REPORT OF PROCEEDINGS BEFORE

STANDING COMMITTEE ON STATE DEVELOPMENT

INQUIRY INTO NANOTECHNOLOGY IN NEW SOUTH WALES

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At Sydney on Monday 28 April 2008

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The Committee met at 10.00 a.m.

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PRESENT

The Hon. A. Catanzariti (Chair)

The Hon. M. R. Mason-Cox
Reverend the Hon. F. J. Nile
The Hon. M. J. Pavey
The Hon. C. M. Robertson
The Hon. M. S. Veitch

KERRY CECILIA DOYLE, Executive Director, Office for Science and Medical Research, Department of State and Regional Development,

DEREK VAN DYK, Director, Science, Office for Science and Medical Research, Department of State and Regional Development,

KAUSTUV MUKHERJEE, Senior Manager, Innovation Statement, Industry Division, Department of State and Regional Development, and

PETER JOHN DUNPHY, Director, Hazard Management Group, WorkCover, affirmed and examined.

CHAIR: Welcome to the first public hearing of the Standing Committee on State Development's inquiry into nanotechnology in New South Wales. Does anyone wish to make an opening statement?

Ms DOYLE: Would it be useful to the Committee if I gave a little bit of context for the Office for Science and Medical Research and the roles of my departmental colleagues?

CHAIR: That might be the way to go, thank you.

Ms DOYLE: I am the Executive Director of the Office for Science and Medical Research. Kaustuv Mukherjee is a senior manager in Industry Division. These are both divisions within the Department of State and Regional Development, the Government's main business development agency. Our respective roles are pretty much explained in the titles of the divisions. Derek and I are responsible for capacity building in science and medical research as a key underpinning for State business development activities, with quite a strong focus on alignment between our capacity building activities and those broader policy and strategy platforms of government, being the State Plan and the Innovation Statement. Kaustuv's job is really about working closely with us to drive that industry alignment and also taking a stronger sectoral approach to industry development, particularly those sectors articulated in the Innovation Statement.

Mr DUNPHY: WorkCover New South Wales has an opening statement that I would like to make. I would like to thank you for the opportunity to present at the inquiry. WorkCover's interest in the inquiry relates to one of our most fundamental objectives, which is the prevention of workplace injury and illness. Our role as a regulator is crucial to ensuring responsible and safe development of the nanotechnology industry. WorkCover also recognises the national and international importance of the issue of nanotechnology and has begun to work on a range of activities in conjunction with other agencies.

I would like to cover three key points in my opening statement: the suitability of the existing regulatory regime, the need for additional research in occupational health and safety [OHS], and the need for a whole-of-government approach that supports the responsible and safe development of the nanotechnology industry while ensuring the protection of workers' health and safety. Firstly, I would like to talk about the suitability of the existing regulatory framework for nanotechnology and the need for a best practice approach to any new or revised regulation. Currently there are no specific regulatory models anywhere in the world for occupational health and safety for nanotechnology.

WorkCover believes the risk management approach outlined in the OHS legislation and the regulatory regime provides employers with a framework to protect their employees. In fact, the overarching general duties of the occupational health and safety legislation are really designed to cover all workplaces and all risks, so it is designed to accommodate new and emerging technologies. Part of that legislation is also supported by a risk management approach that requires the identification of hazards, the assessment of risks and putting in place appropriate controls for those risks, which go through a hierarchy of hazard control including elimination, substitution, engineering controls, administrative controls and personal protective equipment. Then of course there is ongoing review of those controls.

However, WorkCover understands that even with those controls there are difficulties in applying risk management principles to nanotechnology, principally because accurate and cost-effective monitoring and measuring instruments, reference material and testing methodologies are still being developed internationally and, secondly, because the risks cannot be fully assessed while these international standards are still being developed. The difficulty in developing nanotechnology standards and classifications is that it is not as simple as it would be for one type of chemical or material.

There are many different types of nanoparticles and many different properties and structures all with their own unique impacts and effects. There is still more policy work to be undertaken before new or revised OHS legislation for nanotechnology can be considered. Until more is known about the health and safety risks of nanotechnology, WorkCover certainly supports the use of the ALARP principle—As Low as Reasonably Practicable, or as low as reasonably achievable—for health and safety, which has been agreed at the national level by the Australian Safety and Compensation Council [ASCC]. The ALARP principle approach requires industry to ensure workers' exposure to nanomaterials is kept to an absolute minimum and the use of the risk management hierarchy of controls, starting with that process of elimination through to personal protective equipment.

Work is being undertaken internationally that will assist in the development of advice and policy for nanotechnology. For example, the British Standards Institution has published a guide to the safe handling and disposal of manufactured nanomaterials, which uses a similar risk management approach to New South Wales. The guide takes an ALARP approach and advises that the greater the gaps in the knowledge about the health hazard, the more cautious the control measure strategies should be. The Australian Safety and Compensation Council is working on developing a national position paper on regulating nanomaterials in Australian workplaces and WorkCover is certainly working closely with them on that. That will be tabled at the Australian Safety and Compensation Council meeting in June 2008, so this inquiry is quite timely.

The meeting will provide regulators with an opportunity to discuss possible developments and future regulatory controls and practical assistance. The ASCC's role is to identify whether there should be appropriate Australian standards, codes of practice and guidance material in the OHS framework. WorkCover strongly supports the use of a best practice approach to the development of any new or revised legislation that is specific to nanotechnology. WorkCover certainly would advocate using the principles outlined in the guide to better regulation that has been published by the New South Wales Government. Additionally, we believe that the New South Wales regulatory environment should be consistent with international and national measures.

The second point I guess is that we would like to outline that there is a considerable need for research in the area of occupational health and safety, into the implications of occupational health and safety on nanotechnology. There are many gaps in the knowledge about potential risks and benefits of nanotechnology and the current pace at which nanotechnology is being developed is a challenge for us as occupational health and safety researchers and also regulators to keep up to date with the current industrial environment. Because of the unique properties of nanotechnology, as we have discussed, it potentially exposes workers to new risks and to potential health concerns. The health and safety risks of nanotechnology, the extent of worker exposure to nanomaterials and the health risks posed to workers are not yet fully understood. Additionally, as already discussed, specific risk measures, such as a standard nanoparticle measurement and exposure standards have not yet been developed.

In light of the need for better understanding of the occupational health and safety implications of nanotechnology, WorkCover is undertaking a number of initiatives, which include working with the Office of the Australian Safety and Compensation Council to develop and implement a program of work to address the occupational health and safety risks associated with nanotechnology. We are also monitoring international developments regarding the safety issues around nanotechnology and we are monitoring international and Australian patents for new nanotechnology applications.

The other thing that we have been doing is identifying Australian and New South Wales manufacturers and suppliers of nanotech products and components and we have also been identifying and monitoring products in Australia and New South Wales that include nanotechnology products. WorkCover recognises that research occurring internationally and nationally is needed to inform and

guide the development of controls and guidance in connection with nanotechnology in the occupational health and safety context. WorkCover believes that the research in the area of toxicology, exposure controls and the measurement of nanoparticles should be a priority.

Finally, I would like to outline that WorkCover is in support of a whole of government approach which fosters the responsible and safe development of nanotechnology in the industry while ensuring the appropriate protection of workers. Given the number of stakeholders and government agencies that nanotechnology relates to, utilising a whole of government approach will facilitate communication and coordination of policy and activities. The national nanotechnology strategy brings together industry research bodies, the community and governments to assist in addressing these issues associated with the development of nanotechnology in Australia. WorkCover supports the national nanotechnology strategy, which includes specific initiatives to facilitate a whole of government approach to nanotechnology. WorkCover believes that the nanotechnology strategy provides a strategic approach that will assist in the development of the nanotechnology industry while addressing any safety implications.

WorkCover is proactively working at both the State and national level with relevant agencies and industry on a program of work specifically designed to address occupational health and safety issues. WorkCover has also joined the newly established Australian Safety and Compensation Council nanotechnology working group, we are seeking representation on the Standards Australia nanotechnology committee, and we have begun developing networks with stakeholders, including industry groups such as the Australian nanotechnology business forum. I know that was a bit of a mouthful, but thank you for the opportunity to give an opening statement.

CHAIR: Do you have anything further?

Dr VAN DYK: No, I do not.

Mr MUKHERJEE: Nothing from me, thank you.

CHAIR: Both here and overseas, lead agencies have been established such as the Australian Office of Nanotechnology, the US National Nanotechnology Coordination Office and Nanotechnology Victoria. Do we need a similar body in New South Wales to coordinate these activities?

Dr VAN DYK: Recognising what the Australian Office of Nanotechnology are doing and their specific remit around national coordination of this, we would absolutely recognise the importance of coordination. In terms of what New South Wales needs, I think we would recognise that it is implicitly important that we engage with the mechanisms nationally, federally, particularly through the office of nanotechnology, but also through the various health and safety working groups referred to. I think the situation that we have currently in Australia is that there is a large amount of activity looking at regulation and looking at the research that needs to be done, so we would support any efforts at further increased coordination.

From a Department of State and Regional Development perspective in New South Wales, and particularly in terms of the Office of Science and Medical Research, there are going to be benefits of achieving greater coordination in the research sector around this, and I think we would particularly look forward to the recommendations from the Committee around this as it pertains to greater coordination from research, but greater alignment with industry needs in seeking to achieve a regulatory system which encourages the uptake of nanotechnology in a safe and responsible way thereby supporting the economic development and industry commercialisation of our nanotech in New South Wales.

The Hon. MATTHEW MASON-COX: So, yes or no, do you think we should have an office in New South Wales?

Ms DOYLE: I think that at this point in time we are some way from a decision about what kind of formal structure is necessary, so it is not really possible to give a yes or no answer. I think we are acknowledging the need for stronger coordination, but that has to be done with our connection to the national regime and international regimes. I think we are some way from actually deciding

whether setting up a structure, which sometimes do have lives unto themselves, is actually the right approach at this point in time. We do have a science agencies group which allows us to have strong coordination across government around these types of activities and I certainly think it is not something that we would not consider in that process, but I think that we would not wish to jump to it at this point in time.

Reverend the Hon. FRED NILE: If an office were established, would it operate within your department?

The Hon. CHRISTINE ROBERTSON: Who would be the lead agency?

Ms DOYLE: Again that would be very much in relation to what the remit of the office was. We are in a business development agency. Depending on exactly the parameters of the office, it may or may not be appropriate for the Department of State and Regional Development to be the lead agency. I think we are some way from making decisions around that. Certainly at the moment in relation to this inquiry and coordination of industry, I believe we have taken very much a lead role, but as you have just heard from my colleague from WorkCover, there is a whole process and machine around the regulatory side of things that the State is very much engaged in and those things at this point come together at the Federal level.

CHAIR: What is the structure that the Victorian nanotechnology office has?

Ms DOYLE: I might have to defer to Derek.

Dr VAN DYK: I presume you are referring to NanoVic?

CHAIR: Yes.

Dr VAN DYK: As far as we are aware, NanoVic is primarily an industry uptake vehicle and the function that State and Regional Development in New South Wales has would mirror the function of NanoVic in promoting, coordinating and ensuring uptake through industry of research and technology development.

The Hon. MATTHEW MASON-COX: It has been the impression certainly given to the Committee that NanoVic are very proactive and very aggressive in relation to building an industry in Victorian nanotechnology. Can you outline what the New South Wales Government is doing to drive industry in that area in New South Wales?

Mr MUKHERJEE: The approach we have had to the take-up by industry of nanotechnology is consistent with our overall approach to technology diffusion in New South Wales. It is primarily running or supporting a series of awareness events starting from the industry forums, which provided input to the development of the national nanotechnology strategy, so working closely with the Commonwealth Government in reaching out to New South Wales businesses interested or potentially interested in nanotechnology; participating, gathering input, gathering feedback as to areas of further interest expressed by business, and addressing those through mainly awareness events or participation in national forums such as the Australian nanobusiness forum.

The Hon. CHRISTINE ROBERTSON: Can I ask how much participation there is in the coal industry by you people?

Ms DOYLE: By the department?

The Hon. CHRISTINE ROBERTSON: Yes, by the department.

Ms DOYLE: I can only answer that the Office of Science and Medical Research is quite involved in trying to facilitate research. We work closely with Newcastle University, with CSIRO, and we have a focus on and did some research into clean coal, renewables, climate change technologies and those types of things. The department's industry involvement?

Mr MUKHERJEE: Only to the extent of keeping track of the latter, that is, the clean coal research and specific initiatives relating to the clean energy sector.

The Hon. CHRISTINE ROBERTSON: Which I understand has something to do with nanotechnology?

Mr MUKHERJEE: I am aware that there has been some interest by the likes of BHP in nanotechnology, but I am not aware of specifics in relation to application in coal.

The Hon. MATTHEW MASON-COX: In relation to a strategic plan for commercialising nanotechnology, do we have one in New South Wales?

Mr MUKHERJEE: Not that I am aware of.

Ms DOYLE: There is a strategic plan for the commercialisation of discovery. At the moment its title is the BioBusiness Program, but it is more broad than biotechnology. Also the Australian Technology Showcase, which provides both funding and facilitation support on the back of the research programs run by the Office of Science and Medical Research.

The Hon. MATTHEW MASON-COX: In terms of money allocated to commercialisation of nanotechnology to specific projects or industry research, can you outline how much money the New South Wales Government provides to research and industry projects in this emerging area, particularly this financial year and last financial year, and what your budget is for the next three years?

Dr VAN DYK: I might make reference to some investment and funding that has been done under the science leveraging fund. The science leveraging fund is a $40 million four-year fund, which runs until 2009-2010, and it allocates $10 million a year. Currently under that, approximately $22 million has been invested in research infrastructure that relates to nanotechnology. However, to go back to your earlier question, these are not investments that are made on a nanotechnology basis, they are investments that can be used by the nanotechnology research, commercialisation and industry sector.

So basically there are three separate programs supported under the science leveraging fund, and these are Commonwealth programs: firstly, the cooperative research centres; secondly, the Australian Research Council centres of excellence; and, thirdly, the National Collaborative Research Infrastructure Strategy [NCRIS]. Under all of them we have—and including separate support for the Australian Synchrotron—invested fairly strongly in analytical capacity that is specifically accessible by industry, so not only the research sector.

Two examples would be the Australian microscopy and microanalysis facility headquartered at Sydney University and the national fabrication facility. Again this is a network of facilities through the universities of Wollongong, Sydney, Macquarie, Newcastle, and New South Wales, and while it does not provide specific funds for commercialisation—it is more broad than that—it is accessible by any industry sector or company that wishes to. It provides large infrastructure and an extreme technical capacity that enables them to measure and analyse—and in this case which is relevant to the inquiry—the size of nanoparticles and their characteristics.

The Hon. MELINDA PAVEY: From an overall perspective we have received a number of submissions from universities and industry that want New South Wales to take a more leading role in scientific research. I will read out some of the comments in the submissions that we have received. The University of New South Wales said that a ministry should be established that has overall responsibility for research, science, innovation and development, and that such a ministry should be supported by the creation of a New South Wales science adviser or chief scientist. I am sure you are aware that there are chief scientists in Queensland, Victoria and Western Australia. The University of New South Wales also said that a long-term strategic plan should be developed to address critical research infrastructure. That is the evidence that came from the University of New South Wales. The University of Newcastle stated in its submission:

> We need direct State funding for critical research infrastructure for nanotechnology to allow New South Wales universities to compete with their counterparts in other States.

The University of Newcastle also stated:

> We need the development of a New South Wales nanotechnology strategy that addresses the specific needs of New South Wales industry and business.

The University of Wollongong submitted:

> New South Wales should select particular niche nanotechnologies to support through research and commercialisation.

The Committee also received a submission from Pro-tech Pty Limited, which stated:

> Research and research infrastructure should be made accessible to industry and industry should be made aware of what capacity exists.

Given that it is up to the Government to push this, that is probably a difficult question for the Executive Director of the Office of Science and Medical Research, as you are a public servant. Do you have any comments to make on those submissions?

