REPORT OF PROCEEDINGS BEFORE

STANDING COMMITTEE ON STATE DEVELOPMENT

INQUIRY INTO NANOTECHNOLOGY IN NEW SOUTH WALES

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At Sydney on Thursday 1 May 2008

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The Committee met at 9.30 a.m.

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PRESENT

The Hon. A. Catanzariti (Chair)

Reverend the Hon. F. J. Nile
The Hon. M. J. Pavey
The Hon. C. M. Robertson
The Hon. M. S. Veitch

CHAIR: Welcome to the second public hearing of the Standing Committee on State Development's inquiry into nanotechnology in New South Wales. Before we commence I would like to make some comments about procedural matters. In accordance with the Legislative Council guidelines for the broadcast of proceedings, only Committee members and witnesses may be filmed or recorded. People in the public gallery should not be the primary focus of any filming or photographs. In reporting the proceedings of this Committee the media must take responsibility for what they publish or what interpretation is placed on anything that is said before the Committee. The guidelines for the broadcast of proceedings are available from the table by the door.

I remind everyone that any messages for Committee members or witnesses must be delivered through the Chamber and support staff or the Committee Clerks. I remind everyone to please turn off their mobile phones as they interfere with Hansard's recording of the proceedings. Committee hearings are not intended to provide a forum for people to make adverse reflections about others. The protection afforded to Committee witnesses under parliamentary privilege should not be abused during the hearing. I therefore request that witnesses avoid mentioning the names of other individuals unless it is absolutely essential to address the terms of reference.

CLIVE THOMAS NAGEL DAVENPORT, Chief Executive Officer, Australian Nano Business Forum, affirmed and examined, and

PETER NICHOLAS BINKS, Chief Executive Officer, Nanotechnology Victoria, and Chairman, Australian Nano Business Forum, sworn and examined:

CHAIR: If you should consider at any stage that certain evidence you wish to give or documents you may wish to tender should be heard or seen only by the Committee, please indicate that fact and the Committee will consider your request. If you take questions on notice today, the Committee would appreciate it if the response to those questions could be forwarded to the Committee Secretariat by Thursday 22 May. Would either or both of you like to make an opening statement?

Dr BINKS: Yes, I would like to make an opening statement. Thank you for the opportunity to speak in front of this inquiry. I will keep my statement very brief. Firstly I want to clarify that the perspective we take is that of the development industry for nanotechnology within Australia. I would like to make three points from the industry perspective.

First, nanotechnology development and commercialisation is a very long and complex game. It is a very important game where we see substantial benefits for the community, for the economy and for the global system. We see benefits that range from fundamental changes to medical practices, including things like the detection of cancer, neurological diseases, cardiovascular diseases, et cetera, to the development of new systems for converting solar energy and transmitting energy in ways that are beneficial to our economy. Our overall point is that this is a 20 to 30-year process; it is not an overnight revolution. It is one that will have many ups and downs, and many challenges, and will achieve its substantial changes through a whole lot of incremental developments. The first point is that this is a long and complex path.

The second point is that we in industry believe that no technology or set of innovations can be introduced and forced on a community without that community's acceptance, and that a key part of the development of any technology is putting in place the awareness and the understanding, the regulatory systems, the safety mechanisms, and all the other things that are required to make something part of our normal business. But it also includes the leadership and the educational apparatus. That is a very important part of what the industry is trying to do.

The third point I would like to make is very parochial: that Australia has a real opportunity to benefit from nanotechnology, both in terms of our economy and in terms of our community and the benefits that are there, but that we will fail to achieve that opportunity, particularly in a timely manner, unless we can actually work together. Working together means a collaboration between government, industry and the research community; it means collaboration between individual companies and institutions, and between different layers of government and all the other entities that are involved. A significant part of the submission that the Australian Nano Business Forum made is that there is an opportunity for New South Wales to work with other States, with the Federal Government, and with a whole lot of other different players within the game to achieve this opportunity in a safe and responsible manner.

Mr DAVENPORT: I would like to make a brief opening statement based on several other roles I have. The issues that Peter has raised—and I think the issues that everyone here is confronting—are not just particular to New South Wales; they occur at the local environment, they occur at the national environment, and they are also occurring globally around the world.

We are not the only people involved in this at the present time. Everyone is looking at the same types of things. I will make a couple of points about that very quickly. People are looking at the applications of this technology. As Peter has just mentioned, it is a technology; it is not really an industry all of its own. It is contributing to products that either are in existence today or will be brand new products. They will be in different disciplines and different categories. People are looking very seriously at what these new agents are going to be, the processes for translating research into business environments and what those commercialisation products are. There are no set models so the business models themselves are a whole new open area for us—what are these new businesses likely to look like and how do we actually go about supporting them and stimulating them. We are also looking right

around the world at the global supply chains, because it is believed that no one country has every expertise. It is a question of how everyone collaborates on how to find and identify those areas in the global supply chains on which we can all work.

One of the things that is very important for Australia, with New South Wales being a component of that, and which then goes out into the world, is mapping. Some very large road maps have been done, two in particular on a global basis, but the focus has tended to be on the Northern Hemisphere. I think we are part of a unique area here in Australia and one of the things I am very strong about is that we map what our resources are and what the opportunities are. In other words, where are the research strengths, where are we likely to get the greatest traction from industry, and what do we really need to make those things come to fruition?

The next point relates to education, skills and workforce development. There is nothing unique to us here. The whole world is confronted by this because it is a totally new skill set. The manufacturing environments of these technologies that are going into products will be clean rooms, so there are whole new disciplines associated with that. There is also the sophistication of much of the type of equipment that is associated with it. One thing that comes up regularly in these areas is intellectual property and enabling an environment in which people can work very proactively with intellectual property and try to remove some of these barriers that people are regularly talking about. There is a lot of talk about whether there is a mechanism by which we can make that intellectual property far more readily available for people to work on.

The last point, which was also Peter's last point, is that the world is very focused on responsible development and making sure that we identify as early as possible what the risks are—there are also associated ethical issues—and that we encompass that in the broader strategy. As I said, it is not simply a local issue; it is a local, national and global issue.

CHAIR: Thank you very much. Can you briefly outline the reasons why the Australian Nano Business Forum [ANBF] was established and what service you provide to your member organisations?

Dr BINKS: If the Committee is comfortable with this, I will address the first part of that question—why we formed the ANBF—and pass it to Clive who as chief executive can explain more about what we do for members. The ANBF was formed out of a meeting in September 2005 of chief executives and executives of companies that work within the nanotechnology industry who were gathering at a national conference held in Melbourne at that time. We realised that we never got together to talk about a common framework or a set of issues and that decisions were starting to be made about some things that would affect the whole industry. There were already discussions then about toxicology and concerns about public awareness and what regulatory environment might be needed. There were issues and concerns about national positioning, how we talked about Australian nanotechnology and whether we knew if it was well equipped or poorly equipped. We discussed situations such as the chief executive of DuPont coming to Australia and having 24 hours in which he wanted to see the best of Australian nanotechnology. How would we address a circumstance like that? How would we deal with questions of government policy?

We decided we needed to form an organisation that represented not research interests and not necessarily government interests, but one that gave an industry and business perspective—the people who have employees who are exposed to the risks and who produce products they are trying to market into the global supply chains. We formed an organisation that was registered in the Australian Capital Territory that has representatives from each State. We have sought government funding, we have membership funding and we run projects. However, our primary raison d'etre as an industry body was to provide a focus through which we could communicate and address issues associated with the emerging nanotechnology industry. It has been in place for just under three years now. This is an appropriate point to hand over to Clive to talk about our relationship with our members.

Mr DAVENPORT: Building on what Peter was just describing, it began as a forum at which the players could have open and continuing dialogue. A lot of the research community is reasonably well looked after by the likes of the Australian Research Council Nanotechnology Network, but there was nobody at the interface with respect to industry. The idea behind it was that we would get together and hold regular meetings and bring more and more people into this community with

seminars, so there were information environments and workshops. We then started to participate more heavily in some of the international conferences that came to town. We always had a presence there. We would arrange speakers or assist in engaging speakers and bring them in and we also looked at running particular forums within those conferences. There were two just recently. We had a COMS conference—commercialisation of micro nanosystems—in Melbourne last year and the ANBF played a very strong role in organising meetings for delegations that came from other countries, which in turn put Australia in a very good light with those groups. More recently, at a researchers' conference, it was interesting that a fifth stream of the conference was created on business development and commercialisation in industry. The ANBF actually put together that entire section. A point of interest is that it ended up being the most popular stream of the researchers' conference.

Among other things we spend a lot of time in promoting Australia's position in the global environment by acting as a spokesperson for the industry. We facilitate delegations to go from Australia to some of the major events. The biggest expo in the world is what is called Japan Nanotech; it has now become known simply as Nanotech. About 50,000 people attend this conference and expo every year. Over the last few years the ANBF has played a very significant role in acquiring funding from different Federal agencies to mount a very impressive stand at those shows. We have moved it up every year so that we have a greater presence every year. We organise meetings and receptions, not only for the Australian players, where they can meet counterparts in government, research organisations, business groups and industries in Japan. We have also done similar things in Taiwan, which has a similar show called Taiwan Nano. In the United States the largest show of this nature is what we call NIST, which is a nano conference as well. Every year the ANBF takes a position and a leading role in these organisations.

We work with the regulatory agencies, the people who are now starting to look at what some of the standards and regulations should be, and we also contribute to the standards groups that meet. We act as the group representing the commercial or business activity side to governments, so we spend a reasonable amount of time in Canberra as well. As Peter indicated, we brought what we call the Responsible Nano Code to Australia in November last year. This is a self-regulatory vehicle that was developed by industry in the United Kingdom. It started to be accepted internationally, so we brought it here and ran a workshop in November to get a lot more input into it. This was when it was actually being formed. We are carefully monitoring that at the moment and will be looking to introduce it. We facilitate a lot of business-to-business meetings for international groups and local groups. In general, as we are doing today, we act as a spokesperson for this industry sector with respect to what the business opportunities are.

CHAIR: Is DuPont a member of your organisation, or any other chemical company?

Dr BINKS: DuPont is not a member in Australia. We have had dealings with DuPont around a number of different issues, many of them on the regulatory side. I do not think Orica is a member either. We have members who are smaller manufacturers of specialty chemicals; for example, Applied Nanotech, from Perth, Micronisers, in Melbourne, and a very small particle company in Brisbane. These are companies that to all intents are within the chemical industry but focus on processes that produce nanoscale materials. We typically find that the very large companies will have distribution and sales activities in Australia but very few of them have manufacturing activities in Australia. We are probably more interested in the manufacturers at this point in time.

The Hon. MELINDA PAVEY: In terms of manufacturing—I suppose the question should be to you Dr Binks as CEO of Nanotechnology Victoria—how many industries or companies are operating in Victoria in the very broad spectrum of the nanotechnology field? We had evidence from the Office for Science and Medical Research in New South Wales, representing the department, that there are 23 to 25 in this state dealing in the broad spectrum of nanotechnology. How many are operating in Victoria?

Dr BINKS: There would be about 40. The number is a little fuzzy because there are medical product companies dealing with features in the nano domain that may not think of themselves directly as nanotechnology companies. However, when you look at what they are really based on, that is it. There are service providers as well. We think that 23 in New South Wales is a little conservative. We think there are other companies out there of the same ilk and we would put the number just a little bit

higher. It may be the medical orientation that drives that, but the number is very comparable to that of Victoria, which has 40-odd companies.

The Hon. MELINDA PAVEY: In your evidence, Mr Davenport, you said that bringing the researchers, scientists and industry together had been a major part of the success of Nanotechnology Victoria and the Nano Business Forum. Could you give us some examples of how that has worked in helping to create links between research and industry in Victoria in particular?

Mr DAVENPORT: There is an interesting program that is run in what is called a small technologies cluster at Caribbean Park in Scoresby. It is called the STC access program. It is a small grant that was made available by the Victorian Government, which we administer. The idea is to make very small grants of $5,000 to $20,000 available to researchers or to early stage businesses where people are trying to get a business off the ground, to access the facilities in which they can make fabricated devices. It enables them to take the next step on the road towards commercialisation.

What we find out of that is that we have engaged enormously with the research community on a broader scale, in other words not just the universities. There have been university people that have actually applied for these funds, there have been some small industry people that have applied for these funds but we have also had them from some of the hospitals, the Baker Heart Institute and people like that. We found that for a small amount of money it was an incredible way of engaging with those groups and having them orientated towards commercialisation and looking for new business opportunities.

The Hon. MELINDA PAVEY: Has the ANBF had much interaction with the New South Wales Office for Science and Medical Research, which is our division that looks after nanotechnology?

Dr BINKS: We have had a number of interactions over the last three or four years. It has taken a long time to get the conversation going. We believe though over the last six months we have made significant progress and we now have a very good interaction with that office. Clive is actually conducting further discussion later on today with them.

The Hon. MELINDA PAVEY: Do you think those synergies are important, in terms of nanotechnology for the whole of Australia?

Dr BINKS: Undoubtedly.

Mr DAVENPORT: Absolutely.

The Hon. MELINDA PAVEY: Can you expand on that?

Mr DAVENPORT: Can I go back to the original comment that I made that no one nation has all the capabilities. In this new area it is important that at the research level we share resources across the country, in terms of infrastructure, capabilities and facilities, and we also share research programs. It is incredibly important that businesses learn to actually work together in these areas as well. It is really interesting to watch the start-ups in this process because the start-up begins without any capability as well so they are very happy to collaborate.

What we are finding is that at the government level across the States the same issues are prevailing as well. My background is that I came out of a cooperative research centre, which was very focused on making use of the very best groups and the very best infrastructure that was available across the country. We found it an incredibly productive way to work and to me that whole thing simply flows into nanotechnology. No-one has every expertise and every capability and it is incredibly important that we all work together.

The Hon. MELINDA PAVEY: You have mentioned that things have got better in the past six months with New South Wales in terms of communication. For fear of telling us how to suck eggs in New South Wales, do you have any suggestions for the future to continue to grow that relationship and communication?

Mr DAVENPORT: A little bit later on today I am actually continuing this dialogue with the Department of State Regional Development here. There are some really nice groups working here and we should sort of step back a little bit. In nanotechnology the CSIRO group out at Chatswood were one of the first groups in Australia and they have been working on nanotechnology for years. New South Wales already has a really good presence and history in nanotechnology. At the present point in time one of the most active groups in the country, in terms of business interaction and growing cluster environment, is the group out at the University of Western Sydney. That is a very impressive group to work with. I was out there on Monday with them when they were running a seminar—there were some 85 or 90 people there—it was very impressive.

Dr BINKS: If your question is directed at what is the benefit of collaboration, one of the perspectives that we bring from a business level is that there are simply too few resources if you are taking an individual company, city or State to make a meaningful contribution to a sector of a global industry. What we are finding is where we can encourage collaboration between like companies and like research institutions our Australian position is immensely more powerful. We are already seeing such collaborations coming into place around the development of medical devices and technologies and around the development of new materials. So even though the business that I run is primarily focused in Victoria we regularly work with companies and activities in New South Wales, Queensland, Western Australia, South Australia and, indeed, in Tasmania. We use that to bring in expertise to test facilities, to talk about distribution et cetera. Because to us our competition is not New South Wales: our competition is the United States, China and Europe and everyone else where they are investing hundreds of millions of dollars and terrific young PhDs in developing these new businesses. Australian businesses can work very effectively together—they have demonstrated that.

Reverend the Hon. FRED NILE: Do you have any other suggestions on how to improve the situation in New South Wales? You mentioned about the grants and so on but are there other projects that should be put in place in New South Wales to be more effective?

Dr BINKS: The very first step, and the one you have already taken, is actually this inquiry. When we were writing in response to this we made the point that the questions you were asking were exactly the right questions. You were asking questions about the national position, about politics, about benefits to the community, about dangers and about what tangible steps can be made going forward. The fact that you are holding this inquiry is actually elevating the public awareness and interest in nanotechnology substantially. It is actually forcing all the other players within New South Wales and around Australia to start to think about how we can work together. I would commend you on that very first step which is actually a leadership position that is very important.

I guess what I would ask for is that you continue that leadership. I actually think that New South Wales does need to have a position on nanotechnology and say, "Nanotechnology is potentially part of our future, particularly if it can be managed responsibly." It is something that we should encourage and facilitate our researchers, industries, our politicians and our levels of government to think of as part of the equation going forward, as we start to prepare the economy to the next 20 or 30 years. That does not necessarily mean investing money but simply the leadership that you give by saying, "This is something we are aware of and we think may have benefit. It needs to be managed carefully and is incredibly important to all the stakeholders around here."

Reverend the Hon. FRED NILE: In your submission you state that it is an opportunity for Australia to stake out a distinctive position as a leader in nanotechnology. Would you like to expand on that statement and again give some consideration to the role of the New South Wales Government in leading this opportunity? Under ANBF do you have State divisions?

Mr DAVENPORT: Chapters.

Reverend the Hon. FRED NILE: Do you have a very strong one in New South Wales?

Mr DAVENPORT: It is a growing one.

Reverend the Hon. FRED NILE: It is basically in Melbourne, is it?

Mr DAVENPORT: The ANBF began in Melbourne. It actually began with, we will call it, seed funding from the Victorian Government to create this environment for having dialogue but it was made conditional on it being a national entity. The group that we actually work with very strongly here is that group in western Sydney because they seem to have incredible traction out there already. They have virtually got a lot of small businesses coming together to learn more about what the opportunities in this area are. What we are aimed and focused on doing is growing that interaction certainly here in the State.

If I could reflect on the position for New South Wales, on of the things is that a lot of the activity that is going on is also in things like the CSIRO flagships and the flagships are not in one particular department or division but they are actually spread across the country. There is a new one, for example, in niche manufacturing with a focus on nanotechnology. There are groups working in Melbourne on those initiatives and there are groups up here working on those initiatives. If you look at infrastructure, we have what is called the National Collaborative Research Infrastructure Scheme [NCRIS] and that program has been funding a lot of new infrastructure around the country. There are nodes of that in New South Wales as well. These nodes and the CSIRO groups are all about that interaction across State borders. So there is already a lot of that collaboration and cooperation between the different States and areas.

The Hon. MELINDA PAVEY: On Monday we had evidence from the people at our nuclear facility at Lucas Heights. It seems that is another advantage to New South Wales, in terms of technology, the research and capabilities that can happen at that facility. Can you expand on that in terms of that being an advantage for New South Wales at Lucas Heights?

Dr BINKS: The ANSTO organisation is one of the great material science organisations of Australia. The first wave of nanotechnology that is coming out now—I talked about that 30-year plot—is around a generation of new materials. They can be super strong materials, they can be very lightweight materials for the transportation industry, or transmission materials to allow you to transport power more effectively around the country. ANSTO is doing some extra ordinary work around that. New South Wales has a tremendous capability just in ANSTO. As Clive said, you have got probably a third of CSIRO divisions based in New South Wales but the extraordinary work ranges from more materials work—like the stuff that is being done at both North Ryde and Chatswood—but there is also the molecular biology work that is being done. New South Wales has a real hub for the development of medical technologies and the supporting activities around those. We know of a number of companies that are already working in that field. One of Australia's finest known technology companies, and probably one of the top 10 or 20 worldwide, would be Capax. Capax is a super capacitor materials company.

The Hon. MELINDA PAVEY: We inspected their facility.

Dr BINKS: So there is a whole cluster in New South Wales that we think gives New South Wales a very strong position in the technology development around nanotechnology.

The Hon. CHRISTINE ROBERTSON: You mentioned the issue of intellectual property. Have you got any ideas on addressing the commercial in confidence, research in confidence and the scientific and commercial competition that exists for lots of good reasons, but in some cases it causes great problems for your mapping for a start and also the sharing of information is very difficult?

Dr BINKS: I have a very strong view on intellectual property. My view begins from the premise that intellectual property is worthless unless it is actually translated into a product or a process that can benefit a group of people. I think one of the challenges we have in Australia is that we do tend to regard intellectual property as something that should be held secret and should be preserved and hidden from the outside world. One of the challenges we face is that we have an enormous amount of lovely intellectual property that is developed by our publicly funded research institutions, that ranges from the universities through to CSIRO, to departments of primary industry, to ANSTO, and to our defence organisations.

The Hon. CHRISTINE ROBERTSON: The Department of Energy?

Dr BINKS: Yes. There are some wonderful people doing some great work. I think our challenge is actually using that for our community benefit. When it comes back to intellectual property specifically one of the things that we are seeking is ways to effectively make that intellectual property known to the community. From a small business perspective—and this is where Clive and I really come from—one of the hardest things is to actually find a technology when you want one. To go into the University of New South Wales or Sydney University and say, "I am looking for a technology, it maybe a nanotechnology that gives me a super strong material", it is very hard to actually find who the key person is to talk to and which group is working on it et cetera. To then get some idea as to whether it is the best of available within Sydney, New South Wales or Australia is incredibly difficult unless you really intimately know the university system. Then you have got the CSIRO and the other agencies.

I look at the intellectual property challenge as having two aspects that we really ought to consider seriously. First of all, it is almost the knowledgebase of intellectual property and saying we need to find out what is out there and potentially available. A lot of what Clive refers to in the mapping is around saying what have we got that could be potentially used? The second challenge is making that available to companies or organisations to exploit for not-for-profit purposes or profit purposes.

I think in Australia we do need to make significant changes to make this stuff more readily available. That does not in any way deny the opportunity to researchers or research organisations to make returns out that property but we as taxpayers all feel that we have partially funded that stuff anyway and believe that as Australians we should have the right to access it and start to use it for our benefit. We have no problem with paying royalties or paying an access fee or whatever it maybe, but we do want to be able to get into a commercial discussion. In summary, when we talk about intellectual property we think that there are two challenges: one is seeing it and the other is having the right to use it for a commercial or other purpose. We think there are some reforms necessary in these areas.

