



LEGISLATIVE COUNCIL

SELECT COMMITTEE ON IMPACT OF PEAK OIL ON SOUTH AUSTRALIA

Plaza Room, Parliament House, Adelaide

Tuesday 12 August at 10:10am

[OFFICIAL HANSARD REPORT]

BY AUTHORITY OF THE LEGISLATIVE COUNCIL

MEMBERS:

Hon. S.M. Kanck MLC (Chairperson)
Hon. J.M.A. Lensink MLC
Hon. R.P. Wortley MLC

WITNESS:

MICHAEL LARDELLI, Beyond Oil South Australia, 37 Cochrane Terrace, Prospect
5082, called and examined:

134 The CHAIRPERSON: Thank you for attending. The Legislative Council has given authority for this committee to hold public meetings. A transcript of your evidence today will be forwarded to you for your examination for any clerical corrections. Should you wish at any time to present confidential evidence to the committee please indicate and the committee will consider your request. Parliamentary privilege is accorded all evidence presented to a select committee. However, all persons, including any members of the press who might be present, are reminded that the same rules apply as in the reporting of parliament.

Mr LARDELLI: I am representing Beyond Oil South Australia. I would like to elaborate on my written presentation, take up certain points and maybe show a little new data. First, I will set the scene. You need to understand the place of oil and gas, and also coal—this whole set of fossil fuels in our society. We need to remember that nothing happens without energy. Energy literally makes the economy go round.

Oil and gas together—and they are basically the same thing, just different sized molecules—represent 60 per cent or more of world energy production; so they are an absolutely vital part of world energy. Coal is about another quarter of world energy production and then we have nuclear and hydroelectric and other forms of energy which are less important.

I know that people talk a lot about oil in terms of transport, but the thing which most concerns me and on which I would like to focus is food production. These figures are from a study called 'Eating fossil fuels' by Dale Allen Pfeiffer. The figures would probably apply to an Australian situation equivalently. One kilogram of oil is needed to produce every kilogram of food in the United States. These are figures from on the farm. These are not figures for what is done to the food after it leaves the farm gate. About 1,500 litres of oil, or 9.5 barrels, are expended annually to feed each American; and we can imagine that those figures are similar in Australia. We are literally eating oil. Our agricultural system has become totally dependent on this.

135 The CHAIRPERSON: In relation to that figure, do you know how much is for transport, moving the grain to the market? Is that included in that figure?

Mr LARDELLI: I understand that is not included in that figure. The study breaks it down into fertiliser, pesticide use and machinery use of oil, and so forth.

136 The Hon. R.P. WORTLEY: That was taken in 1994. Has new technology decreased the amount of oil or are we now using more?

Mr LARDELLI: I would imagine that it is probably using more as they try to boost agricultural production. The extent to which technology in some ways can reduce oil consumption in some sectors of the economy is a bit overblown. It might occur in some information sectors of the economy but not in terms of pushing a machine around a paddock to harvest grain. Maybe new agricultural practices, such as low tillage, might reduce oil consumption in some ways but then often you often boost herbicide use and so forth. I am not sure whether it evens out.

There is a lot of debate at present about whether or not we are facing a problem with oil. There is something called the export land model. This is not yet appreciated in the media, but it is something which absolutely convincingly shows us that we have a large

crisis heading our way quite rapidly. What we have to realise is that it is not only the increase in oil consumption in the developing economies of India and China that is boosting consumption at present and placing strain on our oil production capacity in a worldwide sense, but the nations that are oil exporters at present are growing very rapidly because they are making huge incomes out of the high oil prices. They tend to have young rapidly growing populations. They also tend to have low subsidised internal oil prices.

All this leads to very rapid growth of internal use which, for most of these exporting nations, because their production is flat or even in decline, means there is less oil to export onto the market. For an oil importing nation like Australia it is not the world production of oil that is important but, rather, the amount of oil available on the export market. In other words, how much we can buy from someone else.

This slide shows a prediction made in 2006. I have the reference here if you want to look it up and you have been given handouts which have all these information. They are basically looking at the 20 largest exporters of oil. They are looking at the history of oil exports and also balancing the internal growth of those economies against the fact that most of their oil fields are now starting to go into decline and they are drawing out the prediction.

This study was made in 2006. They saw the top then and then you are starting to see a decline. By 2020 the amount of oil available on the world export market is predicted to be down by 30 per cent. Just that alone would give much higher prices than today because we have all these economies struggling to grow while the amount of oil available will be decreasing.

