

AGL Energy Limited

Torrens Island Power Station investor tour webcast transcript

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Andy: Look, I hope you enjoyed what you saw. It was a brilliant day and you can tend to see a few things. You can see A station versus B. I don't know if people saw the little plaque that was in A station. It basically was the commemoration of the 1968 -. What you're looking at is things that you won't really ever see again. I don't know if you've noticed the scale and the size of those turbine holes. You don't see people plants like that anymore. It was a time when – and you can see it globally. If something was built by a State Electricity Board or a regulated utility, they tend to be different than what you would see being built new with people who are unregulated. But I'll tell you something else that you see. I don't know if you've noticed there's a lot of pride. People take these plants seriously and people who work in these plants, they're absolutely loyal to the plant. Sometimes more loyal to the plant than they are necessarily to who owns and operates it but they do keep a record. I don't know if you saw in the control room the mugs and hard hats that map the ownership of this facility but we're very pleased to be here now and I think everybody's pleased to wear the AGL logo

I say that because with the closing of Hazelwood we have a chief engineer, Glen Schumacher, otherwise known as Shoey who spent five years at Hazelwood and I think he hasn't stopped crying yet. And seriously, emotionally he hasn't cried but if we played some sombre music, I think he might have. But people take these operations, these plants seriously. They put a lot of hours in. when things go bad one of the things you'll notice in our industry broadly is a real service ethic. People take what they do very seriously. They work hard. When we had the system black event and we were between shifts and people were going home, and they came back. And in the dark got everything running again, and that's not just the management people but people who are in the unions as well. People take this seriously.

So when you think about the challenges that are ahead of us, we keep that in mind. You may have read Richard Wrightson and Doug were doing testimony and I think Doug, he hadn't cleared the statement with me first. He said "This plant was in a rocking chair in a retirement home." I wouldn't have used those words, but one of the things you have to know and I think if you've heard it during the tours is that what wears and tears on a plant is really heating and cooling of metal. It dictates how fast we start these things up and how we take them off and how we maintain them. Now when you're a baseload plant on gas, you start them up and you let them run, and you try to just keep them running as long as you can. When you're in an intermittent or a more load following, it's a different world and with the expansion and contraction of metals, how you manage it, how you look to the market, how you try to – you saw those market screens in the control room. It indicates a different mode of operation and therefore a different way of thinking about operating and maintaining the plants. As these plants get older, operating them is riskier and a commercial strategy in a facility like this with the 8 units and how far we contract into them, is something that – let's see who's worrying about that. We're all worrying about it but Stephen and

Doug, Richard has sleepless nights how far we go into 8 units and when we have to do it. And also remembering that these units now in this State are absolutely critical, given the transformation that's happening in South Australia and the issues broadly in the market.

I think when you think about that, this has always been the canary in the coal mine. Not the fact that we have the issues of having a coal plant and therefore also dealing with CO2 but the aging of the infrastructure, the elimination of synchronous rotating equipment and inertia providing equipment broadly, the need to renew, and even if we didn't have the carbon issue the need to renew capacity. The need to understand how to integrate the large-scale renewables. Storage, which becomes more and more important on a large scale. And what all that means, and these are the kind of issues that we deal with here. We've seen what's happened in South Australia, but we're dealing with it broadly so there is this fundamental rethinking. And I don't know that we get any clarity out of that at the political system. Maybe out of the policy makers, but I think a lot of what's going to happen will be led by players in the market and thought leaders like Tim Nelson who's sitting here. And you've heard our policy advocacy and these are things that we think are right for the industry, for our shareholders, our investors, our customers and ourselves.

So I think that a lot of questions you may have. I'm not really going to spend much time and I didn't even want to talk through the slides but we'll see what's up here. You have the deck. So there it is. Acid renewal. The investment in flexible modern plant. Market design changes. That's what we're just talking about. Critical. And then if we go past that, this is the SA Government plan which I'm sure everybody is really, really familiar with. If you need more clarity on that I think we'll be happy to talk about it, but what was very interesting I had mentioned that our results that we had we were preparing and going to reveal in April, our South Australian blueprint, which we worked hard on and we had it. And the day after we indicated what it was to Government here before we were going to go more public about it, they did this and you can hear the sound of shredding paper because our blueprint was – I don't know what happens to a blueprint that you're never going to see the light of day. So we're rethinking now because in front of you is a lot of interesting things, and we could talk to a lot of these things. They sort of relate or connect back to one of the policy guides that we've given. And when you look at it, quite interesting and probably the one thing there that is the most problematic from our perspective is the Government build and own new 250 megawatt emergency open cycle gas turbine. The reason I say it's problematic is because even though Government has – and I believe them – said they would not run that and it would not compete with us and it was really only there for the ultimate contingency of a potential lights-out situation, I just find that hard to believe will always be the case. And therefore, you have a relatively efficient new piece of equipment that costs taxpayers significant money, and the fact that you believe that it'll just sit there and never run, I think is wishful thinking and surely not the kind of thinking that we would base further investment on.

And it's hard to think through what kind of commitment you would have to have the Government to basically say you would think about earning new capacity. Why is this important? You hear. You've seen these plants. And at some point, even though we deferred the mothballing of a unit. I don't mean a single unit but a unit. A station. We review that on a regular basis, and we probably will be getting to the point where justifying further investment – because it's not only the capital but it's the maintenance costs of some of these older units – won't make sense. And then the question is how do we deal with renewal of capacity in this market because this is and remains an important market to us.

So this is the kind of issues that are ahead of us. Nothing here I'm just telling you is new, but when we look down this list and we're allowed to talk about any element of these things and how we're thinking about it, that's the one I believe is somewhat more problematic. I don't know that we've heard the last thing on that or the last outcome of that because this is a process that's ongoing that we're engaged in. and so if you look at this, we are planning to participate in the EOI for the large scale storage battery. We do believe storage is important. We think this is a good opportunity to get into that game, and the most likely site will be right here. Why? Because we have the electrical infrastructure. We have to make it available but we have it and we need to see how that fits into our longer-range plans. Whether we're successful or not in this competitive process I don't know because we believe that there are plenty of people who are going to be vying for those same opportunities.

And yes, we've been in touch with Elon Musk and his group, and I've always said "Let's wait for Tony Stark to give us his offer because you never know." That's a real popular culture and analogy from Iron Man II and the meeting of Tony Stark, Iron Man and Elon Musk in Geneva where they were – Monaco, I think it was – but we're in the game and we probably will be responding. And then it's just continue to have conversations. We did talk about LNG. South Australia is one of three potential places where we would think about that. We're going to continue to do that work. For us, it's really a question of logistics of where we import that gas because it's very critical to us to ensure that we can get it in and out of Victoria and take advantage of the Iona storage that will come our way by 2022. Is that – 2020, there you go. So 2020, because when we think about storage and we think about LNG, one of the very interesting things for us is the ability to look at orphan cargoes and be very selective about bringing in lower price gas and being able to shape it using our storage on land to do that. We haven't made decisions whether it's going to be an (10:39) [FSREU] or what we'll do on site and all those things around these different locations, but we have not been – we are a lot of gates from this analysis. We haven't found anything that's putting us off. In fact, we continue to think that it makes sense and for those who read the papers where they used to call us crazy and now not so much. So we'll see where that goes and we can chat more about that.

And then Torrens A ongoing operations remaining so to annual review which we do and of course this is secret because we do have to talk to the market operator about

what we're doing with our units because that's quite important. I think many of you know that AEMO came out with its findings and we can really only talk to that in a limited basis only because there are liabilities and issues that are still under discussion and we don't actually agree with all the characterisation in that report. So while we can talk to it, we have to be somewhat cautious and that's why my General Counsel will respond to those. Very informed, can talk in detail but knows the right things to say. But more importantly, what we really shouldn't be saying given that this is still an open item for us.

So that's really all I wanted to say and the next slide hopefully is a holding slide. We'll be glad to field any questions. I'm going to try to get some of the voices you don't normally hear from talking, although Stephen and Brett and I are here, although I don't think we'll be needed because we're such a wonderful – the rest of the executive team here. And Richard and Tim are here to talk to you, so this is a great opportunity for you to meet the rest of the team and the rest of the group. So I don't think we need roving microphones but if you use your outdoor voice, it'd be great and we'll try to use the microphones here to get responses. So why don't we just open it up and I think we have about 90 minutes less my little introduction here. So go ahead.

