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STANDING COMMITTEE ON INDUSTRY, SCIENCE AND
INNOVATION

Reference: Australia's international research collaborations

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HOUSE OF REPRESENTATIVES
STANDING COMMITTEE ON INDUSTRY, SCIENCE AND INNOVATION

Wednesday, 10 March 2010

Members: Ms Vamvakinou (*Chair*), Fran Bailey (*Deputy Chair*), Mr Champion, Mr Cheeseman, Dr Jensen, Mr Johnson, Mr Kerr, Mr Ramsey, Ms Rishworth and Mr Symon

Members in attendance: Fran Bailey, Dr Jensen, Mr Ramsey, Mr Symon and Ms Vamvakinou

Terms of reference for the inquiry:

To inquire into and report on:

Australia's international research engagement, with particular reference to:

1. The nature and extent of existing international research collaborations.
2. The benefits to Australia from engaging in international research collaborations.
3. The key drivers of international research collaboration at the government, institutional and researcher levels.
4. The impediments faced by Australian researchers when initiating and participating in international research collaborations and practical measures for addressing these.
5. Principles and strategies for supporting international research engagement.

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Committee met at 10.10 am**HARTMANN, Mr Michael, Chief Executive Officer, Cooperative Research Centres Association**

CHAIR (Ms Vamvakinou)—I declare open this public hearing for the inquiry into Australia’s international research collaborations being conducted by the House of Representatives Standing Committee on Industry, Science and Innovation. The inquiry arises from a request to this committee by Senator the Hon. Kim Carr, the federal Minister for Innovation, Industry, Science and Research. Written submissions were called for and 67 have been received to date. The committee is now conducting a program of public hearings and inspections. This hearing is the second for the inquiry.

I welcome our first witness. Although the committee does not require you to give evidence under oath, I should advise you that these hearings are formal proceedings of the parliament; consequently, they warrant the same respect as proceedings of the House itself. It is customary to remind witnesses that giving false or misleading evidence is a serious matter and may be regarded as a contempt of parliament. We thank you for your submission. I invite you to make a brief opening statement before we proceed to questions.

Mr Hartmann—Thank you very much. It was almost a case of serendipity when I saw this inquiry being called, given that it came about a month after I had returned from an overseas visit to Europe looking at the potential for international research collaborations with Australia. I would like to run through a presentation which will set some of the scenes and the issues that I found.

A PowerPoint presentation was then given—

Mr Hartmann—My visit was conducted over the majority of October. It was almost like a Contiki tour, I suppose, in that I came from Australia and started in London, went across to Helsinki, down to Amsterdam and to The Hague, to Bonn, to Berlin, to Copenhagen, to Brussels, back to London and home again, tired but happy! The trip was managed by the CRC Association. I was sent across for a number of reasons, which I will go into, but largely taking the lead from Minister Carr’s words, as articulated in the innovation review, that Australia should boldly go out and start looking for international research collaborations. We of course see that the Cooperative Research Centres program is an ideal vehicle to be able to do that in terms of applied industry led research.

The tour had three objectives: to see, to spruik and to seek. Firstly, I was to look at collaborative research programs in other countries and to consider how our program rates in comparison and to see if there are any ideas that we can adopt and vice versa. Secondly, I was to spruik—to educate those countries about the CRC program. Finally, I was to seek—to explore the will and the potential for collaborations with Australia on large-scale industry driven applied science with, as I say, the CRC program as the focus.

Why did I choose the countries that I visited? I took the approach that, if you sit back in Australia and you think, ‘Who is innovative in the world?’ you come up with countries like, off

the top of your head, Sweden, Finland, the Netherlands and Germany. If you look at the figures of GDP per capita, particularly compared to Australia, you can see that they are the high-flyers.

Anybody would argue that there are a lot of other countries that I could have and should have seen, but I only had so much time and so much capacity, so I chose a number. These visits in particular were aimed at a high level. I was basically meeting with departmental secretaries and deputy secretaries and industry research centre leaders. The visits were organised either by the relevant embassies here in Australia, through the ambassadors, or through DIISR's international posting in Brussels. The concept was that, if we were going to see anything that was similar to the CRC program, or anything we could learn from, these were the sorts of countries that we would find that. I am certainly not going to fill you in here on everything that I saw and that I heard and that I learnt. I just want to give a brief overview of programs that are operating in those countries and my conclusions. I will refer to a report that is available on our website, if you should ever need any more detail.

The context for Europe needs to be set within the framework of the European Union. They have set themselves and agenda, or a desire, that they need to innovate if they are going to be competitive in an ever changing world. They set that well before the financial crisis, and it has been strengthened even further as a consequence. In 2005 they set the Lisbon strategy, where all member countries agreed that they are going endeavour to reach investment of three per cent of their GDP towards innovation. Across all those member nations the current average is 1.8 per cent. To facilitate that the European Union have thrown a lot of money at this initiative. Their framework program No. 6 contained €18 billion. Framework program No. 7, which is driving this whole Lisbon strategy, has €50 billion in it. So they are really putting a lot of money behind this drive.

What the European Union are trying to do with that is use it as a catalyst to drive collaboration between their member states and get all the European countries working together. They have also developed a 'cluster policy'. They basically want to see a lot of Silicon Valleys all around Europe, where particular hubs of different sorts of technology are focused. So every member country in the European Union is driving to see how they can collaborate with other countries, how they can form clusters and consequently how they can get their piece of that €50 billion. That is an important overall view.

Going to collaborative programs in Northern Europe: as I said, I started off in the UK. It is really interesting to see where these other countries rate in comparison to what Australia has been doing with the CRC program. The UK has an initiative called the Technology Strategy Board. That is driven to trying to keep UK research outcomes in the UK. They found through past history that a lot of work would go on in the UK and it would end up in other European countries and not come back to the United Kingdom, so they want to keep it in the UK. The Technology Strategy Board have a budget of £700 million a year. Part of what they fund is the knowledge transfer networks, which are a means of trying to exchange knowledge between academia and industry. It is somewhat similar to the CRC program but also different. They have 25 of these KTNs, with 45,000 members. The big difference between that and the likes of a CRC program is that the Technology Strategy Board are the ones that identify what the challenges are. So they say, 'These are the problems; now go and collaborate and work them out.'

Finland was really interesting. I would like a dollar for every time that people in meetings I go to have talked about how Finland is setting the benchmark. When you go to Finland they basically say they are doing a pretty ordinary job. We place them on a pinnacle, but they are not the pinnacle they are made out to be; they are performing, but they still have a lot of issues. On the good side, Finland has a really fast-growing economy. They have increasing labour productivity, particularly in the electro-technical industry, which is even better than the United States. They are among the top 10 countries in competitiveness, as ranked by the World Economic Forum. Among younger age groups they have more people with a higher education degree. And the share of researchers and R&D staff are higher in Finland than in other EU countries, the United States and even Japan. So on that side they are doing pretty well.

But, conversely, measured by GDP per capita they are in the 15th position of OECD countries; they have nine per cent of the labour force unemployed; their population is ageing rapidly; the R&D intensity of the service sector does not reach the level of the top OECD country; immigrants are only 1.7 per cent of the population, while in Sweden and other countries the percentage is higher—up to about 10 per cent in Sweden; and only about six per cent of their PhD students are foreigners, which they are really concerned about, whereas in Australia and other countries the percentage is 15 per cent. They look at that and ask why. They cannot work it out. If you compare Finland with Sweden, the countries are almost the same, but they are completely different when you look at the stats.