Ms DOYLE: Thank you for recognising our position. There are some things that I can say about those submissions, for example, on the back of the Premier's economic statement in 2006. I think the elements more broadly written of such a structure were brought together in one department, that is, the Department of State and Regional Development. So science, research, research and development, and business development are all aligned in one department for the first time in my 10 years as a public servant in this State. Broadly speaking, I think that those elements mirror the structures in Victoria and the new structure in the Federal Department of Industry, Innovation, Science and Research.

I think there are opportunities for greater dialogue and greater alignment by bringing together those things in New South Wales. We took some steps towards that path when the former Ministry for Science and Medical Research was amalgamated with the Department of State and Regional Development. Referring to the chief scientist's position, that recommendation has been made through a number of forums.

The Hon. MELINDA PAVEY: And the State Development Committee?

Ms DOYLE: Indeed. Under the instruction of the Minister we established a government University Working Group to work towards greater alignment between Government and the university sector—work that I think got a significant push along by the establishment of the Science Leveraging Fund and the work that the science team in the office has undertaken. The University Working Group is considering, amongst other things, the chief scientist's position—not necessarily a mirror for every other jurisdiction, although that might be so—and what value adding a chief scientist's position or chief science adviser could make to New South Wales. That is an active dialogue in Government at the moment.

I refer to some other questions, for example, the strategic plan for research structure, and I would argue that the Science Leveraging Fund is again a sound basis for that. It is a responsive fund that enables us to look at opportunities that are arising to leverage funds into New South Wales. To date it has been quite successful. The national review of the innovation system, the Higher Education Endowment Fund and perhaps changes to funding for the National Health and Medical Research Council and the Australian Research Council [ARC] are all opportunities for us, as public servants, to sit down and review the programs and structures we have now and to make recommendations to the Government as to how best to face those opportunities and do the best we can for the State and for our university sector.

Reverend the Hon. FRED NILE: Earlier Mr Mukherjee referred to his role in innovation. What would happen if a commercial company wanted to develop nanotechnology and it wanted assistance? What process would have to be followed? Who in the department would that company contact? Would the company go straight to you? How business friendly is your department to someone who wanted to develop nanotechnology in New South Wales?

Mr MUKHERJEE: The approach from companies is usually in these specialised forums. If a company were interested in nanotechnology probably the first place the company would have contact with or approach the Government would be at those forums. There would be two pathways, if I can call it that, to approaching the Government for possible assistance. One would be at such specialised forums where it is specific to the technology involved. The other is that companies ring up or drop in to the department's offices or contact points in general. Such inquiries would tend to come through to the specialised persons handling the subject of the inquiry.

Reverend the Hon. FRED NILE: Is that someone in your department or in your area?

Mr MUKHERJEE: Yes, it is. We have a number of divisions. The Industry Development Division, to which I belong, handles industry-wide matters and matters relating to industry bodies and groups of companies. The Small Business Division handles start-ups, small businesses and micro-businesses, and the Regional Development Division handles regional businesses through a number of regional offices around the State. So an inquiry could be handled by any of these divisions. The approach is to apply the specialist expertise to the extent that it is available in the department. Therefore, such a nanotechnology-related inquiry would generally come to Ms Doyle's area which is engaged with nanotechnology research and policy development, or it would come through to me as I am responsible for nanotechnology within the industry division.

Referring to what assistance is available, we look for what assistance can be offered through the department's programs. As I said earlier, we do not have a specific nanotechnology assistance program. We provide assistance that is available under our general assistance programs, some of which have been mentioned by Ms Doyle and Mr Van Dyk. Referring to research assistance and assistance to businesses to commercialise or develop their technologies or internationalise their capabilities, we would look for assistance that could be made available under small business assistance programs or trade development programs. In such a case we would look for opportunities to assist a company under the Australian Technology Showcase program, which is about commercialising and promoting Australian-developed technologies, in particular, to international markets.

In relation to our general response through the regional offices, these would filter back through the mechanism that I just described. We have had a series of seminars or events relating to nanotechnology and the businesses that are engaged in nanotechnology that have come to those events. However, they are still at an early stage in determining their future plans in relation to nanotechnology. They have not asked for any specific assistance other than what is available through the department's programs. A number of businesses have been assisted through the department's existing programs.

Reverend the Hon. FRED NILE: I note that page 3 of the New South Wales Government's submission identifies a lack of industry and economic statistics and refers to nanotechnology as "an important issue". How is all this information currently collected? What plans do you have to improve the collection? Why is information important for your department and how would it influence your activities?

Mr MUKHERJEE: I will answer your question from my perspective and I will then ask whether any of my colleagues would like to add something further. From our industry development perspective the primary interest is in determining the number of businesses and the nature of their requirement in relation to support for business growth through the application of nanotechnology. The information we are constantly monitoring is the participation by New South Wales businesses in nanotechnology forums, or the number inquiries that we have in relation to nanotechnology. As I have said, it is early days from that perspective. Looking at it within the continuum of all the technologies with which we support businesses, we provide support for them to adopt a number of technologies such as biotechnology or ICT. We are in the early days of nanotechnology and there are a relatively small number of inquiries.

The Hon. CHRISTINE ROBERTSON: Mr Dunphy, how does that affect your work?

Mr DUNPHY: The way that we try to improve health and safety in the workplace is very much evidence-based. We are interested in using as much information as we can to plan that, whether

it is through trying to identify the areas that we need to target to improve health and safety, or getting a better understanding of the size of the issue or the problem that we need to address. Any of the data that is available is useful for us to plan those interventions and to plan our prevention activities. At the moment we would welcome more information and more data so we are able to assist with that.

CHAIR: Would anyone like to add to that?

Ms DOYLE: It is important to frame the lack of information and data in the context of a fairly nascent industry sector. It is not a problem or an issue that is unique to New South Wales. There are Organisation for Economic Cooperation and Development [OECD] activities that are coming to terms with exactly how to do this: how to define and categorise and what are the information and data needs. The State's role will be to work with its national counterparts, CSIRO, the Australian Office for Nanotechnology and to look at the areas where we, given our strengths, can most usefully contribute to that information and data-gathering exercise.

At a departmental level we routinely collect client information through surveys and databases and the Australian Technology Showcase has a profile. We have industry databases. Our grants management system collects a lot of data trying to drill down to a reasonable level of specificity about what people are doing as well as the milestones we might get for the grants that we are funding. There is not a complete lack of information but I think it is fair to say that we are part of a national and international activity working those definitional and information requirements at the moment.

The Hon. CHRISTINE ROBERTSON: Recognising that, do you think there is potential for some regulatory framework to be put in place in order to deliver this so that there is some knowledge of exactly where nanotechnology is operating?

Ms DOYLE: I think that the term "regulatory framework" is an important one and that it would actually need to be. So, yes, I think there is that potential for any framework.

The Hon. CHRISTINE ROBERTSON: It would have to be Australia-wide?

Ms DOYLE: That is right, and coordination. But I just wanted to stress that it is a framework we are talking about because it needs to be something that recognises the diversity of the field that is nanotechnology for a start.

Reverend the Hon. FRED NILE: Just to clarify that. If nanotechnology is a priority issue, if we went to your office, is there a nanotechnology statistical unit? Are there people actually working in that area?

Ms DOYLE: No, there is not.

Reverend the Hon. FRED NILE: Should there be one?

Ms DOYLE: I think with the statistical collection activity we undertake that nanotechnology would just be a component of information gathering at this point in time. I think we have identified about 23 companies working in the nanotechnology space.

The Hon. MELINDA PAVEY: In New South Wales?

Ms DOYLE: Yes. I certainly think we need to get a better handle on what information is held elsewhere before we actually take the decision to set up a unit that was specific to this task.

Reverend the Hon. FRED NILE: We visited a company that was making these little miniature nanotechnology batteries. One of the things I noticed was that they were very secretive. They have what they regard as company secrets. I just wonder whether all these companies would be so open and come to you? Are there companies developing in this area that are keeping it confidential—they have to sell their product?

Ms DOYLE: Clearly commercial-in-confidence, patents, all of those types of things, are very important, but it depends on what information you are after, of course, and what you are going to

do with that information as to exactly what you can elicit from companies. But the commercial-in-confidence behaviour is integral to people being able to develop and market new products.

The Hon. MICHAEL VEITCH: Following on from the statistical question, do you have a ballpark idea of what nanotechnology is worth to the New South Wales economy each year?

Dr VAN DYK: I do not think we do. The figures that the Committee I assume will be well aware of from Lux Research indicates that the world economy by 2015 will incorporate $US2.6 trillion worth of nanotechnology products and sales. The best estimates that we have seen just do a calculation down on GDP of the Australian economy and then I would assume that if we were to make that estimate we would do it on GSP for New South Wales.

The Hon. MICHAEL VEITCH: Do we have any idea how our investment in New South Wales in nanotechnology compares with other Australian jurisdictions?

Ms DOYLE: We have not actually done a comparative analysis. We can probably provide the Committee with figures on our investment in nanotechnology at the research end in particular and any nanobusinesses supported. But I guess in terms of direct comparisons, we would need to be really sure that we were comparing like with like.

CHAIR: You might be able to provide that to us at a later date.

Ms DOYLE: Yes, I am happy to provide the figures on notice.

Reverend the Hon. FRED NILE: Would we be way behind, say, Victoria in that it would have twice as much investment than New South Wales?

Ms DOYLE: Again, unless we were absolutely sure that we were comparing like with like, what is common in terms of what this department supports as opposed to what the Victorian Government might classify as its support for nanotechnology. It may or may not be a helpful comparison.

The Hon. CHRISTINE ROBERTSON: It would involve many departments because health actually invests. I know that your ministry covers energy and it certainly has a major investment. So it would be very difficult for them to provide that across the board because they are such a focal unit.

Ms DOYLE: Yes. As I say, I will provide a precise figure.

The Hon. MICHAEL VEITCH: Mr Dunphy, in your opening address you spoke about research requirements, and the occupational health and safety [OH&S] implications of nanotechnology. A frequent comment in the literature on nanotechnology is that within government funding generally, here and overseas, research and toxicology, and health and safety issues receive a small percentage of overall funding. Should government funding for nanotechnology include a requirement for health and safety research when the safety for nanotechnology has not yet been confirmed?

Mr DUNPHY: The traditional approach I guess we have taken for substances is that the suppliers who actually produce the risks usually are responsible for actually assessing the level of risk as well. So, we would normally expect that the people who are making commercial benefits out of these risks should be investing in also assessing them. And that certainly indicates in the chemical regime where we require our suppliers of hazardous chemicals to do assessments of their chemicals and to provide us information in relation to those. So certainly it would be a similar approach I suppose in terms of nanotechnology.

Having said that, there are some broader research issues I think we do need to look at and we are working with the Australian Safety and Compensation Council [ASCC] in terms of looking at some of those strategies. That is more in terms of exposure standards and seeing whether there is a need to identify a particular exposure standard for nanoparticles, also some just more broader research ideas into general exposure issues in terms of workers' exposure to nanoparticles, and some of the methodologies to assist employers in terms of assessing the risks. So, I think there is a role in terms of

some of the broader research that needs to be done. In terms of the risks on specific materials, I think there is a role also for the actual industry to be involved in terms of that research as well.

The Hon. MICHAEL VEITCH: From WorkCover's perspective what sorts of education programs have you developed with the industry around protection of workers in the range of existing nanotechnology industries? Have you been able to do anything yet?

Mr DUNPHY: Yes. What we have been doing at the moment, one of the things we do want to be is consistent nationally. So, I mean what we impose or require employers in New South Wales to comply with, we want to make sure that that is a consistent approach across jurisdictions so that it is not putting a different impost on one set of employers to another. So, we have been very mindful of that in terms of working with the ASCC. They are developing some proposals and they will be reporting back to the ASCC in June 2008.

We expect in that there will be some recommendations about guidance material about codes of practice, which would be some practical guidance and assistance for industry in terms of what they need to do, and also potentially recommendations in terms of a national standard, which would have some implications in terms of consistency of regulation. So, I guess we are trying to work practically with industry at the moment in terms of assisting them in their risk assessments, but at the same time we are also working at the national level to make sure whatever we do require in the longer run is consistent with what is required in other jurisdictions.

The Hon. MICHAEL VEITCH: Do you have a time frame for all of that?

Mr DUNPHY: Well, June 2008 is the time frame. So we are expecting a report back, yes, in June this year. We are expecting a report to the ASCC, which will make some recommendations in terms of further actions.

Reverend the Hon. FRED NILE: Just a general question. I know that your charter is WorkCover and you keep talking about protecting workers. Where does the consumer come into this?

Mr DUNPHY: I suppose from an occupational and safety perspective, we are interested in the health and safety of workers. We do not necessarily focus on consumers who may be consuming these products outside of the workplace. So, certainly people who may be exposed to them in the workplace we would be interested in. But that broader issue of community or consumer safety would be outside the scope of our area of, I suppose, our portfolio. So we would not necessarily be in a position to comment on what is required.

Reverend the Hon. FRED NILE: So where is the consumer?

Mr DUNPHY: The consumer I would assume is part of the consumer protection laws. So again, there would be issues I guess there in terms of the Department of Fair Trading to look at some of those issues as they do for others. And there is, I guess, a lot of interface between occupational health and safety, and consumer safety laws. So there would be issues there I guess in terms of ensuring that there are appropriate safety controls and safety information provided to consumers. But, yes, that is outside of our regulatory framework and outside of the area that we would be providing that advice.

Reverend the Hon. FRED NILE: Someone said a fairly irrational statement that nanotechnology is the new asbestos or something like that—the unknown factors.

Mr DUNPHY: It is unknown. It is easy to say that—

Reverend the Hon. FRED NILE: I do not believe that, but that is a comment.

Mr DUNPHY: With all emerging technologies I suppose there is a fear of potential unintended consequences that we do not know about, but I do not think there is any evidence to suggest there is anywhere likely to be that level of risk that is associated with asbestos.

The Hon. MELINDA PAVEY: Mr Dunphy, what jurisdictions around the world are doing well with regulation and frameworks in nanotechnology?

Mr DUNPHY: I can only talk from the point of view of occupational health and safety in terms of frameworks for that.

The Hon. MELINDA PAVEY: That is what I am asking.

Mr DUNPHY: I think all jurisdictions internationally are struggling because it is a new and emerging technology. So in terms of OH&S frameworks we are all looking at, you know, what we need to do next. As I mentioned, in the United Kingdom British Standards have introduced a standard which we think is quite a good standard, which certainly the ASCC is looking at in terms of that.

The Hon. MELINDA PAVEY: Could we get access to that British standard?

Mr DUNPHY: Yes.

The Hon. MELINDA PAVEY: It is a new technology that has met a point in all of these jurisdictions—the invention of the wheel?

Mr DUNPHY: That is right. In some ways I guess in terms of occupational health and safety we do have a very strong focus on consistency through the ASCC, which I represent, the Australian Safety and Compensation Council, which is represented by all the States and Territories and the Commonwealth. So, we do try to make decisions about particularly new and emerging risks—make sure that we remain consistent.

The Hon. MELINDA PAVEY: So you are meeting on a regular basis with the ASCC and other State jurisdictions?

Mr DUNPHY: Yes, on a regular basis.

The Hon. MELINDA PAVEY: How regular?

Mr DUNPHY: The ASCC meets I think on a quarterly basis or every two months. So, it is quite a regular basis that they do meet.

The Hon. MELINDA PAVEY: But that is not generally on nanotechnology?

Mr DUNPHY: No, but that—

The Hon. MELINDA PAVEY: It is on a whole range of issues and nanotechnology would be coming up?

Mr DUNPHY: That is right, but they have also agreed to establish a nanotechnology working group, which we will have representation on and that will be convening shortly and that would meet on a regular basis, probably on a monthly basis I would think.

The Hon. MELINDA PAVEY: So there is some attempt to look around the world with what is happening in other countries where there has been more technology?

Mr DUNPHY: Yes, there is.

The Hon. MELINDA PAVEY: Just on the point made by Ms Doyle in relation to the 23 companies in New South Wales working in the nanotechnology field, do you have a list of those companies? Do you have a good relationship with those companies in dealing with their OH&S practices?