This slide shows the reality of what has happened since 2006. Oil exports are decreasing despite the fact that the oil price has been so high. Because the amount of oil exports seems to be constrained, we can see that the price is shooting up in response to that as we have growing economies struggling to get enough oil. That situation will only get worse.

We have seen a drop-off recently in the price of oil, but these are the normal fluctuations you see when a market is very tight. In the longer term, looking a year or five or 10 years out we can only see higher prices, unless of course some very serious economic collapse happens which reduces demand dramatically; but we will see about that. This is the reality we face today. I think people need to be more widely aware of that.

In Australia, the top line on this slide shows our consumption and the bottom line shows our domestic production which peaked in 2000. From the peak we have come down to about half within a few number of years, within about eight years. This graph goes to 2010. If we stretch it out for another 10 years you can see that, following that trend, our production will be quite low, maybe a quarter of what it is, or at least a quarter of what it was in 2000, maybe even less.

137 The Hon. R.P. WORTLEY: There are reserves out there that we have not probably found. They are still exploring. Is it too early to say that we have peaked and we are on the way down?

Mr LARDELLI: We could have a whole presentation on that in itself but there are some important things to realise. From discovery to bring oil to market takes at least five years, if not six years. You have heard geologists talking about Australia as being primarily a gassy place, not that much oil compared to natural gas, and it is oil that is driving our transport at present, unless we make a desperate attempt to convert to, say, compressed natural gas.

The problem we have now is that we are in a race against time. The oil shortages are coming. The very high prices for oil are coming. Even if everything was to go right and we were to discover new resources we could not bring them online in time. If we decided to convert our infrastructure, we could not convert it in time. It takes time to do that.

I will say a few words about the Hubbert peak, where the name of the peak oil concept comes from. I want to mention it because I will not just talk about oil today; I want to talk a little about phosphate today. Hubbert's great insight was that the rate of utilisation—and we have to realise that we are talking about rate of production and consumption here, not total production—the rate of utilisation of a resource approximates a bell-shaped curve. You

can use this information to predict the moment when production will be maximum—in other words, the peak—and you can also predict what the final amount recoverable will be.

I will show you why you get a curve. Early on, when harvesting the easiest to access and richest part of a resource, production can increase rapidly. It reaches a peak and then it drops down as the resource gets more difficult to extract, until finally it reaches a level where it is no longer economically possible to extract it.

138 The Hon. R.P. WORTLEY: When can you predict when you will get to the peak or when you will come down? How would Hubbert know? How could he predict the peak?

Mr LARDELLI: I will show you; it is rather an amazing thing. I now show the US story for oil production. This is from a book by Professor Emeritus Ken Deffeyes who was a professor of geology at Princeton University. The book is called *Hubbert's Peak—The Impending World Oil Shortage*. Ken Deffeyes is a professor emeritus. As I said, he used to be a professor of geology at Princeton University, and he was a colleague of Hubbert. This slide shows the history of US production, which we know peaked in 1970 and which Hubbert fairly well predicted but which has since dropped off. What they are saying is that you can fit a curve to this. It turns out that the best type of curve to fit is what they call in mathematical terms a Gaussian Curve. I will just do a bit of a mathematical discussion. If you do not want to follow this, just turn off. This is also from the book.

They are discussing these types of curves. You have heard of a normal curve, and a Gaussian Curve is another word for a normal curve. Other curves include the Logistic Curve and the Lorentzian Curve. The only reason it is important in this discussion is because you can take this information that makes that curve and you can mathematically transform it. When you do that you get a very powerful technique called Hubbert linearisation, and I will show the committee what I mean. This slide depicts a production versus time curve. Here we have the production at any moment per year versus time. We can transform that information and instead of saying 'production versus time' we can call it 'annual percentage growth'.

For example, we look at the production in any one year and we divide it by the total amount produced to that date. On the bottom axis we have put the cumulative production—in other words, we also put the total amount produced to that date. When you do this you find that the Gaussian Curve behaves in this way: it comes down and then it goes linear until it hits at the ultimate amount that is being produced. This is a rather amazing thing. Let us put the American experience onto this. Let us transform the American data in this way. Here is the Gaussian Curve (the normal curve) of production versus time; here is the annual percentage growth (in other words, it is basically a ratio of production per year over cumulative) and here is the cumulative amount.

You can see that it comes down and then falls into this straight line. You can draw a line through that, amazingly, and come down and predict the ultimate amount recovered. That is how powerful this technique is. The peak tends to occur at the halfway point between zero and the ultimate amount recovered. It also enables you fairly closely to predict the peak year. As our experience grows with the US more and more of this figure is looking to be right.