Nonetheless, funding innovation is not a problem in Finland. While other countries are working to three per cent of GDP funding for innovation, Finland is at four per cent. It is a no-brainer: if you are going to fund innovation, go for it. An agency called Tekes is the funding agency. They have a program called SHOK. I am not going to tell you what that stands for in Finnish, but in English it is Strategic Centres for Science, Technology and Innovation. These are very prestigious centres where existing consortia can come together, apply to become a SHOK and get access to €120 million. They have a lot of prestige, and there are six of those in different areas that Finland has chosen as being the key areas that they need to work in.

The Netherlands are about doing more with less—about maximising leverage, trying to find out what other people are doing and getting their teeth into that. They have identified six areas that are critical to what they are doing, such as flowers and water. They have a big problem with water; conversely to the Australian situation, they have too much of the stuff. They have developed top technological institutes that are joint ventures between industry and academia. The Dutch are very proud of these. A couple of years ago one of the heads of their innovation department came to Australia to look at our CRC program and take some ideas to help with the development of their TTIs. While the Dutch will say that there is no other program in the world like the TTIs, he said that that is true except for one case: the CRC program.

CHAIR—I am just mindful of the fact that I did not tell you that we are going to have a division at 10.30 am. That is going to be an interruption to the process. I do not know about others, but I think that this is very interesting. I am wondering whether we could find a way of trying to get some dialogue going and asking some questions, given the limited time that we have.

Mr Hartmann—That is fine. I can fly through it pretty quickly.

CHAIR—Yes, because this is very interesting—

Mr Hartmann—I know!

CHAIR—but we are going to find that there is no time for anything else.

Mr Hartmann—That is fine. Similar programs are going on in Germany, with their competence networks campaign. They have developed a high-tech strategy and 128 networks across nine themes. They also have four major programs that they fund to assist with their research. Fraunhofer is seen as the most similar to a CRC program, but it is not necessarily; there are a number of major differences between the two.

Denmark is really worth talking about, because they are trying to develop themselves as a powerhouse for innovation in Europe. They do not have any natural resources; their only resource is innovation. They are really driving innovation in SMEs—

CHAIR—Those are the division bells. We will suspend the hearing so we can attend the division.

Proceedings suspended from 10.23 am to 10.39 am

CHAIR—Before we continue with our inquiry, I welcome all our visitors who are here to observe proceedings today. My apologies to those sitting behind the chair. You have caught us in the middle of a presentation and before we go into dialogue but we will be doing that shortly. I hope you find the proceedings here interesting and of value.

Mr Hartmann—I realise that I am a little overindulgent but this presentation leads into some really key points that I think are essential—

FRAN BAILEY—You could fast-track it.

Mr Hartmann—I am certainly fast-tracking it. I spoke about Denmark and how it is developing itself as a powerhouse of innovation and has developed a whole bunch of institutes to assist their industry do that. One really important thing that we should not forget about Denmark is that if you go into a souvenir shop you can buy an Aussie flag. I will lead on to that later, but do not underestimate the Mary factor.

Finally going back to the European Union, while they are leading setting the framework for which all this works, they are also developing some strategies themselves, particularly with the knowledge and innovation communities. This is an attempt to try and get in three particular areas industry and academia working together. When I was over in Europe this was very embryonic and they had not really been able to publicise much about it. I did manage to find the guidelines, and the guidelines for that program are suspiciously familiar to the CRC program. In fact, in some cases it is verbatim.

Importantly, the conclusions. From what I saw, Australia should be really proud of the CRC program. We are into 19 years now and the rest of the world is just starting to catch on to the idea but not to the same scale that Australia has developed. There are other programs that are

similar in other countries but none that are the same. Importantly, each of those countries that I visited has a different concept of industry led research. It is the governments themselves that are dictating what those areas of research will be and then they say to the industry, 'Please go and drive it,' kind of like giving them a train on railway tracks and saying, please drive it. In contrast, in Australia the CRC program says to industry, 'You tell us what the problems are.' That is quite novel. But of course there were some ideas over there I saw that we could apply to the future of the CRC program.

Europe are big on international collaboration but their concept is very EU-centric, it is collaborating with other EU countries. It is where there are countries that have a desire for global collaboration that we see real opportunities. There is a genuine will to work with Australia but, believe it or not, we suffer from this tyranny of distance still. A number of countries said to me, 'Look, we know that you have got great researchers, we know you have got great universities, we know you have got great facilities, but you just so far away.' The Germans might say, 'There's a wonderful researcher in Australia that we would dearly love to work with but there is also a pretty damn good one in Switzerland.' Where are they going to go? They say it themselves: they are frightened of the 23-hour aeroplane flight.

So my view is that we can improve our universities, improve the quality, throw as much money as we like at that, but it is not necessarily a field of dreams proposition; it is not saying build it and they will come, because they still will not. We need to rethink Australia's value proposition, and my concept is that we try and sell Australia as a unique laboratory, a place where work can be done that cannot be done anywhere else, firstly because of the natural resources we have got, so if you want to do work on solar panels Australia is wonderful, of course. But there are other things like the structure of our industry. We have got basically a small number of players in our industries. In the construction industry, for example, you have got only a few big players whereas in other countries they have got lots of big players and it is hard to get them together to work with each other. So there are things you can do in Australia you cannot do in other places.

Taking away from the natural sides where we talk about wind farms and all those sorts of things that we are already starting to do, Denmark, for example, are trying to develop the nation as a demonstration site for electric cars and they want the rest of the world to come and look and say, 'That is how electric cars work in the real world.' As I said to them, that is great, but as far as Australia is concerned, if we went over there to see how electric cars work it is going to show us how you will be able to work around inner cities but trying to drive from Sydney to Dubbo we are not going to get that feeling in Denmark because of the size and all those issues are so different. But Denmark wanted to do something of that work in Australia, if it works in both those countries it will work anywhere. Other work can be done in Australia. I know of a team working on air traffic control. You can do that in Australia because you can send aeroplanes out into the desert and let them circle around. You cannot do that in Europe.

FRAN BAILEY—I am speaking with the chair's indulgence. You just said 'work that can't be done anywhere else'. I would have thought that electric car technology could be done anywhere. One of the areas is marine biology and AIMS. What role would the CRC have when we have already got such a world-class scientific institution up at Townsville in AIMS?

Mr Hartmann—Particularly with issues like climate change, let's again go back to Europe. If water temperatures and so forth increase like they are planned to do, then they are certainly going to be getting Mediterranean diseases in the North Sea that they have not had before and that they do not really know how to deal with.

FRAN BAILEY—But my question to you is: what would a CRC do better than what AIMS is already doing? You have said that if we in Australia are going to capitalise on areas of research and innovation that we are doing and no-one else is doing and if we are going to overcome, as you still maintain, the tyranny of distance—though I would disagree with that—wouldn't we be looking at something like all of the research in marine biology? No-one else has the sort of ecosystem that we have off the coast of Far North Queensland.

Mr Hartmann—Absolutely.

FRAN BAILEY—My question is: what would the CRC do in collaboration with a similar European body that AIMS does not already do?