Mr DUNPHY: There are a couple of things that we do. One is that we do monitor the patents. So we look at the patents that are being approved and—

The Hon. MELINDA PAVEY: Lodged?

Mr DUNPHY: —lodged in New South Wales and Australia.

The Hon. MELINDA PAVEY: Approved or lodged, because there is a difference?

Mr DUNPHY: Lodged. Yes. That is true. Yes

The Hon. MELINDA PAVEY: Approval can be set in tenures.

Mr DUNPHY: Sorry, lodged. So we are actually trying to identify, I guess, which companies are active in terms of the area of nanotechnology and we do that through that process. There is also a nanotechnology business forum, which we also are starting to develop relationships with them. We do tend I guess in WorkCover to try to identify the industry groups and try to work with them on the issues. So we have started to develop a relationship with them and we are working with them I guess in trying to let them know what is happening at the national level but also using that as a network to cultivate that when we do get some clearer direction I guess from the national level that we will be able to work through that group to implement.

The Hon. MELINDA PAVEY: Do you have a different attitude towards nanotechnology that is toxic in food or skin products as opposed to computer chips or products that make batteries last longer? Is there a different focus?

Mr DUNPHY: Not really.

The Hon. MELINDA PAVEY: Given that nanotechnology is such a broad spectrum of things?

Mr DUNPHY: Yes. We cover a very broad range of risks. So I think the occupational health and safety legislation, as I mentioned, covers all workplaces and covers all hazards and all risks in the workplace. So, we are familiar with having to work with the sort of multirisk approach to issues. So, we are very familiar with having to work with very toxic and hazardous chemicals right through to less obvious sorts of hazards such as manual handling and on the whole range of working environment issues. So, I mean each hazard we have a different approach to and it just depends on our level of knowledge of the risk associated with it and also what is the best way in terms of tackling that particular issue, whether it is to do with behaviours, whether it is to do with engineering controls, administrative controls or personal protective equipment. There is a whole different approach I guess to each hazard as to how we actually deal with it.

The Hon. MATTHEW MASON-COX: Dr Van Dyke, earlier you mentioned a $40 million, four-year fund—it was an innovation fund, or something like that.

Dr VAN DYK: It was the Science Leveraging Fund.

The Hon. MATTHEW MASON-COX: I presume there are a few buckets of money—there is always a few buckets of money you can find for new technology like nanotechnology—but I want to understand the current process by which the New South Wales Government assesses an application for money and decides what money will be given to what projects, and whether that will be for scientific research or commercialisation of that research.

Dr VAN DYK: Let me again go to the framework of the Science Leveraging Fund and the three programs that are under that. The Cooperative Research Centres [CRCs] are a Commonwealth Government program. In New South Wales, we support, through a separate fund, business development plans and the applications, in short, directed to that process. The intention of that is to get a strong, well-articulated application which, we would assume, obviously increases the body's likelihood of getting funded. Once they have put their application in and the Commonwealth application process then comes back to them and says please develop the second part of your more detailed application, we, as part of that application, will indicate upon that certain analysis. That analysis looks at what the level of research by that CRC is going to be in New South Wales, how

many researchers, its relevance to industry, et cetera, et cetera. We will allocate a quantum of funding accordingly, provided that that CRC is successful in the Commonwealth process.

The Hon. MATTHEW MASON-COX: So it is the Commonwealth process that dictates the outcome primarily in terms of where you allocate?

Dr VAN DYK: It is the Commonwealth process as well as the operation of the CRC in New South Wales, or the extent of operation.

The Hon. MATTHEW MASON-COX: Okay.

Dr VAN DYK: Under NCRES there was a separate process. That was basically again through the Commonwealth process and a number of committees. The process was facilitated at the Commonwealth level to look across Australia at where specific strengths were. Once identified, we worked with those researchers to again support them through the Science Leveraging Fund.

The Hon. MATTHEW MASON-COX: So it seems that the Commonwealth is taking, if you like, the lead role in terms of assessing those types of applications for funding?

Dr VAN DYK: In terms of the Science Leveraging Fund, that is correct in as much as it was set up, as its name suggests, to leverage and attract funding from the Commonwealth through to New South Wales. Those investments will only be made in areas where New South Wales has specific strength.

The Hon. MATTHEW MASON-COX: So the State would be a party to developing an application to the Commonwealth or have a role in that? In the department, do you have scientific expertise by which to make an assessment of the relative merits of an application from a commercial perspective?

Dr VAN DYK: No, we do not, and generally the funds that come out of the Science Leveraging Fund are not aimed at commercialisation specifically. They are aimed at investing in infrastructure that the commercial sector, the university sector and government, for instance, can use. So it is very much infrastructure and technical capacity.

The Hon. MATTHEW MASON-COX: Do you have any other buckets to look at commercialisation and to look at assessing applications against that sort of benchmark?

Mr MUKHERJEE: The Australian Technology Showcase has a process of evaluating applications using a panel of experts, so the application is assessed by at least two technical experts from the field. One of the criteria is to look at the commercialisability or the commercial prospects of the technology that is being supported.

Ms DOYLE: There is a range of programs that the department supports. Where there is a need for scientific expertise in judging the scientific merit of a particular project, for instance, the Life Sciences Research Awards or the Spinal and Other Neurological Conditions Fund, it really is about a research project and the science that is involved. We use peer review processes because you really have to go out to an expert in that absolute field. While we have people with strong science backgrounds in any office of science and medical research, clearly we will not have the expertise for every project or proposal that comes across their desk. Similarly the medical research support program provides quite broadly based funding for infrastructure to underpin the funds that are attracted from the National Health and Medical Research Council and other peer reviewed areas. It is a bar of excellence that is about peer-reviewed funding as assessed by objective experts in the field, so there is a range of approaches.

The Hon. CHRISTINE ROBERTSON: I will just extend that question a little bit. Is there any chance that New South Wales could influence a norm coming into that process that requires in the development and commercialisation a consideration of the effects on the community and the occupational health issues? Is there any way that we could influence that process? The CSIRO seem to think that there could be some way we could.

Ms DOYLE: Look, I am sure there is a range of mechanisms by which we could have some influence: I instance the current review of the National innovation system which is the whole approach from the research and development pipeline through to actually influencing innovation in industries. That is one pathway. I am sure that Peter Dunphy has other areas that he would see as being appropriate as well.

Mr DUNPHY: From an occupational health and safety perspective, certainly what the ASCC is looking at are ways of, I suppose, building on the existing frameworks that we have for hazardous chemicals and the assessment of hazardous chemicals. I guess there is potential to look to see whether there is some way of making sure that nanoparticles are either picked up in that regime or that we have looked at some sort of regime which mirrors the requirements we currently have for the assessment and provision of health and safety advice on hazardous chemicals.

Reverend the Hon. FRED NILE: There is obviously close cooperation with the Commonwealth, but as there is a new Commonwealth Government, are there indications that there will be a higher priority for nanotechnology? I suppose you will not know until the budget is announced if there is a large allocation of funds.

Ms DOYLE: I think that is right. The only thing that I would notice is that at the moment the funding for that technology strategy at the national level looks like it has been truncated to two years. That is the only public information that we have at the moment. That said, it is clear that there is a very active engagement by the Commonwealth in this area that the department is involved in, and also the opportunity arises through the review of the National innovation strategy.

Reverend the Hon. FRED NILE: It would be a great opportunity as has happened in other areas for all the States to cooperate closely with the Commonwealth.

Ms DOYLE: That is right, and get back their alignment.

Reverend the Hon. FRED NILE: I have just a general question for Mr Dunphy. I am not sure if I made a correct note. Did you say there is no regulatory regime for nanotechnology in the world?

Mr DUNPHY: I was referring, I guess, to models for occupational health and safety regimes. In terms of OHS frameworks or models which we could use to adapt, there is not really any jurisdiction that has introduced a model regime for nanotechnology. While the ASCC has identified elements through some of the policy and guidance that has been developed in other jurisdictions, I do not believe any jurisdiction has actually identified a regulatory regime for OHS that could necessarily be effective.

Reverend the Hon. FRED NILE: I suppose I really am asking how thorough is your investigation around the world, given the advancement in the United States. I would be surprised if even state governments such as California and some of the other states have not made some progress.

Mr DUNPHY: That is right, and I think there are some specific areas where there are local ordinances that have been done—I think in Berkeley and also in Cambridge—in focusing on the research elements of nanotechnology and health and safety requirements. I suppose I was looking at more an overarching control of all nanotechnology issues. The ASCC has not identified a regime that we can easily just pick up and adopt. There are elements but there is not a comprehensive regime.

The Hon. CHRISTINE ROBERTSON: Have any of you been involved at all in the issue of the lack of definition of nanotechnology and nanoparticles?

Dr VAN DYK: When you say a lack of definition, do you mean the lack of agreement—

The Hon. CHRISTINE ROBERTSON: It is part of the problem of setting up any sort of regulatory framework or any occupational health and safety issues or any community issue. There are still debates among scientists about what it means and about what is a definition of a nanoparticle, et cetera, et cetera. We heard this from a scientific group. None has sort of come across your desks at all?

Dr VAN DYK: It has. From the perspective of science and medical research I make the point that this is why it is so important that we engage nationally and internationally through the International Standards Organisation and the OECD process, which is coordinating a look at this internationally. Those are the avenues that I think we have to go down. It is important that not only does output increase but we need to ensure that the information flowing from the internationals, particularly the United States, Japan and the United Kingdom, flow back into Australia and into New South Wales appropriately.

Ms DOYLE: We also have investments and facilitation work in relation to capacities that will actually go some way towards helping us address those issues in New South Wales. We have done some work with the National Measurement Institute—

The Hon. CHRISTINE ROBERTSON: Yes, it was those people.

Ms DOYLE: —and in characterisation kind of work. So I think from the perspective of what the office's agreement is, it is about investing where it makes sense because we already have some capacity in New South Wales to boost that capacity and to be able to answer these questions specifically and broadly. In linking into those national and international efforts, because it is so big and there are so many questions to answer, sharing the workload, if you like, is the only approach that really make sense.

The Hon. CHRISTINE ROBERTSON: I realise that there would be no way that one of the government departments could actually invent the definition and that it is a huge international issue. I am just wondering what sort of effect that has on your work—whether you are actually encouraging an industry that could be incredibly dangerous, or whether or not with your work you can actually pick that up. So it is still just like that?

Mr DUNPHY: In terms from an OHS perspective, I guess we would be relying on the definition that the ASCC comes up with and that all the jurisdictions will adopt. We have done that consistently with other hazards, such as the definition of what dangerous goods are, what are hazardous substances, and what manual handling means. What the ASCC will come up with is a framework that, in doing that, it will recommend what the definition should be for the jurisdictions to adopt, and we will try to be as consistent as possible.

The Hon. MICHAEL VEITCH: I wish to ask a couple of questions around consumer awareness. One of the terms of reference points refers to consumer awareness and education regarding nanotechnology. There have been a number of calls for mandatory labelling of approved nanomaterials or nanotechnology-based ingredients or components or products. Could New South Wales enact such legislation do you think around labelling laws for nanoparticles or nanotechnology? Are you aware of any other jurisdictions that may have that?

Mr DUNPHY: I guess I can only talk from an OHS perspective. I suppose the difference between the OHS framework and the consumer safety framework is that the OHS framework is very much focused on identification of what are the hazards of a particular material and then the employer has a responsibility to do a risk assessment to determine the most appropriate controls for the workplace. It is quite different in the consumer context because the consumer just wants to know whether it is safe or not or what they need to do, and labelling is a way of actually identifying that and providing that risk assessment for them, and telling them what it is they need to do. The regimes are quite different in terms of the sorts of information provision that we do. I cannot really comment on what would be the best way for consumers, but certainly from an OHS perspective we do use labelling, for instance, for hazardous chemicals. We also use materials such as datasheets, which are more about identifying risk information that employers can then use to assess the appropriate controls for their workplace.

The Hon. MICHAEL VEITCH: Does anyone else have any comments?

Ms DOYLE: Really just again to stress that our role will be around creating the research capacity in New South Wales to contribute to the evidence-base so that your labelling and consumer information, et cetera, is as balanced, comprehensive and well-thought out as is possible.

The Hon. MICHAEL VEITCH: So if I were a consumer who wanted to conduct research about a particular nanoproduct in New South Wales at the moment, do we have a website or a webpage that the New South Wales Government provides around nano?

Ms DOYLE: No, there is not a nano-specific website.

The Hon. MICHAEL VEITCH: Do you think there is a need for one? I will give you an example. There are baby pacifiers on the market that have silver in them. When you talk to childcare workers, they do not know that. Some of the literature we have obtained shows that they are available on the market now.

Ms DOYLE: I think the question of how that information is provided is outside the remit of everybody here at the table. Whether or not one website or just integrating these definitions, health and safety assessments, across the appropriate government agencies is the best approach is something that we have not tackled in a structured way at this point in time, but it is possible to get very good information just using the Internet at the moment about a whole range of things pertaining to nanotechnology. So I think it is not that there is no information out there.

The Hon. CHRISTINE ROBERTSON: But there is very little knowledge amongst the community. The Hon. Michael Veitch is putting up an issue that he perceives as a problem because people do not know something, but there is also an issue in relation to this very exciting field of science being perhaps blocked off because there is such poor knowledge amongst the community. It is so easy to stick fear into the process and have it all knocked off. Is anyone talking about a strategy about communication?

The Hon. MICHAEL VEITCH: It is about informed decision making on behalf of the consumer.

Ms DOYLE: As far as I am aware there is not a broader-based nanotechnology communication strategy in place. In the department we undertake a range of activities that go from schools right through to industry in terms of information sharing, from Science Exposed through the business forums and those types of things.

The Hon. MICHAEL VEITCH: If there was to be a website set up, for instance, which government department would be the lead agency to set that up and be responsible for maintaining it?

Ms DOYLE: Again, not to try to obfuscate on this at all but I think it absolutely depends on what information the website will contain.

Mr DUNPHY: In terms of the Office of Fair Trading, certainly, I think they have a similar sort of set up that we have for occupational health and safety where there is a national forum which they meet to try to ensure again consistency because again you would not want New South Wales suppliers having to provide different consumer information to suppliers in other jurisdictions. It may be that the Office of Fair Trading has some sort of mechanism that it could do something similar to what we are doing in terms of occupational health and safety in ensuring that there is consistent risk communication information about occupational hazards. I am sure there is a mechanism within the consumer product safety area to do that as well at a national level.

The Hon. CHRISTINE ROBERTSON: Recognising that you are not a whole of government—you do work together and stuff—so it is a bit of a hard question, no-one seems to have responsibility for communication to the general public about scientific progression within New South Wales. Is that right?

Mr DUNPHY: We would have—

The Hon. CHRISTINE ROBERTSON: I am sorry, but to put it hard on the line I am talking about the issue in relation to what has recently happened and is happening all over the world to genetically modified crops, which is exactly the same sort of question. It is even worse for this one

because it is much more difficult science for people to understand. So the question is: How on earth will we address community information about this issue so that fear structures are not put in place?

Ms DOYLE: To use genetically modified organisms as an example, a lot of the work around community education and community attitudes, community education at a very specific level and also a very broad level has come out of the Commonwealth Government around biotechnology, stem cells, GMOs, and I think there is great potential for the Commonwealth and the States to work together to take such an approach in this area going forward. While there may be some jurisdictional-specific issues, the real questions that need to be answered are common across Australia.

Reverend the Hon. FRED NILE: Following up on that consumer issue, would it help if, when there are grants for nanotechnology research, a percentage must be spent on this issue of health and safety, the impact on the consumer. Companies could get a grant and say, "We want to develop our product". Should there be a requirement, or is there a requirement, for some of that to be spent on the health and safety area?

Ms DOYLE: We do not provide project-based research grants in New South Wales, with one exception, that being the Premier's spinal fund, and I do not know the details of the approach at the Federal level around nano. However, I note that any research that is funded by the State and nationally must comply with all the legislation and regulatory frameworks that abound. I assume that through the Australian Research Council, for instance, there is significant research into occupational health and safety and other broader areas that the University Research Centre takes care of but I am not aware of a specific requirement. Given that we do not do that type of funding, I am not sure that it is a question that I am able to answer at this point.

