ECONOMICS AND INDUSTRY STANDING COMMITTEE

INQUIRY INTO MICROGRIDS AND ASSOCIATED TECHNOLOGIES IN WA

TRANSCRIPT OF EVIDENCE
TAKEN AT PERTH
WEDNESDAY, 16 MAY 2018

SESSION ONE

Members

Ms J.J. Shaw (Chair)
Mr S.K. L'Estrange (Deputy Chairman)
Mr Y. Mubarakai
Mr S.J. Price
Mr D.T. Redman

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Hearing commenced at 9.28 am

Professor RAYMOND WILLS
Managing Director, Future Smart Strategies, examined:

The CHAIR: On behalf of the committee, I would like to thank you for agreeing to appear today to provide evidence in relation to the committee's inquiry into microgrids and associated technologies in Western Australia. My name is Jessica Shaw and I am Chair of the Economics and Industry Standing Committee. I would like to introduce the other members of the committee: to my left, Deputy Chair Sean L'Estrange; Stephen Price, member for Forrestfield; Terry Redman, member for Warren–Blackwood; and Yaz Mubarakai will join us later. It is important that you understand that any deliberate misleading of this committee may be regarded as a contempt of Parliament. Your evidence is protected by parliamentary privilege; however, this privilege does not apply to anything you might say outside of today's proceedings.

Before we begin with our questions, do you have any questions about your attendance here today?

Prof. WILLS: No.

The CHAIR: Would you like to make a short opening statement about your submission?

Prof. WILLS: Future Smart Strategies is an advisory firm that helps people to understand the megatrends that are coming in this twenty-first century. We are seeing rapid economic change. Future Smart Strategies' job working with clients is to help them to understand how that change impacts their business or their community. What we are really focused on is the rate of change and how to prepare for that change. We work across all technologies. Although clean technology and energy is a special forte, we also work across architecture, the built environment, transport, planning, infrastructure—everything from ICT through to education and energy.

The CHAIR: Thank you very much for providing a submission. I see you also forwarded to us this morning a slide pack. I will give you a bit of an overview of the way in which we are tackling this inquiry. We will be looking at the microgrid issue in two stages. First of all, looking at the opportunities that it presents both in term of upstream opportunities in the minerals and resources sector, and advanced manufacturing—the sorts of technical benefits that it can offer network operations, or energy supply operations, throughout the state—and, if you like, operational benefits. The second phase of the inquiry will be looking at regulatory and market issues and barriers, so there will be opportunities for parties to make additional submissions on those issues, but, at this point, I guess we are in that scoping phase to really try to understand the magnitude of the opportunity for Western Australia so we can then come up with some sensible recommendations about how to then enable that. Hopefully, that will give you a guide to the sort of evidence that will be of most assistance to the committee at this time, but it certainly does not close off opportunities to provide additional information to us on other topics should you feel the benefit of doing so.

Prof. WILLS: Excellent; thank you. I think one of the issues that has changed is that we have moved in technology from having a headline a year to having a headline a day. I think as you progress through this inquiry, you will discover that even the rate of change within the time frame of the inquiry will create enormous new information.

The CHAIR: I think you are quite right. Even this morning, one of the news headlines is about the Deloitte report that has just been put in on the transformational impact of electric vehicles. You are quite right; every day there has been a headline.

I want to pick up one of the comments that you make early on in your submission around the IEA for two decades spectacularly underestimated the growth of renewables. Could you maybe give us some observations on the growth and on the reasons for missing that? Perhaps you could give us some information on that.

Prof. WILLS: The first part is that if anybody is going to talk about the future, invariably they are going to be wrong. There is that old adage. I guess the role of a good futurist is to attempt to be the least wrong. In many cases, the role of the IEA in this space has been the most wrong. The IEA defend themselves, logically, simply by their terms of reference in terms of what they are offering. The IEA are not doing projections; they are doing forecasts. A forecast, if you are familiar with the term, means you take a dataset from history and you extend it into the future. A good friend of mine Rob Koh refers to it as "Excel spreadsheet drag right". It is simply just a projection of numbers into the future that really just reflects on the numbers of the past and it does not take into account that assumptions change. The International Energy Agency actually says that. They are saying they are not forecasting a scenario of the future; they are simply saying that these are what the numbers will be if we do not change anything. At a time when everything is changing, those numbers sets are next to useless; they do not tell us anything.

One of the challenges then is: how do you actually understand where the pinch point is for change, where is the threshold of change occurring and then how do you actually say how far that change will go? The answer is that we have had an economy functioning on a consumer-based economy for 100 years and we know how products enter the marketplace. Therefore, what we are failing to do is to take the learnings from the broader economy and then apply it to this very specific sector of energy. I think that is what the IEA, largely, is failing to do.

Ironically, in their forecast on motor vehicles, they have done it very well, in my view. In fact, it is pretty close to my forecast. If they are forecasting on the uptake of energy efficiency, they have also done that pretty well. They have made assumptions and they have said, "We're going to see a 30% decrease in energy consumption as a consequence of energy efficiency", which is vitally, vitally important. But when it comes to the changing patterns of energy production, they have failed to assume.