Mr Hartmann—The whole point about the CRC and what is missing in any of those other countries' programs is that whole really industry driven research side, whereas the industry players themselves are saying, 'These are what our problems are.' That is what I think is the gap in any of those European innovation programs—what they agree with as well.

FRAN BAILEY—But our concern is if there is any gap in the CRC program, not the European counterpart of it.

Mr Hartmann—Sure. I was discussing how the CRC program can be used as a means of developing international collaboration and—

FRAN BAILEY—But only if it is of benefit to Australian industry and if it is furthering Australian innovation.

Mr Hartmann—Absolutely.

FRAN BAILEY—We are not in it for altruistic reasons for European counterparts.

Mr Hartmann—No, not at all. There are things that they are doing. There is technology in Europe and so forth that we can all share. Those are the key points that I wanted to make. I wanted to go through each of those countries to show that, yes, there is an area on industry driven applied science that a lot of the countries are tackling but have not captured to the same degree that Australia has. We would argue that there are opportunities for industry to work together internationally and that the optimal way for us to do that through Australia is with the CRC program, where the mechanism exists and where it really is driven by industry needs. Sharing is already happening, but under the new structure it is a lot more open—as we say, as long as it brings something back to Australia, which it certainly will.

CHAIR—I might open up with questions. I think everyone is very keen to ask questions. There are a number of issues that I am interested in. I am going to Denmark on a delegation, and you have noted that Denmark is a great example of an innovative country. They do not have

resources; we do. That often can skew our innovation capacity as well. Can you shed some light on what scientific fields we might share in common or that both Australia and Denmark have an interest in that could be developed? Are there any existing at the moment?

Mr Hartmann—A key area that they are working on is in clean energy and wind farms and the like. We also have collaborations working through the CRC program with Denmark already with Vestas, the company that make the wind farm propellers. There is also work with our Antarctic CRC, working with the Arctic research people through the United Nations and so forth. I mention Denmark specifically because also you will note when you are there, as I say, the photo about buying Australian flags. The tyranny of distance does not matter to them because they already know and want to go to Australia. They are very receptive to working with Australia; whereas the other countries I noted—and they said this themselves—have this barrier in front of them that they need to get over.

CHAIR—Is distance the barrier? I know you mentioned that, but I am just wondering whether there are any other issues.

Mr Hartmann—I would not be surprised if there were other issues under the surface, but that is a major stumbling block.

CHAIR—You have been over there and you have had a chat to them. My view when I sometimes go to Europe is, ‘Yes, we are very far away but, despite our presence globally in a number of fields—and I would have thought science and medicine was one of them—we do not rate as a big player.’ I know distance may be one of the issues, but I do not think it is enough to say it is just because we are too far away. There have to be other reasons and it may be that we are not substantially marketing ourselves. The Europeans obviously have a lot of money. What would attract them to Australia, do you think? In Denmark they have a princess from Australia. That is a light-hearted way of breaking the tyranny of distance, but there could be something more substantial.

Mr Hartmann—You have really pointed it out with the word ‘marketing’. It is about selling what Australia is about and has to offer. A princess in Copenhagen has broken that already. I am sure that for other countries distance is something of a convenient excuse but it is a real factor. We had a German delegation here last week saying exactly the same thing. They came over and saw the opportunities and said, ‘We now just have to convince our people to get on an aeroplane.’

CHAIR—Maybe rather than waiting for people to get on aeroplanes to come and find us we should be out there developing and promoting our capacity.

Mr Hartmann—That is right. In Europe where they are looking at framework money and seeing how they can work with each other, what is going to attract them to work with Australia, which is, as far as they are concerned, down the other end of the planet? We need to focus on what you can do in Australia that you cannot do in Europe.

CHAIR—I have just one more question. This committee has been involved in a previous inquiry about research capacity. I am sure all of us are fairly familiar with the positive side of our research capacity but also the inhibiting factors. There seems to be a bit of a slide in our

reputation or our ability to do as well in areas that we have traditionally done well in. We have looked at structural reasons for that, our education system and a whole series of other things that are happening. They are still here and real. Maths and science seem to be constantly on the agenda. It is becoming obvious to us in this country that most of our young people seem to be developing careers in minerals and in building industries. Innovation is just not profitable. I think that is a major problem for us. Do you think perhaps the rest of the world—mainly the Europeans—may be seeing evidence of that in Australia as well and may not feel that we have the capacity they want in order to engage with us as a serious partner?

Mr Hartmann—That certainly did not come across in any of my discussions. The point they reiterated many times—and I do not think they were just being polite—was that they were aware of what we have to offer. They work with a lot of Australians. We have an awful lot of Australians who are working in overseas countries who are wonderful ambassadors. They did not seem to see that as a big problem.

Dr JENSEN—You are identifying areas where Australia has some unique attributes. I would like to explore the potential for the CRCs to get involved in defence issues. The reason I say that is that one thing that we have with our size and sparse population is a lot of areas that are very electronically silent. A large amount of money is spent on defence worldwide. The Europeans are very into it; the US is very into it. One reason one of the two final sites chosen is in Western Australia—and hopefully we manage to get it—is that electronic silence issue. Are there ways you can think of engaging with defence and defence industry? Also, how would you look at potentially marketing that and growing that side of it?

Mr Hartmann—Certainly we have an example of that which only started in the last 18 months, which is the Defence Materials Technology Centre. It is classified by the government as CRC-like. Because it has secrecy provisions through defence it cannot actually be called a CRC, but it was developed by and is managed through the CRC program. All its work is about making stronger, lighter, more effective defence materials.

That is a step in that direction, whereas the defence forces have said, ‘This is the work that we need; these are our major issues. Let’s pool together the best academics and the best CRCs to work together in those areas.’ So we have a footprint there already. Again, it comes down to identifying those issues. They are talking about communication shadows and the like. We will have CRCs working on that, such as the CRC for Spatial Information or others that are coming together into the new bids. Where the industry is identified—whoever the industry is; it could be remote farmers—and they say, ‘We can’t use GPS to do our farming because there is a shadow,’ the CRCs will ask, ‘How can we address that?’ It is all about the industry pool and the industry drive.

Dr JENSEN—Have there been cost-benefit analyses done of the effectiveness of CRCs?

Mr Hartmann—There have. Work was commissioned by the then DEST a number of years ago, which showed conservative figures but came out showing that, for every dollar the government contribute to the program, there is a \$2.16 return to the GDP. The number is probably higher, but the simple fact is that the government is doubling its money in high-risk research for the CRC program. I think that, in anybody’s book, is pretty good.

Mr SYMON—I am interested in your views of what you picked up on your European tour. Maybe we could benefit from some of those programs in various countries and the way they are run. Obviously, the CRC program has a pretty good name; it is good that we have been heard overseas. But are there examples of specific countries where they do things better than us in terms of not only research but funding streams as well?

Mr Hartmann—This goes back to why I put you through that presentation. There are some fundamental differences and the main one is the framework program, with \$50 billion, or €15 billion, sitting in there, which would be wonderful if we had that capacity in Australia. It is hard to say if there is anything that is better or if there are any funding mechanisms that are better but there are some concepts that I see as being valuable to bring back here. I mentioned Finland's SHOK program. My personal view is that that might be a really good option for the future of collaborations that are coming through the CRC program, to see them established longer term as some really prestigious industry-driven applied science program that was initially born through the CRC program. Those are the sorts of things that the association is currently working with the government on, to look at those post-CRC, next-life issues.