Reverend the Hon. FRED NILE: Dr Van Dyke talked about cooperation between the State and the Commonwealth and the funding or grant area. That is why I thought it was relevant.

Dr VAN DYK: I think it is. Both the Australian Research Council and the National Health and Medical Research Council are engaged strongly as representatives in the national debate on nanotechnology. In terms of your question on whether a component of all research and intrasearch project be useful, I would suggest that you would get better outcomes from a more directed approach to health and safety and an institute or a number of organisations doing that with a focus. I would point you to NanoSafe at RMIT in Victoria, which is well engaged and I would say is a leader in providing such information.

The Hon. MATTHEW MASON-COX: Nanotechnology is an interesting term, and it means different things to different people in different sort of capacities. The thread I get from a lot of what you are saying is that it is just another industry and we have the necessary mechanisms in place for each of these different sort of industries that come through our door. Is that a fair summary of your approach to nanotechnology?

Ms DOYLE: That it is just another industry?

The Hon. MATTHEW MASON-COX: That it is just an industry, we have a bucket of money for this which could go to that or go to this, it is another innovative industry, we have a range of different industries that do a range of different things, we do not need to do anything special, we have the current mechanisms in place which deal with an industry.

Ms DOYLE: I do not think we would take the approach that there are not always more targeted or improved ways that you can look at anything. What we are trying to put on the table is that we take a broad capacity building approach in terms of research and development in New South Wales rather than an uncritical approach to it. We look for areas where the State already has research strengths. The research strength is important from the industry development perspective but also to provide the evidence base for regulation and information and translation back into the community. We have also indicated that we are connected into and responsive to very specific activities at national and international levels and that most of the programs we have are set up in a way that allows us to be responsive to those things where it makes more sense to be responsive than to take a unilateral approach.

CHAIR: We have received a number of submissions that have called on the Committee to support a moratorium on the commercial use of nanotechnologies or the commercial release of nanotechnology products until health and safety issues have been resolved. The question of a moratorium has been placed in the public arena and may become one increasingly considered by members of the public, particularly in the absence of a formal counterargument. Do you think government at either the State or the Federal level should provide a public response to the question of the need for, if not the moratorium, then information of the public? Are there areas using nanotechnology currently where you have concerns about safety?

Mr DUNPHY: In terms of the occupational health and safety approach, we support the responsible and safe development of nanotechnology, balanced with ensuring that there are appropriate protections for workers as part of that process. It is no different to any other hazard that we have had in workplaces. There is no such thing as a risk free industrial process. All industrial processes are not without risk and it is a matter of balancing the benefits to society and the protections in terms of occupational health and safety, as we do with hazardous chemicals, carcinogenic substances and a whole range of things that workers encounter in the workplace. Our focus is on ensuring that the hazards that have been used in the workplace are being managed responsibly and that there are appropriate controls in place for the workers based on a risk management approach.

Reverend the Hon. FRED NILE: Does Ms Doyle have an answer to that question from the departmental point of view about the moratorium issue and how to deal with it?

Ms DOYLE: In responding to a question earlier about approaches, I indicated that the view to date is that a framework is important because nanotechnology encompasses such a wide range of activities and technologies that it is difficult to see how one would implement a moratorium even if one was of the view that that would be a position. Clearly, if we have already the ALARA approach there is in terms of WorkCover's responsibilities a platform or approach that government is already putting forward. More broadly, the terms of reference for this inquiry indicate that the position we as bureaucrats are charged to deliver is a balanced approach that manages risk and evidence based against economic development needs. So I think that is actually where we are charged with delivering at this point in time.

The Hon. MELINDA PAVEY: Of the 25 companies that are doing nanotechnology in New South Wales that we know of, are any of them in regional New South Wales?

Mr MUKHERJEE: I would not know off hand. We could find out.

Ms DOYLE: We can take that. I am sure we have the names. Again, some of that which we know of is contextualised in the factor of how the companies define themselves, but I am sure we can take that question on notice.

Reverend the Hon. FRED NILE: Could that include a list of all the companies? Is that public?

Ms DOYLE: Let me check on what I can provide. I am advised that it is public so we can provide that to the Committee.

The Hon. CHRISTINE ROBERTSON: The issue we are discussing at the minute is a lot about the different pieces of ministries and government departments not actually knowing everything that is going on within the other departments. So the question about what is happening in regional New South Wales, other bits of government department would actually know. Is there any way of structuring the process so that somebody knows everything? I have come from the public sector so I can ask these questions.

Ms DOYLE: I think there are ways of structuring a process where we have greater coordination and better sharing of knowledge and information both for government policy making and for public education. I think a good first step has been taken around that with the establishment of the science agencies group in government. I think that the linkages between ourselves and our industry division colleagues actually see that that flow of information goes between industry and the research sector in government and back the other way again. But, yes, there is always room for improvement

and more structured and more formal approaches. In relation to being able to give detailed information about companies, it is not that it is not available to us, it is just that we do not have it to hand right at the moment.

Mr DUNPHY: In relation to regional New South Wales, it is not so much who is producing and supplying it but the relatives within workplaces that the materials are being used throughout New South Wales. It is a regional issue and it is one that we would be monitoring whether it is a workplace in Sydney or Bathurst because workers are working with materials or articles that have nanotechnology and have particles as part of them. WorkCover covers the whole of New South Wales so we would be certainly conscious of ensuring that if we did an intervention it would be rolled out across the whole of New South Wales. We would be working with industry in terms of providing advice through all of our networks whether they are metropolitan or regionally based.

Reverend the Hon. FRED NILE: Do you have a list of companies?

Mr DUNPHY: A construction site may be a workplace whether nanoparticles are being used and that could be for a few months but close once the construction work is completed. So it is not so helpful in focusing on the companies that are supplying and producing them, actually nanoparticles are being used in products throughout many workplaces.

The Hon. MICHAEL VEITCH: The sphere of nanotechnology is actually quite an exciting opportunity for New South Wales. What is the one tool you do not have in your toolbox as a bureaucrat to help the State harness this opportunity?

Mr DUNPHY: I guess for us it is coordination and consistency and making sure that we know what others are doing and that we are using best practice so that we understand other jurisdictions, and we are being consistent in terms of our approach. For us it is knowing what is going on at the national level and what our other jurisdictional counterparts are doing, and making sure we are consistent in terms of advice.

Ms DOYLE: I think the tools are largely there and that greater coordination and with that, I suppose, a degree of visibility around what it is government is already doing in a very active and structured way. Again, to refer back to the science leveraging fund, one of the key components of the State support for the national Collaborative Research Infrastructure Strategy is that this major research infrastrucure is accessible by industry so that it can get the knowledge it needs, whether it is from definition or characterisation, new products, seeing what they are doing, or uptake of knowledge that comes internationally. That has been a considered policy platform for going forward in our funding.

CHAIR: Is there anything else you would like to add?

Mr MUKHERJEE: I want to take this opportunity to share one point that has not come through, that is, at many of the industry events and forums that we have had, companies have said that they have been doing things that they have not known to be nanotechnology. I think that is quite significant, first, because companies do no relate to the term and therefore do no put up their hand as existing users or potential users of nanotechnology, and, second, it is something that I am sure would need to be kept in mind when thinking of regulation, moratoriums and so forth. Where do you draw the line? If companies are doing things already and some regulations are imposed, how are they covered? How does it affect their business? Also does it put New South Wales businesses at a potential disadvantage in relation to other jurisdictions? I am sure those sort of issues need to be looked at at a national level, rather than just be State-specific.

In relation to communication strategies, the Australian Office of Nanotechnology, through the national Nanotechnology States and Territories Committee has actually a specific charter to raise public awareness of nanotechnology and to engage the community in an informed debate about nanotechnology development in Australia. I suppose if anyone were to develop a website or information material in relation to nanotechnology, that would probably be the best starting point.

The Hon. CHRISTINE ROBERTSON: For how long has it had that charter?

Mr MUKHERJEE: The body has been in existence just for a very limited time, maybe a year or so.

CHAIR: The Committee has further questions it wants you to take on notice. Does 19 May present a problem to get answers to the questions back to the Committee?

Ms DOYLE: I think the Minister has been quite clear that she would like us to be as responsive as possible, so we undertake to get them back to the Committee by that date. If there are any issues with getting the information, if the Committee could just bear with us we would come back to you if there is any need for a longer time frame on anything specific.

CHAIR: Other questions will be sent to you. I thank you for participating and for giving your time to the Committee, it is much appreciated.

(The witnesses withdrew)

(Short adjournment)

GRAEME ARTHUR HODGE, Professor of Law, Centre for Regulatory Studies, Monash University, and

DIANA MEGAN BOWMAN, Postdoctoral Research Fellow, Centre for Regulatory Studies, Faculty of Law, Monash University, affirmed and examined.

CHAIR: Would either of you like to make an opening statement?

Professor HODGE: Thank you for your invitation to make a presentation today. Firstly, we congratulate the Committee on conducting this inquiry. It is an important topic deserving lots of policy attention and scientific attention. As you know, our centre at Monash University has had an interest in this domain for a few years and in that time we have been able to establish an international reputation in the arena. We would like to focus on three parts of your terms of reference: health, safety and environmental matters, which is item (b); appropriateness of current regulatory frameworks, item (c); and improving awareness of nanotech issues, which is item (f). There has been a lot written on nanotechnology and this Committee has a huge responsibility to try to sort out the reality from the rhetoric, or the real risks from the ravings! It is an important task.

The Hon. MELINDA PAVEY: Can we put that line in our report!

Professor HODGE: The first comment I would like to make is that I think it is helpful to differentiate the nanotechnology phenomenon from the science of engineered nanomaterials. In some ways we actually agree with the commentators who say there is no such thing as nanotechnology. Nanotechnologies are not a simple technique. There are a whole range of sciences from material science, biotechnology, medicine, physics and chemistry to health care and so on. They certainly all aim to manufacture nanomaterials at the nano scale, 10^{-9}. That is what they have in common. We could just as well have labelled this new field as "new developments in chemistry, physics, material science and biotechnologies at the atomic scale". We did not because it is too cumbersome. We have shorthanded this to "nanotechnology", so we tend to see nanotechnology as a label these days for the phenomenon rather than the science. It is a phenomenon that describes an immense range of technologies.

The Hon. MATTHEW MASON-COX: Is it a natural phenomenon? Sorry.

Professor HODGE: I will get there! Is this distinction important? I think it is because once you label a phenomenon like that you allow science fiction stories such as Michael Crichton's *Prey* to be sold and you allow six-million-dollar man movies to be made. You also allow urban myths and concerns to circulate, many of which rely on the power of the nanotechnology spectre. It is a bit like the old *Master's Apprentice* nightmare, an apocalypse of endlessly reproducing broomsticks, if you are old like me and enjoy the occasional Walt Disney cartoon. The many sciences making up engineered nanomaterials are more diverse, complex and difficult to describe, but they are more realistic. Having tried to separate the phenomenon from the science, I will however use the shorthand as this parliamentary inquiry has done, so we will continue to talk about nanotechnology here today.

Nanotechnology has lots of definitions. We provided 18 of them in our 2007 book, *New Global Frontiers in Regulation*, which I believe the Committee has access to. No matter which definition you choose, I think it helps to talk about engineered nanomaterials rather than this phenomenon of nanotechnology. Even when you look at engineered nanomaterials there are still lots of definitions of what constitutes a nanomaterial. We breathe nano air particles every minute. We probably sprinkled glucose or sugar on our breakfast, which is less than 30 nanometres. We probably take vitamin C—again, less than 30 nanometres. Once we are outside we probably suffer from the nano-sized carbon black emissions from car tyres. We do that every day, but rightly we also remain nervous about potential new technologies that promise lots of benefits whilst being silent on the potential dangers ahead. We are still discovering much about both the phenomenon and the science.

It is certainly time to take more seriously the promises of the coming nano age. Certainly there will be some terrific benefits, but at the same time we will consider nanomaterial regulation more seriously. It is also true that there has been sufficient research to reasonably conclude that there are some applications that will present problems and that certain applications of nanotechnology will

present risks unlike those we have encountered before. Those are the words of Andrew Maynard from the Woodrow Wilson International Center for Scholars in the United States, an acknowledged international expert.

The real question is not whether we should be concerned about future risks—we are always concerned about future risks. The real question is which facets of nanotech should be regulated now and by what mechanisms. The interesting time in history at the moment is, as two of our Israeli colleagues commented at our workshop a couple of years ago, that probably for the first time ever the attempt to develop a regulatory framework for a new technology is emerging on the public agenda hand-in-hand with the development of the technology itself. These are interesting times. Again, this leads to today's sensible inquiry.

One of the crucial learnings in nanotechnology whenever you start researching is just what we do not know. If you define risk as the product of hazard and exposure, there is a lack of scientific information available at the moment on both hazards and exposure. We know little about the potential exposure pathways through inhalation or through the skin, let alone duration and anticipated levels or exposure. The toxicity effects of these and the accuracy of our nanomeasurements and so on are all somewhat unknown. What scientists do agree on is that there is an inadequate state of knowledge for determining the risks of most nanoparticles and definitive risk assessments are probably some years away.

So how risky is nanotechnology, or how risky are nanoparticles at present? We really are not sure. In any event, risky compared to what? Do you mean compared with perfection, or compared to the air we breathe, including those levels of natural and manufactured pollutants? I notice on your schedule today you have Brian Priestly and Paul Wright. This area of toxicology is really their territory. A significant complication here is the fact that whilst we spend a lot of time talking about the size of nanomaterials as being the most important characteristic, it is only one important characteristic. We know that as particle size decreases there is a corresponding potential increase in toxicity, but shape, too, can be important. So can 14 other physio-chemical characteristics be important. They include things such as crystal structure, particle size distribution, surface charge, chemistry and even the manufacturing process. There are a lot of characteristics that matter when we are talking about the science of nanomaterials.

I guess the question is, as Don Chipp at the Federal level used to say: How do we keep the bastards honest? Depending on which group you belong to, of course, the "bastards" are not those nasty other political parties as Don Chipp used to say but the bureaucrats, the nanobusinesses, the independent regulators, and even the professionals themselves. All of those quarters require trust if we are to continue to enjoy the higher level of public trust and public accountability that democratic and regulatory regimes in New South Wales do enjoy.

So there are some things we do know. Governments have already been in the process of reviewing the effectiveness of existing regulatory regimes—the US, the UK, Germany and so on—and, to the Australian Government's credit, they have certainly undertaken a comprehensive review. It was a major analytical exercise and a good start, and we look forward to its public release. We could also recommend that the New South Wales Government undertake a detailed scientific review of the adequacy of its own regulatory regimes. But you do not necessarily have to wait for the Federal Government's document to become public or for you to learn something. If you simply sat at the world-wide-web and downloaded a bunch of relevant legislation and regulatory mechanisms you would observe several things. For a start, what you would see is that there is a huge coverage of existing regulatory instruments—Acts, regulations, guidelines, codes, standards, and so on. All frameworks applying to conventional products also apply to nanomaterials. They also apply throughout the product life cycle.

What is important here is that many of the regimes have significant latent potential to restrict the availability or use of nanomaterials based on our knowledge of specific health, scientific and environmental effects. I guess what I am observing here is that we are covered by huge regulatory webs already and my main message in this respect is do not panic because we are covered by strong existing regimes. Having said that though, once you look at the international literature, in fact once you read through the submissions that are made to this inquiry, there are many parts of those regulatory regimes that will probably need amending and, as we get new knowledge on risks, hazards,

exposure monitoring tools and so on, there are six areas that I think we will probably end up focusing on.

The first one is a question of the significant potential gap, as to whether new nano-forms of products are really the same as existing forms of that product. Is the new nano-form different to the existing form? Our regulatory apparatus at the moment often names a particular substance or an article and prohibits it—like hazardous pesticides, for example—or permission is given through the therapeutic goods regime. The question is: Should future nano-forms of those products be treated the same as existing approved forms? I think that is a reasonable question. There is some doubt as to whether they ought to be treated the same.