The CHAIR: Do you think that is because it is such a radical mind shift? Energy has always been such a highly centralised sort of top-down, or spoke and wheel, model; it has never really been more of a consumer-driven sector. Do think it is a real change in the way we conceptualise this industry?

Prof. WILLS: Absolutely. It is a wicked problem, it is a data-rich problem and if you make the wrong assumptions, then you are going to be going in the wrong direction. For 50 years, the nature of energy growth has been a centralised power production through a coal plant or a gas plant or a nuclear plant. It has been based on resource consumption that leads to particular project capitalisation and particular project financing, and since 2011 all that is out the window. I will show a few slides later on to try to emphasise that point about how rapidly this scenario is actually changing.

The CHAIR: How aware do you think consumers are? I do not know whether you have had the opportunity to have a look at Synergy's evidence to us last week—no, you will not have, because transcripts have not been published yet. One of the things I tested them on was around their retail function and the degree to which the uptake of these types of technologies is either pushed from the retailer or demanded from the consumer. I was asking them about consumer awareness,

consumer demand and consumers' ability to actually engage with these types of technologies, understand them and have the time to optimise them in the household. Do you have any views on that?

Prof. WILLS: You can really break down how the market changes into three simple levels; there is a whole pile of complexity, of course. The first one comes from government. It is about a regulatory change. It is when government puts an impost on like a carbon tax or like an energy efficiency impost on refrigerators. Once you get that take into the market, then you can create change. You have a second level of change that is really to do with the consumers who care. Those who are activists in their space and therefore making purchases as a consequence of their view that things need to change. But until you get volume and scale, you do not get a consumer market. So, ultimately, until you get to that third level of getting a scale up of production that produces a volume of goods, you really cannot get consumer participation.

What we are seeing right now is that third driver becoming important, but all three levels need to be addressed. Ultimately, although the other to get it going, the most important one for success is if you do not get a consumer market, if you do not get volume uptake, then you will not get the scale of change you require.

The CHAIR: I would like to spend a bit of time on electric vehicles, because it is a term of reference that we have that we have not as yet received an overwhelming amount of information on and it is something that I know you have done some thinking and some work around. I was very interested in your observation or your thoughts around the fact that probably the most significant game-changing factor is going to be changes in commercial fleets as opposed to private customers buying vehicles. I wonder whether you could talk us through that a little more.

Prof. WILLS: The largest proportion share of consumption of fuel in an economy is transport fleets. The average distance a private car goes is usually 12,000 or 14,000 kilometres a year. The average distance a commercial vehicle will go is usually four to five times larger than that number. It just means that they consume more in that distance and, of course, they are also a larger vehicle. Even though they are a smaller proportion of the overall vehicle fleet, at the end of the day, they still consume 40% of the fuel or thereabouts, and it varies between location and between jurisdictions.

The key there is that there is an opportunity that goes alongside that; that is, the electrification of that fleet in the first instance is simpler because it is smaller scale—it is a smaller proportion of the fleet—its impact is greater because it takes a greater share of the fuel market and its impact is also consequently greater in terms of emissions savings as well. Beyond that, if you get the conversion, in this case, to electrics—if that is going to be the solution—to be cheap enough, then it ultimately creates savings right throughout the economy. So, the impact that that potentially has is not only about fuel consumption, it is not only about energy efficiency and emissions, but also it is ultimately about a far greater cost saving to the economy.

The CHAIR: I guess the savings, if we start moving towards automated electric vehicles as well. With electric vehicles for commercial fleets, there is not the personal ownership of the car. Really, a business is always going to take the least-cost decision, but then when you think about the occupational health and safety implications of having safer driving technologies for workforces, that is probably going to be a prime driver as well.

Prof. WILLS: I think it reflects on where we are in the technological development of our economy. In 20 years, we will look back and see how primitive we were, but right now we think we are really advanced. With the solar revolution itself, which is just a silicon chip—a silicon chip is really just like a computer chip—we were not able to have the solar PV revolution in the 1970s, like Jimmy Carter tried to foster after the oil crisis, simply because we were not at a point where we were producing

silicon chips in the way that we do today. The computer revolution really bedded down the opportunity for solar PV to then actually flourish. The manufacturing ability that we developed to produce silicon chips has really delivered the PV industry. Now the same is true not just of that, but of all the other things that we are going to use these new technologies for—for example, not only the electrification of cars, which is simply coincident with the self-driving phenomenon we are starting to witness now.

Self-driving does not have to be an electric car; it can be a combustion engine. But the point is that the technologies are coming together at the right time and the demand for fleet turnover will come. I refer to it as dumb cars versus smart cars, as well as combustion engines versus electric cars. Those things are partly unrelated, but they are going to conjoin and it is going to be a perfect storm in terms of the opportunity for fleet renewal and fleet replacement. That will extend right through to the issues of car ownership model not only in commercial fleets, but also, ultimately, in the way that we move around privately and the way that that impacts us privately.