The Hon. CHRISTINE ROBERTSON: So this intellectual property issue is huge in education, health, social sciences—you are asking for an incredible leap.

Dr BINKS: It is actually not such a huge leap. In education we handled it quite well. I think in Australia we have developed extraordinary intellectual property through our education system in what we teach in our schools very well and we have become remarkably successful at dispersing that around Australia, using that in overseas circumstance, using that to essentially lift the knowledge of the community. We have been less successful in industrial and other circumstances. We are becoming very good at it in fields like safety and environmental awareness. It is merely a translation of those. I think that this has little to do with nanotechnology per se, but is actually more about the entire technology field but in nanotechnology is pertinent because the IP field is still quite fuzzy and we are still trying to work out what is natural and what is engineered, and a lot of the claims are still being sorted out as to what these technologies can do.

The Hon. CHRISTINE ROBERTSON: Mr Davenport, in relation to separating nanotechnology from general scientific and industrial endeavour, can you tell me the pros and cons, or do you have to work very hard to keep yourselves in the mainstream? Is it a dangerous or a good thing?

Mr DAVENPORT: I have an interesting perspective on it and it comes from, I guess, years of being in the field. I will use a little story and hopefully it will explain everything. There was a conference that was being held in Melbourne back in 2000 and there was a forum at the conference. It was just after Congress in the United States had announced the $500 million that was going to be invested in nanotechnology research. I asked everyone in the forum—I was moderating—for a show of hands of how many of them considered themselves to be nanotechnology researchers. About half the hands in the audience went up. My next question was: Hands up all of those who were microtechnologists last year? And the same hands went up. The premise of the forum was: Does nanotechnology need microtechnology?

Where I am coming from is that, to me, nano is purely a size and it is part of a continuum which begins at, say, the atomic level, goes through a molecular level, goes all the way through micro,

meso, intermacro products, and it is almost seamless. One of the questions asked earlier was—and I think Peter responded to it—that some of these areas are very fuzzy. What is a nanotechnology company? Are we going to try to determine a nanotechnology company because of the particle size it uses, and I should say taking into consideration that not all nanotechnology is based around particles? For example, you could machine a slot in a piece of material, in other words a channel, which is nanometres in dimension. That is also nanotechnology and there is no particle in it. So we have to be a little bit careful as to how we actually depict these things.

From my perspective, there is an area that we have to pay attention to with respect to the risks and things that are associated with re-regulation, but we have to be very considerate of the fact that in the world there is a lot of research going into this at the present point in time. It forms in many different disciplines and I think that the areas that we are going to see will be not purely nanotechnology as we know it but will be multi-disciplined and it will cross the barriers of microtechnology, biotechnology, et cetera.

The Hon. CHRISTINE ROBERTSON: So a sphere of influence? By creating a separate organisation you are creating a sphere of influence across the sciences; you are not pillaring?

Mr DAVENPORT: That was my original point. In the fraternity or the community of all of us that work in what we now refer to as small technologies, many people used to put up a Power Point slide in the definition of nanotechnology and what it had against it was that it was a grant stream for funding.

The Hon. CHRISTINE ROBERTSON: I understand. You have talked about the nano code that has been done, but not implemented. Are you planning on it being a Federal code?

Dr BINKS: I ran part of that workshop and I am happy to try to respond to that. It is actually a voluntary industry code. Let me address the question as to why you would have a voluntary industry code. We have been working very closely with not only the regulators but the regulatory advisers over the last four years to say what should the rules around nanotechnology be, and it is a very complex issue. It is complex because a lot of the standards are yet to be put in place. A lot of the measurement technologies are yet to be put in place to say that you could actually measure exposure to certain kinds of influences at the nanoscale.

So the regulatory apparatus is going through its process and going through as quickly as it can to try to put laws in place and it will take a considerable time to do that, but when you are running companies like I am and you are producing nano products and you have employees who could potentially be exposed to those you have a real duty of care and you have the responsibility to put a regime in place that protects your employees, your contractors, your customers—everyone—from any possible influences. What we started to do about three years ago in Australia was to say: Well, there are certain things that we are going to do. We are going to put in place some labelling of our own so that we can indicate where there are products that contain nano materials. We are going to have safety protocols, which we gather from everyone who has worked in the field, cull them together and say, look, that seems as good as we can do in advance of the regulations.

We then had a similar discussion with an association in the United Kingdom and found that they were in advance of us and they were facing the same kind of issues and we said, well, let's kind of hook on to your bandwagon and look at the principles that you are adopting and we will introduce those to industry associations. It is not law; it is a voluntary code behaviour. It applies to the boards and the directors of companies, it applies to the management of companies, and it says: This is the way we think about problems. It involves things like the obligation to make everyone who is associated with nano materials aware of the potential risks associated with those; the obligation to inform boards and boards to inform stakeholders of any risks they are exposed to in these processes; the obligation to inform of uncertainties and of measures being taken to address these. I emphasise that none of this is law, but it is actually what the companies who work in this field think is the right thing to do in advance of there being law.

The Hon. CHRISTINE ROBERTSON: So is a voluntary process the appropriate way to go?

Dr BINKS: No, it is the best we have at the moment.

The Hon. CHRISTINE ROBERTSON: Because the law is not there?

Dr BINKS: Yes, and we certainly envisage that as soon as laws are starting to be formed they of course would—

The Hon. CHRISTINE ROBERTSON: Consider your code.

Dr BINKS: Our experience—and we see this with other codes—is that the hard kind of black-letter law is never quite enough. You still need to go a bit further and say: How do we actually behave in these circumstances when something changes? We think we will always need behaviours which support laws.

The Hon. CHRISTINE ROBERTSON: Before the courts step in?

Dr BINKS: Yes.

The Hon. MICHAEL VEITCH: In your submission you gave consideration to the existing regulatory framework. I am interested to see that you are developing a voluntary industry code. That would indicate to me that you have identified a gap between the existing regulatory framework and where the industry is at the moment.

Dr BINKS: Yes.

The Hon. MICHAEL VEITCH: What are the gaps that you have identified?

Dr BINKS: Let me illustrate the two gaps, but let me also kind of endorse what codes there are in place at the moment. There are gaps, for example, when you think about exposure to ultra-fine particles, to nanoparticles, and if we think about dosage, if we thought of dosage of particles, the way that is measured within the chemical industry is in terms of mass, mass per unit volume, so you will say there are X milligrams of a material within a cubic metre of air. When you move a particle size down to the nano domain—and I will take an engineering perspective here—you dramatically increase the surface area compared to the volume and the mass. Surface area is really important because it is surface area of a particle that interacts with the body, so you are increasing its availability for uptake by a biological or environmental system. So it turns out that the smaller and smaller your particle gets, the less its mass is important and the more its surface area is important, but our dosage regulations and most of our measuring equipment are based around mass. You could actually have a very small mass of materials which, if they were divided up into nanoparticles, have quite a considerable surface area and therefore pose a very different threat or very different interaction with the biological system than a larger clump of material. So there are changes that are required to measurements and how things are stated and all those kinds of things.

But where I will come back is to say that most of our chemical regulations are extraordinarily robust. They have been developed by the chemical industry and material industry over a long period of time and the frameworks are very, very good. My belief is that—and this is actually what is happening at the moment—the regulators need to re-examine those and ask the question: What happens if we are now dealing with something that is very small that may have a larger surface area and may behave differently? Do our regulations cover it or do we need to make modifications to those? That is the process that they are going through. But I certainly would not be saying that we throw out the existing regulations or say that they are irrelevant. They provide a great structure to work from but, like almost everything else, they need updating and tuning.

Mr DAVENPORT: If I could add to that, I think it is incredibly important that as products evolve they fit within that regulatory framework as distinct from having yet another party because as soon as you do that you might have products that people think, "That does not quite fit in that one, I will slot it into that one", and things go through the cracks. It is incredibly important that it fits right within the framework, but we do need to expand the framework.

The Hon. MICHAEL VEITCH: Dr Binks, earlier you were talking about voluntary labelling. One of our terms of reference is around consumer education and awareness. Can you talk us through the process of labelling and give us some examples of how you are doing that?

Dr BINKS: At the moment there is no legislative requirement for labelling based on the size of a material. We have come to the realisation that the size of a material does impact upon its properties. That is a kind of fundamental of nanotechnology. So we, in both Nanotechnology Victoria and through the Australian Nano Business Forum [ANBF], have been calling for design of a labelling scheme that allows consumers and manufacturers and partners to be aware of the difference between nanoscale materials and macro scale materials and to identify the former. We do not properly know how to do that.

What we did within Nanotechnology Victoria about three years ago was, almost in desperation, put together a small team and said, "Let's just design some labels that we can put on our own materials and materials of everyone who works with us which says there are nanoparticles in here". We designed some really crude labels that said: These are the size bands that we know of, they are in solution or they are dry. We also designed things that impacted upon the hazards associated with them, so we tried to identify is there a respiratory hazard, is it potentially a flammable material, et cetera. We developed some very crude labels and we have used those quite successfully. We know that they are non-compliant; they are not proper labels. To a certain extent it is not our job to develop proper labels—my job is to protect my staff, my customers and my colleagues—so we are wherever possible trying to nudge the appropriate authorities into saying, "Please let's try to work together in a way that puts a labelling scheme in place that allows people to be aware of what is going on".

One of our strong beliefs is that, coming back to your point about public awareness, where there are concerns about a particular material we think that consumers have the right to know if the material is present and can make a choice around that, so we want materials that are out there to have some indication as to whether or not they do have nanoscale materials if people are concerned about them.

The Hon. CHRISTINE ROBERTSON: The labelling is very complex because it is not just related to size but also the properties of the actual nanoparticles, which behave so differently, so it is going to be incredibly difficult, is it not, to make a generalised label for something that binds with some things and does not with others?

Dr BINKS: It is very hard.

Mr DAVENPORT: I do not believe you can do a generalised one. As I mentioned before, nanotechnology covers voids as well as particles and I think the major focus at the moment is on particles as distinct from the broader spectrum of what nanotechnology also is.

Dr BINKS: It is a very complex challenge though. It is with that realisation we are urging authorities to get on with it.

The Hon. MICHAEL VEITCH: You advocate labelling but you are not quite sure what to label?

Dr BINKS: For example, the grating that Clive described with the nanoscale channel, I do not believe that would need a label. I do not believe that there is any way that is a hazard. The nanoscale particles that we develop as new forms of colourants that can be used within the painting industry and ultimately may be within the medical industry as markers will require labels. So we duly apply those. Unfortunately, it is going to require a real effort for people to sit down and classify nanomaterials. The International Standards Organisation is already well down that path, and Australia is playing a great role within that. So classify materials, classify the hazards, then start to understand where labelling makes the most sense and then develop appropriate labels, but it is a big task.

The Hon. MICHAEL VEITCH: Does the voluntary code address the environmental impact?

Dr BINKS: It does.

The Hon. MICHAEL VEITCH: How do you accommodate that in the code?

Dr BINKS: We need to keep in mind that a code is something you apply to a board of directors and to a management group. It really sets principles, and they are principles about how to make information available, what kind of investments you make, what kind of disclosures you make. We have made it very clear that the voluntary code covers not just the safety and health aspects of material but also their impact upon the environment and the full life cycle impact that they have. So we have double worded everything to say "health" and the "environment" for all seven principles of the code.

The Hon. MICHAEL VEITCH: The full life cycle could be a very long time.

Dr BINKS: It is.

Mr DAVENPORT: It was interesting; it came up in discussion at the seminar on Monday night. The CSIRO here in Sydney are leading the way on a lot of that work and looking at the whole life. The example they gave was sunscreen, these new nanozinc sunscreens, very fine particles. You put it on your skin and the major concern is when it goes on your skin where does it go? Does it go through your skin to your body? That is what the major concern is. When you look at the environmental ways, you then go and look at the ocean, river, stream or swimming pool when it washes off you. Where does it go from there? This goes then into the whole of life. Suddenly it is now in the water environment, it is running down streams, it is getting into the ocean. What will be the impacts ultimately on that? The approach that the CSIRO are adopting—certainly it was my interpretation of what was presented—is that they are looking at literally models by which they can look at particular categories of particles and things like that and be able to say that they believe if something else is now developed within this particular domain or has this particular structure, it will probably follow that particular life cycle.

The Hon. MELINDA PAVEY: Australia may be acting like good corporate citizens, and I applaud your code. What about imported products? We have had evidence and discussion about the dummies with silver in them and other products. How could Australian consumers be assured about what is happening overseas and proper education measures in relation to that issue?

Dr BINKS: I think that is one of the trickiest areas. It was the area where we first made the regulatory authorities sit up and take notice. We did that through a rather crude mechanism about three years ago. We were talking about the potential impacts of carbon nanotubes, which are in a particular form. They are a kind of sooty stuff and there is potential for respiratory hazard associated with those. A group that was working with me imported carbon nanotubes from the United States. There was a website "cheaptubes.com" which does these very cheap carbon nanotubes. They arrived in a plastic bag with a piece of paper that was not a material safety data sheet. They were delivered through the post and arrived at my postal address. That is where they turned up. The group I was working with used this as an example. That was really where the regulatory authorities started to say, okay, this is not just a problem about Australian research institutions or companies, this is something we need to solve for the community and we need to think about how that can be addressed. I am not an expert in that matter, so I do not know how they are going to do it. But my expectation is that we will need to develop things that effectively come back to the usage. So if you are going to put something on Australian supermarket shelves there will be requirements about what information must be displayed to Australian consumers. That is the mechanism that will cover both domestically engineer products and imported products.

The Hon. CHRISTINE ROBERTSON: So a condition of import?

Dr BINKS: I am not an expert in this area. It may not be a condition of import so much as a condition of sale or a condition of use in Australia.

Reverend the Hon. FRED NILE: In relation to your earlier comments that there may be 40 companies in New South Wales involved and because of intellectual property issues there was a degree of confidentiality, we were told by our Department of State and Regional Development that there were probably 23 to 25. Would you agree that there is a need for a national database showing all

the companies, commercial and research, universities and so on? If so, who would be responsible for the database? Would it be the Australian Office of Nanotechnology? Is a directory or database being prepared?

Dr BINKS: It is a terrific question. It really gets to the point that Clive and I were making. Yes, there is a need. There is a need for what Clive refers to as a map which says what we have got and what they do. We do not believe that in any way infringes upon anyone's commercial activities or confidentiality or anything like that because these are registered companies. It is just a matter of saying what do they do and how does it fit into everything else. We would say there are two aspects. First of all, from a management perspective we need to know what is out there. Secondly, there is a real opportunity. Australia does have a very good nanotechnology plot. It is just never articulated in a way that says we have all these companies, we have these great capabilities, we are a good place to do business with, we are good place to invest, this is a place where our children ought to look to get jobs in the future. So there is a real up side to that. You also asked a question whether the Australian Office of Nanotechnology should be the repository. Yes, they are the natural holder of such information.

I would also say, and we made this point within our submission, that to this point in time the States have been the natural leaders of nanotechnology in Australia. New South Wales has made some really good efforts, but Queensland and Victoria have been notable in putting in concentrated efforts. There was a specific question in the questionnaire you put to us about the Australian strategy for nanotechnology and the point that the Australian Nano Business Forum made was we think they are making the right moves, albeit slowly, in terms of public awareness. They are starting to put the regulatory framework in place; they are starting to think about toxicology. But we do not think they are doing enough in terms of industry stimulation and support and building an economy around this where we can have employment, investment and those kinds of activities.

Mr DAVENPORT: I should say that we are in active dialogue with the Office of Nanotechnology, AusIndustry and Global Opportunities over doing exactly that. Everyone does see the significant value of it. It comes back to the question just raised about imports. We are also in dialogue with NICNAS [National Industrial Chemicals Notification and Assessment], the people who are really concerned about what is coming into the country. They are recognising only too well that they only know about the things that come in as materials when they go and look at the import regulations, and so on. As to what is coming in in other products, we are having active dialogue with them on Monday as to some of the other ways we can address that. One of the ways would be to have this map or database as to who the players are as well.

CHAIR: There is no doubt that we will have further questions for you. It would be much appreciated if you could provide answers to those questions by 22 May. In conclusion, are there any comments you wish to make to us?

Mr DAVENPORT: Can I quickly go back and answer a question asked earlier, which we did not quite answer, that is, where do we think New South Wales' or Australia's opportunities are. Maybe I could position that a little bit. We already have some really interesting great examples that are quite unique to Australia. A lot of the rest of the world have been pushing in different materials. For example, Peter mentioned carbon nanotubes, which were discovered in Japan. They are pushing really hard re new materials, microelectronics, nanoelectronics, and so on. Where we have really interesting opportunities for the world is where we have natural strengths. We often talk about biotech, medical devices and so on, and we can start to combine some of those technologies with some of these new disciplines. For example, in this country we have a huge depth of capability in polymers. We produce the world's plastic banknotes and things like that. They are very unique attributes. We are starting to see some of those materials merging with some of these application fields, such, as, what we call biodiagnostic chips and things like that, where we have natural strengths. Those I believe will be the types of areas where Australia has niche applications that we are going to do incredibly well.

Dr BINKS: I would like to make one comment too. We have not touched on education. Something we have become aware of over the last five years is that nanotechnology is quite cool and kids really find it interesting and exciting. The Hollywood filmmakers and cartoonists know this. Our kids see nanotechnology through the things that they watch and they read. That is an extraordinary opportunity for Australia. We are already seeing in schools in Victoria, which I know a bit better,

where they are doubling science enrolments by starting to twist their chemistry around and say, "We will be covering nanotechnology. We will be talking about what you can do with smart new materials." Australia has very good education and science education and our nanotechnology education at a secondary level is probably leading the world. We have proponents from all around Australia doing extraordinary things. It is something that we ought to factor into our equations that there is this enthusiasm in our children for science that is being awakened by the potential of some of these new technologies and fantastic new materials and what they can do to address water problems, health problems and energy issues.

The Hon. MELINDA PAVEY: Are they Victorian Department of Education programs?

Dr BINKS: The Department of Education has actually been a little lethargic in this area. The exciting thing for me is it is led by individual teachers. You get clumps of teachers who will get together in schools and approach people like Clive. Clive is speaking in August at a major forum. I work directly with the schools. The science teachers come and say, "Can you give us something about nanotechnology because our kids want to hear about it?" and we give them everything. This is where the IP [intellectual property] angle comes in.

The Hon. MELINDA PAVEY: They are coming to your office seeking input and guest speakers?

Dr BINKS: Yes. Country classes are as good as urban classes. They are the ones who come and say, "How can we get to see your stuff?" It is very exciting.

The Hon. MELINDA PAVEY: That is a significant issue, because everyone has Ipods and nanopods.

CHAIR: Thank you, Dr Binks and Mr Davenport, for your time this morning. Your contributions will be of great help to us and I thank you particularly for your support and for sharing your knowledge with. I wish you a safe trip home.

(The witnesses withdrew)

(Short adjournment)

DAVID ANDREW HENRY, Occupational Health and Safety Officer, Australian Manufacturing Workers Union, PO Box 67, Granville, affirmed and examined:

CHAIR: If you should consider at any stage that certain evidence you wish to give or documents that you may wish to tender should be heard or seen only by the Committee, please indicate that fact and the Committee will consider your request. If you take any questions on notice today we would appreciate it if your responses to today's questions could be forwarded to the Committee secretariat by Thursday 22 May.

Mr HENRY: Sure.

CHAIR: Would you like to start with an opening statement?

Mr HENRY: Yes, thank you. Firstly, thank you for the opportunity to be here this morning and to talk about our views on nanotechnology. After sitting through the evidence given by the last witnesses I indicate that I do not come here as a research expert or as a professor; I come here purely as a representative of workers interested in their health and safety and, in particular, the health and safety effects of nanotechnology in our workplaces. It is important for you to understand that the Australian Manufacturing Workers Union [AMWU] does not have a fundamental opposition to the development and use of nanotechnology. We recognise that globally, and within Australia, there is a future for the manufacturing and use of nanoproducts.

It is not surprising that Australian businesses have moved towards this technology, particularly given the figures that have been touted that it has a global worth of $2.5 trillion, which is an astounding amount. The concerns we have is that whilst bodies have sat back and looked at the potential profits to be made from this technology, it is hard to find any estimates with regard to the financial or non-financial costs of this technology, which is why we erred on the side of caution in our submission. Things must be looked at in perspective with regard to the cost to Australian industry, the cost to our health system, the cost of productivity, the cost of workers compensation and, ultimately, the potential cost of life.

This sort of research has to be done now at the inception of this industry. We cannot wait until we see evidence of problems and then decide to do some research to establish whether there is a problem. Finally, the AMWU submitted recommendations, as found in paragraph 9 on page 3 of our submission. We put those forward to you as something for you to consider.

CHAIR: Thank you. Your submission notes that the AMWU has membership in the manufacturing of nanoproducts and in the nanotechnology research arena. Has the AMWU received any approaches from members concerned about nanomaterials in their workplace?

Mr HENRY: The answer is no. When I was doing research, which was the basis of our submission, I started speaking to some of our members who are engaged in nanotechnology industries. As part of our membership we have laboratory technicians who are involved in the research field and we also have numerous production-type workers. Nanotechnology, of course, has been used in the production processes of sunscreens, chocolates, and things like that. One of the areas of concern when looking at this submission is that no-one is raising concerns because people are oblivious to the risks. Without having been told about the potential risks they are working in the belief that they are not handling a potentially risky product.

I suppose that goes to what has been said previously that there is a major issue around labelling—an issue that everyone is recognising—but there is no labelling. If there is no labelling how would people know that the products they are handling and dealing with have a potential risk associated with them? As a result of speaking to certain bodies we established that there is some grumbling at the coalface and that there is concern about what they are being exposed to. To be honest, prior to our union looking into it there was nothing there.

CHAIR: In some of the submissions that we have received people have questioned whether there should be a moratorium. What is the position of your union? Do you have a position?