139 The CHAIRPERSON: Hubbert, from memory, predicted the US peak within a matter of months.

Mr LARDELLI: He gave a range for the peak, but he did predict it fairly accurately.

140 The CHAIRPERSON: That was 20 years before it actually peaked.

Mr LARDELLI: About that, yes. He actually predicted the world peak. I think that he made a prediction of the world peak back in 1965. I am not sure whether that date is correct. He actually predicted that the world would peak in 1995. I have taken those slides out of this presentation, but what happened then is that the oil crisis of the 1970s (which was a politically-motivated thing) cut off world production—it cut off the normal Gaussian behaviour that you see here. A lot of people use that to say that Hubbert was wrong and that he could

not predict the world peak. However, on my computer I have a TV interview he did back in 1976—so, after the crises had begun to come.

He says in that interview that, because of the constraining of production by the Saudis, the peak will be shifted by about 10 years. He still got it correct, but the formal publication of his estimate says '1995'. However, he was actually seeing then the peak at about 2005.

141 The CHAIRPERSON: The main message is probably that this mathematical modelling has proven to be very correct?

Mr LARDELLI: Yes, it works.

142 The Hon. R.P. WORTLEY: The oil crisis was, what, 12 months? How long did that last?

Mr LARDELLI: I think there was a number of them. There was something in 1973 and then, I think, there was something later on in the same decade.

143 The Hon. R.P. WORTLEY: Why did they extend it for 10 years? Why did two years of an oil crisis extend the whole life for 10 years?

Mr LARDELLI: I am not so much up on the history. I do know also that, under Carter, the US began to put in a lot of measures to move away from oil once it realised that it was so vulnerable. So, you had not only a great growth of nuclear energy but also the introduction of car efficiency standards, and so forth. We have managed to keep a top on consumption for a while and reduce the oil consumption of the US. The US is such an important part of oil consumption. This is also going on in Europe. I want to get away from oil for a second to tell the committee about something else which is going on and which virtually no-one seems to know about.

This is what you see if you apply Hubbert's technique to other resources. Originally, the Hubbert's technique was designed around other resources which, if I remember rightly, he then applied to coal. I want to talk about phosphate, which is known as being the critical limiting element in agriculture. We know that Australian soils are very poor in phosphate and that we need phosphate externally applied to our soils in order to keep our agricultural production high. Importantly, there is no substitute for phosphate—either you have it or you do not. There is no other molecule or other compound that we can substitute for it.

I want to look at the experience of Nauru which is a phosphate source but which is completely mined out. There is not much there now. This is producing guano, which is this organic form containing phosphate and which is basically bird poo fossilised. The production history which you can see forms a part of a curve. There is production versus time. If we do a linearisation analysis on it we can see the straight line part of the graph. You can see that you can draw a straight line through that and come down to your ultimate recoverable reserves. The next slide depicts world phosphate production. As you can see, we appear to be peaking; and, if we do the linearisation analysis, that is where we are.

This predicts that we have basically used up 75 per cent of the accessible phosphate in the world. Fairly soon we will have to start asking: what will happen to conventional agriculture? As you can see, we are already in a phosphate crisis. Prices have gone up something like 700 per cent in the last 14 months. Prices have gone up massively. People are blaming this on certain things. People will be blaming the great extra use of biofuels, and so forth. However, at the moment, the world is struggling to produce enough phosphate for food production. I have even read articles from the BBC which say that Indian farmers are complaining that they cannot afford phosphate and so their production now will be half what they were expecting.

I think that, within a very few years, phosphate plus high oil prices will start to reduce the world's agricultural production fairly significantly. You can see that urea is also going up. Urea, which is our nitrogen fertiliser, is produced from natural gas. So, what will happen in 10 years? In 10 years in Australia (but, of course, starting soon) we will have almost no domestic oil production, or at least it will be at much lower levels than it historically has been. Oil available to buy on the export market will be down by about 30 per cent, which means the prices will be extremely high. People need to understand that economic growth

and energy production are very tightly tied. You can say from that, that because energy production is about to go into decline economic growth is about to go into reverse, and therefore Australia and most of the OECD will be in long term economic decline.

In 10 years' time, money for investments to cope with this will be very difficult to find. The reason is that we will be in an economic crisis. There will be unemployment benefits to try to pay for people, subsidies from government to try to buy food for people and so forth. The government will be trying to cope with the crisis: it will not have the money to devote to things such as big investments in renewable energy and so forth. We will not have the energy to do that. The absence of money to do it will simply be a reflection of the fact that we do not have energy to build those things. If there is one lesson to learn, it is that, if we want to have a move towards renewable sources of energy, we need to do it now in a crash program, because waiting until the problems hit, means that you cannot do it. You cannot do anything without energy, so waiting until you have problems with energy is the wrong way to go.