Mr SYMON—When we are talking international collaboration, a CRC might then be impacted with commercial differences between industries in one country versus another. Do you have any ideas in that regard?

Mr Hartmann—Every CRC that goes offshore has to deal with those issues. All CRCs are signed up with the Commonwealth agreement, but you cannot take that to another country. You might be able to take it to New Zealand, but you cannot take it to China because it is a completely different government structure, a different language and there would be difficulty in trying to translate it et cetera. The best way to do that is through a memorandum of understanding where you say, 'This is what you get, this is what we provide and this is how we're going to work together.' We base it on that, rather than go into the fine detail. That is how CRCs go about it. You need to be a bit practical about it when you are working with other countries. Indeed, there are many benefits but it is also a lot of hard work.

Mr RAMSEY—Just for Dennis's benefit, I can tell him that Woomera are very busy at the moment. A lot of countries are currently coming to prove technology, try technology out there. I think their bookings are pretty solid for the next two years. The focus here is on Europe. That has been the provider of a great amount of our technology in the past. While it will not measure up on a GDP per head, there is enormous investment now going into scientific research in the Asian countries, driven out of China, India and Malaysia. We know this.

Mr Hartmann—Yes.

Mr RAMSEY—Do you see the prime drivers of science in the world shifting into a hemisphere that is closer to us, so we are not fighting that tyranny of distance? Are we trying to play catch-up where we should instead be in front of the pack and looking somewhere else for those collaborations?

Mr Hartmann—The world is getting smaller every day—certainly from Australia's perspective—and tyranny of distance is not an issue for us anyway. Indeed, the corner basin of China has been growing like crazy over the last 10 years and there are definitely collaborations

between our two nations through the CRC program. It is not necessarily about where we focus. We can focus anywhere as long as, as we were saying earlier, there is a positive return for Australia. The collaborations—looking at medical science, for example—can be in areas such as the basic research side, which is fantastic. There has been a lot of work in those areas. The point that I am talking about, in particular, is on the applied science side—the industry-led side—where the existing CRC program is a working model that can be used almost as a hinge for a lot of those collaborations.

FRAN BAILEY—Can you tell me how many CRCs there are?

Mr Hartmann—At the moment there are around 46 CRCs.

FRAN BAILEY—What is the annual budget for those?

Mr Hartmann—The budget through the CRC program within DIISR floats at the moment between around \$150 million and \$170 million a year.

FRAN BAILEY—That is a fair amount. As you said to us, it has been in existence for 19 years.

Mr Hartmann—That is right.

FRAN BAILEY—What would you nominate as the top three examples of innovation that have come out of the CRCs?

Mr Hartmann—In my role I have a little bag that I pull all those stories out of. The one that I always pull out first is the CRC for Advanced Composite Structures. Australia is shortly about to be delivered with its first Boeing 787 Dreamliner aircraft. Boeing, in Seattle, does not build aircraft, it just puts them together. All the bits come from other countries—from the USA, Japan or Australia. The Australian parts are the bits that move on the wings: the flaps, the spoilers, the ailerons and things. Those are the bits that make the aeroplane go up, go down and stop, and they are built using technology that came out of that CRC.

FRAN BAILEY—When did it come out?

Mr Hartmann—About two years ago. The company was then Hawker De Havilland, which has subsequently been taken over by Boeing. That new technology—I will not go into detail—won a \$4 billion contract for them. That is equal to the amount of funding that the Australian government had put into the program over 19 years.

FRAN BAILEY—Just so that I can understand that better: this came out of Hawker de Havilland. How was the CRC involved?

Mr Hartmann—Hawker were a major partner of the CRC. They were a part of the CRC because they had a big problem working with carbon fibre in Australia. They said, 'There has got to be a better way of to do it. This is our industry problem. It is stopping us progressing any further with our industry.' There had to be a better way to do it; they had to get away from using centrifuges and those kinds of things. So through the CRC and with all their partners they

developed a new technology. If you go to Port Melbourne you can see the old technology and the new technology working. That was then robust enough for them to get the Boeing contract.

FRAN BAILEY—I would be interested to know some more history about that. What other examples could you give us?

Mr Hartmann—One you would be aware of is Meat Standards Australia, in the beef industry. Once upon a time you would go to the supermarket and buy two pieces of meat: one would be juicy and the other would be like an old boot. Through the beef CRC, the industry came together and said, ‘We need to address this consistency problem because we are losing market share to chicken and the like. What can we do about that?’ The CRC developed consumer-testing panels where they had about a million tests—blind taste testings and the like—with different pieces of meat that had been prepared in different ways. They knew all the history of those pieces of meat and could work out consumer satisfaction.

They found it was very repeatable—what one person said was bad, another person said was bad. They were able to then calculate all the critical control points that go in making a decent piece of meat. So, now, pretty much all the domestic beef in Australia has that technology behind the way it is graded. I would say that it has saved the beef industry—that consistency problem has largely been eliminated using critical control point analysis.

FRAN BAILEY—Who drives that research? Is it industry?

Mr Hartmann—That was driven by the Australian beef industry.

FRAN BAILEY—So industry approaches government. Do you then form a CRC for that?

Mr Hartmann—The industry come together and identify their significant challenge, form a consortium with the best academics and researchers from wherever—indeed, internationally—pool their resources and then go through the application process to government and say, ‘This is what our problem is and—

FRAN BAILEY—Does that CRC still exist?

Mr Hartmann—That CRC is currently in its third generation. It has moved on now to looking at genomic work—gene markers for different traits, like tenderness and so forth.

Mr RAMSEY—There are very few being funded for the third time.

Mr Hartmann—The last round has seen some CRCs actually go into what you could effectively call a fourth term. But, post the Cutler and O’Kane reviews, a border has been put around the program. That is the end as far as they are concerned. To continue they need to find funding outside the CRC Program. They can still get government dollars but they will have to come be from a different part. You also need to be aware that, while it is a lot of money that has come from the federal government to the program, that money on average accounts for about 20 per cent of the CRC’s funds. The vast majority comes from their partners.

FRAN BAILEY—This might be difficult—Australia is not a member of the EU—but how many memorandums of understanding are you aware of that Australia has through its various industry groups with areas of the EU?

Mr Hartmann—That is certainly not a figure that I could give you off the top of my head. I am sure the department would have a better understanding. What I can say is that I know there are CRCs working internationally and, for some countries, they find that an MOU is a better way to go than a formal contract. Again, it depends on which country you are working with. Working with New Zealand or England is probably different to working with China or Indonesia.

FRAN BAILEY—Where do you see the CRC Program going in the future? What would you like to see happen with it?

Mr Hartmann—My dream would be for programs that are developed by the government to try and either stimulate innovation on an industry basis or bring in industry based collaborations. Rather than developing new programs, it would be better to bolt them onto the CRC Program because that has been tried and tested and works. Through the work that I have conducted I have seen that there is really nothing like it. The rest of the world are just trying to catch up now. Rather than reinvent the wheel, let's strengthen the one we have. The CRC Program is a wonderful way for collaborations to come about that would not have happened otherwise. The evolution would happen in the steps following that. I think there is scope there. In our innovation system we have the likes of ARC centres of excellence, which are around basic science. I would love to see something similar in applied science; that could be what CRCs grow into.

