing that gets ministers really focused better than a blackout, and that's what we saw in South Australia. So there are some substantive issues that need to be addressed, and Alan's referred to those in his report. In addition to that, we do have the upcoming review of climate policy in this country. It was more than interesting that within 24 hours of Donald Trump being declared President Elect, Prime Minister Turnbull ratified Australia's commitment to the Paris Agreement, which in theory means we're committed to doing it. Now, the conversations of the last week or so might suggest that that might be an issue itself and open to debate, and it's that conversation that's going to take place seriously over the next little while. So that context of climate policy is important because fundamentally I would suggest the issues that Alan's identified in his preliminary report, most if not all of them would not be occurring if it wasn't for the need to address climate change. So there is this significant elephant that's driving the whole lot and I think it's difficult to avoid.

So, we're going to try and explore the full roundness of the Finkel Preliminary Report and some of the issues that Alan's raised already. We're going to have a short conversation with the panel, I'll raise a few questions that come out, I've also got some questions that some of you here tonight and some who may not be here tonight have submitted, and then, of course, we'll have some questions from the audience. I guess we should try and get one issue, not out of the way Alan, but at least upfront and then make sure we cover some of the others, and I refer to two pieces of media, both of which are in the media today. One is Ross Gittins in today's Age where he says "the Chief Scientist – I think that's you – has decided the best approach to achieve our 2030 target would be to introduce an emissions intensity scheme on the electricity generation industry". Then the Financial Review this afternoon, after the COAG Energy meeting finished, said "the AEM, Australian Energy Market Operator and Dr Finkel have all advised the government that such an emissions intensity scheme would be by far the cheapest way to reduce Australia's power sector carbon emission in line with the nation's power supply climate conference commitment of 28% by 2030". Now of course you'd be very much aware that in the last week the Prime Minister has ruled out looking at an emissions intensity scheme as part of the climate review.

I'm not going to ask you whether you believe this is the best policy or not, what I'm interested to know is in your report you talk about a much more interesting important question, and that is the lack of predictability of emissions reduction policy and the mechanisms to achieve them in the electricity sector creates uncertainty around investment and divestment. If businesses do not invest when needed, this will impact on security and reliability of electricity supply. So given you've got your work and the climate review, which has been constrained or whatever you want to call it by the politics of the last week, can you talk a little bit about how you see your work interfacing with the climate review?

ALAN FINKEL: We've been asked, as you mentioned when you were talking about the trilemma, to look at the security and reliability of the system, but we recognised that we can't do that without simultaneously looking at affordability and the drive towards lower emissions. We are looking at the electricity sector. Of course, we've talked about gas because gas enables that electricity sector to work more effectively, but we're looking at the electricity sector.

What we recognised and what the people whom we consulted with recognised is that the electricity sector has to play its part in achieving that 28% reduction of the 2005 baseline by 2030 and the

investors, the people who are going to build the new technologies that will enable the NEM to deliver over the years, want to know what kind of environment they're investing into, that's why they're looking for predictability and stability in the system. So what we said there was that the pathway to that is not yet clear. I don't think that should be interpreted that the government isn't thinking about it. The government is clearly thinking about it, they've got a number of policies that are already out there, such as the National Energy Productivity Plan and they've got the commitment to doing the review next year. I see, and I'm sure Chloe would agree, that the work that we're doing is to look at this big sector, and the emissions from the electricity sector are the biggest single source of emissions in Australia, it's about 35% of all of our emissions, we've got an opportunity to see how it can be a secure and reliable system and affordable and make a contribution to achieving the 28% emission reduction. Some people say that it might be hard to get the reductions that we did in other sectors and the electricity sector might have to do more than its share, so we'll look at ways of achieving that.