The second trigger area is that many of our regimes rely on a threshold weight or volume. For example, you are allowed to bring into the country 100 kilograms of particular chemicals, but should that apply to nanomaterials? That is a good question because 100 kilograms of carbon nanotubes is a huge amount with huge potency. The third area of concern is that sometimes our appropriate regulation requires particular knowledge of the presence of nanomaterials or the risks of those nanomaterials and the fact is, as I have already said, existing scientific awareness is not sufficient for us to be able to guarantee that that is triggered. An example, I guess, is food. If you read the food legislation, it talks about the fact that you cannot sell food that is likely to cause bodily harm, but where foods or containers around foods contain nanomaterials, scientific knowledge is not such at the moment that we can guarantee that that may be the case.

Fourthly, there is a wide range of risk-assessment protocols and, whilst they apply at a high level currently, their application under a nanomaterial regime is subject to some doubt and to the degree that there is uncertainty this reduces our confidence in the assessments of those risk assessments. There are also research and development exemptions for bringing in and handling particular materials and again an exemption for nanomaterials may well have greater significance than traditional materials. Lastly, many of the things that we deal with in terms of standards and so on in our regulatory frameworks actually refer to international documents and are sourced outside our own regulators, so to the degree that those standards are international rather than local they may lead to a further regulatory gap.

Summarising overall, there are a huge range of existing regulatory instruments covering nanomaterials, but there is also lots of work that needs to be done. Some of the future regulation nanomaterials might even be occurring outside of government too, in areas that are likely to be benign, such as the use of information technology products like memory chips. The manufacturing that is applied there depends on super clean and advanced manufacturing facilities and it is pretty likely that the use of nanomaterials in those environments will be benign. In other areas there are going to be codes of conduct between large companies and several society groups that will be adopted perhaps at the international level, and they will be adopted proactively probably without waiting for governments to act.

The latest scientific information and any potential adverse effects will need careful consideration. All the risk assessment protocols and metrology matters will continue to be important. The path ahead is obviously going to be a long-term one as the regulatory agencies and large commercial companies improve their understanding of nanomaterials and they adjust their regulatory arrangements in the light of new knowledge that we will get as well as the new measurement tools that we will get. Thank you.

CHAIR: Dr Bowman, did you want to add anything?

Dr BOWMAN: No, I think that is more than sufficient as an opening statement, thank you.

The Hon. MELINDA PAVEY: In relation to your six triggers concept, Professor Hodge, and how it relates to nanotechnology, could you expand on that?

Professor HODGE: I might take these questions as open questions. I should say that, this being an area of Diana's doctoral studies, she is certainly an intergalactic expert. I will say a couple of things just to get the ball rolling. On the question whether a new nano-form of a product is the same as an old conventional form, in a regulatory regime such as the National Industrial Chemicals

Notification and Assessment scheme [NICNAS] for industrial chemicals we have a question as to whether a new nano-form chemical is the same as an existing approved chemical and, whilst it might well have the same chemical composition, it is now being manufactured at the nano scale, not the micro scale.

What I would say is that, whilst at one level there seems to be a gap, at another level, if NICNAS as the regulatory agency has sufficient knowledge that they suspect there ought to be a new assessment done, they have the power to call for that new assessment and to do a new risk assessment. So on one hand they just kind of look at the gap and, on the other hand, that particular agency has the power to call for a new assessment. The issue there is that once you end up with hundreds of new materials coming on to the market you will probably be calling not for one new assessment but for hundreds, and there is a question of workload.

Dr BOWMAN: I would continue on regarding the new versus existing question. This seems to be one of the questions being grappled with around the world at the moment. With the NICNAS system as well as most other industrial chemical regulatory schemes around the world, the basis on which we define a chemical is based on its CAS number, so if you have a look at titanium dioxide it will have a CAS number that will be used and that will be the trigger around the world. Part of the problem is that that does not look, as Graeme was saying, in terms of the actual size of the particle. One of the areas of debate when the REACH regulation in the European Union was going through was whether you actually differentiated a nanoparticle on the basis of its CAS number, whether it had a prefix or a suffix that indicated that it was different from its macro or micro scale. That might solve one of the problems.

The further issue associated with that is: What nano size particle are you talking about? If we look at, say, a zinc oxide or titanium dioxide molecule at the nano scale, it actually may behave differently at 10 nanoparticles or 20 nanometres—sorry—so when you start to differentiate a nanoparticle from its larger scale product it is which size nanomaterial are you talking about. So this issue of old or existing versus new in itself has many layers to it. We have started to see that some products are carbon buckyball, which looks like a soccer ball, and which will be used for drug-delivery purposes. You can now look up a caste number for that and it is differentiated as a C60 molecule and also a C72 molecule. The buckyball in itself is carbon and may traditionally have been labelled as carbon under the caste system. We are already starting to see a differentiation under this system. But specifically how do you want to regulate this new nanoparticle, and how much differentiation do you want to see if you were to go down that track?

The Hon. MELINDA PAVEY: You mentioned during your opening statement that codes would come into play before regulation or laws. Could you tell us about the potential development of some of these codes?

Dr BOWMAN: In the United States we have started to see a lot of action occurring with DuPont. Several years ago DuPont announced a partnership with Environmental Defense to create a risk governance framework. That six-step process was a very open and public process to develop the framework. A framework is now publicly available. It is about a 100-page document and it goes through how you could potentially manage the risks associated with the production of nanoparticles. It does not take an assessment of what the potential risk of each nanoparticle may be; it assumes that it is unsafe until the science proves otherwise.

There was a lot of debate when they first released their draft framework and the Consumer Coalition came out and argued that this was default regulation and that industry was taking the initiative from government. They strongly opposed the regulation, or this form of regulation. DuPont and Environmental Defense decided to take a proactive response early on with the development of this framework and putting it in place in their own company. I guess you could say that that is a proactive and positive step. They also thought it would make it freely available for other companies that did not necessarily have the capacity to develop their own risk framework, so you could see a filtering down.

One of the arguments this Consumer Coalition came out with was that basically they were going to create a default regulatory framework and government would defer to that rather than government doing its own proactive work in this area. Other companies that have been proactive in this approach include BASF, which has a code of conduct and which has done since 2004, so that

governs its own manufacturing processes. We are also seeing the Nanotechnology Industry Association, an international association of nanotechnology companies, or you could classify that as companies producing nanoparticles. It is currently in the process of developing its own code of conduct.

That principle-based code of conduct will have 12 principles to drive the behaviour and activities of those companies in the process. So industry is taking quite a proactive approach. I think more and more companies will be doing their own thing in safeguarding their workers. The European Commission came out with a code of conduct for the research side of working with nanoparticles, so you are seeing a multilateral organisation such as the European Commission also looking at codes of conduct and guiding activities with nanotechnology.

Reverend the Hon. FRED NILE: You referred to DuPont, which has a history of class actions against it. Is this a pre-emptive move to prevent future class actions if some nanotechnology has a detrimental health outcome?

Dr BOWMAN: I cannot speak to the motive of DuPont. An article that was co-authored by the chief executive officer of DuPont and the executive leader of Environmental Defense in 2006 appeared in a Wall Street journal. They very clearly said that it made good business sense to engage in this type of partnership and to do so proactively. Reading between the lines on that you would think that this was definitely the way; that should nanoparticles be proven scientifically to be hazardous and there be some adverse effect with their worker population they could turn around and say that they have done everything that was reasonably foreseeable to protect their workers. I do not necessarily think that that would be their only motivation. In playing a leadership role they are trying not only to look after their workers but also to look after other workers who may potentially be exposed to nanoparticles.

Reverend the Hon. FRED NILE: You keep referring to workers. What about consumers who are using the products? Those are the people I am thinking of.

Dr BOWMAN: I referred to workers in the DuPont example, given that they have a manufacturing process where workers in its manufacturing lifecycle will be the first ones exposed to nanoparticles—and these are free nanoparticles. In a lot of consumer products you have nanoparticles that are bound in a matrix and that are not free. So you have nanoparticles in memory chips, computer screens or television screens, and you presume that, given that they are fixed, they would pose little, if any, risk to consumers at that time. Certainly once they go into the waste cycle and they are broken down from the matrix potentially they are a risk. But there is definitely a potential for risk to occur to consumers through applications or products that have nanoparticles that are free. So obviously with something like a cosmetic or a make-up product where nanoparticles are not fixed in a matrix and are being continually applied to your skin there are potential risks. That is obviously one area of concern that is increasingly being shown up in literature.

The Hon. MICHAEL VEITCH: A number of submissions talk about the need for labelling, or consumer awareness education. How we would label this because of the potential for a chemical to be different once it is broken down to the nanoscale. Do you have any views on labelling?

The Hon. MELINDA PAVEY: Like the silver dummy.

The Hon. MICHAEL VEITCH: Like silver being put on baby pacifiers, for example.

Professor HODGE: It is a tricky one. There is a tension between what I see on the one side as a kind of a democratic right to have something labelled because we, as citizens, said it should be labelled and therefore it should. On the other side you have the scientific question of, "We ought to label things that really are dangerous." If there is any evidence around to suggest that these things are dangerous then logically that ought to occur. When we talked to our United States colleagues they certainly said that things ought to be labelled if there is that risk. In the absence of that risk things ought not to be labelled because it implies that there is a risk.

I see a tension between my demands as a citizen saying, "I am not sure about this new nanophenomenon, therefore, I want it labelled", and the science. In a way it also opens up a bigger

question—the fact that we in Australia do not know how many nanomaterials are around. We just do not know, in part because it has come out of all these different traditional disciplines. We had instances where in other countries there have been scares of new nanoproducts. There is the example in Germany of a cleaning product that came out—a new version called Magic Nano. Dozens of people were hospitalised as soon as that product was released onto the market. Various groups came out and said, "We told you that this nanotechnology is a terrible thing."

In the end it turned out that it was not a nanosized product at all; it was just using that label. Of course, that came out weeks and weeks after the scare and the crisis in the newspapers. It really has had a couple of impacts. The first is that industry has become interested in this question of labelling because it wants sensible, scientific advances to be protected. It does not want charlatans in the market using the nanolabel just for advertising purposes. It has meant that it has been far more interested in the labelling question but it does not necessarily solve it.

Dr BOWMAN: I think part of the problem with labelling is: What do you label? We still do not have a universally agreed definition of what is a nanoparticle. Are we talking about something that has one dimension at the nanoscale, so less than 100? That is how most people would define a nanoparticle. I attended a workshop in Europe where members of the food industry were present. One person from the food industry got up and said, "We define a nanoparticle as having at least three dimensions at the nanoscale", which becomes a very narrow definition. So what are you labelling? Until there is greater consensus I think that would be a very hard path to go down.

What does it also mean to a consumer? If you read the surveys of what public knowledge is on nanoparticles you will find that most people maybe have heard of the term, but if they could give you a definition I think you would looking at a minority of people. So there is also the question: Would labelling necessarily assist them? Some companies obviously have got on the nanobandwagon and you have your iPod Nano and your vitamin supplements that are nanocreten and nanoglutamate. These companies identify the use of "nano" as being positive in their marketing and they can charge a premium because it has nanotechnology in it. The question is: Do they have nanosized particles in them? Are they actually using nano?

There seems to be the potential that the issue of labelling could be misleading and deceptive. In some instances it could give companies an advantage over their competitors. We are also starting to see an example at the moment whereby because of some fears or adverse press associated with the term "nanotechnology" the companies that have used the term "nano" on their labelling previously are now taking it off. They do not want to be known as a company using nanotechnology. Until you can define what a nanoparticle is and what is the purpose of labelling a product and a nanoproduct, those questions have to be addressed before you can address the issue of whether to label or not to label.

The Hon. MATTHEW MASON-COX: Professor Hodge, I enjoyed your refreshing perspective relating to nanotechnology. The Committee has heard a great deal about it being some sort of separate science rather than the science of small things. Your reference to a phenomenon reflected a lot of that. In your opening comments you said that there are new risks from nanotechnology and you mentioned six triggers relating to whether we should intervene in identifying whether there are risks in respect of nanotechnology. Could you give us some concrete examples of how, if you were sitting in our shoes, you would intervene and introduce a regulatory regime or regulatory points to counter some of those risks?

Professor HODGE: It is the $64 million question. I am not sure whether I can give you specific examples of where I would change regulatory regimes simply for nanosized materials, in part because of this definitional issue; in part because we are covered by a huge array of existing regulatory regimes that cover things down to the atomic scale, but they cover more traditional products; and in part because we can only regulate for risks that we know about today. It is difficult for me to suggest that we ought to put in place some regulatory regime for something that might happen at some point in the future.

By way of actions from parliaments both Diana and I have been writing for some time about the need to be a lot more careful and to resource more carefully areas of metrology—we still have trouble measuring things at the nanoscale and before we set up standards and so on we have to be very careful that we are measuring accurately—and areas of toxicology and exposure. We need to know a

heck of a lot more than we do at the moment before we concern ourselves with new regulatory regimes. I think our initial submission made the comment that no government in the world has put in place nanotechnology-specific legislation, with one exception.

Reverend the Hon. FRED NILE: What exception is that?

Professor HODGE: The City of Berkeley, a local government area in the United States, put an ordinance in place that states you cannot transport things throughout the municipality. In some respects it sounds a little bit like, "We will have a nuclear-free New Zealand"—a piece of symbolism—but perhaps it is also a message from the scientists involved in the universities there to say, "We want to know what is going on, so tell us so that we can monitor things." I think a lot more research and monitoring must be done before we take the evidence-based regulation step. I take this opportunity to go back a step. We commented earlier on the work that is going on between some of the major companies, for example, BASF, DuPont and so on, and several society groups. To a degree what they are doing is putting in place regimes of monitoring and being more careful than they otherwise would have been so that they can learn as they go through. I actually suspect that a lot of the regulatory regimes that we see in the next five years will come out of those several society and business corporations.

Reverend the Hon. FRED NILE: From what we have been told we now know that nanoparticles can penetrate the skin. As well as studying the nano, will you actually also have to study the human being? Will you have to find out what impact a nanoparticle can have on an eye, on lungs, et cetera? Somehow we need to have a parallel study rather than just on nano in isolation? How vulnerable is the human being?

Dr BOWMAN: It would seem to me that a very much multidisciplinary approach has to be taken in terms of the study of nanotechnology. Nanotechnology, as we have discussed, is a multidisciplinary approach, and in responding to the challenges I think you need to have your toxicologists, your environmentalists, your occupational hygienists as well as your lawyers actually all involved and, as you say, at the same time. In a report put out by one of the scientific committees in the European Union as part of the European Commission they were looking at the issue of nanoparticles and cosmetics. Their report, which was released late last year, started to differentiate on which type of nanoparticles might prove to be the riskier of the two. So, they were looking at the insoluble metal oxide nanoparticles, such as your titanium dioxide and your zinc oxide, which, once they are actually in the body, do not necessarily break down.

So, there is potential for those to be stored in the fat cells or to pass through barriers that have potentially been impermeable beforehand. They then differentiated between your soluble nanoparticles, such as your liposome or nanosoma, which actually could be used to transport drugs or other materials across the skin and into the body and then break down and then are insoluble and excreted from the body in normal processes. So, again it is starting to actually identify and mark out which of the potential nanoparticles could be problematic and which ones need to be studied further in terms of the lungs or the brain, passing through the placental barrier into a foetus. There is a lot of work that clearly has to be done by a diverse group of actors to actually get that data sooner rather than later.

Professor HODGE: I should say that in some ways that illustrates beautifully the dilemma you have: on the one hand the nanosciences promise new drug delivery systems through new pathways and so on, and when that is promised for someone in my family, I reckon I will weigh up the risks and I will say we will go for that if there is a chance that my mum can be saved, as it were. But at the same time those new novel properties, which allow for these new pathways, present a risk and we are not sure of the size of that yet. There are some studies that suggest that there are problems. What I would say though is that you have normally got to get many studies on the table before you get overly active, I guess, in regulating because all science is subject to peer review and one person's way of doing experiments differs from another. Particularly with nanoscience we have to subject toxicology evidence and exposure evidence to pretty hard peer review before we then regulate as a result.