FRAN BAILEY—How do you assess the 46 CRCs? Are all 46 very successful in delivering real innovation that is picked up by industry? If two or three are not performing, what do you do with them? Does the funding get cut off and do they get disbanded?

Mr Hartmann—There is certainly the potential to do that. Over the history of the CRCs, there have been 170 and none of them have lost their funding. The reason for that is that there is a lot of checking and balancing and reporting back to government as they operate. They have a major third year review, and each year they have to do annual reports, questionnaires and a lot of other reporting.

FRAN BAILEY—Who does the assessing?

Mr Hartmann—That is done through the department.

FRAN BAILEY—Is it benchmarked against international best practice? How is it benchmarked?

Mr Hartmann—They utilise some of the skills of the likes of ARC and NHMRC—and the CRC Committee are involved—which contain a strong skills base that can assist with that work. But it is also looking at what the CRC said it was going to do when it began and whether it is still meeting those milestones. There is an awful lot of flexibility in there because you are working with industry, and industry changes—when one gets taken over and so forth. Basically, the way that I would answer that question is to say that no CRC is being defunded but some

CRCs have outperformed what they were expected to have achieved. The composite ones are a great example.

CHAIR—Are there any other members who want to ask a question? We did not really explore the end-user driven paradigm, which is characteristic of our CRCs. It seems to be a feature of your submission. I am interested in the various attitudes. Obviously, the Danes are interested in this concept. What about the rest of the Europeans? And what would it take to get them to shift? I imagine that governments are basically controlling their direction.

Mr Hartmann—That is right.

CHAIR—Is there a strong awareness of the fact that maybe there is another way to do this that yields more results? I am trying to get a bit of an assessment from you on that.

Mr Hartmann—As I said, the Danes have twigged to the idea; they see that they have a gap in their system. In other countries there has been this big drive, with the whole framework program and so forth, to try and get this working. So they have developed some programs and said, ‘What are we good at? What do we need to do better? We’ll get some government people around the table and work out what the priorities are.’ It has happened so fast that they have only really just, in the last three or four years, recognised the power of collaboration. My feeling is that they will go down the line a bit and then realise that they are missing something really important, which is industry telling them what the problems are. When I talked about our program they were saying, ‘This is way ahead of our thinking’—yet it was our thinking in 1991.

CHAIR—So they are a long way from not only having thought about it but actually doing something about it?

Mr Hartmann—Yes, absolutely.

CHAIR—There is another hearing scheduled, and I have just being informed that we have to be out of here by 12 pm. So, as much as this is an interesting conversation, I would like to thank you for this morning.

Mr Hartmann—It was an absolute pleasure.

CHAIR—Do members have anything further that they wish to ask?

FRAN BAILEY—You have given us a couple of what you think are stand-out examples of innovation. Perhaps you could send us some examples of where there is the opportunity for international impact and collaboration.

Mr Hartmann—Certainly.

FRAN BAILEY—Thanks very much.

CHAIR—On behalf of the committee I thank you very much for your presentation.

[11.14]

HOLE, Dr Matthew John, Chair, Australian International Thermonuclear Experimental Reactor Forum

MATHER, Dr Dennis, Managing Director, Australian Institute of Nuclear Science and Engineering

CHAIR—I now call representatives of the Australian ITER Forum to give evidence. Although the committee does not require you to give evidence under oath I advise you that these hearings are formal proceedings of the parliament and consequently they warrant the same respect as proceedings of the House itself. It is customary to remind witnesses that giving false or misleading evidence is a serious matter and may be regarded as a contempt of parliament. We thank you for your submission and welcome you to make a brief opening statement before we proceed to questions.

Dr Hole—Thank you.

Dr Mather—I will start while Matthew is preparing the presentation. It is interesting to make a comparison between the previous witness and us, in that his research is very heavily industry driven. This does not have quite the same focus. However, there are very real outcomes at the end.

Dr Hole—I am a plasma physicist and engineer at the Research School of Physics and Engineering at the ANU. I am also chair of the Australian ITER Forum, a group of multidisciplinary scientists and engineers from several Australian institutions advocating a role in the next-step fusion experiment, ITER. With me today is Dr Dennis Mather, Managing Director of AINSE. I would like to thank the committee for this opportunity to speak about the important topic of Australia's international research collaborations. I am here today for two reasons: first of all, to explain to you the concept of fusion energy, which offers the world a near-zero greenhouse gas emission baseload power supply capable of sustaining civilisation for millions if not billions of years; and, secondly, to explain the intrinsically global nature of fusion research and the vital importance of international research collaboration to highlight the opportunities and impediments faced by Australian scientists and suggest solutions to these impediments.

I have a presentation that I would like to give. I understand the issue about timing, so perhaps I would invite the chair to interject if you would like me to expedite the presentation.

CHAIR—In fairness, so that we can get the opportunity to talk to each other, perhaps you could expedite it, but not to the point where you gut the presentation until it has no meaning. I cannot make that assessment, so I am going to leave it up to you.

A PowerPoint presentation was then given—

Dr Hole—I have a couple of introductory slides. I think they can probably be compressed. These two slides talk about the world's primary problem today, which can be viewed as climate change. This is largely driven by the burning of fossil fuels, and that is well recognised. Solving the climate problem means reducing our use of energy and changing our energy supply. Fusion, which is the power of the sun and the stars, is one option. It is a reaction that was first discovered by Sir Mark Oliphant in 1934. The easiest reaction to initiate involves fusing deuterium and tritium—isotopes of hydrogen, the most abundant element—to produce helium, an inert gas, and releasing an energetic neutron, whose energy would be harnessed to produce electricity.

Successfully taming fusion offers clean baseload sustainable power generation virtually free of greenhouse gas emissions. Almost all emissions are derived from the construction and processing of materials and fuel used in the reactor. Unlike fission, the direct products of fusion are not radioactive. Rather, radioactivity is generated indirectly by neutron activation of the first wall and vessel structure. Employing present day technology, the materials used in a fusion power plant which become radioactive could be completely recycled within 100 years of shutdown. Fusion is also intrinsically safe. There can be no chain reaction, explosion or meltdown. At worst, a loss of magnetic confinement will damage the first wall of the system. Magnetic confinement fusion cannot be used in a weapon or in weapons construction.

Fusion fuels are deuterium and tritium. Deuterium is present in water. Tritium does not occur in nature but must be bred by neutron activation of lithium, a mineral common in the earth's crust. These fuels are also incredibly energy dense. Half a bath of water and the lithium in a laptop battery could provide enough fusion power to last an average person 30 years. Coincidentally, Australia is also well endowed with the fusion fuel lithium and many of the advanced materials used in the construction of a fusion reactor. The Greenbushes mine in Western Australia is the world's second largest producer of lithium minerals and the world's largest and highest grade spodumene deposit. Other important materials include the structural elements vanadium, tantalum, titanium and zirconium, and the superconductor niobium. Rather than sell these in their raw state, these elements could be value added by processing and component manufacturing.