144 The Hon. R.P. WORTLEY: Five years ago, we very rarely saw car companies coming out with hydrogen cars and prototypes of these things. Suddenly, on TV I have seen a number of hydrogen cars and prototypes coming onto the market. These take years to develop, so obviously things are happening out there about which we do not know and which are being kept for the appropriate moment. How do we factor in the fact that companies are doing lots of research? The boardrooms around the world are hearing what you are saying and are actually doing things now to take its place.

Mr LARDELLI: I think the boardrooms around the world still do not fully understand what is coming. They have been talking about hydrogen and so forth because they are thinking in terms of climate change. They have not been developing these things in terms of alternatives for energy. Hydrogen is not an alternative, anyway. There are huge problems with the use of hydrogen. We probably will never see a hydrogen vehicle economy simply because hydrogen needs to be produced using some form of energy. At the moment, most hydrogen is produced from natural gas, so that is really no substitute.

You can imagine scenarios where we have hydrogen being produced from solar energy and so forth, and then putting it into fuel cells and making electricity. To be honest, it is far more efficient to put the electricity straight into a battery rather than playing around with hydrogen, because there are so many problems with hydrogen. I do not want to go down that road because literally we could talk for half an hour about how the hydrogen economy will not occur—and you can read some articles about it.

There are massive problems with storage, energy density of the substance and so forth. There is also a whole question about the connection which is not really appreciated; that is, the connection between complexity and energy consumption. People seem to assume that, in the future, we will be able to have this wonderful high-tech society using a tenth of the amount of energy we do now, but when you think about the way the globalised economy works and the way all this high-tech manufacturing works with just-in-time logistics and sending components all around the world to build machines in specialist factories and so forth, once all that slows down and becomes more erratic because fuel supplies become limiting, all that high-tech economy just does not work very well anymore.

Imagining that there is some fantastic high-tech solution to the energy crisis is probably a bit wrong headed. The solutions to the energy crisis are a matter of dramatic reduction in consumption and simple technological solutions. In the end, it will be the simple solutions which will be the viable and sustainable ones. Phosphate prices will be sky-high. You can pretty much predict that Australia's food production will be dramatically reduced by limited oil, phosphate and urea. We are already seeing that climate change is having an impact on our food production with what is occurring in the Murray-Darling Basin.

In overall terms, we have to remember that, at the moment, world population is increasing by 76 million people per year. I believe that Australia's agricultural production, that is, its grain production, in a good year can feed about 80 million people. Simply, one year's population growth is Australia's agricultural production. Grain consumption is now actually exceeding production, but the reason why we have not had a massive crisis yet is that we have had some reserves from good years in the past. Those reserves are now dropping rapidly.

However, we also see that oil availability is now decreasing and phosphate production, I would predict, will soon collapse. Other fertilisers are becoming expensive. One prediction I have heard is that, for every one degree rise in world temperatures (on average), we will see a 10 per cent decrease in grain production. I am afraid that we will face a world food crisis in fairly short order.

In light of this, I would like to talk a little about our own society and how we can maybe cope with this. I want to talk about this thing which is a rather popular concept at the moment called 'resilience'. We hear it a lot in terms of people's psychological resilience. It is a rather popular thing to hear being discussed on the radio at the moment. I want to talk about the resilience of our society and physical resilience.

What is resilience? I define it as the capacity to recover from shocks and challenges. What do we need to be physically resilient? What we need is reserve capacity. We need something to fall back on. When things become limited, we need to have something in reserve. For example, we need a reserve capacity of water for drinking, growing food and washing. We need food reserves to fall back on if suddenly there is a disruption to food supply or food temporarily becomes limited. We need to have enough shelter and warmth for everyone, and we also need to provide for movement of people and resources.

What we want to avoid doing is operating (as I will show you) at maximum efficiency. When you are at maximum efficiency, you do not have any reserve capacity; that is, you do not have anything to fall back on when one of your resources becomes limited. You need some waste in the system as a kind of buffer. How can we increase reserve capacity or resilience? We can find more resources, but we can see now that that game is coming to an end. We could reduce population, because if we reduce population, then that gives us more resources per person and so we have a buffer then to fall back on; or we could use resources more efficiently (which basically means using less per person).