The CHAIR: In terms of the coalescence of technologies, obviously we are looking at microgrids. One of the things that has been put to me is that there is an idea out there that individual households can become completely self-sufficient. You can have a PV system on your roof and a battery, and you come home at night and you plug your car in and away you go. A comment that has been made to me, though, is that it is not that simple and the rate at which car batteries need to be recharged is essentially a week or a few days' worth of household electricity consumption in one go for one charge of a car, so, by necessity, if you are going to have electric vehicles, you need to retain a connection to the grid. There is also quite a bit of debate about the timing of recharging and the impact that having masses of electric vehicles plugging in at different times of the day could have on particular points in the network and then the broader electrical system. There is quite a lot in that question, I know. Particularly with the recharge factor and this "you can live in the hills, have a battery, a PV system and a car and never contact Western Power again", I would be really interested in your views on that and then the broader impact of EV on grids.

Prof. WILLS: First of all, very commonly, commentators are viewing from a point in time and not seeing that point in time being flexible. If we went back to 2011, we were installing one or 1.5 kilowatts of solar. Today, in 2018, the average size of a solar installation is over 5.5 kilowatts. Even in six years, we have completely changed the nature of the scale of what we are installing on homes. When we get to a point in a few years' time, it is very likely that the average install will be up around 8 kilowatts, which is around about two to three times what the average house needs. Why will it be that big? It is because batteries, which right now are still reasonably dear and, in my view, while affordable, are still at the top end of what most people would find as affordable.

But by the time we get five years on, batteries, too, will have scaled up in size and reduced in cost in exactly the same way as solar panels have. So, for us to statically talk about, "We're going to expect to plug a car in and charge off the grid", I do not think we are. I think in five years' time, we will go home, where we have a set of batteries in stationary storage, and we will plug our car in to trickle charge, and it will not be off the grid; it will probably be off our own battery set, because we will have such a volume of batteries at home that if we are truly going to be off the grid, we are going to have 25 kilowatts of batteries in the house and we going to start to recharge the car using our battery system, not the grid. That is the potential outcome.

The CHAIR: It has been put to me that trickle charging car batteries is really not a very good way to treat those batteries. They need to be very quickly charged and you would have to have a massive battery bank sitting there to charge a car in 20 minutes.

Prof. WILLS: There are two parts to that. First of all, a battery-to-battery recharge can be fast. There is no reason for it to trickle charge. It really just is a question of the interconnection between the two. The second element is that what we see as a massive amount of batteries now, in five years' time simply will not be. We thought 1.5 kilowatts on the rooftop in 2011 was fantastic. Now, if we have anything less than five, we are going, "That's pretty ordinary." The same thing will happen with battery storage, because it is simply going to be a consumer item that will scale up very rapidly. We are already seeing that scale up in the data to this point in 2018.

With the projected growth that we are seeing, if we focus simply on the car industry, there has been over $100 billion worth of orders for batteries placed this year. That is $100 billion worth of orders that were not there the month before. When you look at the way the industry itself is preparing for scale, that volume and scale is there. If that actually happens, as one of the graphs that I provided in the submission shows, as you increase volume of production, you reduce cost of production. If you reduce cost of production, you bring down cost to the consumer, once you reach a threshold that becomes affordable from a few, to many, to everybody. Once we hit affordable to everybody, it is just a consumer item. We buy a TV set, we buy a telephone and we will buy a battery.

Mr S.K. L'ESTRANGE: Ray, in terms of modelling for this new future, ridesharing is tipped to become even more prevalent, so with the onset of electronic vehicles—the current consumer habit is that you might have two to four cars per home—have you looked at modelling that might say that, in the future with advances in electronic vehicles, advances in driverless vehicles and more prevalence of ridesharing, the household will have fewer vehicles and what impact will that have on this battery market or the EV market?

Prof. WILLS: Yes, I have. I think it is the third-last slide set I provided today—it has purple colours on it. It models what will actually happen in this transition from dumb vehicles to smart vehicles. The slide is titled "Self-Driving Electric Markets". So, 70% of vehicles available for sale in 2017 already came with the option of driver assist level 1 to 3. That level 1 to 3 is stuff that you will be familiar with. It is emergency braking, it is driver assist, it is lane following and it is active cruise control. That fits into that category. Only 30% of cars were sold with it, but 70% had the option of buying it if you wanted the option.

The next phase on from that, though, is a higher level of driver assist. I think that will really start to unroll in 2020–2021. The level that we really want, though, which is where we start to abandon the car as a car ownership model and into a rideshare or a carshare model, is once we go to fully autonomous. Fully autonomous self-driving vehicles are the ones that really will not have a steering wheel. The expectation is that they will really start to emerge in 2023–2024. That is my expectation. There are a few others who have that similar expectation and others who are saying that it is at least a decade or two away. I think they are wrong, but we will see who is right in a few years.