Turning now to global R&D, the promise of fusion combined with the need to address climate change has sparked the worldwide expansion in fusion research. Next generation infrastructure under construction exceeds US\$15 billion. Research funding has also grown. If I look at the US and the UK, research funding equates to a tiny fraction—two times 10 to the power of minus five—of GDP. In smaller nations such as Holland and Switzerland this figure is even higher. Unfortunately, Australia does not compare well. Applying the US and UK funding formula to the Australian economy would imply a budget of \$16 million per year; the actual figure is less than 20 per cent of this total.

So ITER is the next step in fusion power. In Latin, 'iter' means 'the way'. It is a 500 megawatt fusion experiment designed to explore the burning plasma regime where the energetic products of reactions self-heat the plasma. To put it in perspective in terms of scale, one of Australia's largest coal-fired power stations is Eraring. Eraring has four 660 megawatt generators. Hence, ITER is comparable in size to a medium-scale coal-fired power plant. The plasma would sit in a 60-metre-high tank inside the vessel. The entire vessel would be cryogenically cooled to permit operation of the superconducting magnetic fuel coils. At the plasma core, the central ion

temperature would approach 100 million degrees centigrade—nearly seven times hotter than the core of the sun.

ITER will demonstrate fusion energy for peaceful purposes. It will explore the hitherto unaccessed burning plasma regime, demonstrate the integration of technologies and address the crucial materials issue. It is also a growing consortium of nations and alliances comprising the EU, Japan, China, India, the Republic of Korea, Russia and the US. Collectively, these nations comprise more than half the world's population. Kazakhstan has also expressed an interest in participation, and accession talks are underway. More widely, there are collaboration agreements with the IAEA, CERN and the principality of Monaco. At a construction cost of \$12 billion with tenure operation of \$6 billion, fiscally ITER is the world's largest science experiment.

I turn now to fusion energy development timescales. The ITER experiment will start to produce results in 10 years, enabling the construction of a demonstration reactor, DEMO, in 2025. In turn, this would allow the first commercial power plant in 2050. By 2060, we would envisage 10 plants operating and, by the beginning of the 22nd century, about 1,000, or 20 per cent of global electricity.

I draw your attention to the critical time window for ITER engagement which exists over the next few years. The ITER site has been chosen and construction work has begun. Final design completion is now underway, with machine assembly due to commence in 2013. Additional contributions cannot be retrofitted to an experiment of this scale. The nations supporting ITER intend to use the R&D outcomes, which will be owned by the ITER partners, to build a demonstration power plant. Thus, for the first time in the history of this field, ITER will differentiate nations as either fusion-capable or not.

Why should Australia engage? Australia should engage for a number of reasons. Fusion energy promises an abundant supply with near-zero greenhouse gas emissions. Fusion energy R&D is now driven by the ITER program and ITER partners. ITER defines, as I said, the fusion-capable haves and have-nots. Engaging in ITER would equip our nation with skills to assess and/or adopt fusion power during DEMO. ITER is also one of the world's largest, most innovative and challenging scientific projects. Engagement would demonstrate Australian leadership and earn the nation esteem. Engagement would also grow international research linkages, provide skills and training which would be portable to other energy technologies, present opportunities to Australian high-tech industry and mineral exploitation and increase cross-fertilisation of related ideas of science.

So where and how would Australia fit into ITER? Australia has an impressive history of fusion research. To understand where Australia might fit, we need to have an idea of our R&D strengths and identify how these could be used to secure an involvement in ITER.

Turning to our relevant national capabilities: our capabilities are distributed across a number of institutions. The core capability rests with the ANU, which hosts the Australian National Plasma Fusion Research Facility, featuring H-1. We also have a vigorous theory program. Scientists at the University of Sydney have developed a cathodic arc to develop new first wall materials and conduct plasma diagnostics experiments. Staff at the University of Newcastle investigate construction of new high-heat flux alloys and there are also staff in programs at Macquarie University, the University of Wollongong and ANSTO that are fusion-relevant.

During 2006-07, our community developed a strategic plan that was subsequently released in parliament. The key recommendations of this fusion strategic plan included a fellowship program, which was to develop a broad national capability; a machine contribution to ITER, most likely a plasma diagnostic or piece of measuring equipment, which would be a flagship for Australia's effort and deliver defined national benefits; and enabling infrastructure to develop the ITER diagnostic and broader capability. This plan also has support from a wide number of universities, research institutions, learned academies, professional bodies, the ITER organisation and members of parliament.

Since 2007 there have been a number of developments which are of relevance. In May 2008 the ARC Future Fellowships scheme was announced. These were similar to the Fusion fellowships scheme but not mission orientated. In 2009 there were community health scoping discussions with representatives of ITER to identify a particular diagnostics package. In 2009 the government had invested \$7 million into an upgrade of the Australian Plasma Fusion Research Facility. This only funds local infrastructure and its development. There is no research project funding or funding for people and no funding for international engagement.

Turning to this facility now, the Australian Plasma Fusion Research Facility, valued at \$30 million, is Australia's only fusion-relevant research facility. Recently facility funding was extended to 2013. We have decided to use the upgrade to improve suitability as a testbed for diagnostics; improve plasma production, reliability and cleanliness; improve opportunities for collaboration; improve data analysis and provide computational support; and improve diagnostics. The mission of H-1 is to study the physics of hot plasmas in a helical magnetic container, host development of advanced plasma measurement systems and maintain Australian presence in fusion.

Why have we focused on a diagnostic for ITER? Principally because we are a world leader in plasma measurement science technology. Diagnostics are also largely standalone modular systems and thus constitute a well-defined Australian contribution in scale and budget. The ITER diagnostics are also modular, being assembled in port-plugs around the vessel. During a scoping discussion in February 2009, representatives of ITER suggested an integrated package of an erosion monitor, a dust diagnostic and a tritium analyser, with estimated development and construction costs between \$15 million and \$20 million.

Let's turn to the impediments to major international engagement. There are two main impediments to major international engagement, the first of which is that there is no analog to the mission orientated funding agencies that normally support this work in other nations. Principally in the US, for example, this is the US Department of Energy, and in Europe it is EURATOM. In Australia, nearly all fusion R&D capability rests in the university sector, but it is not funded to do strategic R&D. Our project and collaboration funding is largely supported by discovery based competitive grant schemes. This includes the former International Science Linkages scheme, which was very good for small to medium scale enterprises but had limitations in scope and scale. The former ISL scheme, for example, could not have supported an Australian engagement in ITER. There is an exception to this in government support for local research infrastructure.

The second related problem is that no single government department has responsibility for large-scale international engagement. Rather, responsibility is fragmented across the Australian

government—across the Department of Resources, Energy and Tourism, the Department of Climate Change, the Department of Innovation, Industry, Science and Research and even, indeed, the Department of Foreign Affairs and Trade. Such splintering creates a disconnect between the domestic and international research community and the Australian government. What do we propose as a solution? We propose the solution to major international engagement is to evolve the International Science Linkages scheme to create a new program to assess and support projects outside the scope of existing programs. The new program would cater for small-to large-scale international engagement and enable small projects to evolve to large-scale funded projects, act as the single contact and legal engagement agency between the Australian government, Australian scientists and international consortia and coordinate policy response from the Australian government and have an advisory function to government. We believe that this new program would provide a mechanism to support an Australian role in ITER.

