RESUMED **[12.01 pm]**

COMMISSIONER: We will reconvene, 1200 and I certainly welcome Richard. Thank you for joining us, Richard Turner, the Chief Executive Officer and board member of ZEN. Mr Jacobi?

MR JACOBI: Mr Richard Turner is the founder and CEO of ZEN Energy Systems. ZEN was established in 2004 to develop innovative and sustainable energy technologies with a focus on solar energy and energy storage systems. Mr Turner is a member of the Australian Institute of Company Directors and has a Bachelor of Business Administration from the University of South Australia. He has been the recipient of multiple Entrepreneur of the Year awards from a variety of organisation including Earnst and Young's Australian Entrepreneur of the Year in 2010 for the CleanTech sector and we call Mr Richard Turner to the Commission.

COMMISSIONER: Richard, clearly we're very interested in your views of battery technology, where it's going and the time frames, but we'll get to that quite soon. I'm interested in your view in a broader sense of the opportunities and threats in the Australian energy market.

MR TURNER: Going right down to the basics, we have a very big country, a very small population and 50, 60, 70 years ago the mandate was to electrify the states, and fantastic for economic development at the time - great jobs - but we are unfortunately left with the legacy network across this country that is hugely expensive to run, approaching end of life and when we pay our power bills these days, over 75 per cent of our power bill now is reflected in the cost of transmission distribution and retail. So really, only 20 per cent or thereabouts of our power bill is the actual cost of energy, and that's a real issue. In fact, in this inquiry we're focussing on the minor part of the issue, not the major part of the issue.

We could give power away in this country and still be paying a lot of money for it, but we have an enormous economic advantage, an opportunity in this country with renewable energy. We have the best renewable resource in the country, we have the ability very soon in a very short time frame to produce the

lowest cost power in the world and if we can deliver that to our manufacturers, our economy, the transformation that we have the opportunity to partake in, in our economy, could make this country a real manufacturing powerhouse once again.

MR JACOBI: I'm interested - we've heard from another witness, Professor Quiggan, and in the course of his evidence he referred to the relationship between the nature of the types of tariffs that are paid by electricity consumers in Australia. I'm just interested in your view as to the significance of the form of those tariffs to battery systems and the consumers making a choice to install battery systems.

MR TURNER: Yep. Tariffs are changing in Australia in a way that really doesn't favour renewable energy, to a degree. So we have traditionally paid for our power in the amount of power that we purchase. That is now changing to what's been called a cost reflective system, but unfortunately renewable energy reduces the amount of power we consume. Now, if we're going to be charged as a fixed demand method of charging, then the amount that we reduce is not being truly reflected in those tariffs. So we're moving to a system of peak demand charges and off-peak demand charges. Battery systems do give us the ability to store off-peak power and use that power during peak demand times.

COMMISSIONER: Can we refer to I think one of your slides?

MR TURNER: The really interesting thing - - -

COMMISSIONER: Can you walk us through that?

MR TURNER: Yes, so what I've put up there - and we've been a solar energy specialist since 2004, so we understand that market, we understand the capital cost of the equipment well. So the economics of solar energy right now - if we buy power from the grid we pay about 35 to 40 cents a kilowatt residentially for our power. So people who check their power bills will see that amount. The cost of solar power now over 10 years is approximately 10 cents a kilowatt hour, so you're under a third of that cost. Over the conservative life of the system, which is about 25 years - so we're looking at over 20 years - the cost of solar power is five cents a kilowatt hour. So it's dirt cheap power delivered directly into your home, on your rooftop, behind the metre.

What I've said beyond that is to make it a 24 hour solution and be relatively grid-independent, moving towards consuming - or full self-consumption - so solar plus storage, so adding in the cost of your energy storage system, you're getting a 10 year cost of power at about 30 cents a kilowatt hour over 20 years and we've got new battery technology we're about to release that have a close to 20 year life, you're looking at a cost of power at around 15 cents a kilowatt

hour. so under a half of what we currently pay for our power.

MR JACOBI: You expressed a view as to - we've had some evidence about the extent to which you would need a storage system in order to be able to insulate yourself against periods of low demand in winter and so on. I think you've expressed yourself in terms of relatively grid-independent.

MR TURNER: Yes.