What we did recommend is that there be a real focus from our leaders through the governance process on achieving a national co-ordinated approach to energy and emissions reductions policy. Exactly how that is done is yet to be determined. We talked about a few in the report, we'll engage with the broader public as we go into the consultations and I'm sure that we'll come up with some recommendations, and our report with those recommendations will inform the national multi-sector approach that the government is taking to its emissions reduction commitment.

TONY WOOD: That'll be a more than interesting interface conversation that plays ahead over the next 12 months.

ALAN FINKEL: It will.

TONY WOOD: And it's interesting, the government's certainly given itself the whole of 2017 to solve that problem; that'll take a bit longer than fixing the electricity system, which is yours, right? The other thing that I was interested in, which I don't think you referred to quite so much in your introductory comment Alan, was the question of governance. It's almost a matter of who decides. Up until now we've had this thing called the NEM and the "M" stands for "market", so we've had this idea that this market was going to deliver affordable and reliable electricity and investment and divestment and so forth.

Now, this is not a free market, this is a market that was constructed by governments, introduced in 1998 in Australia and certainly, as far as I know, doesn't have too much in common with the Ten Commandments in terms whether it has biblical truth associated with it, but it is a market that's arguably delivered quite a lot in respect of affordable and reliable electricity, at least until now, and I guess it's interesting as to whether those things will be fundamentally threatened or not. But as you look at this and you look at some of the questions you've exposed, and you've talked a little bit about technology and planning, do you think that market itself is going to be under tension to the extent that if you look at the UK, for example, it seems to me in dealing with some of the issues that you're grappling with they've just given up on markets and gone to a centrally planned regulated approach. We could do the same thing, but it would be a good idea to do it knowingly rather than inadvertently. I'm not suggesting we should by the way, but there would be many people who think that some form of further regulation is required.

I'm interested in whether you have a view yet as to whether the market needs to be let to run, needs to be given a bit of a shove, or needs to be kicked into touch completely?

ALAN FINKEL: I came into this, as Chloe mentioned, open-eyed and very much aware of the fact that the national interests in market, as you just said Tony, has delivered in spades for a long time, but in recent years it's been struggling because of the rapid onslaught of technological change. So ipso facto the market has to change. It can't stay like it is and still serve our needs given that all the assumptions, the axioms that underpinned its design in 1998 have changed, but that doesn't mean it has to be thrown out and started again. You're right, in the UK and some other markets around the world have gone towards capacity markets and a lot more central planning. I can't pre-empt what we'll put into the blueprint because we don't know yet, but it is apparent that if we're going to be able to cope with this rapidly changing technological onslaught in consumer preferences then the market will have to be more sophisticated and possibly less complex, because complexity and sophistication are not the same thing and it's a very complex market, that's part of the challenge, but it can't I think be as focused on just trading energy as it's been in the past. There needs to be some planning because you can't say let the cheapest generator always be the next generator to come on if you've got to the point where you have no capacity for that kind of generation. So there's got to be a framework and some planning, some rules about connecting new generation onto the grid.

Then at the other end, where you're talking about the retail and the sale, we've traditionally had meters that are locked down to the retailers and distributors who are managing those meters, but now we need to make them available. Those meters will have IP addresses and consumers will need to be given the right to share that connection information with financial technology companies or other companies who want to aggregate the data and provide services to the consumers. So it has to change, but that doesn't mean it has to become a centrally planned rigid system. It can still be a market, but it needs to be finessed with a bit of planning. Chloe, would you feel the same?

CHLOE MUNRO: Yes and some of the remarks I know at the beginning were pointing towards that. I think a lot of the analysis that we need to do is how you balance things, and the balance between planning and regulation and standards and market mechanisms is a very important one. I actually think one of the central challenges for the governance is that actually sometimes you have to make a call. So I don't entirely agree with Tennant about total technology neutrality, sometimes I think you have to say well actually, as we have said, gas could very usefully play a role and some things have to be done to make that gas more accessible. So in that sense there is some planning and there are certainly standards around reliability and what the system has to be required to deliver under all circumstances which require some central control. So it really is about the balance, the trilemma is about the balance, and it's how you get good decision making framework so that decisions are made and they're made with sufficient speed to maintain those standards that people expect.