Audience: (12:45) [indistinct/faint]

Andy: Sure. Who wants to do that? I could do it but Doug, why don't you give that?

Doug: So the blueprint was really an opportunity to invest in some combined cycle aero derivative technology, so efficient gas turbine types of technology and we had a view of 200-400 megawatts over some period of time. We looked at having a battery option to look at storage so something in the 100 megawatt-type size. And we saw that as an advantage to give you ongoing frequency control and response on the grid in a real time, all the time basis. And give you time to get a gas turbine aero derivative up to speed and therefore producing, so you provided grid security, firm in capacity, frequents a response. And we saw that as a natural opportunity, and that gave us the ability to manage some gas savings that we could see here at (13:49) as you see the operation. We have opportunity to save gas through that process.

We also looked at some future expansion of wind and solar within the State as well and potentially a second storage option at – co-located with a solar farm. So we saw it as being a lot have good ideas some of which may still bear fruit but we need to re-evaluate with it all.

Andy: And I think an interesting thing if what Doug has described and which was at the heart of this is what we're starting to call a synthetic – you know our virtual power plant. Well, this is our synthetic, financial plant and this is an idea that Tim has had. He's been advocating in terms of the firming up or stapling of firming capacity to enable this. Tim, maybe you want to talk about that concept just at a very high level.

Tim: Yeah. I guess most people have made the assumption that it's all around physical security of supply but I think longer term, renewal generation really does need to actively participate in the market for the market to function properly. And there's two reasons why I think that in the long term has to be the answer. The first is that renewable generation tends to suffer from a price penalty the more renewable generation you put into the market because by definition when the wind is blowing, you're getting way too much power relative to demand if you over-build. And same with solar. But what a firm capacity obligation does, it allows them to basically create a synthetic financial entity that can then offer contracts into the market. So longer term, it facilitates active participation that not only overcomes that price penalty issue but it also means that the contract market functions effectively in a market with potentially 100% renewables. So we know that that's had quite a lot of sway with some of the policy makers that are actively looking at NEM 2.0 as they're calling it at the moment. And I think the advantage of it is it tends to be something which can be incrementally delivered rather than throwing the whole rule book out and starting from scratch. So I guess we're all watching this space to see what people like Alan Finkel will come up with but I think it's certainly something that people are actively thinking about.

Audience: (16:19)[indistinct/faint] In such a situation, are you actually all (16:21) because you actually don't have a gas line turbines in (16:25) coal fired power stations for (16:30) is AGL actually (16:34) means we've got to go spend a lot of money building gas line turbines and (16:38)?

Andy: There's a couple of different ways to work with. Richard, why don't you take the first piece of that? Or you could take all the pieces.

Richard: Yeah. The proposal isn't necessarily about building turbines to go with it. It's stapling firm capacity with it, the existing assets or new assets coming through. So that's why some of the battery work comes through to that. Is AGL well-placed? Our portfolio's reasonably flexible across NEM. We've got good sites to build near renewables and firming capacity associated with them, but we can also leverage our existing sites. So I think we are reasonably well-placed. I don't think we propose anything yet that would destroy our business, so we believe we've got the sites and that's why the SA blueprint – everything around the SA blueprints supported this. It was about new fast stock aero derivative plant. It was about battery and it was about new renewable projects coming through for South Australia. And we're obviously now working to see how, given the SA Government's announcement, how we can still maintain that in light of that announcement and still deliver new capacity for South Australia.

Doug: I'd like to just add a little bit on the capabilities we've been building. Our capabilities internally in terms of people and skills and relationships with engineering firms and suppliers that can support gas turbine technology. So myself, for example, have worked gas turbines for a number of years. Colin Mills, who you've met earlier,

he's run a lot of gas turbines around the world as well. So we have people inside the company who understand them well and we have key partner and supply relationships that also do that as well.

Andy: Yeah. One of the things let me just build off this. One of the benefits of this team is there's a lot of broad experience and we challenge each other all the time. And so one of the outcomes of one of our ongoing – and I'd love to say it was a Yammer session but it was not. It was just typical email going back and forth. And there was this whole question about is gas really going to be that transition fuel? What happens to coal? What happens to renewable? And I think that's a really very powerful sort of discussion and mind exercise, and I'm going to let Brett – I know you hear from him a lot but I think since he was one who wrote the first email challenging our thinking, I thought maybe we should give him the reward of explaining it at a high level, because I think it's somewhat of a different view and it's quite insightful and it's on this topic. So Brett, why don't you go?

Brett: Yes. The perils of email. Look, we've been thinking a lot about what happens at the big end, the big scale. We're doing a lot of work at the smaller end, the household level, but what happens at the big end of town? And particularly if you imagine a future where we've got maybe to 2050 – to put a date on it. Our last coal fired power station has closed. If we're closed then you would think all other power stations have closed. We've got the best fleet in the market. So in that low or no carbon future if the market and the community desires to get to that point, what you're starting to talk about is a market where you've got anything up to 100% renewable energy. So then you go okay, if I want to get to 100% renewable energy, once you get past about 35% renewable energy – and this is 35% of demand – it stops becoming a discussion about capacity and starts to become a discussion about how do you time shift energy into other periods of the day. And that's a really important thing to think through because if you look at what's been happening on the political scene even here in South Australia, despite all the challenges that have happened here in the last couple of months, the Government has not backed away one iota from their 50% target. And other State Governments, Labor Governments are certainly focused on that as well. So if we desire to get past that 35%-ish level of renewable energy, we must have storage. You can't get more demand satisfied. This is different to capacity management. You can't satisfy more demand without time shifting renewable energy into other parts of the day. When the sun doesn't shine and the wind doesn't blow you need to move your energy around. So if you think about then what's that really big discussion it starts to say that what we need to see large amounts of storage starting to be introduced into this market if we desire to get to beyond 35%, 50% more renewable energy. That's got to come with an awful large amount of storage to time shift a lot of renewable energy into other parts of the day. So think about a world where you're closing down all your coal fired power stations and that big end of load. What are you going to do?

To put some very rough numbers on it, and I'll use big rounded numbers to make it easy. The NEM load at the moment is a bit under 200 terawatt hours. So I'll just use 200 to keep it simple. I know it's a bit less than that. 200 terawatt hours. If you want to supply 200 terawatt hours of renewable energy, you need – again in rounded terms – maybe a hundred gigawatts of renewable energy. So again, to put that into perspective, the NEM currently has I think, about 15 gigawatts of RE. And Damo estimates that we might put about another 10 gigawatts onto roof tops over the next 10 or 20 years. So you can muck around with the numbers and move them up and down a little bit but it says there there's anything up to about a 75 gigawatt need of RE, if we want to get to 100% renewable. But the other thing that comes with that is you need an awful lot of storage to shift that into other periods of the day. So what we're starting to think more and more about is how does that world look. Where do our old power station sites start to transition to? We can really start to see a future for some of these sites where you start to think about well, what's a good place to put a lot of storage. Somewhere perhaps where you've got an awful lot of transmission and interconnectivity already. Some of our old sites really start to make sense where you can put a lot of storage there. You can start to maybe use them for more renewables but also what you start to do is you think about through that transition, does that transition go via gas or what role does gas play? Or do you go straight from coal to renewable energy? And I personally think if we desire as a community to get to anything like 100% RE, in Australia with the price of gas the way it is, we'll go directly – more or less – from coal to RE. Big gas, big new gas will not replace big coal. There may be some parts of the market where it makes sense. Even here in South Australia where we're looking at some peaking, but in a really big way that big volume that we're talking about, what I think you'll start to see is that paced closure of coal matching the paced building of RE and the bow wave of how that change will occur will be all about the cost of RE – sorry, the cost of storage and how much storage are you getting into the market, the time shift of your RE to enable your RE to be built as your coal starts to shut down.