MR JACOBI: How grid-independent are you with a system of that sort, in terms of needing to buy power in from the grid in times of low solar insulation?

MR TURNER: Yep - with solar energy you generally produce about 30 per cent more during summer and about 30 per cent less during winter. So it's just a matter of how you model the system as to how grid independent you want to be. If you averaged it out over the year, you would buy in a small amount of power during winter and you'd be exporting a small amount of power during summer. So you would need some form of backup power, which the grid would provide if you were connected to the grid during winter, so you'd buy in a bit of power and you'd be exporting a bit of power during summer, but you could model that system towards winter generation of solar to be more grid independent if you wanted to be.

MR JACOBI: Am I to take it from the chart that we have in front of us that we're looking at - to look at the storage system alone, we're looking at about over a 10 year period, about 20 cents a kilowatt hour, is that - - -

MR TURNER: 10 year period of solar and storage? About 30 cents a kilowatt hour.

MR JACOBI: No, I'm just interested in the storage component of that.

MR TURNER: Sorry. Storage component - yes, 20 cents a kilowatt hour.

MR JACOBI: Am I to take it from that, that your view is that solar and battery systems are viable as they stand at present, as against grid electricity?

MR TURNER: Absolutely, and once we release - and that's with current battery technology that we've already been using for about five years now, so - - -

MR JACOBI: What's the existing battery technology that you're using?

MR TURNER: It's - lithium ion phosphate is what we're currently using.

We're now moving to a new lithium ion polymer chemistry that is a newer release from LG in Korea, but we have many companies in the world now releasing similar technology, and that has now a 6,000 plus cycle life, so - - -

MR JACOBI: I think we've got a slide for that.

MR TURNER: Yep, so that's what you have - so these are new rack mount-type format batteries that are 48 volt, designed for more residential use, probably up to a hundred kilowatt hour storage system, which could be a street-based transformer to manage several homes in the street, but yeah, these do a 6,000 plus cycle life. So a cycle at home is virtually a full charge, full discharge, which would be a day and a night cycle, and it's 6,000 cycles, is about 16 and a half, 17 years, but we believe the way we manage the batteries will get significantly more life out of them than that.

COMMISSIONER: Do they degrade as the cycle number goes up?

MR TURNER: Very little.

COMMISSIONER: Very little?

MR TURNER: Very little, yep, and in fact there's a second and third life after they've finished their useful life in this application.

MR JACOBI: In terms of the rationale for the transition between the technologies - the chemistries that you've just referred to, is the reason for the transition one of cost or is the reason for transition one in terms of the improve performance?

MR TURNER: It's improved performance. So the economics over time just get better. Yep. It's like, say, buying a laptop. Laptops really haven't got that much cheaper, but the performance and battery life, and everything else in them has just incredibly increased in - yep.

COMMISSIONER: Richard, for a particular home how many of these racks would be required and what sort of cost is involved?

MR TURNER: Three of those - the middle picture there, three of those is about 10 kilowatt hours and they're, like, virtually the size of a server rack that you would see in your business. So that would be about the size of, say, Tesla's 10 kilowatt hour battery that they've released. I mean, Tesla really - they've done a very good job of attracting attention to the industry but haven't really achieved anything more than any of the other major players in the world at that level.

COMMISSIONER: What do you expect in terms growth for the price of the battery? Do you have a view of where it's going to go in the next five to 10 years?

MR TURNER: Yes. There's estimations out there that about 400,000 residential systems will be installed in the country in the next two years.

MR JACOBI: Sorry, who's projections are they?

MR TURNER: I don't have the report on hand, I can find out the details of the source of that but there is a number of reports that are pointing to those sorts of numbers. And we know in talking to utilities, and we are working with utilities on this because energy storage is a big part of optimising our current utility grid. Some of the utilities are looking at placing orders towards 1,000 systems at the end of this year with projections of up to 100,000 systems in the next five years. So when you look at just three or four utilities buying a 100,000 systems plus the residential market with a product that is all ready economic, you are going to hit those numbers.