Mr HENRY: We have a position that we put forward in our submission. We are supportive of a moratorium. As I said in my opening statement, we are not about retarding industry or killing off industry in Australia, particularly from the union's point of view. The livelihood of our membership is dependent, to some extent, on this industry succeeding in Australia, but not at any cost. When we find out that there are not what we would consider appropriate controls in place to ensure the health and safety of our members, we will draw a line. All we are seeking is for industry to take a step back until such time as appropriate controls are put in place or the risks are eliminated.

It is important to look at the legislation that currently governs this State. Not so long ago I was in this room talking to a group about nanotechnology. I drew the conclusion that if you were to strictly apply the New South Wales Occupational Health and Safety Act it would create a moratorium. Industry does not have the capacity to identify hazards, to assess risks, or to put in place adequate controls. Based on our own legislation you create a moratorium. Until such time as they are able to assess those risks and put in place adequate controls, the work should not be taking place—the commercialisation and the use of these products should not be taking place.

CHAIR: If a moratorium were in place would that not ensure that New South Wales takes a step forward?

Mr HENRY: I do not disagree with what has been said. As I said, it is not our desire to retard New South Wales industry as we have a vested interest in it through our members. The issue for us is: What is the cost? At what point do we take a step back and say that we are prepared to expose people to new technologies that we do not know and whose effects we do not fully understand? Some preliminary research has been done that indicates an adverse effect on humans. That research needs to be viewed with some caution. If we simply ignore the research that is being done and we put up red flags we are likely to step back into the same scenario that New South Wales lived through with asbestos.

Because of our membership this is one union that lived, disproportionately to the rest of society, through the horrors of asbestos. As a union we are not happy to step back into that position. We are not happy to sit here and hear people say, "We are protecting the workers" but there is no scientific or research basis behind their words of comfort. All we are seeking is to do this properly. Let us get the research in place. Let us ensure that when workers are handling and using nanotechnologies it is being done safely.

The Hon. MELINDA PAVEY: We are not sure how many companies in New South Wales are working in nanotechnology. The department told us that it is 23 or 25, but we just heard evidence from Victoria that as many as 40 could be working in nanotechnology-related companies. How many of your members are working in those companies? Do you know?

Mr HENRY: I could not hazard a guess. Part of the problem is the commercial in-confidence issues. Companies are not opening up to us and saying, "We are handling nanotechnologies." When I was doing research for the paper there were some obvious places where we expected to find it. At this stage, given the infancy of the industry, it has not developed any sort of register to identify it. We certainly believe it is a worthy task to identify those companies. We have gone one step further.

Once we have identified them we need to have some sense of regulation about the companies—not so much interfering in the products that they are making or the way in which they are making them as long as it is done safely. Look at the hazardous substance industry and the way it is being looked after specifically by WorkCover with its own unit and its own funding. We believe that model could be adopted in the nanotechnology industry, particularly in the short-term to medium-term whilst research is being done.

The Hon. MELINDA PAVEY: Can you explain to me what a moratorium means?

Mr HENRY: Our understanding of a moratorium is a cessation of the commercialisation of products.

The Hon. MELINDA PAVEY: So that companies that are operating could still operate and you will not stop them from operating?

Mr HENRY: We believe that the companies should be focusing on research with respect to health, safety and environmental issues relating to their products. Once companies are in a position to give it a tick and say, "We understand the implications of our products, how they are to be treated and how they should be handled safely", it is fair enough that we do not have any objection to the commercialisation of those products.

The problem is that we are not there yet. As I was saying earlier, no-one has done the figures. Everyone hears references to $2.5 trillion or $3 trillion but no-one has asked, "What is the cost?" We do not want to end up with the scenario—it would be damaging to New South Wales—where New South Wales gets a net value out of the commercialisation of a product and it then has to pay a heavy cost as a result of the ill effects of that product, as we have seen with things like asbestos.

Reverend the Hon. FRED NILE: We are all concerned about the negative aspects of nanotechnology. In your submission you said:

> The AMWU is concerned about the research showing potential for serious health impacts.

Paragraph 6 of your submission then refers to studies and states:

> Current research has identified the potential for a number of disturbing health impacts to lungs, brain damage, et cetera.

Can you send us those reports? Do you have access to them?

Mr HENRY: I can certainly identify the research and come back to you.

Reverend the Hon. FRED NILE: That would be very valuable.

The Hon. MICHAEL VEITCH: I have two questions. One relates to worker education about nanotechnology. We have learnt that the nanotechnology spectrum is very big, from quantum computing right through. Does the union have a view about TAFE's involvement in worker education or worker programs for nanotechnology?

Mr HENRY: The union is very supportive of any education programs. It all comes back to how you educate anyone until the research has been done. Once it has been done and there is some understanding, we can start running out comprehensive education through TAFE and any other forums. Mention was made of schools. However, we can start running out education about safe handling and processing of nanotechnology. The union does not believe that the research has been done to such a level that it is meaningful. At the moment, it should be trapped to generalisations or assumptions as opposed to any solidly based research.

The Hon. MICHAEL VEITCH: I refer to employers within the nanotechnology field and their workers. You are saying that strictly applying the New South Wales Occupational Health and Safety Act would suggest that this activity cannot be undertaken.

Mr HENRY: Absolutely.

The Hon. MICHAEL VEITCH: Where does that place the insurance of those workers in the longer term?

Mr HENRY: With regard to the workers compensation, given that it is a no-fault scheme, there is no issue. The broader problem is that there could be a significant issue with regard to common law claims, particularly if as has been suggested in some research that this nanotechnology could get into certain parts of the body and lead to tumours and so on and all of a sudden mortality becomes an issue. As I said, that is part of the work that has not been done. Everyone has a perception of the benefits of nanotechnology, but no-one has bothered to assess the real cost or the potential cost. Of course, that potential cost is then mitigated once we start doing the proper research and putting in place the adequate controls. We have jumped the gun a bit.

The Hon. CHRISTINE ROBERTSON: Do you think it might be valuable for the union to be actively participating in the forums working towards setting up regulations, codes and processes? Do you think that would be valuable?

Mr HENRY: I restrict this to occupational health and safety legislation. Absolutely. We have always played a positive and collaborative role in assisting government with regard to legislation and we would not consider this issue as any different from any other health and safety issue.

The Hon. CHRISTINE ROBERTSON: Your union probably has the most workers involved in this industry. Would it be worth approaching some of the business and scientific groups that have spoken to us very sensibly about these concerns and what they are trying to do to introduce codes? Do you believe it would be good for the union to be at the forums delivering on that? It is not that up to the Committee to tell you, but I am asking what you think.

Mr HENRY: What we have proposed in our submission is the formation of a tripartite body. What you are suggesting is what we have suggested. However, we believe it needs to be tripartite—the legislator should be sitting at the table and hearing the discussion between the employers and employees and moving forward in a tripartite way.

The Hon. CHRISTINE ROBERTSON: This is not an occupational health and safety issue, but it is about work. The Committee has been told that this science has the potential to change work practices and the kind of employment people will be available for. Would it be appropriate for your union to be working with other people to sort through this process for the future?

Mr HENRY: Without understanding what has been presented to the Committee on that front—

The Hon. CHRISTINE ROBERTSON: It is only a little idea.

Mr HENRY: We are open to sitting down with industry and talking about any aspects or issues that arise out of nanotechnology. We are not opposed to doing that.

Reverend the Hon. FRED NILE: Has there been a discussion at the state level with Unions NSW?

The Hon. CHRISTINE ROBERTSON: After he started it.

Mr HENRY: Yes. This is the Australian Metal Workers Union's [AMWU] first sole submission. The AMWU first introduced this in 2006 when the Australian Council of Trade Unions [ACTU] did a submission to the Federal Government. I had some involvement with the ACTU submission, but I must say that the ACTU did a lot of that work. This submission has been a great learning experience for me. Members can probably appreciate that within the structure of the unions, I do not put submissions to the Parliament without the state secretary being aware. The State secretary is certainly aware of this. The benefit for our union is that we have found that we do not have a policy position. Our state conference is coming up at the end of this month and a resolution will be presented and then forwarded to our national conference to be adopted nationally. It is certainly something that state leaders are aware of, and very shortly the entire union will be very much aware of it.

The Hon. MELINDA PAVEY: Have you had any discussions with any union counterparts across the world? Australia is small player in an emerging technology that is huge in the United States and Europe. Have you had any discussions with counterparts to establish their position or what codes may be operating?

Mr HENRY: As far as talking to people is concerned, I have had only one opportunity to speak to a colleague from New Zealand about where New Zealand is placing itself with regard to this. As expected, New Zealand is at the same level of infancy. They also approach it with the same degree of naivety that we do; that it, we do not know a lot about it but we are learning quickly. I have looked at some papers from Canada about the issue. Certainly, the positions that have been put forward by the unions and our counterparts in Canada reflect those that we have put forward: Let's not jump the gun;

let's ensure the research is done and done properly and that workers, consumers and the environment are protected.

The Hon. MELINDA PAVEY: Have you had an opportunity to look at the responsible nanocode developed with industry? We have just heard evidence about it from Nanotechnology Victoria and the Australian Nano Business Forum.

Mr HENRY: I will check that what I have is what you are referring to. One of the documents which I have been given and which has a number of signatories is the "Principles of Oversight of Nanotechnology and Nanomaterials". A number of bodies have signed up to that. With regard to the document you are referring to, I do not believe I have.

The Hon. MICHAEL VEITCH: Now that you have been alerted to and are becoming enlightened about nanotechnologies and the broad spectrum, has your union had a chance to speak to WorkCover New South Wales about your growing concerns?

Mr HENRY: I have had an opportunity to speak to a couple of inspectors who have a particular interest in nanotechnology. I understand that WorkCover is at a similar stage as the union in how it plans to tackle the issue. We are certainly looking forward to continuing dialogue with WorkCover. If a tripartite body were established, there would be an expectation that WorkCover would hold one of those seats.

The Hon. CHRISTINE ROBERTSON: Does your union have a representative on the TAFE consultation group?

Mr HENRY: I am locked away in the occupational health and safety world.

CHAIR: Thank you very much for appearing today. Do you wish to make any further comment before we conclude?

Mr HENRY: This is an area that creates some angst. One of the issues is whether there should be a moratorium. The AMWU has made a number of recommendations and I ask that the Committee consider each of them on their merits. We can do a number of things moving forward. It is positive for our industry to be a leader in nanotechnology. If we are going to be a leader we need adequate regulation, and we need to move quickly on that. I am not saying quickly in the sense that we should simply put something together and hope it does the job. However, we must move quickly with regard to developing it and establishing tripartite bodies and getting the labelling done. I find it hard to understand how industry is operating without labelling and proper education for workers and how it is doing a lot of the things it is doing. I am concerned about why the occupational health and safety legislation in this State, which has been so effective in many other areas, is not being applied with the same rigour in this area. I ask that the Committee consider these issues.

CHAIR: We will forward the questions that we would like answered. Thank you for appearing and for your evidence. It has been informative for the Committee.

(The witness withdrew)

LESLIE DAVID FIELD, Deputy Vice-Chancellor (Research), University of New South Wales, and

ROBERT GRAHAM CLARK, Professor, University of New South Wales, and Director, Centre for Quantum Computer Technology, affirmed and examined, and

MICHELLE YVONNE SIMMONS, Professor, University of New South Wales, sworn and examined:

CHAIR: If at any stage you consider that certain evidence you wish to give or documents you may wish to tender should be heard or seen only by the Committee, please indicate that fact and the Committee will consider your request. If you take any questions on notice today, the Committee would appreciate it if the responses to those questions could be forwarded to the Committee Secretariat by Thursday 22 May. Would any of you care to make an opening statement?

Professor FIELD: You have a submission from us that was reasonably comprehensive in which we basically made three important points. Firstly, that nanotechnology is a very broad term. It is often quite difficult to define what nanotechnology means. The critical issue for us is that it encompasses such a broad range of activities, disciplines and sectors of the community that it is difficult to get overarching principles that cover everything all at one time. So, the thing we were trying to get across is that when you are looking at nanotechnology you need to look at things on a case-by-case basis. It will be difficult to find overarching principles that generically cover all of nanotechnology.

The second issue we raised was that from a New South Wales State Government perspective we saw nanotechnology, or this review in particular, as part of a larger issue, which was basically strategic planning and vision into the future for issues that concern the State and Australia as a whole. I thought this was an opportunity for us to state that the State of New South Wales could look at the way it actually forecasts its strategic priorities, particularly in the areas of research, science and technology, many of which are not well understood by the general community. One of the areas we raised was the issue of the chief scientist or somebody of similar ilk who could be regarded as somebody who could communicate to the wider community on issues of science and technology in particular.

CHAIR: Your submission notes that nanotechnology is an incredibly broad subject area; it covers an incredible number of fields of application. You, like others, have recommended that discussions or recommendations must focus on the different risks and benefits of specific applications. Could you expand on that comment and can you draw a distinction between the various research projects being undertaken at the UNSW from other nanotechnology applications that have given rise to public concern?

Professor FIELD: As I mentioned before, nanotechnology is an extremely broad phrase. It really deals with anything in this very small dimensional regime, sort of one millionth of a millimetre. So, it is the stuff that we cannot see—particles suspended in solution. It deals with dusts and powders. We are talking of the things of the dimensions of viruses and smaller, and things that find themselves in medicine, in industrial technology, microelectronics et cetera. So, it is a very wide area. I think the issue we took before was that a case-by-case basis is necessary. If we are looking at issues to do with medical devices, then it will be a different set of issues that are of concern than if you were looking at industries like the microelectronics industry. So that is why we were talking about a case-by-case issue.

The issues will be entirely different. In some cases it might be environmental pollution, in some cases it might be potential damage to health. In the long term in some cases it may well be acute exposure to something that has an immediate effect. So, the issues are completely different and I think that is why it is difficult to deal with nanotechnology in its entirety or breadth. I think most of the public concern comes from the fact that nanoparticles, nano anything, are things that you cannot actually see because they are of so very small dimensions. They are things that most of the public would not understand in terms of what are the issues concerned with small particles or small devices. I think the public concern comes from the fact that there may be a lack of understanding of the OH&S issues around nanotechnology, nanoparticles; the fact that people have a fear that they could be used

for the wrong things. Maybe they are potential weapons, maybe they could be used in terrorism, maybe they could be used for different things. I guess people also regard them as possible pollutants, which would go into the future. So, there are these things that I think are of concern to the public.

The nanotechnology that we are doing or developing at UNSW is on multiple fronts and it is really no different to the nanotechnology that is being done anywhere else. So, I cannot segregate our nanotechnology as being different to anybody else's nanotechnology. But what I can say is that what we do at UNSW by way of research, we do as skilled professionals. We take the same sorts of precautions and deliberations that we would with anything else we are dealing with, whether it be a new development in nuclear science, whether it be a new drug that we are developing, whether it be some sort of chemical reaction that we are developing. All of this we do as skilled professionals, so we treat them as we would any other research program. I can leave it to my colleagues to develop this further, but I think that answers your question.

The Hon. MELINDA PAVEY: Professor Field, the University of New South Wales submission states that research, science industry and technology do not fit well within the current structure of the New South Wales Government. To that end you make three related recommendations: a dedicated ministry, a chief scientist and a long-term strategic plan for research infrastructure. In making these recommendations you make reference to the approach taken by other State governments. Could you expand on your proposals and, in doing so, possibly give some examples demonstrating how New South Wales has been comparatively disadvantaged?

Professor FIELD: Yes, I can. We do not at the moment have a dedicated ministry dealing with innovation industry and research. We have a very good Minister at the moment dealing with science and medical research and I have no complaints and I have no wish to say anything against our Minister. She has been an exceptionally proactive person in the way she has interacted with science and medical research. However, I can point to the fact that she has a very broad portfolio and, compared to, shall I say, Victoria and Queensland, where I find that there is a lot more proactive activity in engaging the research and development and innovation sector, I suspect our Minister has other things on her mind a lot of the time. So, compared to the University of Queensland, for example, where there is a direct engagement with that major university aggressively and hardly a week goes by when the Minister and the university were not in constant contact about innovation, industry interaction, things that would push the state forward, I think we are a notch behind both Queensland and Victoria in aggressively chasing research and development activities with the State Government.

In terms of long-term strategic objectives, we do not as a State have clearly articulated plans for tackling the big research issues, particularly in science and technology, into the future compared to other States. This means we do not tend to position ourselves terribly well to deal with the issues. We can talk about things like energy, like water resources, like environmental issues, manufacturing sustainability, climate change—all of these things are the sorts of issues where it would be good to have a State perspective, a State strategy, as to how we might tackle these things, and I do not see that State vision coming at the present time. This is one recommendation we made, that a chief scientist should coordinate or somebody, a person of that ilk, should coordinate, a body of that type.

Research, by its very nature, is a long-term process. It is something that does not get done overnight. It is something that transcends the terms of governments. Five, 10, 20 years is the horizon you need to be looking at in a rolling sense of consistently reviewing your processes and priorities, but we think that strategic thinking and long-term development are really important for New South Wales to develop economically and scientifically.

Places where we think we may have been disadvantaged in the past—that was your question, I think—I can give you some examples. When I look back over the notes I had, the NCRISS program—this is a major program of the Federal Government for supporting major research infrastructure—our State Government did come to the party in the end but it took a long time for it to engage in this process. Some of the other State governments were very aggressive in trying to attract major infrastructure to their States, realising that that major infrastructure would set the scene for the next 10 or 20 years for industries that might depend on that infrastructure and the jobs that might flow from the fact you have research and development happening in those States. In particular, even the smaller States like South Australia were very aggressive in supporting some of the NCRISS initiatives to ensure that they got the infrastructure that came with NCRISS into their States.

The Hon. CHRISTINE ROBERTSON: With money?

Professor FIELD: With money. Well, with money and planning. It is money, and commitment is the other thing. Money is one way of saying it but commitment into the future is important. Victoria and Queensland have both invested very heavily in biotechnology and biomedical sciences. It has been part of their strategy to position themselves as leaders in that area.

The Hon. MELINDA PAVEY: And take market share from New South Wales?

Professor FIELD: They take market share from New South Wales.

The Hon. MELINDA PAVEY: We are strong in that field ourselves, are we not?

Professor FIELD: We are strong, but if you look at the national health and medical research funding, for example, it goes disproportionately to Victoria and to Queensland at the expense of New South Wales. It is part of the strategic plan of those two States to invest heavily and build that up. That is not saying we have to be in biomedical research, but I think we should be in some sort of research. We should have a strategic plan that says what we will be in and we should aggressively take a lead in that.

We have found that in the bids for major facilities—and these are things like the centres of excellence, research centres, major infrastructure, et cetera—we have always been on the back foot from New South Wales in being able to mount convincing cases for locating such centres in New South Wales. We have done reasonably well but we have always been at a disadvantage when it comes to drawing up the strategic plans and the business plans that need to go with those sorts of activities.

We are always in a competitive situation and if you have a business plan that does not have a firm commitment from the State, it makes it a lot more difficult to argue the case, and you do need a firm commitment from the State for a major initiative in the sense that we rely on the fact that the major infrastructure supporting such a case will be in place. You really need a firm statement from the Government that yes, if we located it here in New South Wales the infrastructure will be available, and the commitment that it fits with the State's strategic plan. In other words, it is not something that the State does not want to do. Funding agencies are not going to put money into something if the State then says we are not going to have that in New South Wales.

The critical thing for us is to have that commitment at an early stage upfront. Usually what we have from the New South Wales State Government is a commitment in a soft sense that we might support it and then as the bid progresses it firms up a little bit and it is usually five minutes before the decision is made that the State Government will come on board. That has been quite a difficult thing for us to deal with.

Other States have also introduced schemes such as Smart State initiatives. At least in Western Australia they have scholarships which tend to attract some of the best fellows. It is similar to the Federation fellowship scheme but at a State level. It is focused more at a State level, and Queensland has a similar program. Both of those are attracting talent, I would say, away from New South Wales.

The Hon. MELINDA PAVEY: So, we have people leaving New South Wales to do their PhDs?

Professor FIELD: We have people leaving New South Wales to go to other States, and other States are attracting people who might have come to New South Wales to undertake research programs, to set up research programs as research leaders in particular, rather than coming to New South Wales. So, I think we have been put at a disadvantage.

Reverend the Hon. FRED NILE: Earlier you said that nanotechnology is an incredibly broad subject area. Do you see a problem in trying to regulate it and would regulations, if they are not carefully drafted, restrict research and commercialisation?

Professor FIELD: I do not see a problem in regulating nanotechnology as it stands because we have a reasonably good regulatory framework in place already through such things as NICNAS, the national industrial chemicals notification and assessment scheme, which regulates basically chemicals. We also have good occupational health and safety regulations which cover most aspects of nanotechnology.

Reverend the Hon. FRED NILE: Have you had any problems in applying the occupational health and safety requirements to what you are doing at the University of New South Wales?

Professor FIELD: No, not so far. Not at all. And we also have the Therapeutic Goods Administration [TGA], which handles the medical side of things. My understanding and the framework under which we work at the University of New South Wales is that these frameworks are robust and they work reasonably well. I can see that in the future they need to be bolstered in some ways, to pick up specific issues which turn up as issues might arise, but at the moment I think the framework is solid and robust. It may need to be reviewed when specific instances turn up. I can think of things like dusts and powders which pose an industrial risk in some industries. It may well be that certain types of dusts and powders become a subset of the regulations which are enforceable by those various agencies but, as I said, I see this more as the framework being in place. It may need to be bolstered to accommodate new developments as they arise, but it is no different from nanotechnology as it would be for the biomedical industry as new pharmaceuticals come on line, et cetera, et cetera, et cetera. I think the framework is robust.

Reverend the Hon. FRED NILE: As you do your research, would you also, in a parallel sense, be looking at those potential health, safety and environmental factors relating to the research?