One of the other forecasters in this space, Tony Seba from Stanford University, has suggested that once we get to level 5 autonomy, he expects four in five cars to be retired—that is, only one in five cars will be kept. If we do that, we will see a massive retirement of fleet. The projections I have, you can see that I have forecast peak cars. I am not forecasting peak cars based on EVs, I am forecasting peak cars based on vehicle autonomy and the rate of retreat that I have is only at 6%, but even at that 6%, we see a halving of the global vehicle fleet by 2040. That is an extraordinary loss and change in the way that we move about.

The reason is that when we own a car, we do one or two journeys a day, but when a car is shared by many, it does five to 10 journeys a day. The consequence on car ownership is obvious. The consequence it also has on infrastructure, on roads, is also there. The challenge is that that is pretty

radical transformation. In my view, it is actually only three to five years before I know whether I am right. If I am right, then it will be obvious. If I am wrong, then it will be another decade.

Mr D.T. REDMAN: There are some pretty unique arrangements in Australia and in Western Australia, with our environment and distance. Western Australia, in particular, is probably the sharp point that. Do you see our car and vehicle environment being different to what we might be measuring all our numbers off? Central Tokyo to use an example, whereby density is close and you can understand why technology has an easy chance to overtake current arrangements. Do we have a uniqueness that we need to consider? I cannot imagine taking my electric four-wheel drive 200 kilometres outside of Esperance, for example.

Prof. WILLS: The answer is that you will. You will have a 700 to 800 kilometre range battery. Is it here today? No, it is not. Will it be here in 2023? Absolutely. We will have that kind of range and that kind of time frame—five years away. The second element is separating what is a question about electrics and what is a question about autonomy. The much higher sovereign risk question, if you like, is that Australia no longer manufactures cars. If the rest of the world decides to build electric vehicles, guess what we will be buying? You may find some boutique arrangements spring up to build combustion engines for particular purposes for which they are ideally suited, but, equally, I am even sceptical about my own comment.

I do not believe that there will be anything that electrics cannot do to answer that issue. Range anxiety is a fair one, but, in my view, it will be solved. The second question then is: what about autonomous, are we going to take an autonomous vehicle, as Terry told us, to the back of Esperance? The answer is: no, we will still have some sort of human input in those scenarios.

Mr D.T. REDMAN: The big car manufacturers have set what I think are some pretty aggressive targets to be out of internal combustion engines by 2040, or whenever it was. You have come to us with a much more aggressive approach to that. I must say that I was surprised at their numbers, but I am even more surprised at yours. That tech is coming on fast. I guess these people read the writing on the walls, so that is a strategic decision by them to get into a marketplace that they know is coming.

Prof. WILLS: The question I have asked of the market is: is the market capable of rapid change? In 2008, before the GFC, we dropped eight million cars in production in one year in the car market as it exists today. After the GFC, we added 16 million cars in production in 2010. That is a 24 million car variation in the space of just a couple of years. It is the car industry variable and flexible? Yes, we already have evidence in the data that it can change that rapidly. The second thing is that, at the end of the day, in the case of electrics, they are just cars. It is just a different drivetrain, but it is still just a car.

The autonomy is a different question. That is a very different style of car with a different level of technology, but, at the end of the day, it is just an option on a car. We are not actually talking about ending the car industry and starting a new car industry, we are simply talking about changing the production line. You can retool a production line in four to six months, so your ability to adapt in this space is quite extraordinary.

The CHAIR: The whole concept that, at the end of the day, it is a production line, particularly around the automotive industry, is something that I had been thinking about for quite some time in connection with this inquiry. We will have AMEC come to speak to us after this hearing and I am obviously aware of your involvement with the lithium paper that they have put together. Skipping over the primary commodities that are inputs into a manufacturing process, we have no advanced manufacturing capability now for the automotive industry here in Australia and one of the things that has been suggested to us is that there is significant advance manufacturing opportunity for

Western Australia. We will not worry about the other states; we are very focused on WA. What are your views on the prospect of advanced manufacturing in connection with these sorts of technologies in WA? Do we have a competitive advantage, how well set up are we and what would we need to do to get ourselves set up?

Prof. WILLS: First of all, the way that we build things has been changing for a while, but robotisation is now the catchphrase of the end of this decade. We are now seeing new factories being built in new places that have robotics in them. Robotics drive things like 3D printing and at an industrial scale 3D printing is called additive manufacturing or advanced manufacturing. It is about the integration products. That robotisation can happen anywhere. If you are going to build a factory, you are going to tool it up. The tools that you put inside will be robots. This is a really important point: is more likely to be robots than people. We will still have people associated with the factory, we certainly will still have people employed outside the factory, but the likelihood is that the factory floor itself will be dominated by autonomous production.

The answer to that is that you build it where you need it. What are the advantages that Australia has? There are the very obvious advantages that we are all familiar with: we have a great system of governance, we have good environmental controls and we have good access to our resource materials. In fact, Australia, by Future Smart's measure, is the best place in the world for energy metals in general and energy resources in general as far as creating storage devices is concerned. You carry that downstream from making big rocks into small rocks, making small rocks into concentrated product, concentrated product into refined product. We are doing most of that in WA, but that is about where we end.