TONY WOOD: Tennant, your organisation presumably has a view about the role of the market and regulations, so how do you see that tension?

TENNANT REED: Right now we are stumbling by default towards central planning, but with eight different central planners. The Victorian Government, the New South Wales Government and potentially the Queensland Government propose a set of contractor difference auctions to bring new renewables into the market, and the ACT has already done within a narrow frame a very successful set of auctions in that way. If that becomes the main driver of investment in the market then they are

designing the system, but one of the risks is that they run those auction processes within a very narrow definition of success, lowest levelised costs or lowest contract costs within those auctions, rather than lowest system cost for the system that they're building. Our electricity system was built by the states back in the day, there were inefficiencies in that but it worked, it's something that you would need to do with your eyes very much open and at the moment we're backing into it while having furious fights about alternatives.

TONY WOOD: It was interesting, I think it might have even been in this room in the week before the last election, the current Shadow Minister who was at that stage hoping to be Minister made a comment about one of the consequences of the Federal Government RET - and we should recognise that it was that target which produced all the wind in South Australia, not anything to do with the South Australian RET. He made a comment that we shouldn't have got all this in South Australia, even though he's a South Australian and is very proud of the fact they've got wind, he was staring down the gun of the consequences in terms of having so much intermittent supply in one place, but he was also talking about the idea of integrating some form of option process if Labor had been elected.

Now obviously that may or may not re-emerge in a future Labor Government, that remains to be seen, but there is that view that at some point people would prefer to direct what's going to go on because they know what the answer should be, rather than let answer emerge from the uncertainty of markets. I guess that uncertainty is going to be one of the challenges here as to how much you can plan, particularly about transmission. One of the issues that was raised today in AEMO's report on the transmission line system is the idea that we need more transmission between South Australia and New South Wales or between Tasmania and Victoria. Interestingly, the COAG ministers had what seems to have been a vigorous debate around that issue. So some of this planning role, whether it's transmission or even generation, is going to be one of the things that's going to come out.

ALAN FINKEL: It is key. Going back to what Tennant was saying, we can learn from overseas. In August 2003 the whole of the eastern seaboard of America collapsed, and it collapsed not because of a weather event but just a series of system failures, one led to the next and you had this cascade. A lot of the reviews on that blamed the fact that from 2000, when there was the Supreme Court ruling that opened up the market so that any company that wanted to build a generator could bid in at the lowest cost and put it exactly where they wanted to, you ended up with a lot of generation remote from where the users were and that system led to massive overload on the transmission capacity between the generators and the users. Therefore there were the system costs that you just talked about unrelated to the actual generation costs and they recognised the need for better planning.

I was talking to someone in the audience before we started here about Texas. Texas is an interesting case. They've got a lot of oil, as you might know, but they decided they can get more money by selling the oil, a bit like we're selling natural gas, and that they should use their wind resources. But in order to encourage that they went through a planning process where they put in, and it was billions of dollars to do this, a long transmission line down the pan handle where there was no generation, there was nothing. That set up an opportunity for windfarms to sprout, which they have and they now make an enormous contribution to Texas' wind needs and its market, it's a market-driven wind supply situation there. So they made a commitment to planning and spending money to enable the market to operate, and that's what I think we're all taking about here. You need a bit of balance. That wasn't necessary in 1998 when the NEM started, but things have changed.

TONY WOOD: We may see the re-emergence of a concept that was looked at and discarded in Australia to do something like that Texas view for building transmission lights which renewables in more remote areas could be connected to. Let's move on and get some input from you, the audience, and open the floor to questions.

AUDIENCE: Alan, there are so many vested interests in this area, the regulators potentially have vested interests, including retailers and the grid operators that have shamelessly exploited the system and overbuilt our grid. How do you stop being captured by the significant vested interests in the sector?