In summary, fusion offers millions of years of clean energy with no possibility of meltdown and no proliferation concerns. ITER is the gold standard for large-scale international science. It will define the way large-scale international science is conducted during the next century. We have articulated our strategic plan for Australian involvement in ITER and we believe Australia should engage with ITER for a modest investment. We believe we can make a significant impact, realising fusion energy. Secondly, our main recommendation to the committee is that it should consider evolving the International Science Linkages scheme to create a new program which can evaluate, engage and fund Australian engagement in large-scale international projects on the scale of ITER. Thank you.

CHAIR—Thank you. Dennis, did you want to make a statement?

Dr Mather—I do not have a presentation, but I am very happy to field questions.

CHAIR—I am just wondering how the international community views our scientists and our research in this area. Obviously we are engaged at one level and not at another. Are we, overall, considered to be important? I sense that we are, and certainly the presentation says that.

Dr Mather—Absolutely. The ITER partnership has come to us and said: ‘We would like you to participate in these areas. This would be a good thing.’ We called a meeting back in—was it in 2007 that we had the workshops?

Dr Hole—It was in 2006 that we held the workshop, which involved five of the seven ITER partners.

Dr Mather—There was no trouble getting representatives from just about all the partners to come to Australia to talk to us about how Australia might engage in ITER.

CHAIR—They did not have a problem with the tyranny of distance?

Dr Hole—That is not an issue.

CHAIR—I am just joining dots here. I am trying to get at the significance of the contribution, and obviously on this issue there is significance.

Dr Mather—They are already dealing with distance. They are distributed across the world, and it is just not an issue with this particular project.

Dr Hole—In terms of other international recognition, we also get lots of things like invitations to talk at prestigious conferences. In fact, I presented a slide on this, which I did not have time to talk about—editorial positions, prestigious physics and journals. Australia is a member of the IEA Implementing Agreement on the Stellarator Concept.

CHAIR—I sense we are significant players, though—is that correct?

Dr Hole—We are significant players. We are viewed by the international community as significant players. What is new is ITER, which has become a paradigm shift in the way fusion science is conducted. ITER, as I have said, will define the fusion capable and the have-nots, and we believe that Australia, if it wants to maintain and grow a fusion relevant capability, needs to give serious consideration to how it would engage with the ITER program.

Dr JENSEN—I would like to back you up on that. In fusion research, they have been talking in terms of 50 years in the future since the late 1940s, but this is the first time I actually see the time lines as being realistic because of the actual science and the results that are being obtained. What will involvement in the ITER project get us in intellectual property and, potentially, royalty streams from countries that are not in the consortium, building these fusion reactors in the future? Alternatively, what would be the likely cost to Australia in royalties that we would have to pay to use this technology, given that this clearly is the way of the medium- to long-term future?

Dr Hole—The first point to make is that the technology of ITER itself is owned by the ITER partners. The research outcomes, which were produced by ITER, are owned by the partners. That means that demonstration power plant designs and so forth constitute privileged information to those countries that have participated in the ITER project. For another country that is outside that framework and that wants to come along and use that technology and develop its own form of fusion power plant, that country either would not have access to it or would probably have to pay for it.

So there is an implication for those nations that will have some access to the fusion technology to enable this power generation capability to exist as well as for those that do not. In terms of quantifying that—because of the time frame involved we are still talking about decades out from realisation of commercial power—it is a little bit difficult to quantify the risks to Australia in financial dollars of not engaging. I would answer perhaps more broadly that if Australia elected to not have some ITER engagement it would put at risk Australia's capability to, in the first instance, even evaluate fusion power as a candidate technology should Australia want to consider that in future. It would also put at risk or indeed eliminate the possibility of Australia being involved in any form of technology development associated with the ITER program.

Dr JENSEN—You put up a number there of \$63 million over 10 years. Would that get us an in as far as the IP is concerned, so that we would potentially be able to use their technology?

Dr Hole—This is an issue that the Australian government, if they wish to take it up, would have to address with the ITER organisation directly, as to what IP rights that level of engagement

purchased, or what was made available to Australia by involvement at that level. At least it would involve the IP associated with the contribution itself. We would argue that perhaps it would also enable us a broader capability or some broader subset of the research outcomes of ITER, but I cannot answer on behalf of the ITER organisation, and I cannot answer on behalf of the Australian government either.

Dr JENSEN—My concern is that I foresee potential sovereign risk here if we do not get involved. I do not like using the term ‘breakthrough technologies’ because it brings to mind all sorts of implications, but in terms of seeing the shape of the future I think it is clearly defined, and that is not often the case. For us not to be involved in the way of the future is a significant risk. Back in the 1950s, we made a decision. We could have been right at the cutting edge of the semiconductor industry—solid-state electronics and so on—and yet over here the view at the time was: this is just newfangled stuff; it is always going to be valves. So we missed a significant opportunity. I am concerned about the potential loss of opportunity in this one.

Dr Hole—So am I. It is the reason why I have gone to the effort of presenting this.

Dr Mather—There is another aspect, just on the side of this, which is that in some of the areas that we would be involved, which is materials development, there are other spin-offs that relate to the other kind of nuclear power in the first instance but other smart materials that can operate in harsh environments—high temperatures, high pressures, high radiation fluxes.

Dr JENSEN—I imagine that there would be huge potential advances in things like learning about brittle fracture and that sort of thing, given that the neutron bombardment of the container vessel gives you problems with embrittlement of the container.

Dr Hole—Yes. Certainly materials are a critical issue, particularly with regard to structural materials, which is what you are talking about.

FRAN BAILEY—I am a nonscientist. Can you explain to me in layman’s terms the advantages of fusion over fission?

Dr Hole—In simple terms, fusion is the combining together of two lighter nuclear isotopes—for example, isotopes of hydrogen—to form a heavier neutron or a heavier element. In this case, it combines hydrogen to form helium, which is an inert gas. The difference in fission is that you are splintering apart heavier nuclei to form daughter nuclei. Both of these will produce energy, but they produce energy by different mechanisms. You can look at Einstein’s famous equation $E = mc^2$ and look at the mass difference between these two. There is a mass difference in both the reactions, and the mass difference in fusion produces about 17½ MeV. The mass difference in splintering uranium produces about 200 MeV.

Dr Mather—Perhaps I can answer your question in a slightly different way. The prime difference between the two energy sources is that the waste materials from fission are around for hundreds of thousands of years.

FRAN BAILEY—We do not know how long they will be around for, do we?

Dr Mather—The process itself produces radioactive materials. With fusion, the process itself does not produce radioactive materials intrinsically.

FRAN BAILEY—That is what I was wondering about.

Dr Mather—The neutrons bombard the shell that the plasma is contained in, and that bombardment causes that material to become radioactive.

Dr Hole—So it is indirect.

Dr JENSEN—And it is short-lived.

Dr Mather—The half-life there is down to hundreds of years as opposed to thousands of years.

FRAN BAILEY—Would there be some other advantages of fusion over fission? I think the waste material is actually a very good argument.

Dr Mather—Raw material supply is another one.

Dr Hole—The raw material is pretty much limitless. If you look at the world supply of deuterium and lithium and look at its capability to power civilisation, you are talking about millions, if not billions, of years. You are talking about ages of the earth.

FRAN BAILEY—Why don't we hear more about this?

Dr Hole—I do not know.

FRAN BAILEY—You obviously talk about it a lot.

Dr Hole—Some of my other colleagues talk about it as well.