To advance beyond that, we need to take our refined product and turn it into electrochemicals. We are starting to move from that mining extraction process into a processing process and then into a manufacturing process. As our AMEC report has identified and as other work that Future Smart is currently working on has also identified, our ability to establish in that electrochemical space and then that one step further down into manufacturing of battery cells and then assembly of battery cells into product, whether it simply be a storage device or a device that goes into a motorcar or a mobile device or a computer, is a great big gap. But it is an achievable gap, because the right thing to do today is to build an autonomous factory to build it and that is independent of your employment factors and so therefore building in Australia makes sense.

I will also add an additional caveat to that, which is an observation that we have been making for some time now, that the Australian labour market was expensive during the boom, but it is no longer expensive. It is no longer expensive for two reasons. First is that we have not seen significant wage growth, but the second reason is that the Australian dollar has shrunk and that means that our services in cost overseas are in fact diminished by 25%. I think we are forgetting that element of our ability to manufacture here. Ultimately, would we go back to building cars in Australia? I do not think so. Would we go to building maybe specialist transport vehicles for the mining industry or for the Defence industry? That makes a whole pile of sense to me.

The CHAIR: You raised the point that you have to basically create the facilities to build this stuff—who? Why Australia? I hear you on labour costs, but you said previously in your evidence that labour is not a massive cost component in these processes because a lot of this is highly automated or robotised. Why come to Australia to set those sorts of factories up? Why would someone find us an attractive destination or how could we make ourselves more attractive?

Prof. WILLS: I think that is a really simple answer: we have the materials that are required for everything downstream. The security of supply, the ability to secure supply in that process, is one. I would not necessarily prescribe a mechanism. Obviously, a gas reservation mechanism is an

example of how you may actually tie a supply to come to the state. It is not something that Australia has traditionally done. We have not traditionally done it simply because last century we regarded our labour costs as high and we regarded our ability to specialise, in particular, in that last century example, to producing steel in the country, and we have gone to specialist steel producers in Japan, Korea and China.

One of the things is that we are used to taking our materials overseas and not looking for solutions in Australia, because that is the way that a centralised industry has always demanded it. But this century is no longer about "command and control"; this century is now about what I call "suggest and choose". We now have distributed energy systems on rooftops, but that is just reflective of all the ways that the economy in its digitalisation is also becoming distributed. Uber rideshare is distributed, Airbnb is distributed and banking systems on your mobile phone are distributed. So too, your ability to manufacture is simply going to reflect that megatrend of the twenty-first century; that is, we do stuff where we need it, because we are going to automate it and we are going to have a digitalisation of our processes.

The CHAIR: Who are our major competitors? Who else has access to these inputs and materials in the same way that we do here?

Prof. WILLS: On specific areas, there are easy examples. For example, South America is obviously a good lithium supplier and the other dominant lithium supplier in the world.

Mr S.J. PRICE: Do they have facilities as well?

Prof. WILLS: The lithium resource in South America tends to be different. We have a hard rock resource, which we are mining, and they have a brine resource, which they are concentrating, so there is a very different approach. Their extraction is impacted by climate and by weather. If they have an extreme rain event, then their production is going to be down for a while. For us, a soggy mine site is less conducive to efficient working, but we still keep our mine site going. We have a security of supply that they do not have. If you stack up all the materials—you can rattle down the list; it is not just lithium, but also copper, cobalt, nickel and graphite—they are all available in Australia. If you coordinated Africa into a single economic unit and a single governance unit and tied all the African countries together, Africa would probably be superior to Australia, but it is not. In a single jurisdiction, there is no other jurisdiction on the planet that has all the resources that we have.

Mr D.T. REDMAN: Is other tech being worked on in terms of batteries? I have a friend who is involved with doing some very early work on zinc bromide because they see some risks in the volatility of some of the other battery systems. There are some weight issues and a range of other factors. Do you see other tech emerging? Everyone is talking about lithium right now, so lithium is the catchword, yes, those other ones are attached to it, but do you see other tech coming in and competing in that space and therefore being a factor in play?

Prof. WILLS: It is a fundamental question. First of all the answer is that every technology has a window of opportunity to exist, and once that window closes, we are on to a new technology. The obvious example is that we had VHS and we made a choice between Beta and VHS. Right now, in the battery market, lithium is the VHS—Beta is not going to work and so some of those other ones will—but somewhere down the track, that technology may shift.

Then in the same metaphor is: What is the CD player? Where is the DVD player? What about the Blu-ray? What will be the Cloud storage device that replaces all of that? These battery technologies will evolve. We will always have some form of energy storage, but the question is: what is the technology that is delivering energy storage? Right now, our view at Future Smart is that we are

absolutely secure for about five years and we are probably very secure for up to 10 years. Meanwhile, we have to be self-aware and understand that technology shifts. If we build a new industry, we need our industry to be able to be flexible and adaptable so that it can move and continue to be an energy storage industry, not necessarily just lithium. However, at this point, it is also our view that even with the evolution of technology, lithium is still likely to be a core player; it is the world's lightest metal.