Andy: Yeah. Sounds right but there's a lot of details around it. But the great insight is that what is the role of gas going forward? Who's going to invest in large gas plants to replace large coal? What's the cost of these various technologies in decline? And the advancement of storage? Now we think storage, we're not just talking about potentially batteries but there are other things. Pump storage, mechanical storage, chemical storage which is batteries, but of all those pieces, none of those other than pump storage can effectively time shift. And it really depends on the economics. Batteries right now are just – the chemistry and the material science of batteries will ultimately give you confidence that we can get there, but right now there is very little economic time shifting with batteries. And this was one of the big challenges with people like GE where they didn't want to be in the battery business because they thought it competed directly with their gas turbine business, and even they now have made this move because they're recognising this change. So it does do a few things. It gets us indicating what we think are the right

things to get smart about. Our desire to being responding to this battery EOI is part of getting in there and building those competencies and fighting our way better. It's also the way of looking at a site like (25:32)[Torrens] where we know this is a critically valuable site. Well, what's going to be here when it's time to actually start seeing individual units at A station close? So there's a lot here to this and it all goes to this question but how we're positioned, how we're thinking and what this transition look is like. So we're doing a lot of thinking around it and hopefully in combination with the work that Elisabeth is driving on the new energy front, which is much more they – what Brett was talking about was the big end of town – is sort of the small end of town. So it'll be a lot of these things across the board we're going to be looking at and a lot of the things which will then of course take policy guidance and which is the type of thing that Tim's working on. But that's where we're thinking. Go ahead.

Audience: So just following up on that Andy, can you give us a little bit more detail? Some numbers around that transition and what's the cost of electricity that comes out of batteries and the cost of a new gas peaker?

Brett: Maybe I'll get Tim answer it but the short answer is we're yet to really start to model all this out. It's about starting from a base that imagines a future with 100% Renewable Energy and work backwards. You know, how will you design a market to make that work? As I said at the beginning there, the bow wave of it will be the cost curve of storage. And so as storage comes down, that enables – storage becomes more and more economic. And as Andy said, there are many forms of storage that could supply that need. As storage comes down, that's what will enable more RE to be built beyond that kind of natural cap. Call it 35%. You could maybe do a bit better if you really design things a bit better but there's a natural cap there without storage, so cost of storage will inform pace of storage will inform pace of renewables will inform how quickly you wind out coal fired or how not quickly, depending on how those numbers work. That's still ahead of us, as to how do we work out and how do you start to estimate of what might be a decades-long change that grand transition in the energy economy.

Tim: The only other thing I'd point to is in the carbon constraint future report we did last year as part of our sustainability reporting suite, we did a whole bunch of modelling and it links a lot of the stuff that Ian was talking and Brett and Richard were talking about. So if you think about storage and peakers, they're not really substitutes in an economic sense. Where storage is very valuable is all the stuff Brett was talking about. Sopping up all of the excess renewable when you don't need it and putting it back in when you do. You can't do that with a peaker. A peaker's really only useful for kind of meeting peak demand so they're not perfect substitutes. And what the modelling shows is that in the very long term – to Brett's point – you've got to make a bit of a call around what's more valuable. Storage or peakers or others. But over the next few years you've still got lots of incumbent capacity in the market that can fulfil the duties of matching renewables before you have to get to the point where you have to make a decision about whether you're

going to go with the substitution of existing plant with peakers or storage or whatever it might be. So for the foreseeable future, it's a manageable transition but there's going to come a point - whether that's 10 years, 15 years, 20 years – where you're going to have to make a call about the economics of storage versus other technologies. But certainly for the next foreseeable while what our modelling shows is that there's plenty of capacity that can complement those new renewables coming into the market.

Andy: Just a close about this part of the conversation. Elisabeth, little batteries is just smaller big batteries. It's all chemistry materials. The only view that she can share in terms of what you see the technology evolution and where that may all be going –

Elisabeth: Yes, it's really exciting because as Andy mentioned and Colin mentioned on the tour as well, advances in material science and chemistry are accelerating. And so as a result we're going to be seeing a movement beyond lithium ion into other types of – say Magnesium and other types of chemistries. Also water. Just water compounds and different types of ions that take away some of the concerns when you're talking about consumer level technologies. So moving away from high combustibility into more steady state type of chemistries that are more easily utilised for consumer residential purposes. And so as the cost comes down, as different types of manufacturing also improves, that also is going to change the availability. We're looking at some really interesting types of companies and all over the world actually that are really pushing the envelope out of the lab into what's going to be possible. And so what's important too is what's been mentioned is that the physics principles are the same. Whether you're talking about very large types of spinning machines or you get down into very smaller types of devices, you still have to deal with voltage, you still have to deal with frequency and reactive power. So because of that, that's where software also becomes really important because if you want to make these batteries actually address edge-of-the-grid needs such as, for example, frequency control, you're going to be able to have to have faster and faster and faster management into real time operational management of those types of grid-edge types of devices. So the convergence of software management systems on top of these types of – whether they be batteries or also your smart inverters for solar – we've just proven for example, with our South Australia virtual power plant we're able to test in real time the ability to do six second off casts, for example, for the frequency control. We just demonstrated that in February successfully with the small group of batteries that we have already operational with the VPP. So that's a software layer on top of that battery system. So that's what's going to become really, really exciting because as you heard on the tour you have to have flexibility. You have to build it to ramp up and down. And so these new types of technologies combined with software give you that type of instantaneous control that ultimately we can aggregate large amounts of them. Then I can hand them over to Richard and they can actually have value in the national energy market.

Audience: Can I just maybe dive a little deeper into hydro pump storage because I guess-----

Andy: Dive into hydro pump – clever.

Audience: Yeah, that wasn't intended. It's obviously, effectively a battery.

Audience: It's storage.

Audience: It's as good as a battery. It's storage. It's a proven technology that exists. Batteries are great. They're coming. The costs are coming down. All these things are awesome. Today as we stand, 100 megawatts is a big chemical battery, 1000 megawatts is a not particularly big pump storage. Can you maybe just share some thoughts on - AGL owns some hydro. Obviously Snowy Hydro's enormous. What role hydro pumps might play and maybe if I could just follow up the risk that Snowy undermines a business case in chemical battery storage.

Andy: Given that there are a lot of different pieces of that and we're just going to think out loud, alright? I think one of the challenges – and look, pump storage makes sense if you have a lot of very low cost stuff like water. Pump storage had its beginnings in terms of the too cheap to need a nuclear. And when people had a lot of nuclear plants they were thinking about pump storage as a wonderful alternative, so then this is not new technology. The challenge that you have is you have to find the right typography, the right resources, right? And so you can't – there is a limit to where you can do it. And pump storage at Snowy – and I don't know enough about the Snowy Scheme but there are other people here who do so I'll let them talk to it in a minute – is probably very practical, alright? In certain ways I don't know all the configurations but yeah, it probably is a good ad given the future that we're talking about. I'm not talking about the risks of development. I'm not talking about the costs of development and all those other pieces but if you have the ability to bring that level of pump storage into a system that's going to have large renewables, I think it could be an effective piece to the system overall. That's not a common on what it means to our business per se but it seems to make sense and resonate. I think in the same period of time where you might be adding in the additional pump storage, I think at that point you're going to see very efficient and effective chemical storage. Batteries. Maybe even larger – because you also have compressed air. If you had the appropriate empty caverns of other things and flywheel technology believe it or not, it's always advancing a little now. I think the biggest one is a couple of megawatts in terms of flywheels. So there's a lot out there but I think the limit for pumped hydro is literally having the typography and the resources. Now Doug can talk to all hydro or someone after him because we've actually asked the same question internally. So let's do it this way. Let's start with Doug in terms of about our hydro resources, go back to Richard on implications of the Snowy Scheme, and Stephen, you might have a view since you spent some time at Snowy. So why don't we just maybe have 3-4 cuts at this thing, starting with Doug?

Doug: Sure. Maybe I'll just define a couple of things around pumps.

Andy: And I'll also say if you disagree with anything I say, say so, because I was just thinking out loud.

Doug: Pump storage really relies on a couple of things. A change in the price being a peak volatility. That's important. But also, there's some mechanical and electrical implications. So if you're a boat owner, you'll know your propeller on a boat is really designed to go for forward propulsion and if it's really well designed for forward, it doesn't stop really well because it's not really good at going backwards. And vice versa, if you get one that's really good for stopping your boat, it's not as efficient going forward so you use more fuel. So that's just – a hydro turbine is really like a propeller. So it takes water, gets spun by it as the water goes through and it generates electricity. Instead of putting steam through it you put water through it. And it's shaped and performed for the available head. And so what the issue with that is if you don't ask it to pump backwards, it's not going to be very efficient. So you have to have it designed with that in mind initially. So a lot of the machines we have do not have that sort of initial design to make them really efficient to go backwards. So the next option is where you install a pump in parallel to it to pump back efficiently. Well, that's a cost to do that. And then in the topography that we have, the further complication is you want to have a vertical arrangement where the upper pond is virtually on top of the lower pond. Our issue is a lot of our ponds in the upper are also off to the side so we have a lot of head loss or friction loss through the tunnels and the piping systems from the upper to the lower pond. So you have the inefficiency of the pumping system and then you have the piping or the tunnelling system which creates further inefficiencies, so it starts to become not all that economic in many circumstances. That's the challenge that our particular hydro assets have.