However, we also need to remember that efficiency gains are subject to what we call diminishing returns; in other words, the first 10 per cent of efficiency gains is easy, the second 10 per cent is harder and it gets harder and harder. You cannot become 100 per cent efficient: at some level, you have pushed it to the maximum. What is it that destroys reserve capacity or resilience? A decrease in resource supply—for example, this drought—and increases in consumption per capita, or just increases in consumption within an area destroys resilience.

We can have increases in consumption by increasing consumption per person or per capita. Those increases are fairly easy to reverse. We can say to someone, 'Okay, you are just living a very lavish lifestyle, you can cut back.' We can also have increases in consumption due to increased population because every person needs a minimum amount of a certain resource. Those increases are very difficult to reverse, of course. Population increases have a lot of momentum behind them and the increase in consumption due to population increases has a lot of momentum.

The worst and the most dangerous thing we could do in the light of the future problems that we have is to try to continue economic growth on the back of efficiency gains, but this is what industry and most of our political culture and most of our society will demand. What happens is, if you reduce consumption by increasing efficiency, you give yourself a buffer. If you then eat away that buffer by increasing population, you end up in a situation where you are being maximally efficient with no reserve capacity, and all it takes is a slight push and the whole system collapses because it literally has nothing to fall back on.

It is suicidal to continue to grow the economy on the back of efficiency gains. That is a game that will only work for so long, and all you are doing is making yourself more and more vulnerable as a result. We also need to remember that only one vital resource need be deficient to cause collapse. What would happen to Adelaide if there simply was not enough water to provide everyone with the food and the drinking water that they need?

In the past in this globalised world we have used cheap and abundant energy to solve our resource problems, so if there was a resource deficiency in one area we would import it from another area. We have a kind of magical thinking about energy. All of us have been born in an age when energy has been cheap and abundant and it literally permeates the way we believe the world works. But the world is totally dependent on energy. So now with

our water crisis we hear people talking about just bringing in water from the north of Australia, not realising that every gigalitre of water weighs 1 million tonnes and that the amount of energy to not only build the pipeline but to pump water from the north of Australia down here is enormous. How many gigalitres does Adelaide use—150 or 200 gigalitres? That is 150 to 200 million tonnes of water per year that would need to be pumped down. It would require stupendous amounts of energy to do that. Cheap and abundant energy has solved our resource problems in the past, but it cannot do that in future.

This is the challenge and we need to realise that these options are simply not open to us. We are entering a new era in terms of the way the world works. If we had cheap and abundant energy there would be no phosphate crisis. If we had enough energy we could simply pump seawater and purify phosphate from seawater. But the amount of energy you have determines what you can do and it is the amount of energy available that determines how much of all the other resources you can access. So, we need a new form of thinking for the future.

What are our options? Unfortunately, this western-style oil and phosphate driven agriculture will soon no longer be viable. There are now too many of us to go back to a hunter-gatherer lifestyle. We do not want to end up like Easter Island, where they consumed all their resources, went through a collapse and pretty much died out. Is there a kind of solution that allows us to continue? Possibly there is. This is where we start to grow our food more locally using intensive vegetable growing techniques. By growing food locally using more human input we drastically reduce the amount of oil energy we need to consume and drastically reduce the amount of transport. We have all heard about food being transported a couple of thousand kilometres around the place: I was buying garlic the other day flown in from America.

Growing food locally also allows us to recycle our waste back to the food growing soil. At the moment we have a situation where we take fertiliser, spread it on the fields, grow the food, eat the food and poo most of it down the toilet and wash it out to sea and the resource is simply gone. Energy you can use only once, unless it is from a renewable source but, as with many resources, phosphate we can keep in the loop. We can capture it; if we capture our own wastes and put them back as fertilisers onto locally grown agriculture, we can close the loop and drastically reduce our need for phosphate.

So, urban agriculture solves a lot of our resource problems and uses far less oil and water. For example, we could grow food locally using drip irrigation techniques. I can tell you that a person growing food locally using intensive vegetable growing with drip irrigation is far more efficient than any farmer hundreds of kilometres away doing it on a mass scale. This then allows recycling of our wastes and provides employment. We can see there will be a lot of unemployment in future as the economy contracts. It provides better nutrition, because people will be eating more fresh food, and it provides exercise. We can also look at what is coming in a number of positive ways as well. If we change our behaviour in this way we can solve a lot of our resource problems and actually cure a fair few of society's ills, such as our obesity epidemic.