Reverend the Hon. FRED NILE: Is that involving animal research and so on? How are they testing it?

Professor HODGE: I could not say the methods they use. It is not really my area.

Reverend the Hon. FRED NILE: They often use mice; we keep hearing about mice all the time.

Professor HODGE: One of the areas of nano I know is happening in the United Kingdom at the moment is that they are holding conferences on nanotesting methods as an alternative to the use of animals in science testing. So, presumably those science areas see that as a positive.

The Hon. MELINDA PAVEY: Given the fertile ground that nanotechnology as a general sphere gives to the conspiratorial alarmists within our community of the many benefits nanotechnology in its various forms can give, and listening to you both present in such a very straightforward manner the many tensions with the technology and, to use Professor Hodge's words, our democratic right to know, have you both thought of a system in which we can better engage the Australian public so we can provide information for people to make up their own minds on this very complicated issue so that at least there is an avenue for better public discourse so that the alarmists do not hog all the headlines?

Dr BOWMAN: I think nanotechnology is a very exciting area and I think there will be a lot of fantastic products and processes that will be made available as a result of nanotechnology. You are starting to see around the world a whole lot of different dialogue processes that have been put into place by governments and civil society actors to educate. I think actually educating the public sooner rather than later about the concept of nanotechnology and what it could offer would be a proactive or positive step. One of my favourite processes has been actively undertaken by the German Government and it is called a nanobus. Basically what they did, they armed a bus with scientists and other actors and actually drove the bus around the countryside. So, it would stop basically at every town.

They would pull up, you know, like at every stop sign, put on the brakes and the idea was to get as many people from that local town so everybody from your children right through to your adult and actually educate them by the scientists and the people working in the area. The idea was to actually run this project for one year. It got such huge demand and due to popular demand it actually has been running I think for 2½ if not three years—it got booked out so quickly. The idea was to stop at every single town in Germany. That is, I guess, kind of a quite humorous example of something that could be done. I think that was quite a proactive and positive approach: that all of a sudden you had people who could talk about the risks as well as the benefits. They could actually give hands-on examples of what was already available in the marketplace as well as products coming down the path line. So it actually did get the people who went through those buses very excited about what nanotechnology could bring.

The Hon. MELINDA PAVEY: Was it an industry or government funded bus?

Dr BOWMAN: It was a partnership between government and industry, which I think was beneficial as well that you could see industry taking a proactive approach and working with government and giving balanced information. I think the key here is really the balanced information to citizens: that if industry is not proactive then it gives a perfect opportunity for society actors to actually get into the headlines when something does go wrong. They have that opportunity because there is just a void of nobody else offering information. So, I think government and industry really nearly could work together with the civil society actors to give a balanced approach.

Reverend the Hon. FRED NILE: So it had a calming influence on the German people?

Dr BOWMAN: After the magic nano-incident!

Reverend the Hon. FRED NILE: In other words they accept nanotechnology as a result of that?

Dr BOWMAN: I think if you read any of the literature regarding public perception or how the public are actually regarding nanotechnology at the moment, most people do have a very positive

response to it once they know a little bit about it. But at the moment we have very few people with that level of knowledge to actually either give an opinion one way or the other.

Professor HODGE: Can I just add a comment. I think there are many, many ways of answering that question. On the one hand there are a couple of dozen techniques that we mention in the paper—I think we actually gave it to the Committee—public interest dialogue in the nanotruck, and nanobus, nanodialogue and so on, some parts of that, but the very fact that the submissions to this inquiry are up on a public website is, to me, part of that information transfer. The very fact that I have mentioned some potential regulatory gaps and triggers and I can line up some of those gaps with the submission by Friends of the Earth. So there are concerns that as we look forward there is actually some agreement on some of these areas of potential concern. The real question though I think is what needs to be done today, and that is where we fall back on. Do we institute nanospecific regulation? Do we institute a moratorium, which is probably practical, or so on?

So I think the challenge governments face in terms of gaining trust in this area in some ways is no different to most other areas of public policy. The only difference perhaps is that we have had a mad cow crisis in one country and a GMO crisis in another country, and as a result of that governments and certainly Germany and the United Kingdom have decided that for the next set of scientific advances they need to be more cunning and more serious about public dialogue. I think there are many techniques we could use in Australia to assist public dialogue. It is public dialogue not from a manipulative perspective but from a perspective that we are trying again to separate the science of what is going on here and what is good for citizens, consumers and industry from the phenomenon of the spectre of nanonasties.

CHAIR: Would you care to add anything further?

Dr BOWMAN: No.

CHAIR: We thank you for your excellent presentation and address to the Committee. It has been a pleasure to have you here and we thank you for your support of the inquiry. We will have further questions for you. If possible, would you provide the answers to those questions before 19 May. If that is not possible, would you please let the Committee secretariat know.

(The witnesses withdrew)

ANDREW DESMOND CHEETHAM, Pro Vice-Chancellor Research, University of Western Sydney, affirmed and examined:

CHAIR: Professor, 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. Further, if you take any questions on notice, the Committee would appreciate it if the responses to those questions could be forwarded to the Committee Secretariat by Monday 19 May. Would you care to make a short opening statement?

Professor CHEETHAM: Yes. I have not really got much to say by way of opening statement. You know who I am and my job. I have only been one year in the position, so I am relatively new to what is a very large university. I have also only been one year in Sydney, so I have not quite figured out the intricacies of this city yet. My background is in fusion energy research, which I spent 15 years doing mostly in Europe. So, I am not a specialist in nanotechnology and, therefore, I will effectively refer any technological questions about the details of it to people at the university, if you require answers. The last witnesses who were here certainly were experts.

I guess what I would like to say is that the University Western Sydney has considerable expertise in nanotechnology. As you may know we set up the nanotechnology network in 2003, funded by a sustainable regions program grant from DOTARS. That funding ran out in 2006. The program is now continuing to be run by the University of Western Sydney but at a somewhat lower level, given the lack of any matching funding from participants. So we are still holding meetings and we are still doing community outreach activities.

Recently, last year, one of the things I did was review our nano-scale research at UWS. A part of the outcome of that is that we are now putting together what we would call a nano-scale theme, an umbrella theme, if you like, which covers a whole pile of different thematic areas to do with technology. I think you already understand because I heard the last two witnesses mention it that nanotechnology is not a discipline in its own right. It underpins so many other disciplines in that it is small-scale particles or materials or whatever, or even techniques, and of course that feeds into biology, materials science, information technology, et cetera, et cetera. I would claim that it is not really a discipline in its own right but a fundamental technique. Therefore it really does become a multidisciplinary activity. That is what we are trying to make it at UWS. It is very difficult to actually isolate it. In that context I guess, I will answer your questions.

The Hon. MICHAEL VEITCH: Professor, it has been suggested to the Committee that the New South Wales Government should establish a Ministry which has the sole responsibility for research, science, innovation and development, and that such a Ministry should be supported by the creation of a New South Wales Chief Scientist. Do you believe there is a need for this, or is the current structure adequate enough?

Professor CHEETHAM: That is a good question to start off with. I was asked that a couple of years ago in the Australian Capital Territory and I said yes. I think the answer is still yes—that is, I do think it would be a good idea. In fact, if you, as you no doubt have, look at the national strategy for nanotechnology, the one that was put out by the government last year, their proposal number one is that there should be a dedicated office in a Federal department. That was for nanotechnology. What you are saying is more for science and research in general, I believe—innovation and development. I would say the answer to that is yes and the reason I am saying that is that although in New South Wales we are doing pretty well, we still do a great deal of research, innovation and development, and that is by and large I guess because of our size: we are by far the biggest State. It seems to me that Victoria and Queensland, our nearest neighbours, are actually doing rather well also. They have had a lot of help from their government. I think this type of department would be able to facilitate that type of help. I am not always talking about just handing out cash.

The creation of a Chief Scientist I think is a very useful position because it acts as a relatively independent interface between the government and any of the research agencies or universities or whatever. When I say "relatively independent", you would normally want a research scientist who actually is a scientist, so they have probably not been in government. Consequently, you could say that bias may be towards the science rather than the government. But you have to choose that person

correctly. They need to be somebody who has probably done it all and now wants to help the government and the country as a whole—the government and/or the State and the country. So if the government has a vision for research and development in New South Wales, the question you have to ask is: How can this person help you implement that vision? It is a sort of two-way interface, if you like, because they can talk to the universities and research institutes and they can also talk to the government.

It gives you an adviser. It gives you someone who can help frame what your strategies and your priorities might be with a relatively high level of expertise in terms of what they can gather from the research institutes and universities and what they can tell you. Hopefully it will be somebody of course who can actually take scientific mumbo-jumbo and put it into English. My short answer to that is yes and I have already given you the long answer, but I think it would be a very valuable position. Significantly, most of the other States, not all, have a Chief Scientist. I think it would be something that would be of benefit.

The Hon. MICHAEL VEITCH: Professor, you spoke about the Victorians and the Queenslanders. Can you give me an example of what those governments are doing that New South Wales was not doing to assist?

Professor CHEETHAM: Yes, I can. A lot of it is actually leveraging. I do not want to give the impression that New South Wales does nothing because that is not correct, but in terms of when the Federal Government put up funds for certain programs, grants, et cetera, et cetera, nearly always these days it requires leveraging funding, either from the university or the research institute or from local government. We have had, shall we say, less success in getting leveraging funding from the government. We have provided quite a bit of our own and got our own grants but I think it is something, which is acknowledged in New South Wales, that we are doing less of. I use that term carefully because I do mean less, not none. That is one example particularly in leveraging.

The New South Wales Government has put together its innovation statement. That is a good start. What we would like to see now I guess is some action on how we are actually going to action those innovation areas. You have four areas. One is clean coal and another is advanced finance, our research centre, et cetera, et cetera. What is the Government actually going to do to say that those are its priorities and now it has to act on that and set something in motion so that we are going to fulfil whatever is our ambition or vision around those priorities. I think that is very important.

The Hon. MICHAEL VEITCH: Given your comments in the context of nanotechnologies, are the Victorians and the Queenslanders ahead? Is New South Wales falling behind in its investment?

Professor CHEETHAM: I cannot make a definitive statement on that. I am sure you have seen it, since you have the Victorian statement on nanotechnology, but that does not carry any what you might call funding or proposals with it. But it does have a set of recommendations there or a vision, if you like, of what they want to do. I do not know about Queensland and whether it has done the same thing for nanotechnology or not; as I say, it is not my area. Another good example which was contained in a report that I included with our submission is the way that Dresden in Germany, for example, went about setting up its nanotechnology vision. Victoria certainly has a statement out, which is quite nice reading—a lot of what you might call motherhood, but at least there is some substance there.

The Hon. CHRISTINE ROBERTSON: At the moment, and extending from Mick's earlier question, different government departments are involved in supporting or encouraging research in nanotechnology.

Professor CHEETHAM: Which illustrates its multidisciplinary nature.

The Hon. CHRISTINE ROBERTSON: That is exactly right. So how would you prevent the new chief science officer from siloing or manifesting that all perception comes from the god, which accidentally destroys the innovative work that is occurring in some other areas?

Professor CHEETHAM: I am sorry, the god being the Chief Scientist?

The Hon. CHRISTINE ROBERTSON: Yes. I was just using examples to talk about silos.

Professor CHEETHAM: Yes. That is something you will have to mediate against, but the Chief Scientist should be above that. They have got to be at a level which is not directly concerned with what is going on at the coalface.

The Hon. CHRISTINE ROBERTSON: You are from a university where competition is very violent. How do you—

Professor CHEETHAM: It certainly is. There may be a lot of competition within universities, but that is not something that I particularly agree with—not that I do not think that competition is good in its place. In Australia we have a university system which is relatively small. We are a small country, and I do not mean geographically, obviously. It seems to me that we lose a lot of energy and we lose a lot of efficiency and efficacy by competing in areas where we should not have to compete. If you have a group or several groups working in a certain area at different universities, there should be a big emphasis, if you like, on collaboration rather than competition.

The current Federal Government is talking about, in its innovation review, the hubs and spokes model where we are trying to connect groups together rather than have them competing. Of course they will still compete for grants, and so on. That competition or the competitive element that we have in universities at the moment to a certain extent, perhaps even to a large extent, was driven by the former Federal Government, which really wanted to see that competitive element. They were effectively driving us—by that I mean universities—into this competitive mode.

Paradoxically at the same time as you drive into a competitive mode like that, although all of the public statements and although a lot of the desire or stated desire was to drive multidisciplinary research—that is entirely understandable because most of the really interesting stuff that happens these days is at discipline boundaries where disciplines meet, which makes it even more interesting—and although this was designed so that it was understood that that was good, many of the processes, particularly the financial processes, put in place actually drove people back into their discipline-based silos, and the research quality framework was really a classic example of that.

I actually believe the research quality framework was a good idea because I think we should measure the quality of our research. It is very important to know that and to know where the quality is, particularly if we are going to go through this hub and spoke model. But the methodology they chose actually made it very difficult for multidisciplinary research to get up with high quality. So it was tending to drive people back to their discipline silos.

The Hon. CHRISTINE ROBERTSON: What is concerning me about the position that we are talking about is how to set the structures up to ensure that different disciplines are still participating and you are not actually removing from each different department the processes that will have to move on to other people.

Professor CHEETHAM: Absolutely. But your Chief Scientist should do that. That has to be one of the performance parameters of the job. You cannot have a Chief Scientist whose area may be—I do not know what, maybe nuclear science or whatever—coming in and then simply focusing on nuclear science.

The Hon. CHRISTINE ROBERTSON: No, not nuclear science!

Professor CHEETHAM: Or whatever it is. It is just an example.

Reverend the Hon. FRED NILE: I would just follow up some of those comments. In your submission you have said that there is a need for a concerted education campaign around the general topic of nanotechnology. You referred earlier to the nanotechnology network that you have at your university. Could that have been a pilot program that could have been expanded? Is that one of the purposes of it?

Professor CHEETHAM: It was one of the purposes of it. It had many purposes in fact and it achieved quite a bit. One of the questions that you tabled for me was indeed, "Can you describe to the

Committee the work of UWS undertaken through the nanotechnology network to promote knowledge and nanotechnology in Western Sydney?"

Reverend the Hon. FRED NILE: That is what I am getting at.

Professor CHEETHAM: Yes. I went to my colleagues who were involved in that. I have two pages of stuff here that they have done, which I will not read out to you, but I am happy to send these answers back to you in a more edited form after this.

Reverend the Hon. FRED NILE: You can make that an answer to a question on notice, if you will send those back.

Professor CHEETHAM: Okay. I will do that. But they have had significant success at various different levels. So we have all of these different levels. For a start, they offer an undergraduate course, a Bachelor of Science in nanotechnology. Having just said to you that nanotechnology is not really a discipline in its own right, you have to say: What is a course in nanotechnology? Of course it is how you apply it to various different disciplines. So you are doing a Bachelor of Science and you are covering physics, materials, biology and geology, whatever, but there is an overarching emphasis on how nanotechnology feeds into those areas. They conduct network meetings with students, businesses, industry, and I am not going to read all of these to you, but they have been out to 240 site visits to businesses and industries in Western Sydney. They have put together various materials, which you know about. They have gone out to a couple of hundred schools and so on.

This is really very much an outreach program. If you like you could call it part of the University of Western Sydney's emphasis on outreach to schools, particularly in the science area. That is something we are concerned about—the lack of well-qualified science teachers—and I think that is, to get back to your original question, one of the keys to education of the population. You asked a similar question of the two who were sitting here before, and they came up with the nanotechnology bus in Germany. I had not heard of that. That maybe almost extreme, but you have to remember that the Questacon national science thing in Canberra Museum runs a bus, the science circus or something, which goes around the place. So we already have the infrastructure in place. You can add nanotechnology to that and you are already in business. But I had not heard of that.