ALAN FINKEL: I like to go back to the public service motto of frank and fearless advice. My wife has me writing a column for Cosmos Magazine under the title of "Incurable Engineer". Basically my philosophy of life, if I might say so, is to not just use the scientific training that I've got, but the engineering training that I've got - and I'm saying this in the knowledge that one of my lecturers from Monash University a long, long time ago is here in the audience. It's the engineering method where one has to stand back from emotion and ideology and the first step is to identify the problem, which sounds trite but identifying the problem is really *the* most important thing, then to analyse the problem, then to come up with the solution and be prepared to test the solution, develop the solution, test and iterate until eventually you have an outcome that you can deliver to the audience that has asked you to tackle the problem in the first place. So it's my intention to be true to that process.

AUDIENCE: Alan, are you disappointed that the government has comprehensively ruled out an emissions intensity scheme and, given they've rejected it, do you feel the government has confidence in your advice, and how will this affect your work on the blueprint going forward?

ALAN FINKEL: I do have confidence that the government will accept not just my advice but the advice of the panel reported by the taskforce and the work that we're doing, because we're doing it in a very objective fashion and we are going to present independent, carefully considered advice. In respect of what's ruled in and what's ruled out, what I'm optimistic about is the government is committed to doing a climate policy review next year and I know through presenting at the COAG last Friday and through presenting at the COAG Energy Council today that all levels of state and national government are deeply interested in what we're going to present and see it as important not only for delivering on the blueprint security and reliability of the NEM, but also as a very significant input into what the electricity can contribute to the climate policy review. So I'm optimistic.

TONY WOOD: There were a couple of questions pre-submitted that relate to levels of integration of renewables at very high percentages. In South Australia we've already seen an average of something like 40% of intermittent supply, and I guess the emphasis on this challenge of intermittency and security rather than the fact that they're renewables or not. Are you looking at this issue not so much in the short term where we are, but as we get into the longer term? Is there a problem with integrating renewables? Is there anything that tells us from so far the way we've dealt with those technological issues of frequency and inertia that gives us a hint as to how far we can go, or is this something that we're going to have to put off and worry about later?

ALAN FINKEL: No, it's a really important issue and if you don't have all the solutions to the missing ancillary services and the additional services that synchronous generation would have given you then if you're generating at really high percentages from variable renewable energy you do take inertia out

of the system and the system is more subject to propagating failure if a generator disconnects or some other problem occurs. AEMO has realised that since September 28th and just last week brought in a requirement that in South Australia, which is the jurisdiction where you're going to run into this kind of a problem in Australia at the moment, there has always got to be two gas generators running. Even if they're running at minimum load, they have to be running in South Australia 24 hours a day, two or more, to address exactly the problem you're talking about. It's difficult to create rules around that in South Australia at the moment because all the generators, windfarms and others who have connected have connected under existing rules, but as penetration increases in other states in Australia there is a case for thinking about just what level of instantaneous penetration you will allow in any given year in any given jurisdiction until you build up those supporting technologies, and as those supporting technologies build up then the percentage can safely be elevated. So it's a manageable problem, but it has to be managed.

AUDIENCE: Tennant mentioned eliminating discussion on a carbon price. My question would be when you're looking at investments into the electricity infrastructure, how do you get businesses motivated to invest in the electricity sector without an incentive mechanism? And the carbon price is a mechanism to encourage businesses to invest. The second question is this infrastructure has worked well, as you've pointed out, to deal with older technology and as the system is now developing how can the infrastructure deal with decentralised sources of technology? There are countries that have got 50%, 60%, 70% and are aiming for 100%. I think these are two questions are linked and they have to be addressed.