Professor FIELD: We are always doing that, and definitely if things are moving out from being research. In other words, if they are becoming commercial entities, they are things that we might want to commercialise to become new products. Part of the process of their being taken up by industry involves a complete occupational health and safety and environmental impact assessment.

The Hon. CHRISTINE ROBERTSON: There is a rule about that, is there? There is a rule that that happens for every product that is moving towards commercialisation, or is it just an accepted norm?

Professor FIELD: It is not so much an accepted norm, but if anything moves towards a commercial product, it must pass all the regulatory hoops. For example, if it is a drug or if it is something that is used for health, then the Therapeutic Goods Administration procedures have to be abided by. It has to fulfil all of those activities.

The Hon. CHRISTINE ROBERTSON: I understand therapeutic products, but many of these products are to be utilised in the home and may not be under such rigid classification structures—these experiments and nanos.

Professor FIELD: I cannot comment on the detail but, like I said, at the moment, I think the regulatory framework is robust. I think it may need to be bolstered in some cases, but I cannot highlight one at the moment.

CHAIR: Would either Professor Clark or Professor Simmons like to comment—

The Hon. MELINDA PAVEY: —in relation to your project and the occupational health and safety issues with the computer atomic technology?

Professor CLARK: I wonder if I can make a broad comment and then a specific comment in that context. I have been involved in several Federal Government reviews. There is the [PMSEIC] nanotechnology process which recommended to government federally and in which I was involved as the working group. Subsequently I was on the National Academies Forum that was recommending back. One of the recommendations of the Prime Minister's Science Engineering and Innovation Council report was to set up a national nanotechnology strategy task force. The task force then commissioned the National Academies to look at the safety or the occupational health and safety risk aspects. I was involved in the committee as well. Recommendations were made. My understanding is

that that National Nanotechnology Strategy Taskforce is in place and operational. It was for three years and now, under the new Government, it will be for two years.

One of the specific ambits of that task force has been to look at the current regulatory framework. I think we have covered three of those, the National Industrial Chemicals Notification and Assessment Scheme [NICNAS], the National Occupational Health and Safety Commission and the Therapeutic Goods Administration, specifically to look at the scope that they cover and to make very firm recommendations about what needs to be possibly developed to cope with different specific aspects of nanotechnology because you cannot cover it generally. I think it is important to realise that federally there have been things set in place that are meant to cover off on a lot of the issues that you are asking about. What extra can these regulatory authorities be doing with regard to the specific aspects of that technology? That currently sits as a task for the task force. I am not sure when that will be reported or how it will deal with that.

Coming back to our own research, a specific example to illustrate that not all nanotechnology is something that needs to be of concern is that we are dealing in semiconductor nanotechnology and we come under the occupational health and safety laws of the semiconductor industry. Semiconductor goods are basically some of the world's safest goods that people work with.

The Hon. CHRISTINE ROBERTSON: I do not even know what it means.

Professor CLARK: Semiconductor nanotechnology is something that is the basis of computers and electronics.

The Hon. CHRISTINE ROBERTSON: That was because I did not go to the computer shop.

Professor CLARK: It is photonics and so on. My apologies. In what we do, we are working on silicon chips, just like Intel would, for example. We are working at a much smaller scale, but the regulatory safety framework that we operate in is robust for us and we are covered under the existing framework. What we are doing is that we work under the standard regulations and that covers us very well. Our products are not unsafe. For that particular aspect of nanotechnology, I do not think there is any concern, internationally or even nationally. That is just an example. We are not the only areas like that. There are very broad areas of nanotechnology that are absolutely, I think, not really an issue and are covered by the regulatory framework. Equally I would say that there are probably definitely areas of nanotechnology that the task force has to look at, with regard to the regulatory framework in place, to see if it needs to be shored up.

CHAIR: Professor Simmons, do you want to make a comment?

Professor SIMMONS: Just briefly, as Bob mentioned, we work in the semiconductor industry. I guess there are two problems there. One is the actual product that we make, which is very safe and has been in production for decades, but also the way that we make them. There we are using chemicals that are at the nano scale. The Semiconductor Association in the United States basically has to look at the safety of the workers, and has been for decades, to ensure that there are no problems for the workers or the things that they use which then go into the environment. Those regulations have been around for a long time. Australia adheres to those regulations. Those regulations are continually updated so they have a task force that is, I guess, a permanent body that looks over those things.

A lot of the fundamental cutting-edge research in that area in Australia, which is quite large across not just New South Wales but other States, is covered for that. That is something that is quite safe. I guess the other thing that I have been heartened by, as a relatively young researcher coming through, is that there are lots of nanotechnology conferences both internationally and in Australia done by the Australian Research Council networks. Within those conferences they actually have sessions on occupational health and safety specifically for nanotechnology and the things that people are using at university in cutting-edge research. They will bring people over from the United States who are experts on panels over there to talk about what they see in Australia, and likewise from Europe. As I say, as a relatively young researcher, I have been heartened by the fact that they take it very seriously here, both at the research level and I guess at the level of the universities in terms of occupational health and safety.

Reverend the Hon. FRED NILE: In summary, it would be dangerous for anyone to try to have a regulatory code for nanotechnology thinking that you could have a code that would cover everything. You would have to almost have individual codes or decide which areas already have adequate regulations. You mentioned about the powders and so on, but there may be simply a code for that particular item.

Professor FIELD: I think that would be my feeling on the subject.

Professor CLARK: Yes.

Professor SIMMONS: I think a lot of those bodies exist. That is what we are trying to say. They are already there. If you have these strategic task forces in nanotechnology, they will be able to inform the existing bodies.

The Hon. MELINDA PAVEY: You mentioned the nanotechnology chemicals. How long have those chemicals been around, for instance?

Professor SIMMONS: The chemicals are used continuously, for decades. They are chemicals, just the standard chemicals you would use anyway, not just for the industry but in university research.

The Hon. MELINDA PAVEY: So just because it has the prefix "nano" in front of it does not mean we need a whole new subset of laws.

Professor SIMMONS: No. That is what I am saying. It is already covered. All those chemicals have been used for years and there is a whole load of frameworks about how to use them, how it is safe to use them, or the risks.

Professor CLARK: I might just say that in our laboratory I think we have something close to approaching 100 different chemicals that we might be using in the processing of a silicon chip. In fact I would just say this: the processing that we did on the silicon chip is no different from the processing that is done on solar cells, which are also on silicon chips and are regarded as a very green product. Actually the process is identical to what we are doing. We use the same chemicals. For each chemical is a thing called a materials safety data sheet [MSDS], and we have to fill out that sheet. It has to be in line with WorkCover regulations before we do it. We have to let the Fire Brigade know that that is in there, et cetera. We need to keep strict inventories of that. We have to come under all of the safety regulations that Australia has, basically. The way that we conduct our nanotechnologies use—within strict guidelines.

The Hon. MICHAEL VEITCH: Professors, I will go back to the earlier comments about the need for New South Wales to have a strategic statement or a strategic document. The submission of the University of Wollongong identifies what they see as the need for New South Wales to target niche nanotechnology areas as opposed to a broad suite of all nanotechnologies. Do you have a view of those comments, if I could ask each of you to pass judgement?

Professor FIELD: Let me start. I think with an area as broad as nanotechnology, it is always the best strategy to identify areas that you are strong in, or areas which are strategically important that you want to develop capacity in, and put your focus into those areas. The perspective of saying that strategically you want to support nanotechnology is too defuse and too wide, and you do need to focus. As to the question as to how you focus and whether you focus on niche areas, I am a very strong believer that you do not select niche areas and then focus resources on them. What you do is look for your areas of strength which may well be in a niche area, or in a particular area rather than the niche area, and you support that and do it well. In other words, you support areas of strength and research excellence.

If you want to depict niche areas, you may well focus on something which is very narrow. You might want to invent a better mousetrap or something of this type and put all of your focus into something that does not have a very big impact. It may not have the sort of strength or importance that

we want, but you definitely need to focus the support on areas where you have strength or where they are strategically important for the future of the nation.

Professor SIMMONS: I guess I feel quite strongly about this. I think research in the long term is undertaken by individuals, and individuals build their research to strengthen their excellence. To select an area randomly and say let us build an area when you do not have the right people there can be a disaster. I really believe that you should fundamentally support the areas where you have research excellence with either individuals or a group of individuals in a certain area.

The Hon. MICHAEL VEITCH: Like quantum computing?

Professor SIMMONS: I did not say that.

Professor CLARK: I would add also that research in most areas is a rapidly dynamically changing field. People follow their creativity and ask questions that take them into new areas. What is the niche area today may suddenly not be a niche area tomorrow. People may move on to something that is more relevant or productive or whatever. I think it is dangerous to anchor yourself to that. I think you need to be guided by the researchers. I think that supports what Michelle is saying. Research is a funny thing. You cannot quite put your finger on it. It is not prescriptive, thank God, and it leads you in directions in which inquiring minds take you—young inquiring minds, generally. Unexpected surprises can happen along the way. I think we should be guided by the researchers themselves, where they are going, what we are strong at.

One of the roles that State Government can be extremely effective is if things are going well and we do have strong areas—and in Australia generally areas flourish where people leverage off a jigsaw of funding streams. You do not get all of your funding from one stream in one lump. The leveraging effect of State Government support is not to be underestimated in supporting strong areas. Also, the thing that State governments are well attuned to do is to look a little bit beyond the research and say, "How might this connect with industry, how are we positioned within industry, how do we get the benefits into the community, the creation of jobs, the creation of wealth, and so on through the economy?" Researchers do not tend to handle that aspect. That is not their role and State government authorities can be very effective in forming a bridge between industry and the research sector.

The Hon. MICHAEL VEITCH: I have a question with respect to what has interested me in travelling around the universities looking at different areas of what is deemed nanotechnology. Can you explain the regulations that you have to abide by when you dispose of waste or by-product from your processes—I am looking at the environmental impact of the processes?

Professor CLARK: Because we work in silicon, which is an extremely stable product, there are very few issues of disposable of what we work on, but in other areas there will be real issues and there are regulations surrounding disposable, just as there are regulations surrounding how we conduct the research and the precautions you take while you are doing it. I think the general message is that we are operating on a regulatory framework, which may need to be finetuned for nanotechnology but not reinvented.

The Hon. CHRISTINE ROBERTSON: I have a question in relation to the recommendation about the chief science officer. Many government departments from New South Wales have very close collaborations with different universities or groups of universities across the State in specific research issues or items that turn into applied research programs. How would you envisage that the chief science officer would operate in this environment and a different ministry? Do you think that will be put together? In the current environment with State Development we have a science group and then we have Ms Firth's group. Minerals and Energy have specific projects that are joint projects between them, CSIRO and universities. The proposal you put forward is about a chief science officer but when you talk about "coordinate", I feel you are talking about coordinating with universities and that officer. How would we stop a silo production that would remove the applied research occurring across government now?

Professor FIELD: I do not envisage that a chief scientist would be aligned with any particular ministry. Most of the chief science officers that operate around the country or in other countries that I know of are people who have an exceptional reputation; they have the trust of the

community and the research institute, so the research community as well as the broader public. They can be called upon for independent advice and a big-picture strategy. I imagine that a chief scientist would operate above all of the ministries. It may well be that such a person has a reporting responsibility to some area within government, but they would not be excluded from other portfolios.

The Hon. CHRISTINE ROBERTSON: So they would not actually create their own ministry?

Professor FIELD: A chief science officer, I do not think, has a ministry. I do not think it is political.

The Hon. CHRISTINE ROBERTSON: I am actually talking bureaucracy, trying to work it through.

Professor FIELD: I know that, but like Professor Peacock does in Canberra as the Chief Scientist of Australia, he sits outside government and provides more or less an independent perspective on things which are science, technology et cetera, as required, and assists the Government in setting down the strategically important areas which should be considered. But I do not believe that he is part of government.

The Hon. MELINDA PAVEY: Or she.

Professor FIELD: Or she, but I was talking of Jim in particular, I do not believe that he is somebody who is part of any particular portfolio.

The Hon. CHRISTINE ROBERTSON: It is not actually creating a new silo of bureaucracy that would exclude the applied research processes that are currently being undertaken with other government departments?

Professor FIELD: Absolutely.

The Hon. CHRISTINE ROBERTSON: I cannot visualise this very well.

Professor FIELD: I still firmly believe that you need a Minister who has primary responsibility for innovation, science and technology in that space as well as having a ministry, which is how government operates in that space; you need somebody who has this strategic focus and the ability to look across all aspects of science and technology.

The Hon. CHRISTINE ROBERTSON: You are talking about a ministry but they are two different positions?

Professor FIELD: Correct.

The Hon. CHRISTINE ROBERTSON: I still cannot quite figure out the two structures that should be set up to ensure that it actually gets the benefits of the different research that is currently undertaken throughout New South Wales with government departments and universities?

Professor FIELD: I do not envisage that the interface between the various portfolios and their particular research institutes—for example, Fisheries does work with the people who do research with fish and environmental people. I do not see any of that changing terribly much except we would have a much better focus in one particular ministry on innovation, the translation of research into the industry and research and development in general.

CHAIR: Christine, are you happy with that?

The Hon. CHRISTINE ROBERTSON: I hear the answer.

Reverend the Hon. FRED NILE: In your recommendations you have a dedicated ministry, chief scientist and this long-term strategic plan for research infrastructure. Who actually would produce the long-term plan and how would it be produced?

Professor FIELD: I would have thought that the chief scientist would be the logical person to do that but I would also hope that it was something that would come out of each of the ministries as they exist. Each of the Ministers, I would hope, would have a long-term focus on where their particular ministry or portfolio should be going. I do not know that I see too much of that at the moment.

Reverend the Hon. FRED NILE: The chief scientist would then coordinate those areas?

Professor FIELD: Yes.

CHAIR: Would anyone like to make a closing comment?

Professor CLARK: I am an extremely strong supporter of very careful attention to occupational health and safety and I want to preface my remark in that context. Also, I believe that what I see happening in Australia and, indeed in some other countries is that we are becoming incredibly risk averse. In other words, we are scared to do something because there might be a problem, rather than "Let's get a good regulatory framework in place to make sure that there aren't problems. Let's go ahead and try and achieve something."

If you look at the big things that have been achieved internationally in the past, the really big projects that have moved nations forward in their economic wellbeing and standard of living for the community forward, it has been a vision, the willingness to get in, roll your sleeves up and take on something new to try and move things along. If we are risk averse as a nation, not just as a State, we will seriously disadvantage Australia in an international context. We have to be a bit gutsy, but gutsy within well-defined regulations. That would be my comment.

The Hon. MELINDA PAVEY: I have a question to Michelle from our meeting out at the University of New South Wales. One of our terms of reference is the adequacy of existing education and skills development opportunities relating to nanotechnology. I remember you telling me that you often visit schools and science students. Could you all share with me your thoughts of trying to get more students from our education system interested in the sciences to deal with emerging skills shortages in all areas of science?

Professor SIMMONS: This is dear to my heart and my experience is that at one level the researchers themselves should go out to schools, which is a very good way of achieving that interaction. I do not know if that is a long-term solution though because you obviously cannot have lots of researchers going out to schools all the time, but one thing that I have seen for sure is that over the last decade or so people have tried to dumb down science and make it very glitzy and not go into the detail. I think that has put a lot of students off from an early level, so teaching them science in a way that is real, showing them what is cutting-edge and having programs that get out to schools at an early age, say from the age of 10 onwards, is crucial.

The academy has got Primary Connections, a scheme the academy runs which goes out to primary schools and it is fantastic. We should be doing more in terms of going out to schools to bring those students through. I think Cathy Foley will probably give a very good indication as head of the AIP. She has been running a lot of initiatives in that respect.

Professor FIELD: I would second that. Science literacy is one of my passionate subjects and trying to get more science literacy into our schools and particularly our high schools is very important. I again do not want to see the fundamental syllabus moving away from science, particularly the understanding of science and technology.

Professor CLARK: I want to add from a slightly different perspective at the other end of that spectrum but related and look at the cross-section and breakdown of members of Parliament, federally because I am a less knowledgeable state-wise. By and large most of the Ministers have a legal background and that is very understandable.

The Hon. MELINDA PAVEY: They did.

Professor CLARK: That is understandable, given all the regulations that you have to deal with. It is important that there is a good connection, not only downwards to the schoolchildren, which is very important, but from the researchers to government and that young students see role models not just being scientists but people coming from a science background in public life more broadly and being able to articulate that as role models for young children.

Yesterday we talked with some members of your own State Government about why do we not put some of our people and interns working with your State government departments for a few weeks on a specific project so that there is an interaction between researchers and your government policy-making so that they can get a taste of it and the policymakers can get a taste of how the researchers think. There are a number of mechanisms that could do that but role models are very important to young children.

The Hon. CHRISTINE ROBERTSON: Around this table we have a shearer, farmer, nurse, small businessperson and a religious worker.

The Hon. MICHAEL VEITCH: It works very well because there are no solicitors.

CHAIR: Do either of you want to make a comment before we close?

Professor FIELD: I have nothing further to add.

Professor SIMMONS: I would like to make a brief comment. Looking to the future is something I am very keen to do. One of the things I have felt since I have been in Australia is that when I talk to young researchers in other States they feel very strongly supported by their State Government in nanotechnology and when I have been to international conferences and I have talked to people in the area of nanotechnology they have said, "Hang on a minute. Isn't it Queensland and Victoria that really support nanotechnology in Australia?" I would urge you to consider that. I think for the future things like Smart State Fellowships and things like that are going to be very crucial to build the long-term future of nanotechnology in New South Wales.

CHAIR: Please return any answers to questions taken on notice by 31 May 2008. Thank you for your evidence and your hospitality when we visited the university.

(The witnesses withdrew)

NICOLA JANE ROGERS, Research Scientist, CSIRO Land and Water, Lucas Heights Science and Technology Centre, PMB7, Bangor,

MAXINE JUNE McCALL, Nanosafety Theme Leader, CSIRO Niche Manufacturing Flagship, PO Box 184, North Ryde, and

CATHERINE PATRICIA FOLEY, Research Program Leader, CSIRO Materials Science and Engineering, PO Box 218, Lindfield, affirmed and examined:

CHAIR: If you should consider at any stage that certain evidence you wish to give or documents you may wish to tender should be heard or seen only by the Committee, please indicate that fact and the Committee will consider your request. Also, if you take any questions on notice today, the Committee would appreciate it if the response to those questions could be forwarded to the Committee secretariat by Thursday 22 May if possible. Would you like to make a brief opening statement?

Dr McCALL: The CSIRO's position is that Australia needs a strong research base to capture the significant opportunities that nanotechnologies present. This research base needs to be multidisciplinary because nanotechnologies require interaction between various scientific disciplines: physicists, chemists, biologists, mathematicians, environmental scientists, material scientists, et cetera. You may realise that it is quite hard to coordinate people who work across the large number of disciplines but a structure that we have in place that can effectively do this is the national flagship program run by the CSIRO. A flagship is a term that describes a large multidisciplinary research program that addresses issues of national importance. The CSIRO has several of these flagships running, and last year the Federal Government provided funding to the CSIRO to establish the niche manufacturing flagship, which is a research program whose objective is to foster manufacturing in Australia in the niche area of nanotechnology.

This presents a major opportunity for Australia to boost manufacturing. We have been losing manufacturing to other countries. This offers the opportunity to focus in the area of nanotechnology. At the same time the CSIRO is serious about the health, safety and environmental aspects of all of our research, and nanotechnology research is no exception. Within the niche manufacturing flagship we have developed a research plan to look at the health, safety and environmental aspects of our research. We can talk more about that later. I realise that you have been sitting here for 1½ days talking about nanotechnology and often it is easier to appreciate things if you have a picture or a sample, rather than using words. So we have brought along some nanotechnology samples if you would like us to show them to you. I think it might help you appreciate the breadth of technologies that nanotechnology covers and also get an appreciation of the very different risks that are associated with the different samples. If you do not wish to look at our show and tell, we are happy to take questions.

CHAIR: We could look at them, with a caution about timing because we have other people to see.

Dr FOLEY: They can be passed around so you can look at them. To go with the samples, we have some pictures so that you can see the nanotechnologies. This one is a super conducting device that is used for mineral exploration. That is on the first page of the handout you will get. The second one is gold nano particle sensors that are used for electronic nodes to be able to detect substances, for example, if you are eventually hoping to detect saran gas or something like that in transport, railway stations. Another one is a picture of samples of printable electronics that are used to potentially reduce the cost of manufacture and also the scale up or the infrastructure costs for manufacture of electronics, which would be very powerful for boosting industry without the huge infrastructure normally associated with it. The final one is a nano carbon yarn or nano tube yarns which have the potential to make fabric which is very strong.

Dr McCALL: There are two sunscreen samples. One is the normal white zinc which we have traditionally used, and the other is one that contains nano particles which goes on the skin in a clear fashion. Both give good protection against burning but often the colourless one is more acceptable to people to wear.

The Hon. MELINDA PAVEY: The non-Andrew Symond's version.

Dr McCALL: The Andrew Symond's version is the little packet. The Megan Gale one is the larger packet.

The Hon. MELINDA PAVEY: How will the flagship program through the CSIRO determine which businesses to support, and what part can State Government, in particular New South Wales, play to assist businesses from their State accessing that support?

Dr FOLEY: Basically, the way CSIRO interacts is identifying, first, cutting edge science with the aim to be making a difference in some way that has a significant impact. We cannot do everything just because of limited resources, so it is important for us to identify what are the biggest issues and which will have the biggest impact. Part of that decision on what will have a big impact depends on the quality of the science and the capability that CSIRO has to be able to provide that science and the development. But the other is also who will be the end user. The CSIRO is meant to be doing research for the benefit of Australia with a global reach, and in doing that we are very cognisant of the importance of not just doing science for the sake of it but seeing it transferred and used in some way.