My answer to that question was that you have to start at the lowest level and work up, so training teachers is one and getting it into the school curriculum is another. It will naturally flow there but it needs to be done properly. But that is long term. The short term needs to be a national strategy, for example, proposal 3 in the national strategy, which was community awareness and public engagement. If you look at the details of the national strategy, there were some details in there which sounded reasonable to me. As for an idea on how you educate the public in this type of thing, all I can say is that you must have something ready to counter what will almost inevitably be a negative media campaign. They will always pick up on the negative stories in preference to the positive stories. You can try to get them on bias or whatever.

The Hon. MICHAEL VEITCH: You are telling us something we already know.

Professor CHEETHAM: You would know a lot better than I would.

Reverend the Hon. FRED NILE: It is a pity that, as you mentioned earlier, the funding was stopped. Where did that funding come from? Was that State or Federal?

Professor CHEETHAM: It was Federal; it was DETAS, one of their sustainable region programs. When I said it was "stopped", it ran out. It was a program that went for three years, and we have not managed to get it renewed. What we would like to do—I believe that the nano network people have been negotiating with New South Wales government departments to extend that funding or get some funding to help continue the network but so far without success. So that may be one thing that would be possible for the Government to do. Rather than starting something new, it would be leveraging what already seems to be reasonably successful, although what I would like to see is perhaps to put some money in there to determine the success of it. One of the questions you asked—

Reverend the Hon. FRED NILE: Was that the Department of State and Regional Development? Do you know what department that was?

Professor CHEETHAM: I do not know.

Reverend the Hon. FRED NILE: Can you find out for us? We may be able to assist you.

Professor CHEETHAM: Yes.

The Hon. MATTHEW MASON-COX: From your perspective, do you have a view on the adequacy of the current regulatory framework with respect to nanotechnology?

Professor CHEETHAM: The current what framework?

The Hon. MATTHEW MASON-COX: Regulatory framework, or lack thereof—the current regime, if you like, applying to all sorts of issues from occupation health and safety right through. Given the wide spread of nanotechnology, do you have any views about whether we need to enhance the existing regulatory framework?

Professor CHEETHAM: This is outside my level of knowledge, but just giving you an opinion rather than anything that is based on evidence I would say, having listened to the people who were here before me, and also having seen what has been going on, that there needs to be regulation. It is clear that you have to regulate something which could have or may have or does have dangerous consequences, but that will be very hard to do simply because of the breadth of nanotechnology—the disciplined breadth, if you like. You do not want a regime in place that would take away some of the benefits that are already coming through nanotechnology by trying to protect us from what we do not know. I am not helping much because all I am telling you is that it will be very difficult to do, but we probably need it. There are people who have studied it, rather than me who has not studied it. So I would say that was my gut feeling.

But once again—I think I put this in the submission—I think that needs to be coordinated nationally. What we do not want or what would be not useful is to have seven different regulatory regimes—or eight; you will probably get a Federal one as well—which would impede the collaborative process across State boundaries which we already have in various fields due to different animal ethics methodologies, different human ethics methodologies, et cetera. My plea or advice is to ensure that this is coordinated somehow nationally.

Reverend the Hon. FRED NILE: As part of education you also said that you had this *Sky High* DVD that was shown in 250 secondary schools. How was that received?

Professor CHEETHAM: All I can say is that it was received very well, based on anecdotal evidence. Unfortunately, because of the lack of resources, we have not done a study yet of the effect of that or how it was received in detail through the children. So that is something I would like to see done so that we can build on that and improve it for the next version. So the answer is that I do not know but anecdotally it was very well received.

The Hon. MICHAEL VEITCH: We have undertaken a number of site visits to universities in New South Wales. One of the recurrent themes is workforce issues, obtaining suitably qualified nanotechnology practitioners. Do you have a view around that? Can you comment, too, on the competition amongst universities in Australia for those quite specialised skills sets?

Professor CHEETHAM: The report that I attached to this, which was written by Kim Levers and Christina Martinez Fernandez, goes into that in a level of detail—not hugely detailed—and I guess simply repeats what we have been seeing overseas in terms of the skills shortage, and I think that will only get less. Let me take your last question first. The skills shortage in terms of academics has not bitten yet but it is already emerging. It is now much more difficult to recruit good academic staff. Putting in a newspaper advertisement, for example, is out; you have to go to websites and to quite detailed levels in order to attract people to apply. So that whole situation is becoming worse and will get worse.

I remember some years ago the then Chief Scientist in Queensland made a claim that Australia would need about another 70,000 PhD qualified people by 2020 or something like that. There was some claim. It turns out that that was probably about right, given the number of academics who are of my age who will be retiring in the next five to 10 years. We had a demographic study done at the University of Western Sydney simply because we were concerned by the demography of the university. It turns out that we are the second oldest university in the sector—that is average staff page, not sandstone or anything. It turns out that when they did the analysis for us the claim was that we would lose something like 42 per cent of our staff in the next six years, which is a huge number. That was simply through a certain amount of attrition but also retirement. Replacing those with similar or better qualified staff will be very hard. That is the second part of your question.

As for the first part to do with nanotechnology, analysis of those statistics indicates that there will be a large increase in demand. Even the surveys we did of the industries in Western Sydney, which was done as part of our nano group, indicate the same thing. That is notwithstanding the fact that the same survey found that many industries do not know what nano can do for them, even at the established process level like materials processing, et cetera. So even notwithstanding that lack of knowledge there was a rise in demand for nano competent people. But I would like to see a much more detailed analysis of what is being claimed: What do we want? What is it that we have to train? Are we talking professionals? Are we talking para-professionals, technicians, factory workers or manufacturing workers and so on? All of those have a different level of what might be required.

For example, the production line worker will need to know about health and safety issues, et cetera, if they are using nano scale materials but you will not want them training nano scientists and so on. So those education programs will have to infiltrate all of our current training programs, whether it is at TAFE, whether it is apprenticeships university, colleges, et cetera, to make sure that your workforce has that knowledge if they are going to need it. I can use an example, if you like. Some years ago I was in another position. There was a proposal to put forward a Bachelor of Engineering in optical communications, because it is the name of the game these days, as you know, fibre to the kerb and all that sort of stuff. When we did a survey of industry the answer was, "No, what we want is well-trained communications engineers who know about opto". In this case I would say that you want a well-trained workforce that knows about nano, and at the top end you need some nano specialists.

The Hon. MICHAEL VEITCH: You mentioned TAFE and that vocational level of training. Are you aware of any vocational level courses that provide people with nano exposure?

Professor CHEETHAM: Let me take that one on notice but it will be interesting.

The Hon. MICHAEL VEITCH: It is the first time anyone has mentioned the vocational level of training.

The Hon. CHRISTINE ROBERTSON: In relation to the demographic study you did on your university staff, was that comparisons with across Australia?

Professor CHEETHAM: No. The study we had was done for us only. It was really just us because they talk in past trends, et cetera, within university.

The Hon. CHRISTINE ROBERTSON: So it was not comparative.

Professor CHEETHAM: No. The data that we had that told us we were the second oldest, that just came from the DEST data that you get for all universities.

Reverend the Hon. FRED NILE: Is there a compulsory retiring age? You say you will lose 46 per cent. Is that because there is some fixed date or you cannot extend those who wish to stay?

Professor CHEETHAM: No. I do not think we are allowed to have a compulsory retiring age these days. It was done by a group from South Australia who do these types of studies. I guess they have some sort of assumption of how many people will retire either before or at 65 and those who will carry on. Academics never retire; they sort of fade away but they will go off the payroll. A lot will them carry on still doing some sort of work either casual or maybe even just for nothing as emeritus. I believe that was all folded into that analysis.

The Hon. CHRISTINE ROBERTSON: Did you make that study public? Is it a public paper?

Professor CHEETHAM: I doubt it.

The Hon. CHRISTINE ROBERTSON: I am sorry to be so obsessed but I am from the country and you could well be reflecting the issue we whinge about perpetually about our ageing professional workforce.

Professor CHEETHAM: The result of that study is that the university has put together a huge plan called "Our People 2015", which I think is public, because that was proposed for funding from the Government and we got several million dollars to implement that plan. The actual study might not be public but the results of it in terms of what we are trying to do about it certainly are. I can get it for you if it is public.

Reverend the Hon. FRED NILE: The New South Wales Institute of nanotechnology has made a suggestion to the Committee. Do you have any views on that or would you rather be incorporated within the universities?

Professor CHEETHAM: I sort of answered that question before from the point of view if you have got an institute that is overseeing—this is to oversee the skilled workforce is it not?

Reverend the Hon. FRED NILE: Yes.

Professor CHEETHAM: And to see about the training et cetera. If it were something that coordinated training across the spectrum, that is, the spectrum I meant right from the lowest level—I do not like that term—from the most fundamental level of say the production line worker up to apprentices, TAFE, colleges, university, if it were a coordinating body, that I think could be useful to make sure that we are doing things the same way. Again, the qualifications that come from different States and this State are meaningful, and mean the same thing. My comment again is that it is not a discipline in its own right, so I would not know that you could have an institute to teach nanotechnology because you would need all sorts of other people in there. You would need all your biologists and your physicists and it is beginning to sound a bit like a university to me.

Reverend the Hon. FRED NILE: I am wondering whether it should be part of the university?

Professor CHEETHAM: Exactly, because it is so broad, it is not like having an institute for something really specific: it is not specific, it is very broad. I think perhaps getting a representative group from universities who currently teach nanotechnology or putting a governmental working party together to try to figure out how you would do it, including, as I said, TAFE and the other areas where a certain degree of nanotechnology training will be required, I think that might be a good idea.

CHAIR: Would you like to refer to anything else that was not covered by the Committee?

Professor CHEETHAM: I have just about said everything that is in my notes, so I do not think so, other than to wish you all the very best because this is actually a pretty tough area. To me it is not unlike nuclear from the point of view that nuclear is hugely broad but the whole word "nuclear" has been besmirched by radioactivity which, of course, is not just nuclear. So when people get frightened by the word "nuclear" they usually mean radio activity, we do not want to do that with "nano". So if people are concerned about certain sized particles being in their food—which is justifiable in the same way that it is justifiable not to want to let something which is pouring in gamma radiation into your house—you do not want that to reflect on the rest of nanotechnology and all of the beneficial things. So, it is the same difficulty in trying to make sure that we actually can do it in a considered way.

CHAIR: Thank you for your attendance, your advice and your answers to questions from Committee members. The Committee may have further questions for you and if you would take them on notice at some stage and reply by 19 May, it would be very much appreciated.

Professor CHEETHAM: Today I got a few questions, which I will attend to.

(The witness withdrew)

(Luncheon adjournment)

SUSAN MARY DODDS, Professor of Philosophy, Head of the School of English Literatures, Philosophy and Languages, University of Wollongong, and

JOHN FREDERICK WECKERT, Professorial Fellow, Centre for Applied Philosophy and Public Ethics, Charles Sturt University, affirmed and examined.

CHAIR: Would either or both of you like to make a brief opening statement?

Professor DODDS: I will first give you a bit of my background. I am a chief investigator on the ethics program of the Australian Centre for Excellence and Electromaterials Science at the University of Wollongong, but also chief investigator on an Australian Research Council Discovery Project on "Big picture bioethics: policy making and liberal democracy". My research areas are in applied ethics and political philosophy especially as they apply to developing technologies, but also to questions about how we make social decisions in a pluralist democracy. That is where I come from.

I want to raise a couple of points in the opening statement about the role of public engagement and the different kinds of roles public engagement may have in relation to the ethical issues that nanotechnology may pose. It seems pretty clear that recognition of the health, safety and environmental issues associated with nanotechnology—the things we do not yet know about—are clear ethical concerns insofar as health is valuable and insofar as we have concerns about who takes responsibility for mitigating risks or cleaning up effects of spills and so on, but also questions about bystanders, the environment over a long time, and the life cycle of products. It also seems it is important for us to recognise that assessments of acceptable risk, or as low as reasonably possible risk, are social assessments. What is acceptable and what is reasonable is something we need to judge collectively.

Further to that, in a democracy where we have public support for research, research institutions and researchers, there is a responsibility for accountability, openness and transparency in the processes we use. It seems to me that social engagement comes out of a range of our collective interests and should be seen as doing different kinds of things. There is a well-recognised area of research called public engagement, or deliberative democracy research, in which debates about the role of public engagement in terms of informing the public, finding out what the public is concerned about, engaging the public in trying to find collective answers to social problems, or providing the public with opportunities to actually control outcomes are different kinds of things you would do with a public engagement process. It seems that in the development of any kind of nanotechnology policy in New South Wales or State support for nanotechnology developments, articulating the different kinds of roles that public engagement may have would be important rather than assuming public engagement means one thing and is always a good thing.

Finally, I just want to say a little bit about democratic decision making. One of the ways that democracies give legitimacy to policy is through processes like parliamentary debates, but in areas where there is lack of information about what is at stake or we do not yet know who is affected and in what ways, we may need to go beyond traditional methods of democratic decision making to actually get back to what concerns different publics and how they may be affected by policy. That's it!

Professor WECKERT: I endorse all of what Professor Dodds said. One of the things I would like to emphasise was one of the points that she made, in relation to assessing risk. Obviously there is a big scientific element in assessing risk but it is not the only one because what one person or group considers an acceptable risk another person in another situation will not. Once all of the scientific information is in and we know what the probabilities of harm in some particular product or technology are, there are social and ethical issues that have to be examined.

We talk about risks versus benefits. There are two issues: one is the question of how the benefits are distributed. It is one thing if the person taking the risks is also the one who gets the benefits; it is a completely different situation, I think, if one person or group has to take all the risks and all the benefits go elsewhere. Another point is whether the benefits are important enough to take any risks at all. For example, there are obviously good reasons for taking risks in certain sorts of medical treatment, particularly if the person who has the problem is taking the risk. It is not clear that it is worth taking any risks for, say, better tennis rackets or something. There are a lot of issues that

come up, apart from the scientific ones, with risk. There are also some other issues in nanotech, apart from the risk of other social issues, where you cannot really talk about risk in that precise way—things to do with the potential for more invasion of privacy, for example.

CHAIR: Thank you. We will now ask some questions. One of the terms of reference of this inquiry seeks to examine the options to improve public awareness of nanotechnology issues. Rather than first seeking your views on what the best options might be, it would be useful to examine what are the issues of which the public should be made aware. What are the key issues, in your opinion?

Professor DODDS: Obviously there are the key issues of our limited knowledge about potential health risks and environmental damage and about the ways in which novel properties are demonstrated by materials which we find to be quite safe at bulk level. There is a big gap in our knowledge about some things. That is rapidly being filled in but because there are so many things happening at the nano scale it will take quite some time to pursue. Secondly, there is the issue of the potential benefits of such technologies, whether it be in terms of cleaner, greener, smaller, lighter or stronger properties that may be available from manufacturing, resolving issues about pollution or providing energy sources.

There needs to be a good understanding at some basic level of how that science works so that the community can anticipate where we are going in terms of technological development to avoid a backlash against certain kinds of technologies. In areas such as medical bionics there needs to be a better understanding of how to evaluate medical bionics in vitro prior to trying it out on people. It seems that we need to talk about how the potential benefits and risks may not necessarily be distributed in a way that perhaps a hyping of the technology might do, so we have to be realistic about how far down the path we are towards getting some of the benefits that are seen to be demonstrable social benefits rather than the ones that might just make some company a bit of extra profit. I think we need to talk about those.

The Hon. MELINDA PAVEY: What are the challenges in engaging the broader community on issues associated with nanotechnology? Does either of you have a view about how the Australian Office of Nanotechnology is conducting that engagement with the people?

Professor DODDS: John has been involved in that so he may want to speak more directly about that process of engagement through the Office of Nanotechnology. In my view some of the challenges have to do with a relatively low level understanding among the broader community about the science involved, so mechanisms to try to engage that would be a bit of a challenge. Some of it has to do with giving realistic information. We can all ask researchers to talk about the promise of research in order to be able to be funded but we actually know that we are going to move much more slowly than that, so we need a realistic assessment of what is possible. It also seems that the breadth of nanotechnology—it would be one thing if it was used only for either manufacturing stronger buildings or for medical applications, but the science of nanotechnology itself has a huge array of applications, so engaging people at the level at which their concerns will be visible to them is really difficult. That probably suggests that much more science information needs to be available without drowning people in detail that they cannot get their heads around.