CHLOE MUNRO: I think those are questions in a pile of big questions that we're addressing. So if you look at the technological opportunity there's no question that you can move towards a zero net carbon electricity system in terms of the available technologies, but it's at what cost and whether the investment will come forward, so what's the combination of market mechanisms and other things that can bring that forward? That's exactly part of the question that we're looking at. Stability of policy clearly has an impact on investment decisions and one thing in terms of renewables is that you can see the levelised cost of electricity from renewables coming down very fast, so if you were going to build a new power station in Australia today or in the next five years a renewable power station would be probably the least cost and could stand on its own two feet, that's not very far away. So then it comes to the system integration issues, which is exactly what Alan was talking about. I think the important point here is we're not starting in some kind of idealised world, we're starting from where we are with the infrastructure that we've got, the investments that have already been made, some of which are now quite ancient and are limping along, they're creating returns but they don't have an extensive life.

So exactly the questions that you asked are the right ones, which is in what framework do you get the right incentive so that people can invest with confidence and invest at a low cost of capital? Because the outlook is reasonably certain, I mean, there's lots of uncertainty: electricity demand is uncertain, world prices for all sorts of commodities are uncertain. So it's how the rules around where the electricity market itself operates and gives a reasonable amount of certainty at least in the way that they operate, and that's really the key and is something we're going to have to ponder very deeply.

ALAN FINKEL: I agree absolutely with everything that Chloe has said and I'd add that in our consultations and also what you're seeing in the newspapers in recent days, industry doesn't want us to recommend or necessarily the government to commit to a particular means of dealing with

emissions reduction; they just want something. They want something that's clearly thought through, that can be accepted across the different state jurisdictions and ideally with bipartisan support so that they've got confidence that it'll be there for a long time. What industry wants and what investors want are rules, they want to know the rules of the game and if the rules aren't what they expected going in that's fine, they're smart, they'll learn how to play with the new rules as long as the rules don't keep changing. That's why we keep talking about predictability and stability, they want rules that they can predictably understand and they want those rules to be there for the long term. The government on its part not only has to deliver the predictability and stability, but also recognise that when it's framing those rules there are two core reasons for developing regulation. They're going to be effective and they've got to serve the public needs, whether it's safety and security and reliability, but they also have to facilitate commerce so that the investors will come into it and do things.

So the government's got to think about how to do this with a very broad brief to serve the public good, if you like, but also facilitate the commerce, which eventually serves the public good as well, it's a two-pronged approach. In response to your second question, I think Chloe's answered it and I addressed it in the beginning as well. It's not easy, but it's absolutely not insurmountable. We can integrate unlimited quantities of solar and wind into the system and other renewable and low emissions technologies if we're careful about planning how to do it and put that planning into the context of a market mechanism.

TONY WOOD: It actually isn't really a technical question. We can do it, but it's how well or badly we do it that's going to be the trick. Tennant, your organisation I think has been one of those for industry that's been pretty consistent for quite a long time in advocating this issue of credible predictability and so forth, even around some particular designs of ways to do this.

TENNANT REED: Yes.

TONY WOOD: I would also argue that some industry groups have in fact done the opposite and pretty well screwed up the whole thing quite deliberately in their own interest, but you guys haven't done that. So how do you see the role of industry now? Is industry now going to try to be the good guys and help Alan do his job, or is industry going to play at some other game do you think? And I'm not asking you to tell stories out of school, I'm just interested in your perspective on the role that industry's played and is playing in 2016.

TENNANT REED: Industry is very diverse and there are lots of different takes that people have on the issues that we're talking about. They're affected in different ways, they have different levels of focus on it, and so I don't think you're going to see any one response from industry, but AI Group had a meeting a couple of weeks back of our Leaders' Group on Energy & Climate. We had 40 or 50 businesses from different sizes, different sectors, producers and consumers around the table and we went around and asked, what's your number one issue? The two things that people said most frequently, a lot of them said prices are sending us to the wall - the suppliers were studiously quiet when that was being discussed - and that we have nothing to plan on, we have no idea what the rules are going to be. So yes, I would totally support the view that we need something, the best can't be the enemy of the good, and also that no scheme, however well designed or attractive it is in a set of models, is going to work the way it's intended to unless it's seen to be likely to stick.