We spend a lot of time trying to engage the appropriate end users and the people in between who take research which is being done in a laboratory, manufactured in some way and then being used by an end user. So it is quite a complex process where you do not necessarily select a particular body to work with. You often go through a long process of trying to interact and engage industry by a range of different things. One example is that at our division of material science and engineering at Lindfield today we have a challenge workshop with a biomedical company based in New South Wales—a very well-known one, Cochlear—looking at the problems they have and whether some materials, which are no doubt nanotechnology-based, can be used to solve some of the issues for them.

We have different ways of dealing with it. One is setting up specific relationships with important companies or industry sectors to look at their specific problems through to—I guess we could say that is technology pull—through to the other side which is technology push where we say we have come up with something innovative. I guess a classic example is the one on the top surface, which is my own personal research area in superconductivity where a nanostructure, which is a nanometre in size, is the basis of a new technology that has been responsible for finding very large quantities of minerals around Australia and overseas. In that case we had to go and engage with the industry significantly, the mining industry, to get them to consider using a new technology. That took a long time of interacting closely, going to their industry forums, to engage closely with them, undertake trials to show the benefit of the technology and to get that adoption.

The next problem was finding someone who will manufacture that, and that is an area which is often a huge hurdle because the end user is not usually the person who wants to manufacture. There are real opportunities, particularly in New South Wales, in electronics because we have the silicon gully around the Lane Cove-North Ryde area where electronics provide an opportunity for us to grow, particularly with nanotechnologies creating opportunities for cheaper technologies that can mean that the infrastructure is not so great. So we have different models, depending on what we see as appropriate depending on the research and the needs.

The Hon. MELINDA PAVEY: What was the period of time for your super conducting magnetic sensor which has had $6 billion of mines found worldwide? What sort of timeframe was that from your discovery to—

Dr FOLEY: High temperature superconductors were discovered 20 years ago and that was just a material. They won a Nobel prize nine months later. The CSIRO instigated a research program straight away based on pulling together a cross-section of multidisciplinary teams in order to focus on that and also interacting with the broader science community. We then had to go through a process from almost zero knowledge in this area in the sense that this is a new material to making something which is, first, perfecting that device and then going through finding an application which is valuable. In this case we developed it initially with BHP Billiton and did trials with them and then they disengaged with us.

We started looking for other industry partners. The first field trials were done in 1991. It was ready for commercialisation in early 2000 but we had to use funding from a Canadian company in order to keep things alive because we were not able to get interest in Australia. We were able to do that without any loss of intellectual property. Then an Australian company took on and started up a new manufacturing arm to build this and then make it available. So it is probably 12 to 15 years from inception. We hope to increase the rate of doing that. One goal, particularly in the niche manufacturing flagship, is to reduce that timeframe from inception to product and industry adoption.

Reverend the Hon. FRED NILE: How do you handle the tension that you are a national body and all the States want to be active in this area? Apparently New South Wales is already lagging behind; Victoria and Queensland are doing very well. Would you be under pressure to give them help, rather than New South Wales, or could you say that New South Wales needs the help so as a national body you could provide further assistance to New South Wales, which is what we would like you to do?

Dr FOLEY: We are going to sound like we are cheap, but we actually work with anyone who wants and needs us because I think boundaries are not terribly relevant to us, apart from doing something that is beneficial and meaningful and has impact and there is a pathway to achieve that. If it is working with the New South Wales State Government because that makes sense and there is a real need then we will put in the resources that are necessary and appropriate. If it is in another State Government we would do the same thing. So it really I think is more looking at what is a needed and addressing that need, and interacting in a way which is suitable and appropriate. It is not like there is a favourite place to operate, it is more to do with what is going to be able to achieve the goals and the strategies that are necessary to have the biggest impact for Australia in general. New South Wales has the biggest population of all the States so in theory we should be penetrating into New South Wales probably more than we are.

Reverend the Hon. FRED NILE: So you cannot move into a vacuum, there would have to be something actually happening in New South Wales so you could then assist that project?

Dr FOLEY: Absolutely, it is a joint thing where we do not just go and do things out there and say "Voila. Here we are. Come and get us. This is better than sliced bread." It is actually interacting and engaging in a way that is making a significant impact, and one of the areas with the Niche Manufacturing Flagship is manufacturing we see is vital to Australia, and a very important industry sector, and with the modern changes, and the growth of China, we have to rethink how we can actually still benefit and create opportunities for the Australian economy by going through another route, which can allow Australia to be competitive. This is something where we will work with most appropriate places, and of course New South Wales is an obvious area in that.

Reverend the Hon. FRED NILE: Were you involved with Ambri Limited? If so, why did they relocate to Queensland from New South Wales?

Dr FOLEY: I did not actually work in that company; I worked alongside some of the staff that were involved with the development of the Ambri biosensor. But it is only hearsay as to why they moved; you should probably ask them directly. I could tell you dreadful gossip but it is probably not appropriate.

Reverend the Hon. FRED NILE: Could we imply they were getting more assistance in Queensland?

Dr FOLEY: That might be part of the reason, yes.

Dr McCALL: May I add something to the previous question, in terms of working with New South Wales? With the Niche Manufacturing Flagship and the focus on nanotechnology most of the technology development associated with nanotechnology probe in the flagship is focused in Melbourne. The reason for that is that we do not have all of the facilities within the CSIRO. We are able to access the infrastructure, especially equipment, major facilities that are available in Melbourne, so that is why a lot of the research is being done in Melbourne.

The Hon. MELINDA PAVEY: What sort of facilities are you talking about, doctor?

Dr McCALL: Things like the sincotron facility. There is a manufacturing facility being established. There is that south-eastern corridor which is very much a science park adjacent to Monash University and CSIRO laboratories are there as well. So there is a science and technology community in that area.

The Hon. MICHAEL VEITCH: Is that Clayton?

Dr McCALL: Yes.

Reverend the Hon. FRED NILE: Does the reactor at Lucas Heights give New South Wales a bit of an edge?

Dr McCALL: It gives us an edge in the sense that we can access radioactive particles for tracing nanoparticles, for example, in environmental studies, but the point I would like to make I guess is that it is interesting that the research that we have got in the nanosafety area within the flagship is pretty much based in New South Wales. We have laboratories at North Ryde, which are working on the human health studies, and we have laboratories at Lucas Heights where Anstow is. CSIRO's division of land and water, where Nicola works, where we are doing most of the environmental studies—not all. The nanosafety research is focussed in New South Wales.

The Hon. MELINDA PAVEY: Who is doing that?

Dr McCALL: North Ryde is CSIRO's division of molecular and health technologies—that is where I work. We have a small animal house there and we are molecular biologists so we are focusing on human health studies. In Lucas Heights we have the land and water division of CSIRO focusing on environmental studies. We have other research elsewhere in Australia as well, but the main part is in New South Wales.

The Hon. MICHAEL VEITCH: Has there been any research that you are aware of, or any life-cycle analysis, around long-term exposures to zinc oxide or carbon nanotubes?

Dr McCALL: To my knowledge there have not been long-term studies done, and that is one of the experiments that we are planning to do in the nanosafety research program. It is very hard to do long-term studies and they are quite expensive. You cannot really do them on humans, not in a controlled way anyway. So we have planned an 18-months experiment where we will be applying the sunscreens with nanoparticles in them to mice. Eighteen months is a reasonable period of time in the life cycle of a mouse, and so we will be monitoring chronic exposure and impact on their health in those experiments.

The Hon. MICHAEL VEITCH: This sunscreen is already on the market and people are freely applying it to their children and themselves, but that research has not taken place so we really do not know what the long-term effect will be on humans?

Dr McCALL: Not at this stage, no. In wearing a sunscreen I think you have to be sensible about it. If you look at the guidelines of the Cancer Council for protecting oneself from burning you will notice that sunscreen is at the bottom of the list. I mean, there is a hierarchy, which you should follow, and basically stay out of the sun at dangerous times, wear protective clothing, and then at the last you put on the sunscreen. Clearly you would wear a sunscreen if you know you were going to be burnt because they do work very efficiently at preventing sunburn, but we do not know if there are any side effects from long-term use of being exposed to nanoparticles that are in those skin care products.

CHAIR: What research has been done on the sunscreens? Has there been any research at all done?

Dr McCALL: Yes. There is research done on nanoparticles that go into sunscreens, and research done on sunscreens, so we will stick to the sunscreen part. Generally, the two questions to ask are: Do the nanoparticles get absorbed through the skin? Do the nanoparticles have any adverse

impact just being on the surface of the skin? So the experiments that have been done in terms of "Do they get into the skin?" have generally been done with what are called diffusion cells. You can get human skin taken from people who are undergoing surgery or you can get pigskin, which is the closest analogy to human skin, and you put it into a device with the sunscreen on top. You have some median on the bottom and you measure if zinc oxide or titanium dioxide travels through the skin and appears in the median underneath.

Some recent research in the United Kingdom—a project called Nanoderm—has declared that these studies give a guide. What the studies showed was that there is little or no diffusion through the skin in those experiments, but they have also stated that the experiment is not really representative of human skin that has sunscreens applied to it when they are going around their normal duties, such as going down to the beach, working as a landscape gardener, kids running around in sun, surf, sand, wind, et cetera.

Reverend the Hon. FRED NILE: What was the advantage of putting it into sunscreen in the first place?

Dr McCALL: If you use Cricket sunscreen that is what it looks like. If you use sunscreens that have what we call chemical absorbers of the radiation they are colourless but there have been toxicity associated with those chemicals, particularly liver toxicity and some of those samples have been banned. If you grind the zinc oxide that is in large particles in this sunscreen into small particles it becomes colourless, and both sunscreens give you protection from sunburn but the clear one is more attractive to most people. Of course, when it is colourless it not only can be put in sunscreens but it can go into all sorts of skin care products. So you will notice that a lot of skincare products now have SPF factors associated with them.

The Hon. MICHAEL VEITCH: That is the zinc oxide. What about the exposure risks around carbon nanotubes in the long-term exposures? Has there been any research?

Dr FOLEY: I do not think the carbon nanotubes are actually in any products as yet. It is still very much an emerging technology. They were discovered sometime ago in the early 1990s and they were sort of like a material finding an application. For example, one is what I showed in those pictures of being able to weave the carbon nanotubes into a very strong cloth, and that is still a long way off because you have to be able to do this in large quantities. So the biggest issue with carbon nanotubes at the moment is quantity, which is done in an economic way. However, because of the nanorod shape that research would need to be done to look at the impact of that.

Dr ROGERS: I will just make a few comments on the research that has been done both on zinc oxide particles and carbon nanotubes to the environment and there is a small but increasing body of evidence with both of those types of particles. One of the biggest problems we have is how we present the particles to the organisms that we use in our tests, and we find that the way the particles are present, it is very important on the outcome we have, whether or not there is toxicity. Initial studies with carbon nanotubes toxicity to fish actually used an organic solvent to try to disperse those particles in the water, because the particles are not dispersed very easily in water. So there was initially a lot of concern that the carbon nanotubes were toxic to fish because the initial study showed that, but subsequent studies showed that it was actually the solvent that was used to disperse the particles so the particles could be presented to single particles, rather than aggregates, that was causing most of the toxicity.

So that is a classic case in eco toxicology where it was the way the particles were presented. There is other evidence that carbon nanotubes are bactericidal, but again there are several different results in some cases, and when they are presented in particular ways they are bactericidal, and in other cases those effects may not be seen. The way that the zinc oxide is presented is important. From an environmental perspective, zinc oxide has been tested simply as a particle, but not as a sunscreen formulation so far. The reason we have not particularly tested sunscreen formulation in the environment is there are so many formulations—this is just but one. The formulation of the sunscreen has an enormous effect on the way particles are presented. So the studies we have got so far are with uncoated particles.

The Hon. MICHAEL VEITCH: The committee was advised last Monday that some earlier research using carbon tubes was actually flawed because of contamination within the nanocarbon tubes?

Dr FOLEY: What did that relate to?

The Hon. MICHAEL VEITCH: A witness talked about contamination and an issue around getting quality.

Dr ROGERS: I think there are perhaps two parts to that. One is contamination certainly, the way that the carbon nanotubes are manufactured they can have significant amounts of contamination, particularly things like metal irons can be on the surface of the particles. As contaminants there are several studies around suggesting that it is actually the metal irons on the surface of the nanoparticles that are responsible for the toxicity. There is something called the Trojan Horse mechanism that the nanoparticles are enhancing the toxicity of metals. You also have the formulation aspect, and I guess other components in formulation could be considered as contaminants in that context. But they are deliberately put there, rather than being natural contaminants.

The Hon. CHRISTINE ROBERTSON: You spoke in detail about working with manufacturers and organisations in order to commercialise or move forward to products. Is there any involvement of employee groups in your processes of consultation and implementation?

Dr FOLEY: Do you mean, with unions?

The Hon. CHRISTINE ROBERTSON: Yes, with unions, for example.

Dr FOLEY: I do not know of any interactions with unions with manufacturers, but I am not over all areas. For example, in our Melbourne division they have nanofillers put in polymers, to be able to improve the properties of a polymer by putting in nanofillers, and that is being used in commercial applications in Victoria. I am unaware of any interactions with, for example, the unions that fabricate the chemicals that are used to make products based on that.

The Hon. CHRISTINE ROBERTSON: The reason I ask the question is that your area is called nanosafety and it is extremely important for a government to recognise that workers are as safe as consumers of a product. Whereas, most of your work has been done on consumption in the environment, is that right?

Dr McCALL: In developing the nanosafety plan we have consulted with a large variety of people. Part of my role as the theme leader for the nanosafety theme is to get around and talk to all the people who are affected by the nanotechnology research. I am working actively with regulators, I do a lot of public speaking, especially on behalf of the Australian Office of Nanotechnology and their public awareness campaign. I talk to companies. I ran out and contacted the Australian Nano Business Forum and Nanotechnology Victoria people, to keep up the interactions after they had presented here this morning. In fact, it was here in this room, when the Greens organised a lunchtime forum, that I spoke and I met with Dave Henry and renewed my acquaintance with Georgia Miller, who is from Friends of the Earth and is appearing today.

Part of the role is to interact with everybody. At the moment not all of those stakeholders are providing input into directing the direction of our research in the nanosafety theme. That is something we are wanting to embrace. It is hard to incorporate everybody; you simply do not get anywhere. But what we are wanting to do is to work more with social scientists to help guide where our research should be so that we can take into account all the issues.

The Hon. CHRISTINE ROBERTSON: I guess my question is about the general community education process. From what we have learned, a lot of people are very interested in the issue, so there is a high interest in a certain sector. But most people in New South Wales do not have a clue what we are talking about.

Dr McCALL: I would agree with that. At the public forum that I have organised, you can predict who is going to be in the audience—and it is not the person off the street.

Dr FOLEY: The CSIRO for some time has had ongoing interactions with the wider community in its public awareness. For example, last year I spoke at a public forum in which we had to explain nanotechnology without any overheads, in five minutes, to a broad community. There were several of us. We had a lot of participation from people, particularly in Canberra.

New South Wales has a particular issue in trying to engage the general public in science. You only have to look at people who try to run public meetings or community events. Often they struggle to get people to come along. Being the President of the Australian Institute of Physics, when we run a public lecture on, for example, nanotechnology at the Powerhouse Museum, we get very poor audiences compared with when we do the same lecture in Melbourne, when we fill the town hall, or in Canberra.

It is really interesting that New South Wales, Sydney in particular, has a different culture or mentality about how they want to engage and learn things. It is something that is going to be a real challenge for the New South Wales Government to work out how best to engage with the general public in a way that they are receptive and understand the things that are important. I am thrilled to hear that you have discovered as the week has gone on that nanotechnology is a very broad area. It is also a level of potential misunderstanding, where non-experience has meant that people have a particular concept which might be damaging to the wider community and can sometimes pick up the headlines—which sell newspapers because they are exciting to hear, and create a level a misunderstanding.

The CSIRO is very keen to do whatever is necessary to achieve an understanding of nanotechnology, which will also prevent a genetically modified food scare. There is an understanding that research that is undertaken—for example, in the niche manufacturing flagship—the integration of safety with research as being fundamental is something that has a lot to offer. It also gives confidence to the community that it is not just people going along and following blindly because science is exciting and scientists are enclosed in dark rooms and do these wonderful things, creating the next blob of grey goo which is going to take over the world. Getting that engagement is going to be a real challenge for the New South Wales Government and also for scientists, who have a responsibility to also make the wider community aware and have a level of understanding.

The Hon. MELINDA PAVEY: With regard to the tensions and fear that are in the community, driven largely by a lack of knowledge, is it unique to Australia or is it happening in other parts of the world? If it is happening in other parts of the world, do you know of any examples of how those areas are dealing with these tensions?

Dr FOLEY: I do not know. I must admit, that is a very good question. We could take that on notice.

Dr McCALL: I have impressions, but I would rather look into it.

Dr FOLEY: Could we take that on notice?

CHAIR: Before closing, would you like to make any further comments?

Dr FOLEY: I think New South Wales should see itself as a pinnacle of opportunity. Sitting in this morning, I have heard some recommendations from other groups about setting up a body, that New South Wales is behind the eight ball. I would like to turn it around and say that there is real opportunity because other States have started, and have been undertaking for some time, some nanotechnology-specific initiatives. By having this inquiry right now, you are able to see what everyone else is doing, and possibly create a level-above strategy that says: how will the nanotechnologies at this stage of development—which are much further down the line—how can we do something which will really make a difference across the board within the State? You can also go through some sort of due diligence process that identifies how nanotechnology can have a major impact in New South Wales, and do it with a lot more knowledge than other States, or even federally, have undertaken.

I encourage you to see this as a real positive, to have the opportunity to look at the models, the way other States are undertaking things, and ask: Is there something we need to do which is different? New South Wales is quite a different State—as we talked about, the culture of the industries and the way the community interacts, and also with government. We should not feel put down by the challenge but should be uplifted by the opportunities, because I think they are really there. We have a lot to offer, with people clearly wanting to interact with you to be able to make this effective and successful.

Dr McCALL: I think that most people focus on opportunities in manufacturing based on technology development, but associated with this we have opportunities in other areas that might not be considered. One of those is that right now we are trying to develop tests to look at the toxicity of nanomaterials. Clearly there is a booming industry just waiting to happen there to do the standardised testing that will be required downstream by regulators –

The Hon. MELINDA PAVEY: Around the world.

Dr McCALL: Around the world. New South Wales could look at these potential opportunities and get in at the beginning. If you are in at the beginning—it is a suggestion to consider. We do not have to focus totally on technology development opportunities but the associated service industries that are with them.

CHAIR: Dr Rogers, do you wish to add anything?

Dr ROGERS: No, thank you.

CHAIR: Thank you all for coming today and for your suggestions, which are very important to us.

(The witnesses withdrew)

JOHN RAYMOND MILES, Chief Research Scientist, National Measurement Institute of Australia, Chairman of Standards Australia Technical Committee on Nanotechnologies, PO Box 1257, Clayton South, Victoria, affirmed and examined, and

MAX MAFFUCCI, Program Manager – International, Standards Australia, 20 Bridge Street, Sydney, sworn and examined:

CHAIR: Welcome, and thank you for appearing before the Committee today. If you consider at any stage that certain evidence you wish to give or documents you wish to tender should be seen or heard only by the Committee, please indicate that and the Committee will consider your request. If you take questions on notice, the Committee would appreciate your responses being forwarded to the Committee Secretariat by Thursday 22 May, if possible. Before we ask questions, would either or both of you like to make a brief opening statement?

Dr MILES: Yes, I would like to make a brief opening statement. This statement and other information is printed on a submission that I will tender later.

Nanotechnology promises to be the next significant new technology, with diverse benefits and considerable economic potential. It is important to recognise that technology at the nanoscale is not simply a matter of applying established classical physics to smaller dimensions. The nanoscale is the arena of quantum physics and new engineering and manufacturing techniques will need to be developed. Consequently new methods of measuring and testing will be required to demonstrate that a product or manufacturing process meets specified demands or conforms to environmental and safety standards. I think it is well known that a metrological infrastructure has underpinned almost all industrial revolutions, and nanotechnology will be no exception. Nanometrology is the science of measurement of the nanoscale and accurate and reliable measurements of physical, chemical and biological quantities will be required at all stages of the nanotechnology value chain.

Essentially the way this is done in most economic nations is by a national measurement institute [NMI]. Most major economic nations have a national measurement institute, and Australia has one. The main role of that institute is to establish, maintain and disseminate physical standards. Australia's National Measurement Institute, therefore, has a critically important role in establishing internationally accepted measurement infrastructure for nanotechnology in Australia. I am talking about physical standards of measurement and we must distinguish between physical standards and documentary standards. Documentary standards are published documents that set out specifications and procedures designed to ensure that a material product method or service is fit for the purpose and consistently performs in the way intended. They establish a common language that defines quality and establishes criteria. The responsibility for developing Australia's documentary standards lies with Standards Australia.

International standardisation plays a critical role in ensuring that the full potential of nanotechnology is realised and safely integrated into society. Documentary standards create a smooth transition from laboratory to the marketplace and promote progress along the nanotechnology value chain from value materials that form the building blocks of components and devices to integration of these devices into functional systems. Finally, standardisation aids growth in productivity by supporting innovation value generation, compliance and regulation. The production of well-characterised and controlled products depends on the availability of documentary standards for terminology, measurement and characterisation, and health, safety and environmental issues.

That is all I want to say at this point by way of an introductory statement.

CHAIR: Did you want to make a statement, Mr Maffucci?

Mr MAFFUCCI: No, thank you.

CHAIR: Could you describe the process by which international standards are implemented at the national level in Australia and what action is required by New South Wales' agencies in this process? Are there any particular challenges posed by the development of nanotechnology?