COMMISSIONER: So this is your view of the - - -

MR TURNER: What I have put up here is a look at the battery cost now as people would well know from what Tesla have announced recently, they were talking about 10 kilowatt hours at about three and a half thousand dollars US. So you're looking at about 350 US dollars now per kilowatt-hour for batteries. The range that we're seeing between the major players is around the 350 to 400 and you're seeing – these are very advanced batteries. What is – that second image there, what is very important to understand though is the cost of the batteries is not the cost of the system. So it's like buying a laptop battery without the laptop. It's very important to understand you need the balance of the system and the balance of the system includes the bidirectional inverter that allows DC and AC power to flow in to the battery bank and out of the battery bank. You need wiring looms, you need cabinets, you need switch gear, you need control systems, all of this goes in with the battery to make up the energy storage system. So what you're seeing there is the battery. Typically make up about a third and you're seeing the reduction in costs there. Now lithium ion, very importantly, is forecast to be the chemistry of choice probably for the next five years. Beyond that, there's many other chemistries being developed now that will reduce the cost of batteries and reduce the size of batteries quite dramatically.

MR JACOBI: Do you have a view as to the sorts of chemistries that are likely to become emergent?

MR TURNER: There is a lot going on in that space, but the things that are

emerging are chemistries like metal air, sodium ion, there is another one, sorry I'll just look that up. Super capacitors of course and super capacitors enhanced with graphene very, very cost effective. Very cost effective one, very cheap energy storage if we get this off the ground. So there's a lot of chemistries being developed.

COMMISSIONER: If we are looking at the reduction of a third of the cost of the system - - -

MR TURNER: Yes.

COMMISSIONER: - - - the other two thirds, do you see that reducing in a similar sort of fashion or?

MR TURNER: Yes. As you can see on that second slide, probably not quite as fast but - - -

COMMISSIONER: Right.

MR TURNER: - - - but still certain a reduction in costs. And look the bi-directional inverters that make up the other major part of an energy storage system, if we look at the cost of solar inverters and how they have reduced in cost over the last few years, it's quite dramatic. So we're seeing a reduction in the cost of solar systems, just in the last three years, it was around 50 per cent. It's significant.

MR JACOBI: In terms of the drivers, in terms of cost and we've heard with respect to solar PV that a key driver is scale of manufacturing.

MR TURNER: Economies of scale, so the – the subsidies that are talked about often in the solar world, that really only happened for two or three years, started off – a well production, you know a production of scale that has just forced the cost of renewables down dramatically. So we're at – now at a point where renewables are as cheap as any other form of power.

MR JACOBI: We have heard from the Teslas of the world that they are investing in large manufacturing plant.

MR TURNER: Mm.

MR JACOBI: Are you seeing investments in manufacturing plant from the companies from which you're buying - - -

MR TURNER: Yes.

MR JACOBI: - - - factories from?

MR TURNER: Yes. Enormous investment. So I've been to countries like China, I haven't been to Korea yet with LG and Samsung and Kocam but I understand they are investing very, very heavily in batteries. We are seeing the first huge orders come out of Europe for these companies for batteries in to the billions of dollars, the German manufacturers. So we're about to see a flood of electric cars come out on the market, high production, high quality production cars in the next two to three years and that will just drive the cost of this battery technology down enormously. I mean energy storage will be a very large market on its own but the electric vehicle market will be enormous. And Tesla have had that pretty much to themselves for a while but everyone else is on the verge of releasing what I would call real technology, which has been available for a while. The implication of course for existing car manufacturers is their after market is designed to service combustion engines, not electric vehicles. So there's been a real problem there but I think they will – they're on the verge of releasing what I would call their real technology, not their toy technology.

MR JACOBI: Perhaps to come back to the first slide in terms of the economics, I'm just interested – we have heard with respect to solar PV that a key crossover point was the point at which paybacks in terms of time period from investment were about seven years. We've heard payback periods in South Australia are periods of three to four years in terms of the installation of panels.

MR TURNER: Yes.

MR JACOBI: Do you expect to reach a point – sorry, when might it be that you might expect to reach a point where you pass the seven year threshold with respect to battery and storage?

MR TURNER: On battery and storage?

MR JACOBI: Sorry, battery and solar?

MR TURNER: Battery and solar. On those price curves, I would expect that to be happening – I mean look it's already over 20 years has halved the costs so I would say in the next – if the learnings in the solar industry are any relevance to this, I would say in the next two to three years you will be down to probably a three year payback.

MR JACOBI: And you mentioned earlier in an answer that utilities would have an interest in terms of the acquisition of battery systems in homes?