So the job that we have set ourselves is to reinforce that message and also that the consequences of failure are pretty severe. In the electricity sector in particular we had a period where we had so much overcapacity of one sort or another it looked like we could just carry along and maybe do a bit of efficiency here and there to prolong this period where we didn't really need to make any decisions. That's over. Some decisions have been made for us by investors saying, "We're getting out of here". If we don't have clarity of some sort, and the detail does matter, but if we don't have clarity of some sort then we are going to have a future of much higher prices than they need to be and much lower reliability than it ought to be, and that is going to see us lose quite a lot of economic activity that we would like to have.

AUDIENCE: Alan, why is gas critical to the transition to renewables? As you said, the key parameters are security, net zero emissions and a low price. Gas is expensive and you said it's going to become more expensive, and methane is far more potent than coal as a greenhouse gas; even at 3.2% fugitive emissions, gas is worse than coal. Should storage such as pumped hydro and batteries be used as backup instead?

TENNANT REED: Can I jump in on this one? We spend quite a lot of time on gas. Gas is a very important fuel for our members and is also an important feedstock for a lot of basic chemicals that we need. What I would say about gas is it may well turn out over the long term that gas becomes a less relevant source of energy. It may well be, and it looks very plausible, that demand-side storage, interconnection and diversity of generation technologies can deliver the flexibility that we need, but right now nothing else can deliver the flexibility that we need other than gas. There's mothballed gas-fired capacity that is finding it difficult to come into the market to meet some of the needs that we've got right now because the gas market is so tight that they can only get fuel if they're willing to sign a 100% take or pay contract. Now if you're operating only some of the time as a backup to provide reliability, a 100% take or pay makes you a very expensive generator and a big risk. So yes, there can be a transition, probably, it's plausible and we'll see what happens, away from gas in the further distance, but we have a very serious set of problems right now that more gas would help a lot with.

ALAN FINKEL: Let me add a little bit to that about the first part of your question and perhaps we'll talk about the pumped hydro and batteries as well. You were talking about the fact that methane is a very potent greenhouse gas, which it is, and if you do the numbers, I'll accept your 3.2% as the level of so-called fugitive emissions, it's probably even less than that that would negate the benefit of using gas as a primary electricity source, but there's no evidence whatsoever that across the gas industry the fugitive emissions are at that level. You don't see it in the global atmospheric rate of methane increase which is slower now than it's been at some times in the past despite the fracking revolution in the United States and the work that we and other countries are doing with gas. So there's no evidence of the problem, plus just because there's a potential for a problem that doesn't mean you run away. I mean, if we did that none of us would be drinking coffee or alcohol, we wouldn't be driving cars, and we certainly would not be in a room with deadly electricity running around in the cables. You have to have regulations to manage the problem and it is manageable.

Going to your second question, absolutely pumped hydroelectricity and batteries are critically important in a largescale future of renewable electricity. If you can use your excess wind and your excess solar to charge batteries, it won't be this year or next year at scale, it'll be perhaps a decade or two, or to pump water uphill so that you can then recover the gravitational potential energy to make electricity again, that's fantastic. They're clean technologies, they work very well and, especially in the

case of pumped hydroelectricity, when that water comes downhill it's turning an old-fashioned synchronous generator. So not only are you getting the benefit of recovering the excess electricity that you generated from wind that you couldn't use, but you're getting a synchronous generation contribution to the grid.

AUDIENCE: Chloe mentioned that it's all got to be about the consumer. Everybody uses electricity, it's an essential service therefore it's a deeply democratic concern. Why are the State and Commonwealth Governments allowed to dodge and run away from their responsibility? In Victoria we were told that the prioritisation of electricity will lead to lower prices; that has turned out to be a trick, if not a fraud. So why are you not recommending that the State Government and the Federal Government get deeply into the planning process for electricity generation and distribution?

