RESUMED **[12.45 pm]**

COMMISSIONER: We will reconvene with Mr Jonathan Whalley. Welcome.

MR WHALLEY: Thank you.

COMMISSIONER: And Mr Jacobi.

MR JACOBI: Mr Jonathan Whalley has 30 years' experience as an engineer and entrepreneur. He has a background in communications engineering prior to founding DSpace which developed new data services for mobile satellite communications. In 2009 Jonathan was appointed managing director of

Danvest Australia, formerly Windesal, a clean technology company supplying off grid wind diesel and solar diesel systems. In 2014 Jonathan became the CEO of Adelaide-based storage company, Latent Heat Storage, LHS Pty Ltd, and based on the preceding three years of R and D within the University of Adelaide and LHS's pattern for its thermal energy storage system, Jonathan developed the company's commercial expansion strategy commencing with the development of a commercial prototype, and we call Jonathan Whalley to the Commission.

COMMISSIONER: Mr Whalley, thank you for joining us. I wonder if you could just give us a bit of history of the background of the thermal energy storage system and then walk us through its development and what it looks like today.

MR WHALLEY: Okay. We have been working with the University of Adelaide for about the past four years. The work at the university was to deal with some of the technical challenges associated with our system, some of the fundamental research. We resolved those about a year ago. We moved into the development of a commercial prototype which is built in a workshop and tested in a workshop. So we're about halfway through that process with the commercial prototype.

We have received some grant funding from AusIndustry to assist us with that and following the completion of the commercial prototype which right now we've completed the spec and the design, we've ordered all the major components and we have taken out a workshop at Tonsley Park. So later this year we will be putting all the components together, as shown on the graphic, and completing the testing and the characterisation of the product. Then just following on from that, we would develop a mark 2 product and that would go into real world site, probably a hotel resort in South Australia, for trials, and then we can do the technical and commercial evaluation from the trials. That's where we're up to.

MR JACOBI: If I can just take a step back.

MR WHALLEY: Yes.

MR JACOBI: I am just interested in perhaps starting at the level of thermal storage itself.

MR WHALLEY: Yes.

MR JACOBI: We have already heard about electrical storage and chemical storage in battery systems. I am just interested to understand what's the concept of thermal storage and how might that be of benefit to electrical systems.

MR WHALLEY: So for our system it's still electricity in and electricity out. Okay. So we can take electricity from any source, wind turbines or solar or even from the grid. We use electricity to heat up the storage medium, which in our case is silicon, and we can then extract the electricity through an engine, in the case of the commercial prototype that's a Stirling engine, but for larger systems we would use Sting turbines. In our case though we provide the consumers with both electricity and heat, so it's a co-gen system. So we take electricity in and we have electricity and heat as an output. By supplying the consumer with both electricity and heat we have very high overall efficiency of our system.

MR JACOBI: If I can come back. You mentioned that the medium in which the energy is stored is silicon.

MR WHALLEY: Yes.

MR JACOBI: Is that the particular novelty?

MR WHALLEY: It's one of the novelties of our system. The reason we use silicon is it has very high energy density. So if we're given a kilogram, we can put in a lot of energy. Also silicon is a readily available material. In fact, the whole system is built out of relatively low cost materials. We store the energy in the latent heat of silicon, that's the transition from solid to liquid and back to solid, that has a very high melting temperature, 1400 degrees C, so one of the, I guess, differentiators or unique characteristics of our system is that operating temperature, 1400 degrees C.

MR JACOBI: What's the particular significance of using that transition phase?

MR WHALLEY: In the transition phase for silicon, silicon can absorb a lot of energy while staying at that temperature. So if we heat the silicon up to 1400 degrees C, that takes a certain amount of energy, we can put even more energy in, while staying at that temperature, as it transitions from solid to liquid.

MR JACOBI: And that improves the efficiency of the system. Is that right?

MR WHALLEY: No, it’s more about the capacity of the system. So, for a given quantity of silicon, we can put in a large amount of energy. We can put in energy, and we can withdraw energy sort of, independently, from the system.

MR JACOBI: Now, the Commission’s also heard about molten salt as a form of storage medium.

MR WHALLEY: Yes, yes.

MR JACOBI: Are there any particular advantages of silicon as against molten salt?

MR WHALLEY: Well, molten salt, it's not operating at the transition phase, typically. It's often coupled with solar thermal systems, whereas ours is a stand-alone energy storage system, it can work with any electrical input. So we operate at a higher temperature, and we have higher energy density than salt.

MR JACOBI: You've explained that it's a co-generation technology - - -

MR WHALLEY: Yes.

MR JACOBI: - - - in the sense that you can output heat. You've explained the electrical output through an engine or a turbine.

MR WHALLEY: Yes.

MR JACOBI: How does the go-generation, the heat aspects from the system, work?