Richard: Just onto the market. Impacts. Obviously, it's a very big battery so it is a comeback. It's the batteries. And obviously, with them competing on price. In terms of market dynamics, my understanding the proposal for what the Snowy Scheme development's going to be is not new energy. Now South Australia has had a capacity problem hence it's had blackouts. The rest of the national electricity market hasn't had a capacity problem. Yes, we had Hazelwood finally go offline yesterday but even Victoria really doesn't have a capacity problem. It actually has a shortage of energy problem at the moment. Brown coal is disappearing. Black coal is in limited supply in New South Wales and nearly 15,000 megawatts of gas generation, they've suddenly discovered it's fuel price has tripled. So the price rises we've seen on the east coast have been driven by energy and the Snowy Scheme expansion is pump storage. As in, it's a net consumer of energy. So in terms of prices, it's not a solution at the price level. It is a solution about building a target of large renewables into Australia because as Brett pointed out if you don't have that storage, a lot of renewables and that's been wasted. That's why if anyone was looking at the market yesterday you saw negative prices through South Australia because the wind was

blowing and we had basically electricity produced that was worthless. People were paying to get rid of it. Now that's the economics of a battery because if you find somewhere to store that, you bring it back later. That is obviously one of the major proposals for storage. If you are going to the 100% renewable, there's room for a lot more of that because there's not the topography in Australia to create that amount of pump storage. I think the only other feasible pump storage that I know about of scale is in the hydro Tasmania. And you've also got to remember nothing's ever perfectly green. Most pump storages in topography, topographies are mountains. Mountains are National Parks. People don't like digging up National Parks. So even pump storage in itself, it's old technology and it can be put in place but you've still got to go through the local environmental issues of building these sites and getting them up. Yes, it will compete with battery. If you're going to 100% renewable, the space for that and other batteries – because there's just not the level of pump storage sites in Australia to manage 1000% renewable future.

Andy: Stephen, anything on the Snowy project?

Stephen: Yeah, I'll put maybe a practical thing on it. So Snowy has already got 600 megawatts of pumps on Tumut 3. What Doug referred to as the underslung ones so they're actually sitting at the bottom. I was there for five years and the five years I was there I don't think we ever used them because - Doug's right – the price differential wasn't there. But I think that's changing. And so I think at a very practical level, I agree with both Brett and Richard in the longer term. I actually think it quite makes sense. It's another storage device but it's not the only storage device. It wouldn't be enough. If you go to a big renewables world, 2000 megawatts of Snowy pumps won't be enough. They'll be able to absorb some of the massive amount of wind that would blow or during the day some of the sun, so I see them as part of the solution. I don't think they necessarily compete. I don't think it's pumps or batteries. I think it's – if we were going to move to that level of renewables, there's a massive amount of genuine storage that can move electricity around between when it's produced and when it's needed. And I see it as a practical solution.

Andy: So we'll go here and then we'll go over there. Start here and go over there.

Audience: Can I just ask, it's hard to make sense of the political landscape at the moment but one thing that appears to need to change is some exposure to peaking prices and reducing prices to actually shift demand or see consumer shedding. And I'm wondering – there's two parts to this question – is that foreseeable and 2) how does that change the profit pools? Will I as a solar generator actually get exposure to that or will that be held by a retailer?

Andy: Yeah, I think we could take a lot of different pieces of this and so who wants to take the first one because I obviously could talk but –

Richard: Just on exposure, one of the things we've been pushing is metering solutions at half hour level. So clearly, where they don't meter, no, you're not going

to see any exposure of that because you can't measure it. So number one thing, power of choice and allowing half hourly meter at the household level. In terms of price shifting customers, again, the customer can see some of that but remember it depends on storage. And I go to Queensland as an example. You're actually seeing the price is getting hollowed out in Queensland or be overlaid now by the rising prices but getting hollowed out because you're bringing a lot of solar into Queensland. When we looked at the blueprint for South Australia, the reason we looked at solar for South Australia was wind is hollowing out South Australia, not renewables. So the diversification of renewables between wind and solar pushes up your 35%. You can install in any State now. The problem with the household solar exposing do I make a fortune out of my solar panel, well, as more renewables come in you actually become part of the problem not part of the solution, which then goes to your Tesla power wall is unfortunately dumb. So if you've got a smart battery installed by AGL, then you get to be part of the solution because you can time shift in the market. If you've got a dumb battery, all you're actually doing – shall I call it Tesla, just called it Tesla dumb – you basically just at your household level, I've got solar. It goes into my battery. My solar is not working. It comes back out again. That's why we're pushing the virtual power plant because we want to say our wind farms are pushing out a lot of energy now and the pull price is -50, where do we put the energy? It would be really great if it's on all our customer's homes. And that's why you get smart.

Andy: We'll go to Elisabeth in a minute but I just want to do the pick up on this because there's an element here that I think is – we seldom talk about which isn't about our business but something else that facilitates this, and then we'll go to Elisabeth.

Tim: I guess if I think through as a consumer, what's the thing that's going to appeal to you? It's largely these opt-in demand tariffs that the networks are now moving towards courtesy of the power of choice and so a cost reflective tariff push forward. The reason I think it's so important that consumers have that opt-in demand tariff is that a little bit like large scale generation. We know that investors don't bank new projects on the basis of thirty minutes' spot data. They want a long-term view about what the price is going to be. Similarly, as a consumer if you're wanting to put in battery, solar, these types of products, you're not going to want to think every half an hour I've got to sit there and work out whether I push the battery in or out. So opt-in demand tariffs actually make a lot of sense. Relative, certain price, and I can extract that arbitrage. So I think that the spot market is going to be a beautiful for efficient dispatch of all of this equipment as per the VPP and these types of things, but to see this world really take off it's one of the reasons why we've been so keen on getting these types of demand tariffs in place. The networks are gradually shifting into that world and I think you're going to see more and more people taking them up because of the very types of technology which our new energy business is focused on.

Elisabeth: And so part of building on the dynamic terrace or important is that it gives customers choice to optimise their type of technology to what's going to make sense for their own household. Because every – whether if you have a large family, for example, you're going to have a different load shape and profile than if you're a single individual in a smaller home. So one of the things, building on the importance of dynamic prices and you can see this - for example, in California where I came from most recently, the demand tariffs that existed in California really helped drive the adoption of batteries. And what that did to your question, it enabled customers to start participating. They're able to get direct value from their solar and their battery system. And so we're seeing for example, real live data with our VPP where the use of the battery with the solar is not only able to smooth a curve for the benefit of the network as a whole, the system as a whole but also then the customer is able to actually get approximately 550 per annum savings off their bill. And what consumers want is predictability. They want to be able to say "You know what? I don't have to worry about what my bill's going to be." They know what it's going to be. They can live in their budget and so that ability to both smooth and provide a network benefit and time shift but then also have the predictability for your household budget, it's a double bottom line benefit. It's a double win-win.

Audience: Yeah, g'day guys. Maybe apologies in advance for asking these two questions but can I maybe get the manager and team's reaction and thoughts on what we should be expecting out of this ACCC review and also, I guess, since Mr Fitzgerald is here, can we get the kind of scenarios and points of contention on the AEMO South Australia review and what we might expect out of that, if that's okay.

John: Sure. Thank you for the questions. So as far as the ACCC enquiry is concerned, I think it's still early days. We have had a good look but a preliminary look at the terms of reference and it's clearly a very broad ranging enquiry as reflected by the fact that the ACCC have been given 18 months to look into it. What I would say is that as an organisation and in fact, as an industry, we've had a repeat engagement with the ACCC on a range of matters. Most recently the gas market enquiry last year, so it's far too early to speculate on certainly any outcomes there. We certainly know what to expect in terms of time and cost and bandwidth that we'll need to respond to it but in terms of outcomes, still a long way down the track, I think. In so far as the AEMO report is concerned, yeah look, we've had a good look at that report over the last couple of days and as Andy said earlier, we don't agree with all of the conclusions in that report certainly. What you're looking at there is a very complex, probably even unprecedented set of events which occurred on 28th September over here last year, so it's taken four goes for AEMO to understandably reach its conclusions. Now as I say, we don't necessarily agree with all of them but what I would say though is – and these are – for us, these are the key points that come out of the report. Our wind farm is operated in accordance with their design on the day. The report also supports the conclusion that they didn't operate other than in accordance with the performance standards. So I'm talking about the NEM rules,

the NER as well as State-based requirements as well. So they're very important points, I think, to come out of that report and they are certainly conclusions that we do agree with. As to comments that we don't agree with, probably I prefer not to go into that in great detail at this point because you'll understand there are other enquiries that are still pending including the upper house enquiry over here and the AER still has some work to do on this as well. Yep.