CHAIR—We are still working our way through the coal industry. I know that Rowan needs to go.

Mr RAMSEY—I will be quite quick. There is an \$18 billion investment here overall. What threat is fission and the advances in fission nuclear reactors? We are talking about generation 4 reactors now and having less waste and all this kind of stuff. Is that actually a threat to the development of fusion power—that they will achieve a breakthrough and it will drain the resources out of where you are going because it will be seen as an adequate solution?

Dr Hole—I would not put it that way. The world's climate problem is so massive that we need to do every single thing we can to find a solution to the need for long-term energy power—an energy solution that is going to sustain our way of life. That means investing in solar, fission, fusion and everything to try to find a possible solution. In terms of the longer term relevance of fission versus fusion, the fuel supply, for example, of fusion is clearly a significantly longer time scale than fission. But you are still talking about time frames thousands of years. If you look at the energy supply of fission, it varies—depending on estimates I have heard—from hundreds to

thousands of years. The real answer has to be looked at in terms of: what does society need to address climate change? And it needs everything. What type of attributes do we want energy technology to have? We would like it to be low emission and low waste. I guess the other elements at the end of the day are going to be economic issues such as cost. What will be the cost of electricity? Projections of fusion suggest that it competes very well with other technologies.

Mr SYMON—I want to take change tack a little bit and ask about spin-offs that can come from project such as this for Australia if we have that international collaboration—especially in the areas of skills and training, as mentioned in your submission—whereby that might be useful for other technologies, which you have just mentioned as well, not in a 50-year time frame but obviously a much closer time frame. Could you enlighten the committee on some of those, please.

Dr Hole—There are still some training benefits in that context. More immediately, as Dennis has already highlighted, some of the next generation materials which are relevant for high-temperature, high-neutron flux are also useful for solar thermal collectors and other forms of solar power. So there is an immediate cross-fertilisation to a different field. In terms of wider benefits and spin-offs, one of our scientists, Professor John Howard at the ANU, has a very successful plasma diagnostics collaboration. Some of his diagnostics have been used to measure the temperature of steel coming out of what was formerly the BHP strip mill at Wollongong. It is now the BlueScope Steel strip mill. This measures the temperature uniformity of the steel product. Having a very high temperature uniformity strongly correlates to having a very fine or high-quality product. Those are two examples I can give of skills and training diversification.

More widely, if you start talking about development of a diagnostic which is qualified for a nuclear environment, there are potential benefits to Australia if it wants to have some footprint perhaps in other instrumentation or nuclear safety aspects, which Australia has always been very big on. There are spin-offs in a number of different areas. Highlighting the last one a little bit further, control engineering is an area which Australia has had a lot of expertise in. This is something that is important to both ITER and any large industrial machine. That is another area in which I could envisage potential spin-offs.

The other point I would make is that—and I noticed the last speaker spoke about Boeing—Boeing Phantom Works approached me to talk about whether or not it was possible for us to build some form of collaborative venture on fusion research, particularly in the control engineering space. I went to Boeing Phantom Works in St Louis and discussed with them the possibility of engagement. We put together an outline of a commercial project that we would undertake with them. The global financial crisis has produced a temporary hiatus for that project, but that is another spin-off that I could envisage. In that case, Boeing is principally interested in control systems engineering.

FRAN BAILEY—In the list of all the academic institutions which form part of the collaboration, I did not see Melbourne university.

Dr Hole—There are actually scientists at the University of Melbourne. The ITER Forum is a network of scientists and individuals. There are networks and individuals that are part of the forum, but that does not necessarily mean that the institution has written a letter of support for

this fusion strategic plan. There are scientists whom I could name—but I won't—at the University of Melbourne who do have an interest in this.

FRAN BAILEY—Mark Oliphant was a Victorian, wasn't he?

Dr Hole—No, I thought he was South Australian.

FRAN BAILEY—I was about to claim him!

Dr Mather—If I could just put a little plug for AINSE here; it is absolutely pertinent. One of the lead players at the University of Melbourne is in fact an AINSE research fellow—a young, postdoctoral researcher with three or four years postdoctoral experience. He is working with materials that might be used for the inside lining of a reactor vessel. He is developing this little team of students who, initially, will start research with him and then go on to do research, presumably, at the university.

FRAN BAILEY—I cannot understand why fusion is not out in the public arena more.

Dr Mather—It was on *Quantum* last week.

CHAIR—Fran is right: unless you are highly interested in watching *Quantum* or are involved like we are, the truth is it is not.

Dr Mather—There is no 'bad news' story.

FRAN BAILEY—Over the past couple of years, with the climate change debate, everybody on every street corner in my electorate would have had a view about climate change. They will talk about nuclear energy, but I have never heard anyone talk about fusion.

Dr Hole—It is an issue. My colleagues and I have gone to great lengths, as much as possible, both to inform the general electorate and also parliament at large, about the possibilities of fusion and the differentiation between fusion and fission. I guess, at the end of the day, we are research academics and paid principally for research.

Dr JENSEN—I think the big problem with it is that, when you are talking about the shape of the energy market and all the rest of it, fission is already there. It is a very real prospect. You can go buy a nuclear power station now and have it operating in a few years time. The fusion thing has been discussed for over 60 years. You are talking about a very long timescale and I think that that is the inhibiting factor in the discussion about it.

FRAN BAILEY—I find it fascinating.

CHAIR—Everyone gets bogged down with the traditional forms of energy that have probably not yet run their course. There is that debate as well. How much can you put into the agenda? You have nuclear, coal, oil and all that is still happening.

Dr Mather—But I do not think you are on the agenda.

CHAIR—Exactly. Wouldn't that be going in an entirely different direction? It would threaten other, existing industries.

Dr Hole—It might, but studies have been undertaken in Europe.

CHAIR—I am not saying it is a good thing; the economics of this, too, must be a strong driving force.

Dr Mather—We need to be sensitive to that, but we also need to face up to the real problems that the coal industry and the oil industry present to society.

CHAIR—That is where I am coming from. I think they are an impediment. Their existence is an impediment to moving faster through this process, because we cannot bed them down.

Dr Hole—In terms of public awareness I guess the space has been largely occupied by that large player. We are trying to increase our footprint. We are thinking about time frames and looking at energy mixes. For example, the US and the European Union have a bunch of studies which look at possibilities for fusion in terms of its footprint in that space. Certainly, it is a higher priority elsewhere. I guess Australia is more unique in the sense that the priority at the moment or the understanding—

FRAN BAILEY—We need to get the debate happening in the public arena.

Dr JENSEN—I think the problem is that nuclear is still associated with it which, with some people—not me—

Dr Hole—You will note that I was very careful to talk about duty.

CHAIR—It has been a very interesting debate. Thank you. This issue is very hard for me to understand, but I get the gist of where things are. Quite frankly, I think it is fascinating.

Dr JENSEN—I am happy to chat to you a bit longer about it.

CHAIR—I cannot promise that I will still understand it.

Dr Hole—The director of the research school, which hosts the Australian Plasma Fusion Research Facility, asked me to extend to the committee an invitation to visit the facility at any time.

CHAIR—A good idea.

Resolved (on motion by **Dr Jensen**):

That this committee authorises publication of the transcript of the evidence given before it at public hearing this day.

Committee adjourned at 11.50 am