MR WHALLEY: It might be helpful to flick to one of the other slides, if we may. That's fine. So what we can see here, in the graphic, the heat is withdrawn from the energy storage device, it's called TESS, and it drives a turbine. Then from the turbine, we have the electricity for power use, and we have heat as a by-product. So that's how we withdraw the heat; we don't take the heat directly out of the heat store, we take it out of the turbine.

MR JACOBI: It's noted there that it's a consumer-age installation.

MR WHALLEY: Yes.

MR JACOBI: I'm just interested in the size. We've heard, from the previous witness, about in home battery systems - - -

MR WHALLEY: Yes.

MR JACOBI: - - - is this designed for that particular market?

MR WHALLEY: No, no, this is not for residential. Look, in terms of the electrical output, we'd be looking at hundreds of kilowatts of output, so that could be agribusiness, it could be hospitals, it could be resorts. Those sort of facilities. It could be apartment blocks with many residents, but not in individual homes.

MR JACOBI: Now, aside from the consumer installation, I understand you’ve got a different, more highly scaled concept for on-grid storage?

MR WHALLEY: Yes.

MR JACOBI: The next slide? I’m trying to get you to explain the difference between the concept that you’ve just explained, and this particular concept.

MR WHALLEY: Yes. I guess first off, I probably should point out that with our system, it’s highly scalable, so it’s the same fundamental technology, we can just build it into larger and larger units. So it can go into shipping containers, 40 foot shipping containers, and then we can have multiple shipping containers for scale.

This is a graphic that shows how a larger system could be installed at a wind farm. At wind farms, typically there’s what we call “spilt energy”; that’s where the wind will be blowing, we could generate electricity, but the wind farm operator can’t sell that. That could be due to a mismatch of supply and demand, the market’s not there, the consumers don’t need it, or it could be technical constraints on the grid, so the energy can’t be sent from the wind farm across the grid, to where it’s actually needed, because of technical constraints or limits on the grid.

What we can do with an energy storage device at scale, is capture that spilt energy, or energy that would’ve been spilt, and then release that at a later time, into the grid, when the market’s there. Or, we can get it through the network. In our case, as well, we would want to put in, or sell, the excess heat to the community, or it could be used for desalination or local industry.

So that’s an example of an energy storage device at scale.

COMMISSIONER: Is there any time constraint, in terms of how long you can store it?

MR WHALLEY: In our case, the heat, over time, does dissipate from the heat store, but we can design this to provide or minimise that, depending on the discharge time required by the client. So if an installation requires a discharge time over say, eight hours, then we can put in sufficient insulation for our heat store to minimise the loss, over that cycle time. It’s a design characteristic.

COMMISSIONER: Realistically, you wouldn’t be expecting to store more than 24 hours?

MR WHALLEY: No, no.

COMMISSIONER: Okay.

MR JACOBI: We've heard quite a bit about off-grid storage, in terms of in customers' homes, and I'm just interested to understand the market need for on-grid storage systems within electricity networks.

MR WHALLEY: Okay.

MR JACOBI: And I think we might have a slide that explains it, in part. I'm just wondering whether you could explain the implications of the load profiles in California, to the need for on-grid systems.

MR WHALLEY: This graphic, colloquially known as the California duck because of its shape, what this intends to show is that over time, due to the increase in residential solar, which generates electricity during the day when the sun shines, and it's reducing the demand on the traditional generators within the state of California, in this example.

So what we see in the centre of this graphic is during the daytime. So over a 24 hour cycle, we get a reduction in the demand on the network, it's going down the slide. But the problem is the peak is not reducing, because there's no solar at that time, in the evening when there's peak demand.

And the problem for the network is that a network has to be designed for the peak demand, so even though the demand from users is dropping during the day, they can't reduce the scale, the size of the network because they need that in the evenings, for the peak.

So the problem then becomes that the capital cost of that whole network remains unchanged, but the demand from the user base is reducing, and the electricity. The utilities have to recover that cost, and pay for that cost and infrastructure over a dwindling user base. So the costs go up per user, which drives more to go and get solar, or go off-grid. Thus, we get a vicious circle.

What the solution is, certainly in California, is to put energy storage onto the grid, to time-shift the energy from daytime into the evenings. That would sort of, flatten that duck curve. So that's how energy storage can be used to deal with the problems facing utilities. And in California, there's legislation to enforce energy storage onto their grid.

MR JACOBI: In terms of the two particular concepts that you have for thermal storage, in terms of the state of their development, can you explain where they're at, in terms of their testing and their prototype?

MR WHALLEY: For our system?

MR JACOBI: Yes, for the test system.

MR WHALLEY: Yes. We've completed the specification and design, and the test plans for our commercial prototype. As I mentioned earlier, we've completed all the R & D, the technology is patented. It's all been developed in Adelaide, I should point out. And, we've placed the order for the major components, and towards the end of this year, at our workshop at Tonsley Park, we'll be putting the commercial prototype together, running it, testing it, and characterising it.