Lisa: I might just add to that, there's actually ten enquiries at the moment into the energy industry and I'd say the upside of ten enquiries is that at least there's mechanisms to air some of these things, so some of the policy objectives that we've had for some time that Tim's talked about, firm capacity, orderly closure, they're being aired. They're being considered. Certainly the Finkel Review. You had all energy ministers agree on the need for that Finkel Review so we've got an opportunity now to really have hopefully a united approach in what reform needs to happen. So and similarly with the ACCC enquiry, it's long. The scope is broad but we've got an ability to really put forward some of the things that really demonstrate how you need competition and actually the Minister in talking about that ACCC enquiry did say that we do need the competition. We need a competitive market in order to have the innovation and the technology. And one thing that all the Governments are united on is the need for that innovation, the democratization of power.

Audience: How does the Pelican Point deal with the Origin sign yesterday help solve all those security supply issues that South Australia has? It gives them gas. It gives them capacity-----

Andy: Look, all the microphones have gone to Richard.

Richard: Shall I answer this one, I think? Solve is bigger than publican second unit coming back in but it obviously is a huge help to system security in South Australia because you've got a thermal unit that looks like it's going to be on and running over a sustained period of time, helps provide inertia into the system. Stability into the system. So I would presume, although I can't talk on behalf of the South Australian Government, they'd probably be very, very happy that that occurred yesterday to get that done. The other important thing it does for South Australia is bring fuel to South Australia that's been lacking into this marketplace. So you saw Pelican switch on last night. No, the night before. It ran two units through most of the day. It started making use of that fuel it's got made available to it. I said advantages for AGL is at least it frees up fuel that we were expecting to burn at Torrens B with extra generation coming on Pelican so that should be quite helpful to us in our gas portfolio because it should back down B, being the most intermediate plant in South Australia and free up some gas from that.

Audience: While I've got you Richard, can we talk gas market? So you said that I guess, the gas market is looking short this winter. You've said that there's not enough gas to supply industry and –

Richard: Very careful, I didn't say that.

Audience: But – okay.

Andy: Well, we'll pass with that and then you can respond to that.

Audience: How short do you think the market is and what does a shortage look like this winter? It is just like a pro-spike? Is it electricity prices? What does the shortage actually look like and how big do you think it might be?

Richard: I read my Hansard very, very carefully. What I actually was saying at the enquiry was the market is short of gas on a contractual sense. I'm still of the strong belief that there won't be a shortage of molecules in pipelines because I'm pretty damn sure – especially after a good talking to from the Fed's – that the LNG suppliers will let molecules flow south. What I was talking about from an AGL perspective, and I think others are in the same boat as AGL – is for AGL to quote business customers, the knowledge that knowledge that molecules will flow isn't that comforting. You actually need to know the price at which the molecules will flow, which basically means you've got to contract for gas. So without the LNG players offering contracts to gas in the marketplace, then it becomes very, very hard for AGL as an entity to price to customers. And I think a lot of those questions stem from a company called Ace Metals in Dandenong claiming that we were charging them – putting the price to them at \$20 a gigajoule for gas. And when I answered said yeah, that was the price we put to them which is – I'm not allowed to use the word – a large price compared to anything they've seen before. In essence though from an AGL perspective because we didn't have the gas in the portfolio, we've made a very conscious decision not to price new customers in the gas space but to price all existing customers on a retention basis all be it at a very, very high level and take a position that we will be able to buy gas through the market and contracts prior to winter. We note that some of the other suppliers haven't taken that approach and have actually completely backed off supplying any quotes to customers even their existing ones. I think Origin is the one with spare gas in the portfolio that has been picking up customers in this space but the market is very, very tight for gas so we actively are taking a view between this site here that burns gas, how much contracts do we put out to South Australia from electricity versus how much contracts we put into the business customer space. I would also pass comment that since we made the statements at the Senate enquiry, AEMO put a statement out about gas markets. Then the Prime Minister had that conference with the LNG players. I'm reasonably confident the LNG players will be offering contracts, and I note that Shell has been advertising for a trading team based in Melbourne to actively trade in the power and gas markets. So I think sometimes with those gas players – and I think it was the

comments I made at the enquiry – they're very focused, their joint ventures are very much focused on getting their joint ventures operating and running rather than seeking short term opportunities to make even more money because it really is a game of getting them up and running and delivering on their core products rather than trading in the market. Hence, I thought that molecules would actually flow when it came down to it. I think what's occurred over the past month or so is probably a bit of a kick and now they're very, very focused on making sure not only the molecules flow but there is availability of contracts all be it at prices quite high.

Audience: I hope I'm not hogging the questions, so I'll try to be a bit more positive this time. You've got the battery tender in South Australia. The 100 meg and you've confirmed that you'll be looking at it. I don't think you've confirmed that you'll be bidding, but please correct me if I'm wrong, but I guess if you did bid, how do you not win given that you'll have the opportunity to manage that battery within your fleet against your customer electricity. You'll be able to save money on gas. You'll be able to make savings here. You'll have the grid connection here, so how do you not win that option?

Doug: Yeah look, we're certainly in the middle of getting all the stuff together but it's a pretty fluid area right now and somebody asked the question what pricing of storage. And we saw an immediate price reduction over Twitter a couple of weeks ago and so it's literally that kind of fluid. And people are trying to make their mark and developing batteries as a viable cost effective storage and I think it's commercial today almost. And so it's really on the cusp and I think there's a few places where people can have some advantage and I do believe AGL has advantage here. Having said that, there's a competitive process and who knows what anyone's going to do out there.

Andy: Yeah, I think that last point and have lived for quite a while in the development world, what I can guarantee everybody sitting in this room is that we will always be very disciplined and rational whenever we participate in something. What's rational for other players as they bid is totally different and a lot of times what you find is that there are a lot of other reasons why people put in offers that just don't seem to be something that we could do. So should we participate we will do it in a very rational and sober way because we have a lot of things to consider but there are other people that this could be their thing and they've assigned tremendous strategic value of some kind that we don't see and therefore they do something that we can't do. So that's how – should we participate, how we can wind up not succeeding but we're always in it to win it.

Audience: Can I just ask, in Torrens Islands case, you've talked about batteries. You talk about the fact the plant's not being run like it was meant to be run. Does the economics stack up just to replace 1-2 of these turbines actually with your aerodynamic turbines like your blueprint irrespective given this is really an efficient

use of gas, given you need 2 hours to respond to a market signal as opposed to 2 minutes?

Andy: So let's talk theoretically. Let's go back a day before South Australia came out with its energy plan and how we would have thought about that exact question. I don't know who wants to take it. Richard, because this comes down to efficiencies, speed of recovery. Go ahead. But again, we're saying this on the basis – this was the world prior to the announcement.

Doug: So efficiency I think, is more important now that it used to just be capacity. And you have a gas turbine to run a peaker, you didn't necessarily care so much about efficiency. I do think the evolution of the market, the pricing of gas, the thought about emissions profiles is becoming more important. So efficiency does matter. Turn down matters a lot and so it's trying to find the balance between turn down emissions performance, efficiency and speed to market. Balancing all those things will drive your decisions and so we're trying to find the balancing point of that right now and then the cost cap gets into it, so out of the economics work and then a review of risk in the market. So it's not just easy doing efficiency calculations I can save 10 tjs a day and therefore I should put this is versus that, and so it's a very complicated model but when we look back at it we think we had a winning formula that would achieve the right kind of metrics across all of those indicators a day before South Australia plan changed.