145 The CHAIRPERSON: With the current water restrictions, however, this really is not an option.

Mr LARDELLI: It worries me, because we need to prioritise what we want water for. The absolute top priority of water should be for local growing of food because without that Adelaide will not be viable in future. If we want a viable Adelaide and want to have people still living here we need to prioritise the local growing of food.

146 The Hon. R.P. WORTLEY: The current situation with environmental use with the Lower Lakes, you are saying that it is better to keep our water in Lake Alexandrina for critical needs rather than let it flow down to the Lower Lakes to stop the acidic soils?

Mr LARDELLI: I am saying that it is better if we get the energy to put the water into Adelaide rather than allowing agriculture in the Murray region to grow our food for us. The water they were using we should be bringing to Adelaide and I imagine a lot of the wine market in the Barossa will collapse in future simply because it will become so expensive to transport wine and consumption around the world will decrease. There is water there that we could divert into growing food locally.

I am talking about a bigger thing than this local problem with the Lower Lakes at the moment. Where in the whole of Australia do we grow our food and use our water? Adelaide only uses a tiny percentage of total Murray flows and, if you were to institute a program of composting toilets to capture wastes (and you would save water because you are not flushing it away)—forget swimming pools and a lot of unnecessary water use—there is probably enough water in the system at the moment if we used it correctly to grow a fair amount of food locally. I am talking of a reprioritisation by our society.

Future energy and phosphate and other shortages mean the only viable future for Adelaide is one in which most food is grown locally, with human and other organic wastes recycled back to food growing soil. This will require sufficient water. This is an important point: if Adelaide already needs desalination to produce sufficient water for its growing population, then Adelaide is already beyond its long-term resource limits, because that energy for desalination will be far more expensive in the future. Admittedly, we use a lot of water inappropriately at the moment. I get concerned when I hear about our using high-tech solutions like desalination. We do not want to become dependent on a high-tech plant because, if it breaks down, what will we do?

Greater efficiency of resource use gives us capacity buffers against unexpected resource shortages, but continued population growth using efficiency gains must lead to collapse inevitably, because our capacity buffers are reduced to zero. In a finite world, continued economic and population growth means starvation ultimately for our children. We need to take a longer term view. The future is rushing back towards us rather rapidly as we see that in 10 years time Adelaide will be a very different place.

147 The CHAIRPERSON: Our State Strategic Plan sees population growing into the future and in fact has as a target that it continue to grow, and they do not seem to see that there is a point at which they will say no further growth.

Mr LARDELLI: Population growth is just lazy economic growth. It is simply stuffing more people into an area to drive things like the housing market. We justify it at the moment by saying that we have the mining boom. Once energy becomes more restricted we will find that a lot of these mining projects are simply not viable.

148 The Hon. J.M.A. LENSINK: What about if it is population growth through migration? Do you have a problem with that?

Mr LARDELLI: You are talking about whether we view this as a world problem or an Adelaide problem. Decreased oil will inevitably reduce globalisation and create crises around the world. We may have a degree of refugee flow by people desperately trying to get out of areas where there are food shortages into areas that still have some capacity for resources. I tend to look at everything locally, because I want my two small kids to survive. I no longer expect them to live the life that I have lived, which has been a wonderful thing with cars and all this technology and so forth, but the game ultimately must be: what happens in 50 years time? Will they get to enjoy at least an existence? I tend to be rather selfish in the end.

I think that, as I've shown you, unfortunately, the world is heading for a crash inevitably. The numbers simply say it is. We can try to blind ourselves to it, but unfortunately the numbers are rather grim. In that, I then unfortunately take a rather siege mentality to the whole thing. When the world is going to pieces, we need to see if we can still maintain something here.

149 The CHAIRPERSON: Do you mean a pull up the drawbridge approach?

MR LARDELLI: Or you could say a one person in, one person out approach. There are ways of controlling population. There are some islands in the world, for example: I think Norfolk Island does not allow net immigration. It says that, if a person wants to migrate there, somebody has to leave or, I guess, somebody has to die. So, there are ways of controlling population. Because I have engaged in Adelaide's population debate fairly intensively, I know how incredibly fraught this topic is. You get labelled a fascist or an eco-fascist or whatever; it is a very difficult topic, but it does not mean the topic does not exist and it does not mean that population isn't something we have to deal with in the end.

What is really irritating about the push for population growth is that there is not even any economic sense behind it. It is not as if they are saying, 'Gee; if we hit 1.5 million we cross some magical economic threshold where Adelaide's economy takes a quantum step up and we all live much, much better.' All it is is population growth for the sake of population growth. In other words, once we get to 1.5 million, the people who are pushing the population growth, like the Property Council, will simply say, 'Right; now we need 2 million' and then it will be 2.5 million. There is no end to it; there is no logic behind it other than the short term logic of increasing consumption in order to drive the economy and drive sales of houses and consumables and so forth.