Mr MAFFUCCI: I will answer some of the question. Due to the fact that Standards Australia is the Australian member on the International Standards Organisation [ISO]—and the International Electrotechnical Commission [IEC] for electrical standards—we have access to this international committee and the right to use whatever it publishes. The most important part, of course, is that we are allowed to participate in the preparation of such documents at the international level. There are two levels of participation. In this case we have the top level, which is P—participating member—although we could be only observers if we wanted. By virtue of that we have also formed a national committee as a mirror committee to the international one, which also serves to advise and formulate a position on behalf of Australia to be presented in the international arena.

Once a standard is published internationally we do not even have to wait for the process to be completed. We can start a national process in parallel. Assuming that the international committee publishes a standard, if the national committee wants to adopt the document as it is—in other words there are no changes to what they publish—in terms of style we produce a cover which says "Australian Standards" and we list the committee and the nominating organisations and interests that participated in that committee. There would then be a period of public comment in Australia followed by a formal vote by the members of the national committee.

In the particular case here, we have a very active role at the international level. I would assume that when it comes to adopting it as a national standard we will have what is called a combined procedure. At the same time as we ask the national committee to vote we will have a period for public comment instead of having two separate steps. Following that the document is published as an Australian Standard. We have the right to make changes to the international standard; we do not have to adopt it if there are reasons based on safety or health, or whatever. We can add appendices and say that in a particular clause there is a different application in Australia. That is basically the process.

Dr MILES: There was a second part to the question about how New South Wales can be involved in that. I suggest that one way New South Wales could be involved in or actually support that process is to have a policy of adopting Standards Australia and ISO standards as a basis of its own regulation and legislation. You do not necessarily have to do that. It is up to the users whether they adopt standards or not, but the Government can take a policy position in regard to nanotechnology.

The Hon. CHRISTINE ROBERTSON: In your discussions with the State on any issues like that, how responsive would the persons responsible for giving us advice on that—the New South Wales bureaucracy—be?

Dr MILES: I am not sure I understand. We do not have direct discussions.

The Hon. CHRISTINE ROBERTSON: So there is no process at the moment for the standards people to say to WorkCover, "These are the new standards"?

Dr MILES: No.

Mr MAFFUCCI: Standards Australia is an independent organisation, we are not a government body. Whatever we publish, even if we adopt international standards, is a voluntary document. They become regulatory only if they are referenced into some regulations.

The Hon. CHRISTINE ROBERTSON: They are voluntary codes. Sorry, I misunderstood.

Mr MAFFUCCI: We would possibly have the regulators on our committees and they take part and at the end they may decide that they are going to call it up.

The Hon. MELINDA PAVEY: Are any other States picking up on that and making those standards their own?

Dr MILES: At this stage the standards do not exist. I imagine that they will be, as they will at the Federal level. We have Federal regulators on our committee who are obviously helping with the international input and process, so I would think they are looking for ISO standards and Standards Australia documents to provide the basis for their legislation and regulation.

The Hon. MELINDA PAVEY: Mr Maffucci, in the submission of Standards Australia there is a reference to the brokering role that Australia might play between European and Northern American perspectives on nanotechnology standard issues. What are the key differences between those perspectives and how could we broker?

Mr MAFFUCCI: I can outline maybe the fact that there are two differing ways of standardising. In the United States there is an organisation at the top called the American National Standards Institute [ANSI]. They are really not standard writers; they endorse what industry produces. In other words, if it is a fire protection standard they go to the national fire protection authority, which does all the standards and passes them to ANSI. They say, "Yes, that looks okay", and it is made an American standard. In Europe, it is quite different. The European Commission in Brussels produces the law. They require that every nation's government provide the secretariat with technical specifications to support the performance requirements of the commission. I would say their way is closer to ours than what the United States is doing. Because in the United States there is this competition business that not just one standard body may be working on a particular field and then there could be—

The Hon. CHRISTINE ROBERTSON: Competitive standards people?

Mr MAFFUCCI: Yes.

Dr MILES: There are over 400 standard development organisations in the United States and they all compete with each other.

The Hon. CHRISTINE ROBERTSON: You have to pay for these standards I suppose?

Mr MAFFUCCI: What ANSI is trying to do is coordinate these activities but sometimes you know.

Dr MILES: Speaking from on the ground at the committee level internationally where I attend, what we see is that the United States standards development process results in much more industry defence driven standards work or priorities whereas Europe gives much more concern to health, safety and environmental issues—a broader top-down approach whereas the United States pushes from the bottom up. Australia does, in fact, try and broker that to try and come to some sort of understanding between those two processes because we are somewhere in the middle, although we are much closer to the European idea I think. What we see, for example, from countries like the United States, Japan and China, the Asian economies, is an emphasis on carbon nanotubes because that is where their industry and commercial interests lie whereas what we see from Europe is much more of a health-safety environmental push and we are trying to bring those people together.

The Hon. CHRISTINE ROBERTSON: I understand from previous discussions we have had that there is a perception that it would be important in New South Wales to align itself with the national standards by mediation of regulation rather than try and make our own?

Dr MILES: Really State governments do not make their own standards. We are talking national and international standards here and I would recommend that is the only way to go if you really want to have international and national trade, for example.

The Hon. CHRISTINE ROBERTSON: We heard from a gentleman from the Australian Manufacturing Workers' Union earlier and he put some very thoughtful ideas forward about a way to progress. I guess the issue with them is that the definitions of risk are very difficult because the labelling standards are not precise enough to fit in with the occupational health and safety laws as they stand?

Dr MILES: The issue of labelling is one that is contentious throughout the world; there are arguments for and against. Recently British Standards, for example, have put out a standard on the labelling of nanoproducts. It is at the very early stages though. There are no ISO standards in train for labelling as such. The problem is if you label, "This product contains a nanotechnology product", that is not precise enough. That could be across a whole range of product possibilities. You have to be

more precise than that and sometimes, in a sense, the information can be misleading so one has to be very careful when you are talking about nanolabelling.

CHAIR: Is that because there has not been enough research done as yet?

Dr MILES: There is undoubtedly not enough research, or there is certainly research needed to fill in the gaps. When we are talking about health, safety and environmental standards at the TC229 level one of the issues with nanotechnology is we are talking about anticipatory standards: standards not based on what we know but what we expect to happen. So they are trying to anticipate business and regulation and health concerns. That is very difficult because the research is not there. TC229 is trying to not only build on what it knows but trying to predict what will happen and encourage research throughout the world in particular on toxicological work relating to nanoparticles because it is true that the knowledge is not there at the moment.

The Hon. MELINDA PAVEY: I do not know whether you heard the evidence from Dr Maxine McCall previous to you, and our nanosafety laboratory through CSIRO at North Ryde, about this idea potentially—because we are lacking this research throughout the world—of pushing for Australia to start on that research. Do you have any views on that?

Dr MILES: I do have a view. I think what is happening is really good. For example, TC229 has a strong liaison with the OECD. The OECD is in the process of drawing up a series of where the gaps are basically—what don't we know? They are trying to promote throughout the world that the work is shared so that we do not duplicate. We will pass that information on to our own researchers, such as Maxine—we are in close contact with Maxine—and we will therefore set up our standards, in a sense, to fit in with international needs as much as national needs, so that we do not duplicate international efforts. I think that is a very good outcome, for example, of the work of TC229.

The Hon. MICHAEL VEITCH: How is the Australian Nanotechnology Technical Committee addressing the concerns of health and safety for the community? We are going to hear this afternoon from the Friends of the Earth and obviously that is the sort of thing they will raise.

Dr MILES: TC229 has an ACTU representative—

The Hon. MICHAEL VEITCH: There is a union representative on that committee?

Dr MILES: There is a union representative on NT001. There is a representative from Consumer Affairs. We have invited Friends of the Earth and they have declined to accept the invitation but we are in contact with Friends of the Earth. We try and keep them involved as much as possible with what is happening. Georgia Miller, for example, we see at conferences and always have a bit of a talk about what is going on internationally and so on.

Mr MAFFUCCI: To take it a bit further, we have got a list of interests on the national committee and I was aware that the Friends of the Earth declined last time for whatever the reason was—I think it was a financial thing. We can nominate them for information so what would happen in that case is that any document that gets distributed to the rest of the committee they get a copy. They can look on the website actually. But if they feel they have an important submission to make they are certainly welcome to do it that way.

Dr MILES: Might I add, for example I am a member of the Australian office of the Nanotechnology Committee which is reaching out federally to community groups and all of the members of NT001 are in very close contact with community feeling on this issue.

The Hon. MICHAEL VEITCH: Dr Miles in your opening statement you spoke about the metrology infrastructure in Australia. Can you advance on that? Is it sufficient? What levels of investment do we need to make, particularly in New South Wales, to the metrology infrastructure?

Dr MILES: Generally speaking the metrological infrastructure is not adequate at present. That was identified in a survey that we would did in 2006. We essentially found that there was a need within Australia for a metrological infrastructure to support particularly dimensional measurements of nanoparticles—metal oxide nanoparticles have been identified as one of Australia's main interests.

This was in fact recognised in the Federal Government's options for a nanotechnology strategy and went into its national nanotechnology strategy document that recommended that MNI establish and coordinate a national nanometrology program, covering physical standards and also establish a nanoparticle laboratory. Funding in 2007 was initially for $6.25 million over four years and subsequently it has been reduced to $3.12 million over 2 years. That is designed to begin the process of establishing a much-needed infrastructure in Australia for measurement.

The Hon. MICHAEL VEITCH: Where is that infrastructure to be based?

Dr MILES: It will be based at the national measurement institute and that will be in Lindfield in New South Wales.

CHAIR: Can you explain to the Committee the importance of measurement for nanotechnology research and development and the commercialisation of nanotechnology? Can you also explain the particular challenges for measurements proposed by the nanoscale?

Dr MILES: Basically there is a saying that if you cannot measure it you cannot make it and you cannot regulate it. That is a very old saying but it is nevertheless true. You need measurement. It is a fundamental aspect of our everyday world. I cannot imagine a world without measurement, particularly in science and industry. What we are looking at from an industrial perspective is the means of controlling processes and ensuring quality and regulating products. Almost anything you do requires a number of some description and a measurement. Of course in research and development the need to make accurate measurements that are then comparable with other groups overseas is a fundamental requirement and therefore we need the international aspects of that.

Sadly I would say the university sector has yet to come into the fold of really grasping this measurement system. It is important to realise that it is a voluntary process to be part of a national measurement system. There is no forcing of people to partake in that system. Traditionally, perhaps, the more academic institutions have chosen not to source traceable measurements, for example. But in industry I think it is much more the case and it is absolutely vital for industry. Research and development rely fundamentally on instrumentation and instrumentation goes hand in hand with the metrological infrastructure because they kick each other along. You develop an instrument and it makes new research and that research builds new instrument—it just moves along like that.

CHAIR: We want to make the general public aware of nanotechnology and what it is all about. How would you engage the general community in this?

Dr MILES: In the field of measurement in particular?

CHAIR: Yes.

Dr MILES: One way it has been done generally speaking is to look at measurement in sport. If you talk to the general community about the importance of, say, measuring the length of an Olympic swimming pool, they tend to relate to that. If you talk about fractions of a second in an Olympic swimming pool and you say that is the equivalent to measuring the length of 100 metres to maybe half a millimetre then they get an idea of what is going on. You can relate it to their everyday life: cholesterol levels and so on. In terms of nanotechnology I think we have got to continue with the public forums in particular, reaching out to the community through schools, through media such as the web and video, television, et cetera. Other than that I do not really have any other brilliant ideas.

The Hon. CHRISTINE ROBERTSON: Once the ISO draft technical report on health and safety practices in occupational settings relevant to nanotechnologies is finalised and published, how do you envisage those practices will be implemented in Australia and what sort of audit processes will need to be set up? Which agency would be the best to do both the implementation and the auditing?

Dr MILES: Maybe Max will say something but I will say a little bit about that. I would anticipate that regulatory authorities would use the new draft technical report only as a guidance document, not a standard. It will be used as a guide, keeping in mind that it is, in fact, only a reflection at this point of current practices—it is a collection of current best practices. It is an interim document coming out from TC229 to assist the community as quickly as possible. Now the particular aspects of

nanoparticles relies on the research we were talking about before being completed and that needs to be fed back into documents such as this which will then go on and make actual standards documents. I would anticipate that in Australia this document will be picked up by Standards Australia ultimately and published also as the guidance document and therefore it will be able to be used by regulatory authorities throughout the country.

The Hon. CHRISTINE ROBERTSON: As a growing document?

Dr MILES: Yes, that is right, and maybe Max can add to that?

Mr MAFFUCCI: The fact that it is a technical report because of the type of technology we are talking about, it is something new, and usually it is quite common that the international committee produces something which is the consensus at the time of all the participants to be further developed. In other words, they put in a technical report so that they are aware of what are the views of all the different countries. Later on obviously the idea is to convert such a report into a full standard or a series of standards, which is most likely to happen, and as Dr Miles said we would adopt it as a national technical report or a guide or whatever, and then we would follow the process with whatever the ISO does.

The Hon. CHRISTINE ROBERTSON: What is the timeframe for this?

Dr MILES: The timeframe for the guidance document—it is currently out for ballot. It is due for completion of ballot in about two or three weeks. It will be discussed in Bordeaux in France next month. I would anticipate that it would then go through the ISO processes, which can be time-consuming, but I think for a technical report it is nowhere near as time-consuming as a full standard, so I would anticipate it comes out towards the end of this year.

Mr MAFFUCCI: That is right.

The Hon. CHRISTINE ROBERTSON: So it will inform people who are working on regulations?

Dr MILES: It is designed for people to have safe handling practices working in nanotechnology. I have a copy of it here.

The Hon. CHRISTINE ROBERTSON: Have you had anything to do with the nano code?

Dr MILES: The voluntary nano code?

The Hon. CHRISTINE ROBERTSON: Yes.

Dr MILES: Yes, Standards Australia did attend the meeting in Melbourne last year, towards the end of the year, where it was discussed. I guess we put input into that process and I think that is developing internationally, but I am not clear on how strong that will be ultimately.

The Hon. CHRISTINE ROBERTSON: Some of the persons who were here this morning who are working in this industry already have implemented it for their own business.

Dr MILES: That is good to hear. I think it is going to depend basically on how strongly the businesses wish to participate in that voluntary code, but Standards Australia has no formal position on that.

CHAIR: Dr Miles, is there a definition of "nanotechnology"?

Dr MILES: How is it going? It is a long story, but it is getting close to the end. Essentially the position is this at TC229: The problem was always agreeing on a definition of the nanoscale, not nanotechnology, and there were two sticking points at TC229 on the definition of the nanoscale. The first was to actually agree on the size range that was involved. The second was to agree on whether or not the definition should actually include unique properties, like quantum type properties that emerge sometimes but not always at those dimensions. It has now been agreed, I think accepted—it has been

printed in an accepted scale, the first actual fully balloted standard that has been put through the ISO process on terminology of nanoparticles—that the size range should say from approximately 1 to 100 nanometres. That has been agreed to, from approximately 1 to 100 nanometres—and it is important to say "approximately". The use of "approximately" was the subject of considerable fighting and debate in TC229 because there were those who felt that the size range should not be so restrictive that it excludes objects lying just outside that range, but those against argued that regulators and so on needed a very clear definition of the actual nanoscale. However, it has now been accepted as approximately.

In relation to the other issue regarding the emergence of unique properties, it has been agreed that that will appear as a note somewhere at the bottom, words something like: Emergent phenomena associated with size quantisation and potentially other properties that are not regular extrapolations from larger size ranges will typically, but not exclusively, be exhibited at the nanoscale. This in my view is a cop-out, but anyway—it is a bit of a wishy-washy note.

The Hon. CHRISTINE ROBERTSON: Big words.

Dr MILES: Yes, they are. It basically says that we think that emergent phenomena may occur, but it is not necessarily part of the definition of the nanoscale. You can have a nanoscale item or object without necessarily a unique property. That is what it is saying. So I anticipate—this is my view and I would like to think it will be completely agreed to at the next meeting—that nanotechnology will be defined something like this: A collective term for a range of technologies, techniques and processes involving the manipulation of matter at the nanoscale, that is, in a size range from approximately 1 to 100 nanometres. I think that is what it is going to look like.

The Hon. MELINDA PAVEY: What is the potential impact once there is an agreed ISO nano definition in countries all over the world?

Dr MILES: I think the potential impact is that people will be able to decide whether what they are doing is nanotechnology or not, and that is what everyone is crying out for. That is why they want some certainty in regulation, in industry, in all sorts of areas. A lot of the push from the United States, which was arguing for the emergent phenomena, was that they did not want to consider what they were doing to be nanotechnology because they had been doing it for 50 years, and yet in this definition that I have read it will be now classified as nanotechnology, so they will have to go through all the nano regulations. That was upsetting a lot of them.

The Hon. CHRISTINE ROBERTSON: And the gentleman who wants to do the mapping will have to go right back through lots of history?

Dr MILES: Yes, people who have been working with silicon dioxide in soup, for example, which has been put in for years and years and years. Nanoparticles of silicon dioxide added to soup to make it flow better has been going on for 50 years.

CHAIR: Do you have any closing comments that you would like to share with us?

Dr MILES: I do, very quickly. I would urge you, along with I think some of the other people who have been at this inquiry, to consider New South Wales' position in relation to Victoria and Queensland. Coming from Victoria, I am very proud of my State and they have in fact done marvellous things in nanotechnology, as has Queensland, and I think it is somewhat behove of New South Wales, which is obviously one of if not the major State in Australia, to actually bite the bullet on nanotechnology.

(The witness withdrew)

(Luncheon adjournment)

GEORGIA NICOLETTE MILLER, Nanotechnology Project Coordinator, Friends of the Earth Australia, PO Box 222 Fitzroy, affirmed and examined:

CHAIR: If you should consider at any stage that certain evidence you wish to give or documents you may wish to tender should be heard or seen only by the Committee, please indicate that fact to the Committee and it will consider your request. If you take any questions on notice today the Committee would appreciate it if the responses to them were forwarded to the Committee secretariat by Thursday 22 May. Would you like to start by making an opening statement?

Ms MILLER: Yes, thank you. Thank you for the opportunity to speak with all of you today. I commend the Committee for launching this inquiry, which has come at an important time in Australia's consideration of how to deal with nanotechnology. I thought I would start by giving you a bit of background about the interest of Friends of the Earth in nanotechnology issues. As you know, we have been working on this for some years now, since early 2005. Friends of the Earth Australia is part of an international network that includes over 70 groups and represents around two million people—members and supporters—internationally.

Friends of the Earth Australia has sister organisations in the United States of America, Germany, France, South Korea and other countries that are also working on nanotechnology issues. I have given you a lot of detail in our submission about the work that we are doing, the concerns that we have about nanotoxicity, and other aspects, but I thought it was worth giving you some detail in the context of this discussion. I guess that context is the really quite remarkable predictions of the implications of nanotechnology that have been made by some of its proponents—the Australian Government its 2006 report "Options for a National Nanotechnology Strategy"; by groups like the APEC Centre for Technology Foresight, the United States National Nanotechnology Initiative, and others—that nanotechnology offers us a technological platform that will underpin the next industrial revolution.

That is a significant prediction because it has implications for every sector in industry and it is the fabric on which our infrastructure rests for communications, agriculture, medicine, the military and energy production. It is predicted that a whole range of sectors and aspects of the way in which society functions and on which our political economy is based will be transformed by new nanomaterials but also by next generation nanotechnology and the convergence of nanotechnology with information technology, biotechnology and a range of other techno scientific disciplines. This is of interest and concern for my organisation internationally because of its experience with previous industrial revolutions.

There was also a time when the basis of industry shifted in the British and European Industrial Revolution from one based on human labour and agriculture to one based on mechanised industrial systems, big increases in productivity, massive changes to the nature of people's work, and huge changes to communications and to people's mobility. It was also a time of a great deal of poverty as displaced workers were made redundant, a time of mass immigration to the new world and a time of big pollution problems. It was really a time of great upheaval. Our interest in nanotechnology is whether it can do some of the same things—whether it can provide a platform on which we can greatly increase productivity and efficiency and transform the way in which industry functions and society exists.

What then will be the implications? What will happen if that takes place over a period of years or even decades rather than 100 years or more? Our concern is that the sorts of implications for labour markets and social relations are not being delved into at all. We no longer have a new world. Should nanotechnology displace existing industries and workforces? There is no safety valve this time. Indeed, we are already in a situation where with climate change, pollution problems and food systems in a lot of ways we are already at our ecological limits. The choices we make now are really important. We are concerned that there are no conversations about where nanotechnology is taking us.

Even though there are predictions of evolutionary change there is no associated assessment of bigger social or economic implications, and there has also been very little attempt to involve the public in a discussion about research priorities and what sort of technology development they would like to see. We are very concerned about the immediate toxicity risks of first generation nanoparticles.

We talk a lot about that in the report we produced on nanotechnology, food and agriculture, of which you should all have a copy. But there are bigger term questions, environmental impacts and social implications. These are the things that we would really like to see a much more focused discussion around.

CHAIR: For a number of years Friends of the Earth has had an active nanotechnology project. How did that project start?

Ms MILLER: My organisation is a very decentralised and grass roots organisation that is volunteer driven. A lot of the projects of active work evolve out of the interests of our members. A number of us have been interested in new technology issues for some time—around genetic engineering, the nuclear industry, renewable energies and other issues to do with technologies. So it was something on which we were keeping an eye. Back in about 2004 there was a critical breakthrough in international awareness of nanotechnology. That was partly because there was a real acceleration in the outputs of industry, and products containing manufactured nanoparticles were reaching the market larger quantities.

There was also the publication of a number of really pivotal reports, for example, from the United Kingdom's Royal Society, from Swiss Re, the world's second largest global reinsurance agent, and from other really eminent bodies. Around this time we realised that there was very little public awareness about nanotechnology—which I think it is fair to say is still the case—and there was also very little political awareness. We thought there was a need for civil society groups to be trained to talk about public interest challenges. That is what we have tried to do with our work.