MR TURNER: Mm.

MR JACOBI: I'm just wondering if you can offer some insight in to the advantage that utilities might see and the extent to which utilities might operate those systems to - - -

MR TURNER: Yes. Look the traditional form where – like our electricity demand traditionally was growing pretty much a straight line. What utilities would generally do, in areas of constraint, would install a new feeder in to that area and that would be at a significant cost and that's fine when energy demand is going like that indicates upwards. When energy demand is going like that indicates downwards, that doesn't make sense any more. So what the utilities are now looking at, is in the areas of constraint they're facing now, who are the biggest consumers in those areas, let's pick out the hundred or 200 or 1,000 highest consuming homes in those areas and put systems in that might add up to three million dollars instead of the 20 million dollar investment. What the utilities need is another layer of control that sits above the energy storage system called an energy management system, that it's a utility piece of software where they, from the national operation centre, can actually control fleets of these systems out in the grid.

So our sister company in the US has developed one of the first operating platforms to do that and that company is called Greensmith Energy Management Systems in the US. Now we have a cross-ownership and cross-directorship with Greensmith. They were set up in 2008; they have developed this operating platform. They have evolved as a company and last year installed one third of the US's energy storage, including the largest energy storage system in the world, a 20 megawatt. But these operating platforms for utilities will be a very critical pathway for them. So really creates a virtual power station within the net work whereas if there is a constraint here, or a constraint there they can literally grab hold of the hundred storage units in that area and dispatch energy. And like a block of energy and also take energy in when they need to.

COMMISSIONER: Might be a good time to ask about – this is mainly about residential, to ask about large energy storage systems and the impact and cost that they might have? Particularly for a state with such a large renewable - - -

MR TURNER: Yes.

COMMISSIONER: energy source.

MR TURNER: We are absolutely heading towards a future of microgrids and we need to spend some time talking about this because the point I made earlier with the cost of our regional networks, and the technology that is now available, it makes sense to build localised power networks around our major

regional centres and have the thinning of the grid or a support network running out that provides virtually back up power to these communities. But these communities will then have a local source of generation which will be an optimised mix of renewables. Most of our regional townships are based on some form of industry, so there are other resources available besides just solar and wind. You may have communities that have a very strong biomass, or bio-waste resource available to them. There can be harnessed hydro as well, geothermal in some cases, but the engineering task is optimised in the right mix of renewables for a community that produces the lowest cost of energy.

Now, if there's a thin grid running out to these communities, obviously it would make sense to have one gateway into that thin grid, to support the micro-grid, but in time, and we're already seeing communities that want to be disconnected from that transmission grid, and can be disconnected from that transmission grid if they want to.

So that slide you see up there is a micro-grid that has all the relevant sources of energy around it, that are localised, that can go directly into the local grid, producing a very low cost of energy for that regional community. There's one connection there to the main utility grid, managed by our EMF system. That one break can be cut off, and you can have a localised backup generation source there, as well.

MR JACOBI: You spoke of the thinning of the grid, and I'm just wondering whether you've got any observations as to how a grid might be thinned, in terms of reducing its overall capacity so you can actually secure the sorts of reductions that we've discussed.

MR TURNER: Yes. Look, it's an issue for the operators to deal with, going forward. It might need some regulatory reform. It is only 30 per cent of their revenue, but it is 70 per cent of their cost base, and that's a critical figure to understand.

So as they are dealing with this, it's thinning the grid, it's making our regional communities much more cost effective, and if you look at all the studies going on in Germany now about circular economies, it keeps all the resources within regional communities, which is a critical thing for the ongoing sustainability and health of those communities.

Of course, if we make the regional communities much more cost effective and independent, at 70 per cent of the cost base, suddenly we remove that issue, our city grid becomes more cost-effective, and it takes that cost burden away, and that will have the overall effect of reducing the total cost of power for everyone.

MR JACOBI: Am I right in understanding that one of the barriers to that might be needing to make an investment early, at the point of the cycle, to actually remove aspects of the grid architecture - - -

MR TURNER: Mm.

MR JACOBI: - - - so as to save costs in the long run?

MR TURNER: Yes, possibly, possibly. The mechanism for thinning of the grid is something that's going to be an ongoing debate I think, for some time, and may require regulatory reform to do that.