TONY WOOD: Whose fault is this, come on?

ALAN FINKEL: This man is the lecturer that I told you about that I had who taught me power engineering and control systems engineering 45 years ago! All we can do through the blueprint is take, as Chloe said, an existing system and try to make it as good as is possible. It's not a broken system, it's functioning and it's delivering what we need at the moment, but it's under pressure and it's not delivering what we need as reliably and securely as it has in the past. That doesn't mean it's broken yet, but if it doesn't get some attention inevitably it will. So our ambition is to use this opportunity, and it's a privileged opportunity that we've been given, to develop a blueprint that will, and again going back to Chloe's opening remarks, not do the trade-off between the three targets, security, affordability and low emissions, but try and do well on all three in an absolute sense. Exactly how we do that I don't know, that's what we're going to be doing over the next four months, but our ambition is to take the system and make it better.

AUDIENCE: I think that the inertia issue is vastly overstated. If you look how much energy you can extract from a spinning turbine it's 0.6% of the rotational energy before it goes out of frequency. So if you run that through the whole system there's 90-100MW that you can draw. That's equivalent to a couple of decent size battery packs. Gas turbines are even worse, 70% of the gas turbines in the US do not provide any services and they're prevented from doing it and they're very unstable at low power levels. And that is one of the key reasons why South Australia had its blackout, because the 100MW turbine at the quarantine station did not fire up because it overloaded before it got to power. So we hide behind this silly idea that gas turbines provide essential inertia and you, as a control systems engineer, would realise that modern control systems don't need anywhere near as much inertia as old ones did anyway. So the question is have we done any proper modelling of inertia? Because I think it's vastly overstated and we are spending a fortune providing a crap service.

ALAN FINKEL: You might be a minority. Certainly AEMO has done a lot of modelling and jurisdictions around the world have done a lot of modelling, and we're talking about the existing system. You don't need the inertia in megawatt seconds to last for a long time; you need it to be there for long enough to take other actions, such as load-shedding or bringing on other generators. We have a system that runs synchronously at 50Hz nominally, it doesn't matter if it drifts a little bit slowly from one side to another but it's when there's a rapid change that you'll do damage to the existing generators that are on the system. Now, originally it was really important that everything ran at exactly 50Hz because our clocks ran on that and our machines directly ran on that, but nearly everything's been decoupled, we've all got digital clocks and the machines run off power conditioning system, so they don't need it

either. But the system is what it is and everybody that I'm aware of, and I've spoken to quite a few of them now from companies and jurisdictions, believe that managing that inertia is really important and your ability to ride through transients is partly the result of being able to manage the inertia. But it's not just inertia that these machines give you. They give you what's called strength, the ability to crank up the output to increase the voltage or the current of power when there's a drop in the grid.

Now if we started from scratch today and we used all new sources and all DC controllers and sophisticated electronics we might have a DC system, we might have an AC system but with a lot more tolerance of lack of synchronicity and frequency changes, but we've got what we've got. My understanding from everybody I've spoken to is that these characteristics are important. 50 years or 100 years from now, as we solve problems by introducing battery-backed power conversion electronics that can give you whatever you need, there's no limit to what you can do with modern electronics, the problem might go away, but we've got to deal with the here and now. So I do believe it's a serious issue.

TONY WOOD: Tennant, any final comments that you might want to make?

TENNANT REED: I'd just like to make one comment on that exchange. That was an exchange between two engineers and it was very important and content-rich. Most of the decisions around this and most of the transaction will be between people with arts degrees or law degrees for whom that discussion might as well have been about phlebotinum, so it's really important that the people who can engage competently with those talk to the rest of us and explain what's going on in words that we can understand, because the political process is the political process and decisions will be made on the basis of a one-page brief summarising all of the work that is done. It's a sausage machine, but it's all we've got.