CHAIR: In its submission Friends of the Earth notes its disappointment that this inquiry did not include specific terms of reference to address the social implications of the potential of nanotechnology. Could you expand on some of the social challenges that you believe nanotechnology may present?

Ms MILLER: Sure. I talked a bit about this in my opening statement, so I will not refer to it in too much detail because I am aware of the time constraints. There are two key things for us. First, it is looking at critical questions underpinning technology. If this technology brings really large changes to industry, to society, to the nature of people's everyday lives, what sorts of changes will we see? Who will control this technology if it is an enabling platform? Looking at who is taking up the patents now internationally it is clear that, even though research is happening on a global scale, Europe, North America and Japan are holding the largest number of patents.

What will this mean? Will it potentially exacerbate existing social inequities? If the poorest countries in the world are on the receiving end of a growing nanodivide what will happen to companies, countries and peoples whose products are displaced by nano? Some analysts, like Lux Research, have predicted that nanomaterials will displace markets for key commodities on a big scale—things like cotton, copper and rubber. What happens if the poorer countries whose economies are largely relying on those commodities suddenly find themselves with no markets? What will that mean? We could also ask that question of Australia, as cotton remains our fourth largest export.

Nowhere have I seen a government assessment of the potential for nanomaterials to displace cotton, even though we are told that that is likely. The second thing relates to its social implications. What is the appropriate role for public preferences and priorities in shaping the way that technology is developed? Where do we put the research money and what conditions will we attach to commercialisation?

I think sometimes we can think that nanotechnology is kind of a predetermined trajectory whereas we know that is not the case. Our experience with other technology shows us this. Where you put the research money will have a big implication on what comes out the other end. So, I guess some of these we see as important social issues.

The Hon. MELINDA PAVEY: We heard evidence earlier today from the Australian Manufacturers Workers Union. They also have called for a moratorium of commercial use of nanotechnology until a number of actions have been taken. This call does not exclude, as I understand,

the research and development of nanomaterials. Has the Friends of the Earth Changed its stance with respect to research of nanotechnology?

Ms MILLER: No. Our position is that until we have actually got laws in place to protect researchers and other workers who are exposed to nanomaterials through their work—I am including in this people like cleaners, maintenance workers and other staff who are exposed in the laboratory context—we think there is a real danger in seeing further commercial oriented research. So, I guess where we are coming from—

The Hon. MELINDA PAVEY: So if it is commercial research you would not support it, but you would support research if it is for what?

Ms MILLER: Yes. At the moment we see there is a really urgent need for research into the health and environmental risks of exposure to nanomaterials. So, our position around a moratorium has been, firstly, that we should not be selling products commercially but, secondly, before we have further commercial research we actually need new standards in place to protect workers in those workplaces. In order to do that we need a whole lot more investment in health and environment-focused research, which at the moment attracts a really tiny proportion of research funds.

The Hon. MELINDA PAVEY: Is that for all nanotechnology? Is it for nanotechnology dealing with toxicity and free particles, if you like? We heard today from representatives from the University of New South Wales who are doing nanotechnology development into atoms and replacement of silicon chips. Do you distinguish between the two types of research or is it just a blanket no commercialisation research?

Ms MILLER: We are most concerned by research that involves manufactured nanoparticles. We do not distinguish between in the finished products if those articles are in free form like in cosmetics or if they are in fixed form as in car parts because we see that at different points in the product life cycle there is going to be exposure to free particles—so, for example, in research, in manufacturing and at end of life. Our call for a moratorium focuses clearly on a commercial sale of products that include manufactured nanoparticles, but we have also said that until we have new standards and regulations in place to protect the workers who are exposed in research places, we should not actually see further commercial research and development. In part this is very much a call to focus on the much-neglected area of health and environment risks. I will just explain why we think it is so urgent that we do that.

Internationally to date there has been about 0.4 per cent of global research into nanotechnology that has looked at health and environment risks of exposure to nanoparticles, which is a drop in the ocean. We are really concerned about this because at the moment, although we know enough to know that we cannot predict the behaviour in the body of manufactured nanoparticles based on the known toxicity of the same substance in larger form, we know very little about what sort of exposure level may cause harm, whether any exposure level may be safe. The alarm around the significance of the risks is such that in 2004 the United Kingdom's Royal Society recommended that all nanomaterials be reclassed as new substances and that they not be allowed in commercial products until they had been subject to new safety assessment and until they were labelled. But at the moment we do not actually know enough to set standards. We do not know enough to set safe exposure standards to protect workers and the public or the environment from exposure. So, I want to focus really clearly on our concern about sales of commercial products with nanoparticles, but also just to say that we need a dramatic increase in the proportion of research money that is directed to studying non-commercial stuff—so, health and environment risks—in order for us to have even safe commercial research.

Reverend the Hon. FRED NILE: Following on from that, today we have had people speaking to us from the University of New South Wales et cetera who emphasised how they have all these health and safety rules and regulations under which they are operating and that it is not an unregulated area.

Ms MILLER: No. Actually, I would beg to differ. It is unregulated. So, each workplace may decide on lab practices and measures that they will take to protect their staff, which is great. I think particularly the people who are most involved in the research probably are most aware of the need to

take measures to protect their staff and that is something obviously we applaud. But it is not correct to say there are actually regulations because at the moment nowhere in the world is there a national level attempt to regulate nanoparticles. What that means is that where the nanoparticles exist that have been previously approved for use in bulk form—and that is a lot of nanoparticles; it is things like zinc, titanium dioxide, copper or gold, things that we work with in larger form—they are treated as if they exist in larger form. That is, our regulations do not make any distinction based on particle size even though we know nanoparticles behave differently. All of the permissible exposure levels are benchmarked to exposure to larger particles.

So it is not correct to say that there are regulations, although it is certainly true, particularly in certain research laboratories, that they are taking measures to mitigate exposure. But, of course, it is a concern to us that outside the research labs in terms of the broader workplace exposure—so, for example, for workers who are involved in manufacturing paints that may have nanoparticles additives, or cosmetics, fabrics or building materials—a lot of those workers would not even know whether or not they are handling nanoparticles let alone have any safety measures in place.

Reverend the Hon. FRED NILE: The New South Wales Government supports industry adopting an ALARA—that is, As Low As Reasonably Achievable—precautionary approach to nanomaterials, as recommended by the Australian Safety and Compensation Council's 2006 Review of OHS implications of nanotechnology. Does this approach satisfy your understanding of the precautionary principle? Probably no?

Ms MILLER: Yes! No. The precautionary principle has had a lot of bad press over the years, so I am going to frame my comments not even in terms of the precautionary principle but in terms of the Royal Society's call for assessment of nanoparticles as new chemicals that because that is the bottom line for us. If you have substances that behave in novel ways, we think you need to subject them to new assessment. You cannot grandfather them, if you like, under the existing assessment of the larger particles. We are concerned that as low as reasonably practicable may not be enough. At the moment we know that we know very little about what sort of exposure may cause harm or be safe, but also about the efficacy of existing control measures to safeguard against exposure.

The early indications are that some systems of exposure mitigation—for example, through bigger control system measures in a research lab—may be reasonably effective, but the early indications are that just personal protective equipment is likely to not be effective. It is interesting, for example, to look at the Health and Safety Executive Report from the UK that came out in 2004, which looked at a whole range of exposure prevention measures. There have been others since then. The bottom line is that we still do not know how well we can prevent exposure and we still do not know what sort of exposure is likely to cause a problem. So, in our view it is not good enough to just say exposure should be reduced as far as we can until we know whether or not that is good enough.

Again I come back to the Royal Society's recommendations because it is not just groups like Friends of the Earth that are saying you need to treat nanoparticles as new chemicals. This is the world's oldest scientific institution, a very credible institution, and it has been extremely concerned about the failure to treat nanoparticles as new chemicals.

Reverend the Hon. FRED NILE: You mentioned in your opening remarks about the global insurance company?

Ms MILLER: Yes.

Reverend the Hon. FRED NILE: Was it indicating some problem? If someone said, "We want to insure our products" or "We want to insure our laboratory" was it raising some issues? I am thinking of James Hardie, which finished up with $2 billion dollars in a compensation fund?

Ms MILLER: Parallels have been drawn between nanoparticles and asbestos by many people and institutions, including Swiss Re. Swiss Re's concern was that the key parallel between risks associated with nanoparticles and risks associated with asbestos exposure may not only have the potential for serious harm but the potential for such harm to manifest a long time after exposure, which makes it really hard for the insurance sector to calculate the risks that may be associated. If you

are fairly sure that there is potential for long-term harm but you are not in a position to calculate that harm, that is a huge liability for the insurance sector and that has been their main concern.

Reverend the Hon. FRED NILE: Are they knocking back policies, or are other insurance companies?

Ms MILLER: To be honest I am not sure what Swiss Re is currently doing, but in its 2004 report it said that it thought that the nanosector would be extraordinarily difficult to insure. That has been reiterated more or less by Allianz, which is another big insurance provider that released a report either in the same year or else in 2005. But certainly the insurance sector has been one of the key critical voices about ongoing commercialisation and products that contain nanoparticles. Swiss Re said that, in the scientific uncertainty, every step should be made, irrespective of cost, to take an approach based on the precautionary principle.

The Hon. MELINDA PAVEY: I probably should have asked this question earlier, Ms Miller. In terms of your nanotechnology—I have just gone through your submission again—does Friends of the Earth have a size definition of nanotechnology?

Ms MILLER: That is a really good question. This is something that we are still grappling with.

The Hon. MELINDA PAVEY: As is everyone.

Ms MILLER: As is everyone.

The Hon. MELINDA PAVEY: In terms of the definition.

Ms MILLER: Exactly, and at what size it makes sense to consider a particle to be nano. As you will be aware, this is a live discussion in institutions across the world. From our perspective, there are two key things. One is the role of particle surface effects. This plays a key role in the way a particle behaves. As you would no doubt have heard from other people or know yourselves, the smaller a particle is, the more reactive atoms it has at its surface. The more reactive it is likely to be, the more likely it is to catalyse oxidative stress-related interactions with other bits of our cells.

One is the particle surface effects, which is a continuous thing, although they kind of accelerate in this range of a few hundred nanometres. I guess the second is the novel nanoproperties, which are the change of colour, the change of strength, the change of solubility, and these kinds of things. There is not a clear sort of 1 to 100 band in which these novel nanoproperties are exhibited. In some particles it may only be below 50 nanometres in size, in some it may be a bit more than 100 nanometres in size, but I guess the nanoscientist in particular picked the 1 to 100 nanometre range to describe nanoparticles because that is where you tend to see most normal properties that are of interest to industry.

Our concern is that once you start talking about biological effects, that is a slightly different question because it partly relates to the particle surface effects and it partly relates to access to our body's cells and tissues. When a particle is below approximately 300 nanometres in size, it can get into our cells. When a particle is below approximately 70 nanometres in size, it can get into our cell nucleus. The ability to get into individual cells, in our view, is a key defining feature of nanotools. It is interesting that in a lot of the medical literature and the food science literature, they are actually describing nanomaterials as being up to a few hundred nanometres in size. There is a whole range of different interpretations for what nano is. Some people say that it is anything less than a micron, which is 1,000 nanometres in size, and some people say it is a few hundred nanometres in size.

The working definition that a lot of the international institutions are developing is the 1 to 100 nanometres in size. In our view that it is just going to be really inadequate for the purposes of health and safety assessment because we have these particles which may not necessarily have novel colour properties or electromagnetic properties, but clearly behave in a way that has unique access in terms of getting into ourselves, which are more likely to catalyse reactions which result in oxygen distress, and which are more likely to do damage to your cells or nucleus. That is why we have taken the view that for health and safety assessment we should be working on a definition that goes up to a

few hundred nanometres in size. There is a sort of a longer and referenced discussion about this vexed size issue in our nanofood report, which is really interesting.

The Hon. MICHAEL VEITCH: Ms Miller, from what we have heard you say today, it would be fair to say that your view is that the current regulatory framework, particularly as it applies to workers but also consumers, is insufficient.

Ms MILLER: Absolutely.

The Hon. MICHAEL VEITCH: Would you be proposing a whole new addendum to the current occupational health and safety legislation, for instance, in New South Wales to specifically cover nanomaterials?

Ms MILLER: We are doing some work, at the moment internally in our organisation, thinking about these governance issues because it may be, for example, that it makes more sense to have a stand-alone kind of nano-specific regulatory mechanism rather than look at addendums to all the different legislation. But that is something we are still thinking through. What we recommend as a first step, which is probably the least kind of disruption and new regulatory effort, is just to require assessment of nanoparticles as new chemicals.

In that instance, the regulatory systems would stay the same. It is just that you would have a trigger for that required assessment of nanoparticles before they are released to market. Just to illustrate why we think that is necessary—say you are making a sunscreen and you want to include a nano form of titanium dioxide in your sunscreen. Because titanium dioxide has previously been approved for use in sunscreens and a whole range of other products, like food and other things, there is no trigger that requires a new safety assessment. Even though you may be using the titanium dioxide for its normal properties, in this case because it is transparent rather than white, there is actually no recognition in the regulations that it may behave in ways other than colour, for example, in its toxicity implications or potential capacity to be taken up through the skin, or whatever it is.

Just to give you another indication with food additives, take zinc, for example, which is often used to fortify food. Because zinc has been approved as a food additive, if you wanted to include a nano form of zinc in food, there would be no trigger that would require a new safety assessment of the nano zinc before you put it in the food. Ironically there is not even a trigger that would require the manufacturer to notify the relevant regulator. We are in a situation at the moment where not only is there no trigger for a new safety assessment, but there is actually no trigger to notify the regulator, let alone labelling to notify the consumer. We are in a situation where there is a really significant regulatory gap in so far as nanoparticles are concerned. The first thing that we think needs to happen is just for nanoparticles to be treated as new chemicals so that there is a trigger that is built into all the respective regulatory systems.

The Hon. MICHAEL VEITCH: In terms of consumer awareness and information—and your submission talks a lot about engaging the community—it would be fair to say that probably 99 per cent of the population has no idea about nanomaterials and whether they are being used. Do you have some suggestions on how, for instance, the New South Wales Government could inform and advise consumers about nanomaterials, particularly in food or cosmetic applications?

Ms MILLER: Absolutely. We have a range of recommendations. If it is helpful for the Committee, I am really happy to present in written form a summary of some of the measures we think could be useful rather than trying to explain them.

CHAIR: That would be great, if you could give us that.

Ms MILLER: Yes, I would be very happy to do that. The key thing I would say briefly now is that we think it is important for the Government to provide information to people about these technologies, particularly products that people are already using, but we also think it is important to go beyond awareness phasing and to look for new ways to involve the public in informed decision making at all stages of the chain—for example, in terms of research priorities and in terms of mechanisms to encourage private sector investment in certain aspects of technology development and in terms of governance. There is a whole range of places in which we could seek useful involvement

of the public, but we recognise that because awareness is so low, we need to look to new initiatives to support information sharing with people who can then be resourced to provide some input back.

We are not suggesting, for example, just holding a whole bunch of town hall meetings, but perhaps looking at some of the deliberative models which are being trialled in other countries. They gather together random groups of people in a facilitated process where information is given from a range of experts, where people are supported to consider these issues and to make recommendations back. I am happy to provide some more information about examples of where these sort of deliberative models have been trialled in respect of technology and the recommendations we have for New South Wales.

The Hon. CHRISTINE ROBERTSON: NanoVic has a web site, as I am sure you know.

Ms MILLER: Yes.

The Hon. CHRISTINE ROBERTSON: I am just wondering how useful you think that is for the public information process and what sort of people would use it.

Ms MILLER: I think that NanoVic does a whole bunch of really great work. We have had ongoing dialogue with them over a period of years. Having said that, we also recognise that 90 per cent of their job is about promoting nanotech commercialisation. I think it would be fair to say that although they take an interest in a whole range of issues, and they do make an effort to raise some of the bigger issues as they see them, it is in a sense an addendum to their primary role of promoting their industry's development in Australia. We would not necessarily see that model as a key example of how the Government could provide information. We would like to see, for example, information coming from a group that did not have a clear link to promoting the industry's expansion. But in terms of the range of things that they cover and their efforts to include some pod casting and links to a whole range of other groups' websites and information on a lot more activities happening in Australia, there are definitely some useful elements on their website.

The Hon. CHRISTINE ROBERTSON: This morning the Committee heard from the CSIRO's nanosafety representatives. Have you been involved in their work or have you listened to them?

Ms MILLER: I have met with some of the members of the nanosafety project. I have met with Maxine McCall recently.

The Hon. CHRISTINE ROBERTSON: Is the work that they are doing the sort of thing you request more certainty about?

Ms MILLER: Yes. Look, we think their work is obviously much needed. The work that they are doing, as I understand it, is basically focusing on a couple of nanomaterials that are the focus of commercial development in Australia, that have been produced here, and that are being incorporated in products here. While applauding the work that they are doing—we think it is really useful—I will also just point out the limitations in that there are a whole range of nanoparticles in commercial use in Australia which are not being looked at by the CSIRO and which do not go through any new safety assessment process before they are put on the market.

I also point out that the important work that CSIRO is doing will take some years in nanoparticles that it is looking at before it will come out with recommendations so that we might know what that means in terms of safety standards. I guess this takes us back to Friends of the Earth key concern around nanoparticles management, which is that by the time we do that work needed at an international level, agree on a definition, to even understand what size it makes sense to consider a nanoparticle to be a nanoparticle, to measure nanoparticles, to do safety testing not just in the test tubes which we are doing at the moment but also in long-term animal studies which are only just beginning. By the time we close the gap in terms of the knowledge gaps and figure out how these things behave in our body, how we can measure them, how we can talk about them, do the work that we need in order to set good regulatory standards that will protect people and the environment from exposure risks, it is likely to be years down the track, and I think it is important for the Committee to be aware of this. It is possible that it may be 10 years down the track.

When you look at some of the recommendations for research strategies that have come from some of the eminent nanotoxicologists, they are talking 10 to 15 years to address just the most urgent priorities of first generation nanoparticles that are on supermarket shelves now. It is important to be aware not only of this research and the time it will take to close that gap but also the huge number of products on the market now. In our submission we have a list of just some of the products that are available in Australia but they are just the ones we know about because for some reason their manufacturers have seen it useful to recognise the nanocontent. There could be a whole range of other products as well that we just have not stumbled across yet.

So we have two challenges. One is that there are so many unknowns and it will take us years to address those unknowns at the pace we are going at the moment. The second is that we have a burgeoning industry and the number of products has expanded greatly in the few years that we have been working on nanotechnology issues. That is part of the reason that we are calling for a moratorium. We recognise that the number of products on the market will only keep expanding rapidly and yet at the moment with the small amount of health, safety and environment research that is going on, we are crawling along at a snail's pace. And it is not just in Australia. I was at the OECD working group on nanomaterials meeting last November-December and all of the OECD countries are in the same boat.

The Hon. CHRISTINE ROBERTSON: How would such a moratorium be implemented?

Ms MILLER: There is any number of ways that that moratorium could work, and I would encourage the Committee to think laterally in terms of thinking about your priorities for the industry's development but also in terms of making sure that we do not end up in a situation where this is the next asbestos, which is a risk that we run at the moment. A lot of people have said to me, "How could a commercial moratorium work? What about the electronics sector? What about tyres in cars that contain carbon black?" One pragmatic response to that, which is not a Friends of the Earth position but something you might want to think about, is what if you just say, "Let's leave the electronics sector. Let's leave car tyres and let's look at this burgeoning number of products that are on the market that contain manufactured nanoparticles that our best knowledge now indicates will pose serious toxicity problems"?

You may want to think about other measures, other approaches that you could take. I am sure you have had a lot of testimony from expert scientists but if it is useful we are happy to provide dozens of relevant nanotoxicity studies that relate to nanoparticles in consumer products sold in Australia. Our concern is that even though the number of studies is quite small, there is a wealth of studies out there that show that products on the market now contain particles that may very well pose serious toxicity problems.

CHAIR: What knowledge do you have in the way of what nanotechnology may be in pesticides or herbicides? Do you have knowledge of that?

Ms MILLER: This is an area where it is very difficult to get information about commercial products on the market. What we do know that over the past probably 10 years there has been a whole range of key review scientific articles published which detail the different ways in which they know can be used to manufacture pesticides, herbicides and other chemical inputs. There are two key ways that I am aware of that scientists have shown that nano can be used. One is by reformulating existing chemicals in nano form so by breaking the emulsion size down to nano size, 100 nanometres or less. For example, we know that Syngenta has done this with its Primo MAXX plant growth regulator, which is sold in Australia.

We suspect that this is also used in Syngenta's MAXX range of products although Syngenta has not acknowledged this publicly. They are also marketed in the same way as the Primo MAXX, as a micro-emulsion concentrate and promoted for their small particle cells. We know that the big agri-chemical companies like DuPont and Bayer have active nano programs, and we also know that there is another range—I talked about the nanoformulation in existing agrichemicals and I guess there is a second branch which is encapsulating pesticides in nanocapsules which are designed to break down in certain conditions and this is a whole other range of research. We know that, for example, several

companies have approached the US Office of Pesticide Programs seeking to register nanopesticides and the reference is in the report.

CHAIR: Do you have a final comment on something you may not have been asked that you want to touch on?

Ms MILLER: I guess the key thing for us is that we know that the national nanotechnology strategy is being reviewed at the moment. The existing strategy will finish in June 2009 so we see the next 14, 15 months as critical. We think that inquiries like this will play an important role in informing the work that happens at a national level as well as what happens at the New South Wales level. We are recommending three things in those 14 or 15 months. One is support for a moratorium, if not on commercial research then at least on commercial sales of products that include manufactured nanoparticles because we think there are serious problems with products on the market now. It makes zero sense for an industry to keep selling products that are likely to be problematic.