Richard: Just the way I was looking at it from a market perspective, flexibility is king. That's why small aero derivative dual fuel units were the preferred option. You think of it from the portfolio perspective, we've got a fairly large wind portfolio customer base in South Australia and Torrens. Torrens, despite its age it's a brilliant unit for South Australia because it's got very, very low turndown. The perfect turndown is down to zero, so when the wind is blowing really, really hard, pull prices are very, very low or negative, you can just write that rather than writing your thermal generation. So the compliment to that is the aero derivatives and the back and forth between myself and Doug was over start times because the idea would be you actually completely switch Torrens off on those high wind days and just sit there with a fleet of aero derivatives you can start very, very quickly as you can see wind tail off. Or a battery. And that's where you got to the blueprint without a battery for the first 5-10 minutes, start up your aero derivative, come in, perfectly fit. And that's also balanced between why dual fuel. If you're looking at diesel, \$150-\$200 per megawatt hour price, you wouldn't naturally want to run with that fuel but the ability to switch between gas and diesel can actually save on your haulage costs because running a power station if you're purely on gas, if you actually want to run it when demand is incredibly high you need to book haulage. And that's a fixed cost. It just sits there. Now if you've obviously got the opportunity to dual fuel, then you can actually better manage your haulage costs through the business. So flexibility was key and then there's a push back, aero derivatives probably aren't as efficient in the use of gas when they're actually running compared to a big open cycle plant that can

get greater efficiency. So you're always playing between that flexibility to efficiency. But that's in my mind where we got to the aero derivatives. Obviously, when you look at replacing plant here flexibility will be the key. Gas plants have been built on Australia because gas has been a waste product. It's been abundant and cheap. Any gas plant that gets built in Australia and in the future, is going to be buying a premium product that's not cheap unless suddenly someone discovers new very low cost gas that can flow into the Australian market. They're going to have to be very efficient with their gas usage and very careful how they use it which was why the flexibility was a key in looking at what assets we built.

Audience: Richard, just a follow-on question on your gas portfolio. You mentioned that you're only quoting for your existing customers. Should I expect you flagging that you'll lower your market share from here? Or do you think you've got sufficient volume now to hold market share at this point?

Richard: In the resi space, we will most definitely maintain share. We've got more than adequate volume in the resi space. And I go back to a little bit of hit through the gas market. Gas market in Australia has been characterised by some very big, very large long-term contracts that were very, very cheap. And AGL's problem over the years since I've been here is a gas bank problem. How do we get rid of gas? So we've been very deliberately picking up market share in the C & I so we're not left with a take or pay problem on gas for so many years. Now we took a very practical view on our portfolio when it came to the C&I space in that we didn't want to lock in high price gas in the hope that we could sell it to C&I customers. Now if you manage the portfolio in hindsight, those decisions would be always perfect. Perhaps we'd have bought some more but in the choice at the time, locking in larger volumes at historically high prices in the hope that then you'd sell them onto customers and make more margin, we decided to pull back the volumes that we purchased for a C&I space which then got eaten more with – think of a Torrens generation. But the C&I customer base will ebb and flow as gas becomes available but the C&I customer base, it's not a market share war. It's a margin play. Always has been. Whereas a resi base has always been the focus and making sure we've got sustained good quality portfolio. We have to manage our portfolio a lot tighter in picking up gas because gas is expensive. If I came to you now and said "We've picked up 20 years of gas and we're paying \$12 a gigajoule for it. Don't worry, we can sell it," I'd see a lot of sceptical faces in this room because the real risk would be that you go back to a \$6-\$7 gas market and we're left stranded with it. So we will be managing the portfolio very tight and buying as we go and where we can buy to make money to supply to C&I we will do.

Audience: A question folks on the demand side of the equation. You've seen massive jumps in gas prices and in electricity prices. In the retail space, how do you see that price sensitive to your customers and focus on putting more solar on roofs and what that means, and then also in the C&I space, what share of that market do you think is in distress and at risk of closure and that in mind going forever.

Andy: Stephen, maybe that's for you.

Stephen: I guess the second one is a question we can't answer because we would need to know the full ins and outs of the cost of production, the flexibility to pass on price increases to customers. So all I can do is anecdotal. So I can attempt a really hard analysis. Do we really think you need to know inside those businesses and their marginal costs and fixed costs and flexibility of their sales and all those sort of things? So anecdotally what I can say though is that clearly, it's causing a lot of angst. So clearly, their discussions with customers are much, much longer and much, much harder. What I would say though is that customers do understand it's a market issue and I don't think tie it back particularly to AGL on the C&I space. I mean, there's been enough investigations into the market and people weighing in on the market to know that there is a genuine shortage of contract of gas as Richard talked about. So whether or not they leave permanently. Is it going to be that dramatic? I don't know but anecdotally their certainly thinking about it hard.

On the retail side, from electricity in particular, the interesting thing there is that we're still seeing as we've been showing for the last 3-4 years now that the initial fall off in demand that happened when it began around about 2011-2012, where we had 6% down, 5% down. Flattening of that has continued. So we were down – adjusted I think it was 1 or so percent when we last reported to the market. That continued flattening of that is happening and I think there's a couple of reasons for that and I'm going to break it into 3 with the third one the hardest to determine. The biggest one dropping initially was the big influx of residential solar and that happened for two main reasons. One is very generous feed-in tariffs and secondly, the best roofs facing north for the sun were all taken and you saw that big initial influx. As the feed-in tariffs have fallen off and that low hanging fruit finished, we've seen that fall away and you're now starting to get into high rise housing and into rental accommodation. With that there is just not the same incentive to put on solar. The second one was around efficiency and go to the pink batts scheme, the new housing stock. That one will continue, but go to that whole changeover to LED lighting. Again, that has happened as time's gone on and I think the low hanging fruit's finished there. So that takes me to the third one. Are we just seeing an outright customers are voluntarily saving, not putting on their air conditioning, putting their air conditioning on to 24-25 rather than 22? In summer, those types of things. I would say anecdotally, we're still not seeing that. The previous charts we've shown you is the fall off and demand has flattened adjusted for the weather. I think it's speculation as to what happens in the coming periods but that's the way I see residential and C&I.

Andy: The question was asked before around demand response and we talked – I think one of the challenges that Australia and the economy has come off a very long period of relatively low cost energy. Whether it was taking advantage of brown coal or waste gas in search of oil. And the fact of the matter is that while we're seeing this very steep and very quick rise in wholesale prices, eventually that should taper as you reach the practical cost of new entry and you can have any view of what that

is, but those prices of the large scale renewables will come down and will moderate somewhat. But the fact of the matter is you're never going to get back to the same prices. There's no – we talk about affordability. The affordability means something different than low price and while there might be great nostalgia, the return to the prices around which industrial and commercial processes were designed and the end-use equipment and things in homes will change. And there has to be a new sort of equilibrium. So demand response will become more important. End use efficiency. Other things, and that's going to take a while to get through there but it's the reason why we're spending so much time in the new energy space which is to find that new optimum. Now there's a question. Does aluminium smelting belong in Australia given where energy's going to go? And do other commercial processes have to re-optimize through new technology to maintain and get the energy productivity that they need not necessarily the question of low cost and efficiency. And these are big questions. And just to show you the tough struggle, when we went through that heatwave and we exercised our commercial rights on the agreement, it was potentially to curtail a large consumer. It was like the world was coming to an end even though that is an extremely efficient mechanism from the system perspective and it was a very clear right under a contract. These are very difficult challenges, and so this question of noise and political debate around things is going to be very significant because the fact of the matter is it has to be a new equilibrium reached and that is going to cause disruptions. And that's where I think we're sort of at that point and some more of that is to come. But I do think you are going to see more in terms of demand response, end use efficiency, end use investments, not only with the commercial and industrial level but at the residential side too and that's something that we need to be involved in. To Stephen's point about rooftops the most active component of solar right now is the C&I space but also remember the challenge that renewables for the most part sort of create energy on a square footage basis. We consume it volumetrically which is very important, and that's why when you look at this two-dimensional picture of a boiler. That's a volume you're looking at, and we're producing things when we have those kind of plants volumetrically. Renewables, whether it's wind or solar, is on square footage. And so when you think about the mismatch between the way we consume energy in volume and the way you produce it with renewables, it does raise some very, very interesting questions. The other question that a renewable future raises which I don't think we've wrestled with yet at a policy level is that once there's no more energy left and it's all capital that's gone in, who bears the load risk? How do you think about the system? So there's a whole level of new policy and regulation that has to be dealt with. Right now we think the struggle with renewables is how do you integrate it into a system that is mostly not ready for the sources but when it's all renewables, it raises a whole another level of regulatory and pricing issues and risk issues that we haven't really grappled with yet as an industry, nor has anybody on a global basis. So yeah, it's a brave new world that we're entering into. So I just want to throw that out there in case you didn't have enough to think about.