Ultimately, that is not possible in a finite system. With the water restrictions that Adelaide is now under we are beginning to see just how finite the system is. You can only fit so many people into this area. In island cultures, people who live within those very defined resource boundaries understand limits far better than us, and they evolve societal systems to cope with living within finite resources. We need to see South Australia as a finite place, and we need to have the right ideas to allow us to live here continuously, otherwise, in 100 years Adelaide will not be here if we continue on our current path—maybe even less time.

That is pretty much where I was going to end. If there is time I might as well mention one more thing just to explain something to you. I find that, when it comes to talking about resource limitations, a lot of people, mainly those with an economics background, will often bring up this idea of the 'resources pyramid'. It is a rather beautiful idea in some ways. The idea is that, when you begin to harvest resources, of course, you go for the lowest cost extraction to make the maximum profit, so you go after the purest resource; the easiest to get at. As that gets mined out you might say, 'Oh; shortages', but what happens is that the price of the resource goes up. Once the price has gone up, they say that you can then justify going after the less pure resource, and actually the resource base at that less pure level is far greater than the previous resource base.

So, according to this economic argument, the further you work your way down this resource pyramid—in other words, the higher the price of the resource—the greater the resource base. The problem with this idea is that it only works in an economy where energy is cheap and abundant. That is what we have had for 100 years. We have basically had a lot of energy quite cheaply. As you move down the pyramid, the cost of extraction in terms of energy is increasing but, as long as that cost in terms of energy and money is marginal compared to the profits to be made, it doesn't matter.

Some people use this concept for oil and other resources to say we will never run out of energy because there is so much resource there. So, you will hear Exxon Mobil, for example, saying that the ultimate recoverable estimates of 2 trillion barrels of oil are wrong, because there are literally 6 or 8 or more trillion barrels of oil equivalent of hydrocarbons out there; there are massive hydrocarbon resources.

It is true: the earth has enormous amounts of hydrocarbons, but we will never harvest them. The reason is that, when we are not talking about mineral resources but about energy resources, the resource pyramid looks like this. When we are harvesting energy, then the energy we use for the harvesting becomes critical. In other words, as you work your way down the resource pyramid, you are using more energy to do the harvesting and so you have less net energy left over. So, as you use more energy for harvesting, you actually have less energy to use for something else once you have produced it.

It may surprise you to learn that 50 per cent of the world's oil production comes out of only 1 per cent of the world's oil fields. These are the largest 1 per cent. Most of them were discovered half a century ago, and the last large oil field to be discovered was back in 2000, I believe, in the Caspian area in Kazakhstan.

When you begin to harvest oil from these giant oil fields—which, because they are so big, are the first ones you find as well—you are getting a huge energy profit. Then, as those start to deplete you have to move to the less pure resources but, because the energy profit is less, the total amount of energy you can get out of them is less and eventually you come down here to a point where the amount of energy you are getting out is the same as the amount of energy you are putting in. At that point the activity stops; it is not physically possible to do it. That is a law of nature, basically. It doesn't matter how high the energy

resource price is; it will not occur, because you cannot get something for nothing in terms of energy.

I wanted to bring this up because a lot of people point to the resource pyramid as an argument that there are unlimited resources out there. Of course, yes: there are huge amounts of resources, but it would take more energy to get them than we would actually get out of them, and that is why it is a different game when it comes to harvesting energy.

150 The CHAIRPERSON: Michael, what you told us in terms of agriculture means that our whole agricultural industry is set for a crisis. In terms of those two things alone—the oil and the phosphate—what should we as a committee be recommending to government that it should do? Should we just let the market determine who will use these resources, or should government pass legislation and say, 'Okay; the oil will be used in this way, and the phosphate will be used in this way'?

MR LARDELLI: I would use whatever regulations I could to encourage people to begin to grow food locally now. I would also ask SA Water to look very carefully at what we could do to increase the amount of recycling of human wastes. At the moment, you are not allowed to use, for example, composting toilets within urban areas. There is some degree of concern about parasite eggs surviving when, for example, human waste is not composted correctly.

Fortunately, it turns out that urine is sterile and that there are no problems with parasites; and 80 per cent of the nitrogen that you excrete is in urine and two-thirds of the phosphate that you excrete is in urine. So, you could make a very large impact simply by harvesting urine rather than the rest of the waste.