Mr S.K. L'ESTRANGE: Ray, if you look at the phone industry in the 1990s, it was Nokia phones and everybody was going for smaller and smaller phones—it was about batteries getting smaller and smaller—and then smart phones came and phones were big again and you had a whole new construct of what a phone did. With the car industry, at the moment we see a car for what it is—a combustion engine vehicle. We are trying to get battery sizes down and, as you mentioned earlier, with longer ranges to cover regional and country driving, will there be a complete shift in what a manufactured car would be in terms of materials that could make Western Australia, or Australia, somewhere car production could be a reality again?

Prof. WILLS: I think that the short answer is: yes, it is feasible, and it is certainly feasible in terms of automation and in terms of the material sources that we have, but, at the end of the day, the middle steps continue to be missing. That is to say that we have to move out of a refining process into a processing and manufacturing capability, otherwise those materials will go overseas and we will re-import them and reuse them. Unless we have that middle step, then the solution we are seeking is fraught.

As far as energy storage is concerned, there is some critical change going on. We are seeing annual improvements in battery storage. We are seeing battery density increasing at about six per cent a year. We are seeing our manufacturing costs slide in the order of 15 to 20% a year. All those things will drive down costs and improve performance, so the size of the battery you will buy for much less money will do much more for us. This century will always be about doing more with less and that is simply going to be about efficiency.

Mr D.T. REDMAN: I cannot remember whether it was your paper or somebody else's that stated that OPEC countries have been caught with their pants down on this. The prediction was that oil prices would come down substantially to try to offset that and for producers to get rid of their last bit of oil before this kills them off. Is that going to be a real factor in play in terms of the pace of change and in terms of their response when they pull their pants up?

Prof. WILLS: First of all, any publicly listed company has a difficult position. They cannot declare today, "We think we've got an asset bubble going on. We think we've got stranded assets in the ground and we're never going to be able to take this out." When you discover that the International Energy Agency, which was set up in the 1970s to combat the oil crisis—it was not set up to do anything about emissions, it was not set up to do anything about renewable energy; it was simply meant to solve the oil crisis. The thinking of that institution as a global unifier, if you will, of action has fundamentally been about oil, with a bit of nuclear and other stuff thrown in, but fundamentally about oil.

Associated with that, the world's largest companies up until last decade were oil companies. In the market cap top 10, of the top 10 companies, six were oil companies until about 2006. I have not checked today's figures, but it might actually be zero. The last remaining member of that top 10 market cap was ExxonMobil, and I think today it is number 11. It may be back at number 10. I am not sure, but I imagine it is number 11.

Oil has left the most valuable companies in the world. What has replaced them? Digital companies. Companies like Apple, Amazon, Facebook and Microsoft, and that distributed economy is what is

now dominating. A fundamental shift in even that economy—I will come back to your question now—is to a consumer economy. We have actually moved from where we have a centralist-controlled economy, which has very large institutions of doing these things, to ones that are still large institutions, but are now worried about corporate social responsibility in a way that they never have.

Apple has a 100% renewable energy purchasing policy, which is now in place, and their 43 locations in the world are now 100% renewably-powered. They now have contracts of supply with all their material suppliers, this is important to Australia, the 23 material suppliers into Apple have all guaranteed that by 2022, they will be 100% renewably powered. We are getting transformations that are not tied to government, but are tied to corporations and tied to corporations that are actually tied to their consumers.

The consequence of that, coming back to your question, is what does it mean about the price of oil? Are BP, Shell, Chevron and Exxon out there saying, "Guys, we're going to have 100% electric vehicles by 2025"? No, they are not. Why? Because it will destroy their shareholder value. They cannot concede that I am right. I do not think I am being all that clever—maybe just a little. All I am doing is saying, "I expect this to change. In the economy in the past these things have changed at this rate. If this thing changes at this rate, this is what it looks like." If I am right, then the projections that I am putting forward are perfectly reasonable within economic experience.

The CHAIR: I want to pick up a few of the strings of what you have just said around VHS versus Beta and stranded assets. Really, what we are talking about is the production and the consumption of energy and electricity, electron based as it is, being immediately produced and immediately consumed, and the nature of that energy. Molecular-based energy systems can be stored quite easily. One of the things that has been put to us in submissions, and hopefully we will go on to have some hearings to test this, is that we could utilise the existing asset bases that we have, particularly our pipeline networks, to store hydrogen as part of a blended gas stream and a transition through to a more hydrogen-based energy production economy. It seems to me to be one of those VHS versus Betamax arguments. A lot of people are even suggesting that you can even convert sunlight into hydrogen and have a very healthy energy export–based industry purely built on hydrogen, but that is a different technology to this. It can also be applied as a transport fuel.