TONY WOOD: Chloe?

CHLOE MUNRO: The thing that I'm hoping for most, while we do need those technical exchanges I think that in the end we have to have institutions that have a great deal of capability and that we can trust to do pretty much what Tennant said and make those operational decisions day-to-day, so that's a very important part. Again, it comes back to that governance point.

The other thing I think is really important and I would make a plea for is an avoidance of intemperate language. I've been involved in controversial issues all of my life in Australia, whether it's been emissions trading or it's been native timber harvesting or it's been genetically modified organisms; you name it, I've been at the frontline. As soon as people retreat to any of this very exaggerated language - and it's always on both sides of the debate - and lose respect for the other protagonist in the discussion, you lose the opportunity to arrive at something that's workable and as Tennant said, the perfect is often the enemy of the best. So what I'm really hoping out of this is that we can have a really objective and dispassionate discussion which does lead to some decisions, and that requires everybody engaging in that in good spirit. And so far what's been fantastic, as Alan said, was that when we started on this process it was just wonderful how so many people said, "We're right behind you, we really support what you're doing, how can we help?" That was the biggest thing we heard, "How can we help?" and if we can carry on going through this process in that spirit I think there's a real possibility of arriving at an outcome that will benefit Australia.

TONY WOOD: Alan, one thing I was interested in was you summarise the “urgent” and “important” issues, and sometimes they’re not the same thing. I notice in the communique that came out today from the COAG Energy Council they said that “the ministers have agreed to fast-track for consideration in February additional measures to strengthen the NEM and accelerate proof of concept projects in order to respond to the issues identified in your report”. What do you think are the issues that really could be worked on immediately to have some impact? Because many people are already concerned about the impact of the summer of this year and next year rather than the years afterwards as opposed to the things that are going to affect the decades which you’ve been talking about and which are important, but may not be quite so urgent.

ALAN FINKEL: A couple that we’ve talked about tonight, one is that AEMC and AEMO, that’s the rule-maker and the electricity market operator, have been talking for a long time coming back to the same topic about developing a market for inertia, because they see the importance of increasing the amount of inertia in the system as the natural amount goes down in the system as we bring in wind and solar, and part of what the COAG Energy Council looked at was the possibility to bring forward the rules to develop a market like that. But in terms of the proof of concept, the sorts of things that are in mind are to have real world tests done on things such as synthetic fast frequency control or controllers on wind turbines that enable them to add strength into the system by using the rotational spinning mass inertia of those wind turbines to contribute to fast frequency control or system strength. Yes, jurisdictions around the world are starting to do that, but we need to test them on the real grid. Not in a lab, but on the real grid, so if this leads to the system operator, through some mechanism that’s funded and co-ordinated, testing things early we can bring them onto the system much more quickly.

TONY WOOD: I think you’ve seen tonight why the COAG Energy Council selected Alan Finkel to do this review, appropriately now called the Finkel Review. I hope that we will also find other opportunities over this next period of time, not just here in Melbourne by the way, to do exactly what Tennant’s suggesting and find ways to help communicate what this is about, because unfortunately of course it does mean that often the complex issues of engineering, economics, regulation and policy all get distilled down into grabs that appeared on the pages of the newspaper and we already know, just from those quotes I gave you before, that often what you read in the paper is actually wrong. So sorting out some of this stuff hopefully are some of the things that we together with our partnership with the Melbourne Energy Institute can do. This is our last *Future Energy* event for the year, hopefully some of you will be back for some of these events next year, and I’m sure that some of the issues that we’ve discussed this evening will be picked up then.

Can I thank the staff at both MEI and Grattan for helping organise this, thank you very much to the panel, and thank you for joining us, I hope you have a safe and happy holiday and come back absolutely invigorated to support by submission the Finkel Review. Thank you very much.

END OF RECORDING