Audience: I just had a chance to look at the slide deck here and I noticed on slide 14 you've got a comment about network valuation and you're quoting some guy called Simshauser. So I just wondered maybe if you could give us some colour on what the message is there for us.

Andy: Sure. Tim?

Tim: Which particular one is it?

Audience: Slide 14.

Tim: Oh, so the networks one?

Audience: Yep.

Tim: So the network is really just an observation around two things. The first is – and this is particularly a northern State story, so New South Wales and Queensland story. Everyone in the room is well aware of the very significant increase in capital expenditure on networks between the two periods you can see on the chart. All we've really done though with this particular graph is tried to break down that network component into its requisite sub-network components. And really it's just an observation that with all of the discussion around policy and new energy and substitution of particular types of energy at the household level, there really is an inevitability around discussion of network value. And so we've done quite a bit of thinking internally around is there any precedent around that, and the precedent goes all the way back into the 40's in the States and the market street railway case in San Francisco. But there's also a whole series of principles around the way in which you think about asset valuation for regulated assets. But what it all comes down to is a policy viewpoint. There is no real regulatory measure by which you go in and say "Right, the world has changed and therefore this is the way we're going to think about the valuation of these assets moving forward." So it's more just an observation that I think with the Finkel Review, the ten reviews that Lisa was talking about before, it's really inevitable that we're going to have a discussion around network valuation. And so part of the reason that we're putting this into the policy debate now is to really try and encourage people to think about what could be done in a way that's least disruptive to consumers, least disruptive to the network businesses themselves and give them some degree of clarity about how that valuation of those assets is going to look over time. So we're not really taking a firm view of network values must be written down by X percent. We're really saying this needs to start in the sense of the conversation now because if we don't start it now and we see more substitution of energy at the residential level with solar, the deployment of batteries which means that even though the energy is still being consumed by the household, the use of the network's not really as great as it once was, we're going to have to have that discussion.

And to give you a feel for it – and this is a shameless plug for a new book chapter that there's a book coming out midyear which we've got a chapter in – but – it's \$150 don't get too excited – but what it shows is that for some households, the network charge in an opt-in demand sense would actually be for exporting their energy once they've got their solar unit and battery. So you can see that the world we're moving into, the old way of thinking about network regulation is going to have to change. You've got two issues. You've got the volume on the regulated asset base. And so that's just a dollar billion number. Is that the right number? And then you've got the allocation of that through network charges, and we're moving into this opt-in demand world, but I suspect it's probably going to become more complicated than that over the next few years.

Elisabeth: I just want to add a real-world example. One of the things that gets complicated about this is thinking through the value as it moves closer and closer and closer down to the feeder level. So it's really about locational value. And it raises a question about fairness and equity for consumers. For example, in real world right now, if you have a group in a neighbourhood and you have a whole bunch of solar in that particular neighbourhood, the question is then once you – I'm just going to make this up in round numbers – let's say you have 10 houses with solar. And then you add the 11th, and that 11th house throws the voltage off on that particular circuit to the point where then you would have to actually make a cable upgrade that will cost several tens of thousands of dollars. Who pays for that? Is it the 11th customer or is it then aggregated back out? And so these are types of questions in terms of the cost and also terms of it gets into fairness and pricing that are really important as we think through how we're going to – because customers want to do what they want to do. And so we have to start raising these questions to make sure that not only there's fairness in terms of the end consumer but then also enabling the innovation that competition is all about. And the innovation with these new types of energy technologies really ultimately is about individual customers being able to do what aligns with their self-interest in a way that doesn't slow down the transition to a lower carbon future. And so these types of really important questions all the way down at the locational value of the distribution network become really, really key and it comes back to physics. And so how we solve that and how we price it is going to become a key point in the future.

Audience: With all this uncertainty you've got ten enquiries. Are we at a point where AGL's at a bit of a capital – ability to spend capital with clear vision is actually very difficult? So for instance, it's not a holiday until we get through all these enquiries. And I guess the other thing is you made a comment before about sites for renewables and the likes. You sort of look at your open portfolio and Cooper's Gap is maybe one. Have you actually gone and acquired some additional sites in the last few months or the likes to have more opportunities there?

Andy: Let's start with the first one. The fact is that I think from a political side, that you really have to look through a lot of the noise to get first principles because you

can literally wind up being frozen in these headlights and do nothing. Alright? One of the things that we've been trying to do is we've been trying to sort of set a vision, come up with a policy advocacy and then starting to move and put our money where our mouth is. Now there's certain things that'll keep us from making big bets. As I said, clearly when we look at South Australia and the fact that there's this 250-megawatt gas project that the Government has and says "Well, we're not really going to compete with you." That's a freeze, alright? That makes you think twice and quite honestly, you get some very focused conversations about what would we do in the market against that because that's a very real potentially tangible piece of kit that's going to be there for quite some time. Likewise, if we really still anticipated and second interconnector, that would be something that we wouldn't play up against, but in terms of issues of increase in terms of market structure and retail and this and that, we have a view of those things and we have a way that we would navigate against it and think about it and be willing to pivot as things happen. But we always try to take a multi-cycle view of things, quite honestly, and not to get overly bogged down in the issue or the story of the day. So there's some level of being first principles having a view and taking this view that I think we are coming to consensus with around storage and gas and coal legacy plants and how they'll play out, that will inform the way we invest and inform the skills that we want to build and tell us what we have to get smart in. Now along the way, we'll have hypothesis that if they prove out, we'll do more and if they don't, we won't. So it pretty much goes to this whole issue that I've talked of. Probably the first time I met some of you back in May of '15 when we did our first investor day this anticipatory mindset or at that time what I called the anticipatory culture. Which is that's why we do Snowy or planning and if Alistair Preston was here he could tell you all about our scenarios and how we're seeing ourselves move from potentially one scenario to the other. And one of the key metrics in there were the number of enquiries that we were having. And so we do have plans that depend on our watch tower that's built off our scenario planning. So scenario planning being number one. Intimacy with technology and markets and stakeholders number two, and then everything else is about pivoting. So we recognise that if we don't have the capability to think in an anticipatory way and build that agility into the organisation we would absolutely be frozen in the headlights. So does that mean we're going to get everything right and place every bet right? Maybe not, but we hope that when we place a bet it's small enough that it's not a bet the form type of thing, which goes to this issue and I think we probably talked about it within the last year. I don't remember once about what this concept of agile capital. In this kind of environment, you've got to change where you think about placing those bets and creating options with all the capital you put out there and also ensuring that you're only investing in the least you have to for the impact and what you need. And the portability of that as well. So it's all part of that, so it's really not a question that we're being frozen by what we see but we have to adapt our processes. The way we think and the way we go to market with it, so that's somewhat of a high level the way we think of it. So no, we're not frozen but we're trying in those headlights to cast a very small shadow and that's how we're going

through this. Now to the question of acquire – well, we do have a pipeline of projects that are teeing up for us for the path, and I either – let's start with Brett on this. So the renewables along the path and then go to Doug and anybody else that wants to put in. This is the question of acquisition of additional science and projects.

Brett: Yeah. And I think maybe just to build a little bit on Andy's comments, we continue to buy capital. We do it firmly and carefully. We do it when it meets our investment hurdles. We do it at times in an innovative way. So the path was a good example where effectively we're still enabling the deployment of up to \$3 billion of capital. We're just being thoughtful about how we're doing it. We tipped Silverton in in the last couple of months. Cooper's Gap, when it goes ahead – I'm sure it will – it will be of a size similar to the Macarthur wind farm in Victoria which was – might still be, I'm not sure – the largest wind farm in the Southern Hemisphere when we built it. Cooper's is of that magnitude. So I think we've publicly said that that should get into the path in the third quarter, the September quarter this year and that's all going well in terms of that process. We also though, continue to think about where else we're going to put capital in and sometimes that will scale to the smaller. Andy was talking to that a little bit particular in say, Elisabeth's world, where we're looking at some more technology-based investments. Some of it will be investing within our own systems and processes where we put quite a bit of money allocated towards the customer digital project and the ERP project that just got approved by the Board formally earlier this week. So CXT, the customer project is about \$300 million. The ERP project is about \$140 million. So these are investing in our own systems and processes as well. And finally in terms of developing options, I'll hand it to Doug to talk to but one thing I'll say is as a company, we've always developed options. We've always believed in putting a bit of money in here and there to create options for the future. We may not always advertise where we're creating those options because there's a value in itself in terms of just creating the option and sitting on it but we never stop looking at sites and creating options so that we've got things to put in to the different scenarios of the future as they start to play out.