Mr D.T. REDMAN: It is not as consumer driven either.

The CHAIR: It is not as consumer driven, but that is perhaps because we are a lot more familiar with solar. It has been around for a very long time. We have had solar hot water systems for decades now and we are more familiar with it. But that is not to say that hydrogen is not as prospective, it is just that at the moment everybody is a bit transfixed with solar. You have not discussed that much in your paper, so I wonder whether you might be able to share some thoughts on hydrogen with us.

Prof. WILLS: Yes, certainly. It is fair to say that I have publicly stated on a number of occasions that I am a bit of a hydrogen sceptic. First of all, thinking of it as a fuel source, it still becomes a thermal fuel source, so you therefore have thermal efficiency issues. That means you stick it into a power plant and you are going to get less than half of that energy back out of that hydrogen.

The CHAIR: Just pause there, though, we potentially have some fairly new-built assets sitting there that otherwise would not be running. There is some capital sitting there. There are assets sitting there. You do not need to go out and buy a whole new heap of solar PV stuff, because you have assets there. You run the business case to see whether there is—yes, you have some thermal efficiency issues there, but it is still a more cost-effective way of producing energy than investing a whole heap capital into a whole other asset class.

Prof. WILLS: You cannot simply inject hydrogen into a methane-burning process.

The CHAIR: I understand that.

Prof. WILLS: So, therefore there will be capital investment in that. Then the question is: whose capital? If it is private capital, the question that they will ask is: "I've got $100 million and I can stick that $100 million into a hydrogen plant, and it may or may not work, because we have not done this before, or with $100 million I can build another 100 megawatts of solar, we have now built hundreds of those, and I know it is going to work, and I will get my money back next year." If you talk about capital investment streams, and this is one of the primary issues that is changing, we are moving from the centralised model, which is a large power plant model. If we build a coal plant, it will take us six years to build. If we build a gas plant, it will take us four. If we build a solar plant, it will take two.

If I have $100 million to invest, would I put it in the coal plant that takes six years to return or stick it in the gas plant that takes four years to return or would I put it in the solar plant that takes two? If I want to whack up some batteries, I will do that in 100 days. That juxtaposition of "Where will my investment capital go?" is a fundamental question.

Back specifically to the hydrogen question, I think the next step beyond that then is a question of: where will we use hydrogen? We are not going to use it in motor vehicles—electrics have already won, unless somebody comes through with a radical new design on hydrogen, and that is always feasible. The door is always open for that and I am happy to consider that, but, right now, the VHS–Beta solution—some people might say that electrics is the VHS and hydrogen is the Beta, but, guess what? We are going VHS. What might we do in the future is a different question.

The second part then is: how do we use it for energy generation? If you are in a city or in a jurisdiction between the thirtieth parallels, it is my view that by 2025—this is a radical forecast—virtually all those jurisdictions will be almost 100% renewable. It will be that quick. It is eight years away; it is still possible to achieve that. I think that Perth itself will be close to 100% renewable powered by 2025. That is purely based on the continued acceleration of the addition of solar panels to rooftops and the occasional expansion of utility scale in the state. We are up to almost 900 megawatts of solar on rooftops today in 2018. By 2025, we should be close to about two gigawatts.

The CHAIR: I guess it depends on where the technology goes. You talk about private capital, but there is a hell of a lot of private capital invested in the gas network here and we have the largest, most strategic energy infrastructure asset in the country in the Dampier to Bunbury natural gas pipeline, which has the ability to transport hydrogen or bring converted sunlight down the pipeline. It is possible to think about optimising existing electricity network assets and gas distribution assets based on a distributed energy system or micro gas turbines. So there are other ways of skinning the cat. I guess I just wanted to test that with you, because it has been put to us by asset owners that have a very clear interest in preserving their investment and looking at other ways to optimise their asset base and other technologies that could mean that they do not have stranded assets, and, in fact, could be very complementary to intermittent generation sources.

Prof. WILLS: We are still hung up on that word "intermittency". That dissolves after 2020—batteries will simply eliminate that word. Right now, we are still, kind of, hung up on it, so right now we are focused on a point in time. Those who are arguing, "The wind's not blowing tonight; therefore, there's a problem"—that argument will disappear. What evidence do I have of that? It is really simple; it is the South Australian battery. It has provided two per cent of the capacity of the South Australian market and it is now delivering 55% of the capacity load for ancillary services that is required—this is new data out in the last few days—and it has reduced the cost of operating the

ancillary market by 90% since it has been installed, saving in excess of $30 million in the period that it has been installed.

Mr D.T. REDMAN: Is it because it caps the peaking load?

Prof. WILLS: It drops off the peakers —

The CHAIR: It supports the network. It keeps network frequency up to scale.

Prof. WILLS: If you simply translate that then to be: is that a solution for other places? Some people will argue, "It's a unique solution", others would not.

Coming back to the question, I will just target a few words there. The proposals are coming from asset owners who are looking to preserve their assets.