MR JACOBI: Much of our discussion has been around residential consumers, and while I would also include, no doubt, some commercial enterprises, in terms of energy for industry, I'm just trying to understand what the relevance of this is, in terms of energy intensive industries.

MR TURNER: Are you talking about regional or metro, or both?

MR JACOBI: Regional.

MR TURNER: Regionals? Look, we have the opportunity to produce the lowest cost power in the world. If we can feed that into a regional industry, it gives them an enormous opportunity to go forward.

In terms of uranium particularly, the mining of uranium, the enrichment process of uranium is a hugely energy intensive process. We can serve that through renewable energy in this country, at a much lower cost than other countries can do that process. I think that's a huge opportunity here, to export uranium to those countries that don't have the renewable resource we have.

We have a great sandpit here to play in, to get these business models right, these micro-grid models right, to deliver low cost energy to industry. We can use that to do things like mining uranium. I also think there's a huge opportunity in South Australia to mine rare earths, particularly graphene, that is used in lithium-ion batteries, and also to enhance super-capacitors for very low cost energy storage, going forward.

If we could build batteries in this state, which I think there is an enormous opportunity for, then that begs the question, let's get an electric car industry up and running in South Australia.

COMMISSIONER: Can I just go back to the question though, which is how do we supply, in a renewable sense, large energy intensive industries in the state. Clearly, if it were to be through renewables, we'd need a source of

battery power.

MR TURNER: Or a 24 hour source of energy, like co-generation through heat. Like, we can go through some mining processes that we've investigated here, that the heat generated will not only run the whole plant, but run the surrounding township as well, that can have up to 20,000 people. So we've done those investigations of co-gen, plus solar, plus wind, can run not only large industry, but the entire township. We're looking at plants up to 70, 100 megawatt.

COMMISSIONER: Are you also looking for that, in terms of battery storage?

MR TURNER: Battery will be the balancing aspect of it.

COMMISSIONER: Okay. So what sort of size do you see?

MR TURNER: It depends on the configuration of renewable resources. Some of those renewable resources are purely day-time, as in solar. You've got wind is day and night, you've got co-gen as 24 hours, you've got bio-gas, bio-waste, hydro are all 24 hour generators. So the amount of batteries required will vary in every instance, so every township will be varied in every instance, to the surrounding renewable resources.

COMMISSIONER: So you don't see an issue with the size of the battery?

MR TURNER: No, no. There is one slide there, I think it may be in your slide set, of the renewable power stations that we are currently building in the US. This is what our sister company is doing in the US, but you can see there, there is a 9 megawatt hour power station on the right-hand side; that would power one of our regional townships in South Australia overnight.

There's a three megawatt power station on the left; this is what our power stations of the future will look like. You'll have racks of these batteries in containers, each container will carry about 1.5 megawatt hours of power, and these large renewable power stations easily can power one of our larger townships overnight, with the generation sources around it.

COMMISSIONER: And industry?

MR TURNER: And industry, absolutely. As I said, it depends on the mix of renewable resources that are there. We have other solutions being developed that can provide backup power through generators, but not through diesel and not through fossil fuels. We'll talk to you more about that later on.

MR JACOBI: We've asked everybody I think, that's come to the Commission

about time frames.

MR TURNER: Yes.

MR JACOBI: And with respect to the micro-grids, as I understand it we've seen some of this with respect to some housing developments, new developments in South Australia at the present time. In terms of the widespread application of micro-grids in Australia, do you have a view as to the sorts of time frames in which we might be likely to see an expansion of that sort of activity, and a transition?

MR TURNER: We are investigating micro-grids for green field property developments now. We haven't publicly announced this yet, but we have about 70 to 100,000 homes in the pipeline for development, under green field micro-grid projects. So it's happening now.

There are parts of the grid that ideally, aren't efficiently or economically run under the current model, that I think the AEO will be focusing on trying to enable a regulatory regime to transition those parts of the network over to different ownership models, maybe community ownership models, under micro-grids that can be run much better under this type of model.

COMMISSIONER: Thank you very much for your evidence, very useful. And I wish you good luck for the future.

MR TURNER: Thank you.

COMMISSIONER: We'll adjourn now until 12.45, when we'll have Mr Jonathan Whalley.

ADJOURNED **[12.28 pm]**