The second think we think is important is reviewing the gaps in the existing national nanotechnology strategy. There is almost no look at broader social implications. There is no rigorous analysis of even the economic implications, which is crazy. We need to look at what nano will mean for Australian industry sectors, labour market, infrastructure needs. That stuff needs to be addressed. The third and important thing is that we need to see public participation measures initiated to inform this review so that when we get to June next year we are not the same boat that we were in June last year, which was having a strategy that had almost no public input, serious gaps and omissions and which did not take a proactive approach to managing the immediate risks of products on supermarket shelves.

(The witness withdrew)

HIMANSHU BRAHMBHATT, Joint Managing Director, EnGenIC Pty Limited, and

JENNIFER MacDIARMID, Joint Managing Director, EnGenIC Pty Limited, affirmed and examined:

CHAIR: If you should consider at any stage that certain evidence you wish to give or documents you wish to tender should be heard or seen only by the Committee, please indicate that fact and the Committee will consider your request. If you take any questions on notice today, the Committee would appreciate if the responses to those questions could be forwarded to the Committee secretariat by Thursday 22 May. Would you like to make a brief opening statement?

Dr MacDIARMID: I will make an opening statement and describe who we are. EnGenIC was founded in 2001 as a biotechnology company by Dr Brahmbhatt and myself. We have from the beginning had a mixture of private equity and venture capital money, all Australian, and we have been very successful in gaining some Government grant money from both the Federal Government and the State Government. Even very recently we received a grant from the Minister for Science and Medical Research for this year. We will show you a short animated DVD to describe the technology because visual things are always better than someone talking.

Basically, we have been able to manipulate bacteria so that when they divide in the centre to form daughter bacteria they also can split off little nanocells at their poles, and these little buds we call the EDV, which stands for engenic delivery vehicle. We have discovered that these little nanocells can be loaded with a wide variety of chemotherapeutics and because of their surface structures we can put targetting mechanisms, antibodies, on the surface and target them directly to cancer cells. They act like smart bombs. They are loaded up with a pay load, they go into the body and they find the cancer cell and deliver the pay load directly into that cancer cell.

We all know that when a person has to face chemo therapeutic treatment, it is like a scattergun approach, the drug floods the body, it goes all through the body and hopefully a little bit gets to the tumour but a hell of a lot of it also gets to other non-target and normal cells. So what we have here is a targeted therapy that can be taken up by the cancel cell, and the cancer cell, in effect, commits suicide. Basically, in our preclinical animals studies we have not seen toxic side effects. So that is the basis of our technology. In the definition, which we wrote in our submission, it is a little hard to define because it is 400 nanometres. If you consider a micron, a micronmetre, then it is a nanocell size. However, the FDA and other people consider that less than 200 nanometres is a nanoparticle. But we think we fit into the nanoparticle size, and it is really the first true nanocell that has been described. We will now show the DVD.

Reverend the Hon. FRED NILE: How does it find the cancer cell?

Mr BRAHMBHATT: We show it on the DVD.

(DVD shown)

Ms MacDIARMID: You can ask questions if you wish.

Mr BRAHMBHATT: One of the points, what you see here, is the distinction—when a word like "nanotechnology" gets bandied around the difficulty is distinguishing highly risky new chemical entities that people might develop, as opposed to nanotechnologies that may have. Every component of the system that you have seen in this nanotechnology, every one of those components has been seen by the human body for a long time—antibodies are known, bacterial cells are known, toxicity profiles are known, the genetic networks are known. The big difference here is that when one goes into these nanotechnologies it is important to actually be able to take it case by case, rather than a very generalised view.

When one puts things into food substances—I was in the audience and listened to the previous speaker—and, secondly if you throw things out into the foods, and people go and make all sorts of nanomaterial—as opposed to nanotechnology—then it can be very dangerous: it is fully agreed. Those nanomaterials need to be clearly identified, what are the components of this particle?

How does this thing work? Therefore, if it shows up clearly that this is a new set of chemical entities, not previously tested in a human system, then it should go through very rigorous testing procedures before such a particle can simply be thrown into a food substance, and the consumer is not aware there is widespread use.

In contrast, you have these types of nanotechnologies where the considerable benefit that can be derived for the hundreds of thousands of cancer patients worldwide is tremendous. In fact, for more than 100 years we have been battling with this problem of cancer. Since our first landmark paper was published on our database alone we have got more than 800 cancer patients from just within Australia. In the morning when we go to the office it is almost heartbreaking to see the emails flooding through "Please do something. Can I not be a compassionate case? I don't have time to live. When are you going to get in the clinics? Can we do something?" There is clear recognition that something like this is actually offering exactly the opposite to what we are doing.

The risk of flooding the body with cancer drugs is far greater than something like this which in nano concentrations can go straight into the cancer cell, finds nothing—yet, given all these, we have over the past two years gone through rigorous testing. We have cleared the safety profile in 64 monkeys. We went through very rigorous testing. We have tested it in dogs. We have tested it in more than 4,000 mice. One cannot deny that, sure enough, one needs rigorous testing but this generalisation is a little bit worrying.

The Hon. MELINDA PAVEY: If you were testing this product in another jurisdiction in another country, would those standards have been the same?

Mr BRAHMBHATT: Yes, in fact, our technology now, the news has spread worldwide, and the United States pharmaceutical companies, regulators, Australian regulators have also had a look at this in detail. They all can clearly see our toxicity data so we have a very large amount of toxicology in monkeys, dogs, pigs and mice, all of this, in a very extensive set of toxicity data. Sure enough, everybody has simply seen that this is too tiny an amount and it is tremendously effective in terms of therapeutic effect. You are actually seeing hardly any signs of toxicity. So regulators worldwide, especially even pharmaceutical companies have literally said "What you have done is actually in excess." Recently we had the TGA say "We are very happy that you have got into the primates, shown in 64 monkeys." We already have planned another monkey study just to take it to the extreme point of studies, full analysis of toxicology. They said they are very happy that we have gone through all of that although it would not have been necessary, given how this technology works.

Ms MacDIARMID: The other thing too is that our little nanocell is broken down inside the cell so there is no remainder of the particle; it is broken down and releases its payload. So the toxic payload is far more worrying than the actual particle itself, but as long as its intracellular that is fine. So it will not get into organules, it is just taken up into the liser zone which is the little factory inside the cell that breaks things down. It is broken down completely and the payload is released.

The Hon. MELINDA PAVEY: How did your company start up in New South Wales, Australia? Have you received any government funding?

Ms MacDIARMID: Yes, we started up by walking the streets, and leaving our job and having an idea and walking the streets to find money. So we got some good backing from private individuals.

The Hon. MELINDA PAVEY: Where had you been?

Ms MacDIARMID: CSIRO, yes, but this was not a project within the CSIRO. We were both working on vaccines for animals. We knew bacteria did this just sporadically and we thought we might be able to make it such that the bacteria did it all the time, and we thought this would be a very interesting way. We first started off thinking about gene therapy and then once we established the company we were able to show that, in fact, drugs go in there very well, and that is a good way to package drugs. Once we had the company established, and had proof of concept, yes, we went to the Federal Government for the Start Grant Program, in those days, and the State Government is not well funded in the science area but we have managed to attract money for some patent support from the State Government and more recently, I think, it is a biobusiness grant.

The Hon. MELINDA PAVEY: Have you been doing any work with the University of Western Sydney, which has a nanotechnology focus?

Dr BRAHMBHATT: No, you see this is a very unique technology. Since it does not fit into the nanomaterials area, it was too unique something to actually go and do in all these other things.

Reverend the Hon. FRED NILE: Do you sell the product you have created to hospitals?

Dr BRAHMBHATT: No.

Reverend the Hon. FRED NILE: Where does it go?

Dr BRAHMBHATT: At this stage we are still going through very rigorous testing. We are doing certain trials in dogs suffering from cancer, so a variety of different cancers. We are doing that not only in Australia at various veterinary clinics but also at Colorado State University, which is the world's biggest animal cancer hospital. We are doing those studies at the moment before we go into a phase one trial in humans. There we will be working with certain hospitals in Australia who are going through all the ethics approval, administration type of approval processes so that will be about a six months period during which time we have to clear all of that before we can go into a first phase one study in humans. In the meantime we have been courted by major pharmaceutical companies in Europe and the United States to partner up. The view there would be that they have certainly got far bigger muscle power to take it through intense toxicology clinical studies and marketing.

Ms MacDIARMID: At the same time they would provide us with a revenue stream such that we could fast track our own ambitions to develop our own therapeutics as well, an EDB base.

Reverend the Hon. FRED NILE: You said that cancer patients were contacting you. How were they made aware of you? Was it through the scientific paper?

Mr BRAHMBHATT: When our publication came out, it was interesting because not only was it extremely well received in the scientific community worldwide because for the first time in the world something like this had come out, but the general media had picked it up in a very big way as well. So it was spread all over the Internet and the newspapers and then an *Australian Story* was made about it by the ABC. So the general publicity gave a lot of people an idea that there might be something revolutionary coming along in terms of cancer therapies. Then people looked at the paper, et cetera, and they realised that we would be fairly close to a phase one trial. That is why people who had no other hope left started approaching us in a very big way.

CHAIR: What is the time frame for your trials?

Mr BRAHMBHATT: We hope that before the end of this year we will get the green light for the first phase one trial, which will be about 15 cancer patients.

Ms MacDIARMID: That being said, regulations move slowly.

Reverend the Hon. FRED NILE: Is it tied in with the Therapeutics Goods Administration [TGA]?

Ms MacDIARMID: Yes.

Reverend the Hon. FRED NILE: You are working with them?

Mr BRAHMBHATT: Yes, and the TGA will give the final approval. So they are working with us at the moment. We have gone through all of that. They are actually very happy with the type of toxicity data that we have generated because we have gone way overboard in showing it in primates. Normally for a phase one trial you are not obliged to do a full primates toxicology study, which is even post-mortem analysis. Everything has been done. So they are looking at it very favourably.

CHAIR: From there, what is the time frame?

Mr BRAHMBHATT: Simultaneously the big pharmaceutical company partnership because we are too small. We have not the funding to take something all the way through to market. If the big pharmaceutical partnership occurs, they will then fast track into phase one, phase two, phase three trials of their own. They will be done overseas, obviously. Then when they come to phase two, there will be multicentre trials, some of them in Australia, some of them in the United States and Europe. The therapeutic index that we have seen is so dramatic and so unheard of before when you have total resistance in the cancer and when the patient has no other option. Most patients end up in that situation because after the first few rounds of chemotherapy all the resistant cells start to crop up. So the patient goes into a little bit of a remission and about a year later or so the patient returns to hospital because the tumour has started to come back again. At that stage there are very few options and people then play around with statistics—"You have a 35 per cent chance of making another six months."

Whereas with this technology what you can do now for the first time, you can actually come in with a dual treatment protocol where you first come in with a particle that can turn off the drug resistance. Then you come in with another particle carrying the drug to which it was totally resistant. Now this particle comes in with the drug, dumps the drug in there and the tumour starts to collapse. We have shown that now in dogs that were totally resistant and we actually reversed the drug resistance and started to get them into remission. With that kind of thing at the phase two type of trial, if the big pharmaceutical companies are shown this kind of result in those types of cancer, there is a very good chance it will get fast tracked to market because there are no potential options for millions of people.

The Hon. MELINDA PAVEY: Do you need to partner up with a big pharmaceutical company to fast track it?

Ms MacDIARMID: We do, because there is just not the depth of funding in this country. We run on the smell of an oily rag. The Americans laugh at what we have done with our funding.

The Hon. MELINDA PAVEY: In a perfect world, what would government do now to ensure that this is fast tracked? Once the clinical trials are approved, what is your perfect world in terms of keeping control of the technology and the benefits?

Mr BRAHMBHATT: Within Australia? That was our original aim and that is why even for a foreigner like myself when I came and started with EnGeneIC, I was the first person to hoist the Australian flag at the company. We still have the flag there. It would require serious funding and possibly even an emphasis to partner up with an established pharmaceutical company in Australia, like CSL. But Australia is at a very early stage. We do not have so many pharmaceutical companies like they do in the United States and Europe. At the moment all we have got is CSL. That sort of partnership would have to be created because all that manufacturing, all that expertise which is in the pharmaceutical industry, all that has to apply.

The Hon. MELINDA PAVEY: What sort of government funding are you talking about, if you had the CSL partnership in a perfect world?

Dr BRAHMBHATT: It is pretty serious.

Dr MacDIARMID: It is very serious money. Clinical trials, multicentre trials cost of lot of money—tens of millions of dollars.

Dr BRAHMBHATT: Most pharmaceutical companies, when they take a product from our stage, preclinical stage, all the way through to market, would be pumping at least $300 million to $400 million behind it. That is what these phase three trials cost. However, we feel that again it is results based. The biggest costs really start running at the phase three trials level because they are multicentre trials. If at phase two people see this is a tremendous set of results where so many patients have gone into remission, then they will fast track to market, shortening the time frame as well as the cost.

CHAIR: Are you talking 5 years, 10 years?

Dr MacDIARMID: Less than five years because cancer is considered an unmet need. There are lots of therapies but there are a lot of people still dying from it. So when people have no alternative, then new radical technologies are fast tracked through the regulatory system.

Reverend the Hon. FRED NILE: Can this technology be used for anything else, any other illness or disease?

Dr MacDIARMID: We have not done any experiments apart from on cancer, but it could be used for HIV and for some bacterial diseases that reside in particular sort of immune cells that these particles are scavenged up by—so tuberculosis, those sort of diseases, perhaps even malaria. But we have not done tests. A small number of people we cannot treat.

The Hon. CHRISTINE ROBERTSON: I was thinking about tertiary syphyllis. It would be interesting to play with that.

Dr MacDIARMID: Perhaps not. I do not feel like playing with that one.

The Hon. MICHAEL VEITCH: In your opening address you spoke about the previous witness and the call for a wholesale moratorium on the nano sector.

Dr BRAHMBHATT: I think that is a little bit overboard. Again, it is because of generalisations. It is nobody's fault. Whenever a new buzzword comes out in society, this is always the case. When gene therapy came out, the same thing—we are going to create monsters. When cloning came out, everyone jumped up and down. It has to be rationally thought through. In nanotechnology any scientific review committee would be able to clearly specify is this chemical entity completely new? Is the method of transmission completely new? In which case, sure enough, one should test it rigorously. When there are clear indications that these materials have already been used in the human system, one should try and draw a distinction between medical use as opposed to general food use.

General food use is where I would certainly be cautious because if one does not have any regulation in this area, people will put all sorts of cans with nice colours on the shelves and people will start taking these things. Sure enough, that is dangerous. It is interesting with certain types of new synthetic chemical entities the type of allergic reactions that they can cause and there could be delayed hypersensitivity, which means years down the track that person will suffer from the disease. Just in nanotechnology terms, the test systems are already being developed to test whether it will cause such a downstream effect. Scientifically it is possible to address those concerns. Where they have glaring loopholes and they do not have a technique of testing out whether this will do that, you can give it to a bunch of scientists and they will very quickly come up with an essay—"Here is the validated essay." Wherever there is a need, scientists will come up with those essays and test systems.

Dr MacDIARMID: Also, with medical nanotechnology our cells are micro metres in size. If targeted therapies are the holy grail, in every disease we want the medicine that we deliver to get to the cell, to get to the disease state. Therefore, you have to have a nano particle to get inside a micro cell.

Dr BRAHMBHATT: It is inevitable; it is required.

Dr MacDIARMID: Perhaps that lady before had a point about getting into organelles inside the cell, so that is in the 10 nanometre range. Beyond that, for medical purposes it is difficult to say that all nanotechnology should be banned.

The Hon. CHRISTINE ROBERTSON: Although the particle you are utilising is larger than the "definition", it is the process of the splitting of the cell and the process of what you are producing going to infected cells that actually makes it parallel or much like nanotechnology, is it?

Dr MacDIARMID: I think we are just using a size that is less than a micrometre.

The Hon. CHRISTINE ROBERTSON: Yes, I understand, but they are talking about components and parts of totals and that is what I am trying to make sure that I have straight.

Dr MacDIARMID: These do occur naturally, it is just that we have manipulated particular strains of bacteria to do it all the time, and then we can harvest those ourselves, so we are not making a new entity.

The Hon. CHRISTINE ROBERTSON: No, but you are harvesting a piece of the original bacteria?

Dr MacDIARMID: Yes.

The Hon. CHRISTINE ROBERTSON: So you are splitting the bacteria?

Dr BRAHMBHATT: That is right.

Dr MacDIARMID: It has all the same properties as the bacteria.

CHAIR: Do you think currently available products like the nano-sunscreens have had sufficient testing by the Therapeutic Goods Administration [TGA]?

Dr MacDIARMID: I would not be able to comment on that.

Dr BRAHMBHATT: In Australia there are several sunscreen-testing laboratories themselves who are actually doing a range of these scientific tests. All that data then gets sent off to the TGA for evaluation. As far as the TGA is concerned, they have been very thorough and very rigorous in how they evaluate the scientific data that comes to them. Some of the difficulties are that these testing laboratories are commercial laboratories. So the manufacturer says, "I want my new sunscreen tested out", and these people are being paid heavily to come up with an answer. I know of one testing laboratory where the scientific director says, "Every time I write a report, if I write one sentence that is adverse, I get a bombshell from the manufacture, 'We want this sentence taken out'". It is that guy's bread and butter, so you have a conflict of interest in this sort of situation, and what eventually ends up with the TGA could be filtered information.

The Hon. MELINDA PAVEY: Perhaps there is an argument for the TGA to do a lot of the testing themselves?

Dr BRAHMBHATT: We were at the TGA and we were shown this massive facility—

The Hon. CHRISTINE ROBERTSON: Or the CSIRO.

Dr BRAHMBHATT: Or the CSIRO, yes. Where it becomes a new material or new testing—I heard the lady also talk about new chemical entities that they are putting into sunscreens. The other thing is that they are developing liquid formulations that go inside the skin, so they seep inside. These little polymers go inside the skin, so you have two points here: One is the chemical entity itself and the second thing is how deep is this thing going to go and where is it going to go? From a scientific point of view you would immediately say these two points would need to be cleared up. Then CSIRO, say, would have a testing laboratory or something and say, "Okay, let's test these things out". Were there any toxic side effects or were they long-term? How far did this material seep into the system? What is the biodistribution of this chemical in the body? On that basis they would come up with an answer. Going to a commercial testing laboratory is a little bit dangerous.

Reverend the Hon. FRED NILE: I think one of the main points you have made is that, because of medical use, you would need to be very careful of anyone placing a moratorium on nanotechnology and also one regulation?

Dr BRAHMBHATT: Yes.

Dr MacDIARMID: Everything should be considered separately on its merit.

Reverend the Hon. FRED NILE: Case by case?

Dr BRAHMBHATT: Absolutely, and when one is on a deathbed, especially when you have a child on a deathbed and they come to our laboratory—we had a grandmother on a Sunday who walked in with her grandchild. We went and opened the door and she was standing there. She said, "My grandson is dying. The doctors are saying that in two months my grandson will be dead. Here, here, go ahead and do something", I mean in a state of desperation. It is very intense. That does not mean that ad hoc somebody goes and does something, and of course we could not do anything about it. Your heart could break, but you cannot do anything about it. But the technologies are definitely coming along to be able to give not only hope, but real hope in these sorts of situations, and therefore technology does not need to be entirely feared, technology must be very cleverly thought through. All experts have to be brought together and, as pointed out, a large amount of involvement is a good idea because you do not have vested interest jumping up, "I will really push this to the market because I will make a lot of money", et cetera. All these sorts of things will happen, but it has to be taken on a case-by-case basis and certainly in terms of medical use one has to be a little more careful because there are real benefits to be gained.

The Hon. MELINDA PAVEY: Exploring that issue further, you have talked about $300 million to $400 million in terms of clinical trials within a five-year period. Is there a vested interest within some of the big pharmaceutical multinationals to keep the clinical trial standards high to such a level that they preclude the smaller players from involving themselves in a market? Is that a concern? Are the standards at times too high and too long to move quickly?

Dr BRAHMBHATT: There are mechanisms in place, for example, as Jennifer pointed out, with unmet need. In terms of cancer, if there is clear unmet need, regulators do have mechanisms by which, if there is clear potential that there is going to be a therapeutic benefit and that there are people who are dying, they will shorten that timeframe and get it out there quickly. That is what happened with AIDS. When some of those chemicals starting coming out—the original Glaxxo-Smith-Kline drugs—they were from the South American jungle, et cetera, and not fully tested up to phase 3, but the public opinion was so strong. There were all these people dying, so they were given to them. There are pros and cons to that as well, but regulators can do it faster.

Reverend the Hon. FRED NILE: It could be argued that people who have terminal cancer would want to be part of the testing?

Dr MacDIARMID: Absolutely.

CHAIR: Do you want to comment on anything that we may have missed or that you would like to point out to us?

Dr MacDIARMID: I do not think so. Obviously if Governments would like to throw a lot of money into nanotechnology medical research that would be—no, I think our main point is for the Committee to think about considering nanotechnology as a whole disparate bunch of technologies and not together, and certainly potential recipients of our nanocell do not care anything about whether it is nanotechnology or zizzo-technology if it is going to do the job.

The Hon. CHRISTINE ROBERTSON: What do you think of setting up a specific sort of nano state unit rather than just have it as a component of science as a whole?

Dr MacDIARMID: Once again, because it encompasses computers and food and medical use, I find that would be—just for me—a very difficult one to do.

Dr BRAHMBHATT: It would get very complicated because the testing procedures for each of these areas is very, very different.

CHAIR: Thank you both very much for your time and your evidence. You have certainly given us a fair bit of information. Congratulations, I hope it works well and I hope it works quickly.

Dr MacDIARMID: Yes, we do too, thank you very much.

(The witnesses withdrew)

(The Committee adjourned at 4.10 p.m.)