The CHAIR: Of course they are.

Prof. WILLS: That is completely natural and perfectly understandable. My answer to that would be: as long as they have an economic solution, they should have a viable outcome. But if their solution is not economic and competitive with the alternative, then the money will go to the alternative. We may get distracted a little by the fact that we have bootstrapped renewables into our economy by subsidy to ensure that it actually arrives, because we wanted low-emissions energy, but actually those subsidies are almost entirely gone now.

Past 2020, my expectation is that we will not require any subsidy at all in any marketplace for renewables; it will simply be the cheapest generation. The adjunct to that is: as long as battery storage is cheap enough. It is all about economics. If battery storage does not get as cheap as I am projecting it will be, and I am wrong, then the entry will be a bit longer and we will need a longer period of transition when we get support from things like gas generation.

I have already been stating now for two years that I do not believe we will build any new gas plant in the world after 2021. I do not work in the gas industry, so I do not have exposure to stranded assets, so I can make adventurous comments like that. But that is my view. Ultimately, we will reach a point where capital says, "Where do I get a return on my investment? Will I build a gas plant, or will I build a complex wind-energy storage system that is cheaper and gives me a faster return on investment and I do not have to sign a gas contract with anybody, because I have my resources right here? Or do I go off and build this gas plant, where I have to sign a contract, I have to build big capital, I've got to wait for four years for my return on investment?"

If you balance those two scenarios, then it is just additive to the perfect storm. It is a death of a thousand cuts; everything that we are changing is changing the way that the old economy worked and is making way for the new economy to come. To think that that old economy may persist in that new model is not facing the digitalisation of the economy and the way that that changes everything.

And there are extra layer cakes on top of that. We have not even talked about demographics and what the millennials will do as consumers in this scenario. Millennials are just getting up to a point now where they start to spend in our economy and make decisions about our economy, and guess what? They are really comfortable on public transport, they are really comfortable with ride sharing and they are going to want to buy local in terms of produce and agriculture, but also in terms of energy on rooftops. So, we are actually seeing a demographic shift that we have never seen before either, and that layer cake is there.

Mr D.T. REDMAN: One of the biggest assets we have is our network asset. In the scenarios you are painting of this big shift that is happening, how do you see the south west interconnected system? Will it become a big stranded asset and the unit cost of being able to utilise that? Is it going to be important to shift electrons? What are your comments about that?

Prof. WILLS: I think the primary one is that first of all it needs a mind shift in the way that we think about that asset. Right now, we think about that asset as a purpose to deliver electricity. We need to change it and regard it, in the same way as the pipeline, as a battery asset. It is not an asset that will necessarily deliver electricity to the home; it is an asset that will actually help balance the whole grid and in some case take electricity from homes and take it to other places with peer-to-peer trading and with Power Ledger and all those kinds of new fandangled things.

I think the nature of the grid must change and the way we think about the grid must change, therefore the way that we think about financing the grid also has to change. We have not done that yet. We have not done that critical thinking. It is happening. I have to say that the sort of work that we are seeing from Western Power, in particular in relation to their grid, and what Horizon are doing in relation to their own networks and their microgrids is all critical thinking. But if I look at utilities globally, the answer is that every utility has to recreate itself. If they think that they are going to continue to business in the twenty-first century the same way they did in the twentieth century, then they are already dead.

The CHAIR: I am going to ask you one very quick question about vehicles. We have focused very much on passenger vehicles. I wonder whether you think the same sort of transformation will happen in heavy freight? Particularly for WA, so much of our stuff comes via truck from over east—long distances. A longer time frame, do you think, for heavy freight?

Prof. WILLS: The Tesla truck is perhaps the example that currently has in excess of a 500 mile range. Now, 500 miles is only going to get about halfway across the Nullarbor. So, do we need longer range or do we need a rapid freight charging system? Currently, when you look at charging networks around Australia, you can see that we are mostly using low-end chargers. What we really need to get to is something like a 350 kilowatt DC charging point. When you have one of those, you will recharge your truck in something less than 10 minutes. Your truckie will get to the stop, they will pull over and they will charge.

The CHAIR: It is not enough time for a burger.

Prof. WILLS: But more likely, if there is a truckie, they will only be a supervisor; they are unlikely to be doing the driving. By the time we get to 2022–2023, I expect that trucks across the Nullarbor will be autonomous.

The CHAIR: That is four years away.

Prof. WILLS: Yes.

The CHAIR: I will proceed to close today's hearing. Thank you for your evidence before the committee today. A transcript of this hearing will be emailed to you for correction of minor errors. Any such corrections must be made and the transcript returned within seven days of the date of the letter attached to the transcript. If the transcript is not returned within this period, it will be deemed to be correct. New material cannot be added by these corrections and the sense of your evidence cannot be altered. Should you wish to provide additional information or elaborate on particular points please include a supplementary submission for the committee's consideration when you return your corrected transcript of evidence.

Thank you, Ray.

Hearing concluded at 10.22 am

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