If I were to say there was something the government could do, it could prioritise water use for the local growing of food—not for gardens; I am talking only for food growing. It could encourage in every way it could people to begin growing food locally to build this culture.

You can see also that we have to stop building on the agricultural land surrounding our cities, and we can also see in that the future there will be a huge pressure of migration of people from the outer suburbs towards the centre of town, so people will be saying we need more urban infill and dividing up blocks, but all that is doing is reducing our agricultural capacity. We really need somebody to look at Adelaide and say, 'Where are we going to grow the food locally? How is it going to be done? How will we house people?'

151 The CHAIRPERSON: Do you think that we should get SA Water in here to provide some advice to us on this?

Mr LARDELLI: I think that would be a very good idea. This is the problem with having, say, a peak oil committee: because energy determines all our activities, we need to look at this entire situation in terms of not just oil but also phosphate, water and so forth. It requires a holistic approach in order to cope with it.

152 The CHAIRPERSON: Your recommendation at the end of your written submission is that the South Australian government should ensure that priority is given to the provision of energy and water resources required for this local food production above all else. You just mentioned water, but what about the energy side? How should the South Australian government take control of that?

Mr LARDELLI: First, I think the South Australian government needs a realistic understanding of where energy is going to be in 10 years' time. It is not just oil. I am not sure about this (you may know better than me), but I think that our coal resource for our coal-fired power stations has about 10 years left, in which case we will then be importing coal from other states. The real difficulty with all this is that we can talk about moving over to renewables, but there are problems with that because of the variability and so forth. As long as we continue to grow the population, there is no way we can ever cope. We will always be running faster and faster just to try to catch up.

Renewables can supply only so much energy, so we really need an honest appraisal of where we are going in terms of future consumption and where our resources are.

To be honest, I do not have much faith in our economic and political system really to do that because we are talking about a complete change of mentality. You cannot go to the business community and say, 'Hey, guys, we've got to stop economic growth.' Of course, politicians face the problem of how they will ever get elected by telling people that they will be able to have less in the future. It does not really work.

I think that the best way to go forward is tactically to start to put in some measures now, such as encouraging local food growing, local education on resource reuse and so forth and then have some plans in place for when the resource problems really hit to flip over into the other way of doing things and be prepared suddenly to say, 'Okay, we're going to have a stable population.'

Start restricting or educating the population now into this idea that maybe we need eventually to stop population growth. Then, when the crisis hits and everyone becomes aware that obviously that is true, we can flip over into that. However, at the moment, it is a very difficult situation. I think it shows, unfortunately, some of the weaknesses of our political system—that we cannot actually cope with what is coming.

153 The Hon. R.P. WORTLEY: Do you think that education is a very important factor in all this?

Mr LARDELLI: Absolutely.

154 The Hon. R.P. WORTLEY: With climate change at the moment, a lot of information has come out and people are becoming more interested in and aware of it. People's attitudes have changed, and they are actually prepared to spend more to reduce their footprint. I have a Korean student with me at the moment, and he showers once every three days. It is what they have been brought up with from young children.

I was recently in Japan. I went to a classroom where they had a lot of rubbish on the table, and they were moving it into piles of what could be recycled. Education is a very important factor, but not enough goes on. You are right: the first thing we need is an audit of what we will need in 10 years' time. We need to get that information and then get that out into what we call the 'literate', into the population, and try to work it through the schools and so on.

Mr LARDELLI: Ultimately, if you reduce our material wealth and energy wealth, what separates us from any other society? It is our education and our wealth of ideas. That is what makes us what we would like to think as unique, and that is what will give us the ability to cope much better than other societies. We could be going back to the energy levels of the 1920s, or further, but the world would not be the same. We have come a long way. We know a lot more than we did back then about how the world and ecology work.

Our absolute priority has to be to maintain that knowledge and spread it through the communities so that they understand. People need to understand the way the universe works. As I say, we have been born into this culture of massive energy abundance. We have a magical way of thinking that things just happen because we flick on a light. We do not actually understand what goes on behind that. We do not understand that, behind every one of us, stand the equivalent of 200 of what we call 'invisible energy slaves'. Every one of us lives like a pharaoh because energy supplies the work of 200 people just to keep every one of us in clothes, transport, food and so forth. As the total amount of energy in the world decreases, those energy slaves just evaporate and we simply have less.

155 The CHAIRPERSON: Our time is up. Thank you very much for a very interesting presentation.

Mr LARDELLI: Thank you.

THE WITNESS WITHDREW