Andy: Let's go to Doug and then let's end this – the question – where Elisabeth, you maybe talk about some of the sort of investments we're making or your investment plan and road map in the new energy area. So Doug, go ahead.

Doug: Right, thanks Brett. We don't like to talk too much of where our sights are for obvious reasons. We're still trying to get access or development processes going but we do have a number of sites in active permitting already or sites to be permitted in all the regions across the NEM so we're looking actively and we see some really good options in the future.

Elisabeth: So in terms of our strategic road map for investment, as I'll remind you quickly of the framework. We're talking about AGL as a personalised retailer and we're also talking about orchestration as a low carbon leader. And so with that framework, building off of that, there's key categories of technology that enable AGL

to start making that transition in a bullish way. And in a practical thoughtful way, because again – as Brett and Andy have just been talking about optionality is key – we don't have a crystal ball. I wish I had one. So in terms of the personalised retailer space, I will be making an announcement of a new investment coming up shortly so we'll look forward to that. We're really looking at the whole area around connected home. If you think about consumers, they want to be able to really optimise around their experience and their lifestyle in the home and so all of that has an energy nexus, whether it's all the way down to plug load, utilising our beloved smart phones and tablets or if we have kids, the play stations or what-have-you. All those things have a plug load so energy efficiency, energy productivity, how that really connects to lifestyle become important. And then also thinking about your home or also if you're building, a commercial business owner, you want to be able to really optimise your own building and you think about how then that translates into load shape. Through technologies it starts to – does aggregate give you an algorithm like an ability to predict, and this gets into the complicated data science area that ultimately will turn these types of buildings whether they be home or larger scale buildings into again, just dispatch able, visible load and load shapes that again have value up into the market area. So that whole area and around the connected home, it starts with the use case of what really makes that lifestyle magical and practical and relevant for consumers, all the way back into then the technology under-girding it that enables it to be valuable as a potential energy asset in aggregate for our market team.

The next are around orchestration, we're looking at what's called an area called DERM's or Distributed Energy Resource Management type of technologies. So we had a great tour today. We saw the big control room here at the plant. So if you think about that control room and you think about that type of ability to then orchestrate and optimise all these small devices at the edge of the grid in aggregate, we're going to need similar type of advanced type of control room as it were technologies that again make that dispatch able and useful for our market trading team. And at the same time being able to optimise algorithmically the batteries on site for the consumers. And again in real world example, with our Sun Verge investment that we made last year which is part of the software and battery solution with our VPP, part of how we get that customer value is the software is actually optimising the smart control of the smart inverter for the solar system, and the smart battery management inverter on the battery. Managing those two things and AC front coupled architecture that actually gives a double benefit for the consumer and a benefit for the aggregation capability which eventually we look forward to monetising as a whole. So that's a quick summary. It's all how we're looking at investments is all linked together with the strategic framework of where AGL's going to go in the future, so that as every time we make an investment we put that capital to use. That's part of how we're actually moving AGL forward into the future in a way that's going to provide security and ultimately growth for our shareholders.

Andy: Okay, given the time we'll take one – if you have one last burning question. Okay.

Audience: I don't know whether it's a quick one, but I just wanted to ask about the ability to pass through the holes. Top brass has given all the political heat, because I think this slide neatly illustrates it. Potentially the whole value chain has to do better to deliver value to customers. There's a scenario where the networks don't get to recover the purple area but if you drew and 2017 bar there, the green area would be larger. Is there a scenario where you guys don't get to capture the uplift in that generation?

Andy: Let's do it this way. And you're right. That's not a short question to answer but we'll try to give, because it's a critical question. We'll try to do this. Let's start-----

Audience: I guess I'm just trying to ask how close to the sun do you guys think you're actually flying, like.

Andy: Well, our wings aren't melting yet. Anyway, let's start with Stephen with the practical position and then let's have a political kind of broader view from Lisa and then that'll be the end of our Q&A.

Stephen: So I think the practical position is it's simply one of timing. And we can talk about what that timing will be, but unlike – I guess it's slightly different to the networks because at the end of the day, at some point the forward curve has to be reflective of what retail pricing is because that is the price for wholesale generation. How quickly it gets there is a secondary question but if it's not reflective of the forward, then there ultimately would be no competition because that is the wholesale price of energy. But I will agree, at a practical at which I'm very happy to pass over to Lisa on is there are issues. I mean serious issues of affordability, of timing of that, of the fact that can consumers – put consumers into two buckets. Vulnerable customers and we had to deal with that as a completely separate bucket of customers. Those that simply cannot afford, cannot pay. And we have programs for them and we need to deal with them and that's actually a three-way deal between us, the social groups and Government. All 3 of us have to solve the problem of consumers that simply can't pay. It's not up to AGL to sort out that problem. It's known it can't be the social groups and we have to all work with Government. For the customers where it's a matter of choice, we need to make sure there's competition. We need to make sure there's innovation but I come back to my simple point, at some point it's only about timing. If the forward curve genuinely reflects what the output price of generation is going to be, that is ultimately what must feed into the retail price.

Lisa: Yeah, I think certainly the scrutiny is unprecedented so I don't know how hot that makes us. Pretty hot. And as Stephen said, it's now – the vulnerable customers have always been important and AGL's done a lot of work to make sure that we're supporting them. We released the A Fairer Way recently and had really, really good

responses on that particularly around writing proactively to customers on the MUT – Concession customers on the MUT and asking them to contact us to talk about a better deal. But as Stephen said, it's the shift is actually more now to mainstream customers. Not vulnerable customers but mainstream customers and I think industry has to do more to help them understand what's going on, what's happening in the market. I know they don't want to be experts in the market but they at least need to know what's driving up prices, how do I get a better deal, how do I compare. So that's much more where the focus is at and as Stephen said, that is a joint responsibility of industry, Government consumer groups to get there.

Andy: Anybody else want any last piece of that question? I saw Tim you were looking like you wanted a go, so go.

Tim: It's just more that – this is a personal view – but if you want a feel for where it's headed, I'd look at the Grattan Institute's report. And forget all the stuff up the front but go straight to the recommendations bit. And the Grattan Institute themselves, if you were just working out what they were saying based upon the media reports, you'd say "Oh, the Grattan Institute's saying Governments get involved." The Grattan Institute actually says Government intervention may actually make what we think is a problem a worse problem. So I think that what they're talking about are the exact same things that Lisa's talking about. And the slide we've got in the pack around price dispersion shows that the market is actually working exactly the way a market should work. It's delivering second and third degree price discrimination in the exact same way that all markets work. And what that means is high consuming households are effectively engaging. They're getting good discounts and customers that are looking at it going "I've got low consumption. It's probably not as worth my while. I'll spend less time engaging," and you get the according results. So I think the market's working perfectly. It's just a case of addressing some of those issues that Lisa was talking about.

Andy: And with that, our wings are not melting. So we'll try to keep aloft. Let me do a couple of things. First of all, let me thank Karl and the team here at Torrens for giving us a wonderful day.

(applause)

I want to thank all of you for being here to engage in what I thought was a pretty good conversation. Secondly, in terms of following all the rules and safety that we have here because as we tell all our people, we want you to leave the site the same way you came, if not better, which we would hope so. And I also want to thank not only my fellow executives but some of the other folks here that you don't always hear from, and I think that's important for you as well to see the team and have a chance to interact. So before we depart, I'm going to ask James to come up and give you a little bit of logistics on how you will depart. Thank you.

James: Thanks Andy, and thanks again everyone. We'll go out the same way we came in, so the bus is on its way back around. The screen will magically disappear into the ceiling and the blinds will go up. Please mind your step on the way out. There's a couple of dodgy steps between here and where the bus will pull up. You can leave your vests here in the room. I know that you may wish to keep them. They're very stylish but please keep them in the room. Those of you joining us for a pizza and potentially even a carbonated beverage made with AGL Torren's certified CO2, that's at 6:30 at Melt Pizzeria on Waymouth Street in the CBD, so I know some of you are staying here tonight and joining us so looking forward to that tonight. So with that, please, if you need to use the bathroom again, please do so and we'll be out into the bus as soon as you can, going to the airport and then to the CBD.

END OF RECORDING (99:26)