MR JACOBI: In terms of the testing of the grid based system, where's LHS in terms of its assessment and trialling?

MR WHALLEY: In the new year, we go into a demonstration phase. So we've analysed multiple sites in South Australia, and some of the sites interstate. We've identified a site in NSW, on the grid, near to a very large solar farm, and we're in negotiations with the network operator to develop a one to five megawatt installation, for tests on the grid, in NSW. But that would be a demonstration system.

We're also in negotiations for an energy consumer-sized test in South Australia at a hotel resort. So we'll do a demonstration for the low end, and at the large end as well.

MR JACOBI: Do you have a view as to where you think thermal storage might fit in the overall market? We have heard about storage in terms of pumped hydro and storage in terms of batter systems.

MR WHALLEY: Yes. If we look at the energy storage technologies, there's a very sort of broad spectrum from the small end, so there's batteries in your mobile phone or in cars, they're lithium batteries typically, right up to the large end which would be pumped hydro in gigawatts, and throughout that whole spectrum there will be different technologies that are more suited for different points on the spectrum. So what we're doing with our tank is we're positioning it for that middle ground, so we're not down at the low end at the residential and we're not at pumped hydro, we're not at gigawatts. So we're going for the middle ground, sort of the 10 to 100 megawatts scale which tends to be grid sized.

MR JACOBI: I think the slide we've got up might assist with this, but in terms of your view about where storage currently is and where it's going to be going, do you have a view about - a perspective about the future of storage within grids?

MR WHALLEY: I think that as you can see from this slide, pumped hydro dominates. The view in the industry is that in that middle ground for that spectrum I talked about, it's sort of like the jury is out on what is going to prevail in terms of the technology or the technologies, so it's a bit of an unknown. What the focus has got to be is for a range of technologies to be developed and for the suppliers to identify what's commercially viable, and then we'll start to see the traction with sales and installations. I think it's fair to say that the view right now in the industry is that energy storage at that middle range is not commercial viable, it's on the cusp.

MR JACOBI: Do you have a view about - - -

MR WHALLEY: There's a need for it, as we discussed with the California (indistinct)

MR JACOBI: Do you have a view about what would be necessary for it to further develop to be integrated within electricity networks.

MR WHALLEY: Well, what we see overseas, particularly in the US, is legislation to enforce the utilities to adopt energy storage on the grids. That's happened in California, and I believe it's happening in other states in the US as well. That creates the market and that creates the industry development as well for that market. Once we've got industry development, costs can come down, time to market can come down, and we would see - probably see in California commercial installations in that middle ground sooner than anywhere else because the Californian state government has taken the action it's taken, and they have done this before with other industries, created the market.

MR JACOBI: Yes. Are there factors or forces that might apply in the Australian context to drive on-grid storage systems to develop?

MR WHALLEY: I mean, we could have legislation, that would be great, but if we don't have legislation there could be incentives, like there's been historically in incentives for renewable energy installations, there could be incentives for storage.

MR JACOBI: Do you see that the RIT might be any driver in terms of - that is the wind transmission entities seeks approval for new substantial assets, that it might be used as a driver to drive consideration of alternatives?

MR WHALLEY: It's a useful factor. We've had discussions with utilities who have to look at alternatives to the poles and wires, but it's not enforced and there's a challenge for companies because we have got to develop our concepts and our proposals and all our discussions at our cost and our risk and there's no indication we're going to be successful for large scale installations, because the choices remain within the utility and if they wanted to do a low-risk option they would probably go with the poles and wires. So I guess what we see in California is the government stepped in, legislation to enforce the installation, so the technology gets developed, the commercial relationships get developed, and that might reduce the perceived risk within the utilities to them taking up those options.

COMMISSIONER: Apart from your product or that silicon, is there anything else in the mid to lower level being developed?

MR WHALLEY: Yes, well, there's other technologies. So there's compressed air storage, there's flywheels, there's molten salt, as we discussed. Yes, some on there. Compressed air is the CAES.

COMMISSIONER: That's what it is. Okay.

MR WHALLEY: Those technologies - I think it's fair to say they're at a similar stage to where we are in that it's not really commercially established yet, and when we look at the characteristics of the different technologies, they will have sort of technical and commercial benefits depending on the application or where they are on that spectrum. So I think there's space for a range of technologies to be developed. I'd be very surprised if there's one technology that was the best technology technically and commercially across that whole spectrum. That would be quite surprising.

COMMISSIONER: Is Germany leading the way in some of these developments as well?

MR WHALLEY: I have to say I think the US is way, way in front. My understanding with Germany, there's a very strong focus on solar and wind and the roll out of that.

COMMISSIONER: All right, Jonathan, thank you very much.

MR WHALLEY: Thank you.

COMMISSIONER: We'll adjourn until 1430.

ADJOURNED **[1.06 pm]**