Professor WECKERT: I think that is right. I have been involved in two of the Office of Nanotechnology forums and I was also involved in a Commonwealth Scientific and Industrial Research Organisation one in Canberra last year. It seems to be the case that there are concerns among two groups—a lot of the scientists on the one hand and, on the other hand, some of the more activist groups like Friends of the Earth and so on, who raise lots of extremely important issues. There does not seem to be an enormous interest or concern by people in general. That is the impression I got from both of the forums.

I was at one here and one in Melbourne. There were not really all that many people present who were not scientists. That seems to indicate that there is not an enormous worry. GM foods have created a lot more interest, but I think that is partly because people are concerned about what they eat in a way that we are not perhaps concerned about some of the things we use and, as Sue was saying, there is such an enormous array of products that I think it is hard for people—well, there is not really a nanotechnology that people can see, there is a whole vast array. But I think there is a lack of interest in the sense that I think there is just a lack of concern.

Reverend the Hon. FRED NILE: Could it be a lack of knowledge, just ignorance—in the general public I mean, not scientists.

Professor WECKERT: Yes, it could be that there is a lack of knowledge, but I guess there are two ways of looking at the lack of knowledge and how we try to do something about it. On the one hand there are people who think that creating or giving people more knowledge is a good way of stopping any sort of backlash, like there was with GM, on the assumption that if people know what it is about then they will be even less worried, they will know that it is fine. On the other hand, there are some who think people should know more, the public in general should know more, because it will in fact make them more worried. I am not quite sure which way it would go. I think more knowledge is better, regardless of whether people think that it shows that it is not so dangerous or if they in fact get more worried.

CHAIR: How do you get that information out to the public? What do you think would be best?

Professor WECKERT: That is something that I guess we have not done so much of in Australia, although Sue talked a bit about that before. There is a lot more work going on in Europe. I would have thought that one thing that perhaps we should be doing is targeting schools a lot more. I know that science is not the flavour of the month in schools either, but I think that that is one area where we could target people who possibly have a bit more interest. I think that what the office of nanotechnology is doing is good, but on its own it is clearly not enough. Sue has probably got more thoughts on that.

Professor DODDS: It seems to me that there are a number of things that would be sensible to go on at once. How many things can be done by State Government versus nationally? How many things should be done by particular research institutions? That is a little bit open, but some of it is about directly getting into schools, engaging the imaginations of young people as they learn science, so that they actually develop a skill at understanding scientific issues, technological issues, because I do not think that nanotechnology raises issues that will be the only ones that will confront us over the next 50 years. I think there will be lots of other technological issues.

The second is things like making available useful and reliable resources of information. The European Union [EU], as John suggested, has done a pretty good job of that, making sure that there is up-to-date information that is relatively accurate, resources for further information. Some of that is about scientists getting out of the lab and being willing to engage more broadly. I think that is a bit of a trick, I mean it is a bit difficult and it requires good science communication. There are certainly growing bodies of people who are engaged in good science communication with the public, but it is still a relatively niche area. While I was saying before that in citizens' juries, in public engagement processes, there are quite a few very good facilitators for social problems and environmental issues, planning problems, there is not very much that has been developed in terms of people getting contestable bits of science out in a mechanism that can be tested, so that experts can actually challenge each other, rather than citizens being passive sponges of information, showing that these things are actually under debate and being developed across time.

The Hon. MATTHEW MASON-COX: From your perspective, is the existing regulatory framework in relation to nanotechnology adequate?

Professor WECKERT: I suspect it is not. I am not a lawyer and I am not a scientist, but from all I have read, from all I have heard from scientists and lawyers and policy people and so on, I think that the problem is—and you may well have heard this already—things that might be dangerous at a macro level that are picked up by current regulations may well not be if it is the same material at a nano level, and that seems to be one of the big issues. One of the big problems, of course, is that there is a vast array of different sorts of nanoparticles, so having adequate legislation or adequate regulation would be no simple task either, but almost certainly current regulation is not adequate I think.

The Hon. MATTHEW MASON-COX: Is that a gut feeling you have or do you have any specific examples that you might draw on?

Professor WECKERT: I cannot think of any specific examples, but it is more than a gut feeling. It comes from the scientists I have talked to who talk about the properties of various materials with which they are working, talking to people who are involved in regulation and so on, but I do not have any specific examples off the top of my head.

The Hon. MATTHEW MASON-COX: From an ethical perspective, when should Government step in and prescribe regulation?

Professor WECKERT: If we take the European approach there would be a lot more emphasis on perhaps not regulation of the product, but certainly a lot more emphasis on actually trying to find out what the risks were very early in the piece rather than sort of having products on the market and then realising that very little or no testing has been done on them and then trying to bring in regulation. The Europeans, who have just recently brought out a code of ethics for nanotech research, emphasised that very strongly and it also comes out in the work of Andrew Maynard and people in Washington in the United States where they are arguing that there should be a lot more emphasis early on in actually finding out what is going on with toxicity and so on. Then there will be hopefully enough information around for governments to make regulation.

The Hon. MATTHEW MASON-COX: And that information or research into toxicity or other potential risks with nanotechnology—should that be conducted by industry or Government or both, in your view?

Professor WECKERT: In my view, well, certainly both at least because otherwise there is always the perception that there are conflicts of interest or vested interests getting in the way.

The Hon. MICHAEL VEITCH: An interesting perspective is also the longer-term impact of the use of nanoparticles. It is difficult to regulate when we do not know what those impacts are. Do you have a view about the current regulatory frameworks capacity to accommodate longer-term issues?

Professor DODDS: My view on the longer-term impact is we would need to develop structures. I think there are some structures which exist, things like collection of data on the impact of things on the environment, but I do think we need to be looking much more closely at ways in which we can detect possible pollutants. That would require both an industry and a government role because we need to know what is going out into the environment and we need to know what we should be measuring and keeping records because of one difficulty with having a fully industry-based regulatory mechanism is that you do not get the longevity required to be able to do the assessment and it seems to me the existing regulatory structures—as John indicated, the biggest challenges that we actually are learning about the properties of the materials as the development is going on, so that trying to regulate entirely up front leaves us wide open to things we don't know or strangles the possibility of the technology, whereas something which created a framework within which you had an independent body that sought reports and there was some obligation on researchers in industry to actually provide the data so that it could be assessed for safety as the development occurs seems much smarter than just wait and see what happens or trying to regulate everything up front, so I think somewhere in between.

The Hon. MATTHEW MASON-COX: An intuitive approach?

Professor DODDS: Yes, which regularly opens up are there new reasons for thinking about this, so the idea of contestable science is sort of at the centre of this. Just to go back to an example John might appreciate, we have a lot of faith in cosmetics being safe for us because they are made of the same materials that have been used for other cosmetics and no one's face has fallen off yet, but we also know that when we use titanium dioxide at the nano level it may have properties we have not yet seen and so it may be that the sunscreen is either working much more effectively or not working effectively at all, so our faith in the regulatory structure needs to be one which can actually be contested, we can actually test to make sure it is effective.

Reverend the Hon. FRED NILE: There is probably going to be a debate and public opinion about technology and, Professor Dodds, you mentioned collective answers, which I take to mean the majority of people agree on the approach, and I think Professor Weckert you said that one of those forums was scientists versus friends of the earth, and we almost need citizens for nanotechnology.

How do you mobilise public opinion so that it is not just one interest group that is negative who would claim they are the voice of the public?

Professor DODDS: If I gave the impression that I thought the majority determinations would always be—that that is a sole test of whether or not you have support for a view, then that would be a mistake on my part. It is rather the case that the idea of collective decision making is the idea, well, we know we come to the table with different perspectives and different views. What could we all live with as a process for determining that that would be acceptable as a process? The outcome some of us are going to be unhappy with if we have very strongly opposed views. There are lots of other areas. I might discover that your concerns are ones that I can take account of, but I need to shift to some degree. So there is that kind of deliberation model rather than, "Can I get enough people on my side?"

Reverend the Hon. FRED NILE: Consensus?

Professor DODDS: It is not necessarily even consensus. We might agree that insofar as the science shows us this, the process is acceptable for now. But we know that if we find out more about some aspect of it we would want to reopen that debate. It is not a case of us saying that we are all happy with the outcome; rather that we can live with the outcome as a process but we can see how we would reopen debate at a future time.

Reverend the Hon. FRED NILE: You mentioned Friends of the Earth. Have other groups taken a negative approach to nanotechnology? Is Greenpeace involved?

Professor WECKERT: Greenpeace is involved. Perhaps I made it sound a bit too negative. If you read the literature that is coming out and that has come out from Friends of the Earth and, in particular, Greenpeace, there have been some good and illuminating studies. It is unfortunate that some people go a bit over the top against some of the things that are going on in nanotechnology. It does not do their cause any good but, on other hand, if scientists get a bit carried away with all the positives and do not mention the negatives that does not do things any good either.

Reverend the Hon. FRED NILE: We do not really want to have scientists verses the community.

Professor WECKERT: No, we definitely do not.

The Hon. MICHAEL VEITCH: Following the questions asked by Reverend the Hon. Fred Nile do you have any suggestions as to how the Government could engage the broader public to inform them about nanotechnology?

Professor WECKERT: This is not an easy thing to do. One of the approaches that could be taken is to focus on issues that people are worried about at the moment. For example, we could focus on looking at both the potential of nanotechnology that helped the energy situation and also perhaps associated environmental risks. I think that may well engage the interests of a lot more people rather than emphasising the health aspect. Most of the health problems come to people like me and to older people, whereas the energy and environment issues are much more a focus of young people. They are the ones who will have to bear most of this burden.

That might be one approach to make it more interesting with respect to the applications. I am not sure that I have much more to add to what I said earlier and to what Sue said with respect to schools and so on. One thing that is worth mentioning in passing is the National Science Foundation [NSF] nanotechnology initiative in the United States that allocates a certain amount of money for social and ethical issues. It has created a couple of centres. It is the role of those centres to help to promote this sort of thing.

Professor DODDS: I think there are some good examples of where some relatively complex science has been presented to the wider public in a way that engages them and gives them a capacity to see what is at stake and to argue about them. The Mayo Clinic, the University of British Columbia and British Columbian biobanks engaged in public deliberation exercises in the United States and in Canada and currently it is being debated in Western Australia as something for them to try. They are

looking at the linkage of stored tissue samples, that is, the tumour you left behind at the hospital because it was removed for therapeutic purposes, or the Guthrie blood spots that were removed from children when they were born, plus medical records from a large public health service.

Using sophisticated computer analysis and DNA work you can find out, for example, who is likely to get which kinds of cancers. That is a simplistic way of doing it. They have been able to get cross-sections of the communities that were going to be affected by reducing the impediments to researchers gaining access to the health records of people whose tissue samples they were able to characterise and to ask those people, "Given the potential for this to have very obvious public health benefits in giving us new information about the risks of privacy and control over this thing, how would you go about it? How would you structure a biobank?"

Taking a relatively specific case—and I think you could this with nanotechnology—and trying to engage a group of people you would not try to get everyone in the community to have an opportunity to participate, but you would use that and those kinds of mechanisms as a way of getting broader public understanding. You have experts available to provide some hard science on what is at stake and you have facilitators to ensure that people deal with each other respectfully and bring back information, but the policymakers are able to decide that it looks as though the issue is not so much one of privacy but of wanting to know who has control over the data. Is it a private industry, or is it a health service? How will that be controlled? Those sorts of issues come out. A similar sort of thing could be done with nanotechnology and there are a few other examples of that kind.

The Hon. MICHAEL VEITCH: There have been public calls for a moratorium on nanotechnology. Nanotechnology is a broad area of study. Do you have any views about a moratorium in New South Wales or in Australia in the field of nanotechnology?

Professor WECKERT: Yes, there have been some calls. I think a blanket call does not make a lot of sense because it has been said a few times that nanotechnology is an enabling technology. Looking at issues in nanoelectronics is different from looking at particles in sunscreens, developing artificial photosynthesis, or something like that. It may be that at this stage there are certain areas where it is not worth taking any risks simply because the benefits are so small, apart perhaps from profit. We might say, "Do not bother with doing this until we know exactly what are the risks."

We have to be careful because stopping development of something for a certain time in certain circumstances might also stop any research on what are the potential risks. I would not want to say that there are never cases when a moratorium would not be justified. In general, I think it is probably not the best way to go. As I mentioned, the Europeans talk a lot about precaution. Sometimes a precautionary principle is put in relation to having a moratorium on some sort of development, but it does not necessarily have to be as strong as that. I think that often the European emphasis is just to ensure that you are always looking at the risks and that you perhaps move more slowly. But you certainly do research on all the risks, at least at the same time as you are doing other research.

The Hon. MICHAEL VEITCH: Does Professor Dodds have anything to add?

Professor DODDS: On the issue of the moratorium I agree with John. A moratorium seems misplaced if it means that we cannot do the basic science to find out what are the potential risks. This is one of those areas where it does not seem that nanotechnology produces risks of a different kind; it is just that the way in which it presents itself may be novel and we may need to learn a lot more before we can do that. I also think that with the issue of moratoriums there is a big difference between doing a moratorium on science—which seem to me like a direct threat to knowledge—and a moratorium on products. If you thought that a particular kind of product posed a serious risk, or we did not know enough to be able to be confident about it, that is a good reason. But it does not seem to me that a blanket moratorium on doing the research would ever be appropriate.

Reverend the Hon. FRED NILE: You mentioned Europe. Europe has taken a negative attitude to GM technology. Is that having an influence on discussions about nanotechnology?

Professor WECKERT: From my experience the people I have been working with do not take a particularly negative view of nanotechnology, but I guess the scientists do not take a negative

view of GM either. I do not think there is anywhere near the negative view of nanotechnology in Europe that there has been of GM products.

The Hon. CHRISTINE ROBERTSON: I apologise for not being present earlier as you might already have addressed this issue. Do you think it would be possible to set some criterion for the lateral effect some nanotechnology could have before commercialisation? Could some research be done on safety and possible lateral effects before commercialisation of a product? Do you think that is possible?

Professor DODDS: It would depend on the product and it would depend on the risk. Obviously, when we deal with pharmaceuticals we have stringent restrictions on when they can be allowed as consumer products. With other things, whether it is foodstuffs or ordinary consumer products such as clothing, we have far fewer restrictions. The difficulty with nanotechnology is that the exact same material may turn up in all three different applications, so you would need to be quite clear about why you were concerned and why you would want to regulate more stringently there.

It seems obvious, if we are to use nanomaterials in pharmaceuticals, that we would want them to meet our current stringent Therapeutic Goods Administration [TGA] requirements. However, we would also want to ask why, if we were to apply that to all potential nanoproducts, there would be a good reason for treating this one more seriously than we would treat petrol or something else. The comparisons need to be made but we must have grounds for such comparisons.

The Hon. MATTHEW MASON-COX: You mentioned the TGA. I want to get your thoughts on cosmetics, which are not tested by the TGA but which fall under the National Industrial Chemicals Notification and Assessment Scheme, or NICNAS. Obviously cosmetics are applied to people's faces and bodies and there are concerns about nanotechnology, osmosis through the skin, et cetera. Do you have any thoughts about why we have a TGA application that goes into all those potential toxicity impacts as well as the efficacy of the product, but we do not have an application for cosmetics that are applied to the human body? We have not looked at that process at all.

Professor DODDS: I suspect that an historical arbitrary distinction was made. I do not know whether or not it would be appropriate to consume it for all purposes. Certainly in the case of the TGA restrictions there are two good reasons. First, if my physician were going to prescribe me something it would be because I had a condition that might need treatment and I would want to have good evidence that it would do me more good than harm before I consumed it. Second, we also have the heavy level of subsidy of pharmaceuticals. We want to ensure that the things we are providing to people are the best medicines, or the safest medicines for that condition. I think those are good reasons for having a more stringent requirement there.

With cosmetics, if the risk of harm is as great it seems to me—we have had a tendency to assume responsibility for potential harm for things that we see as non-necessary—we see it as a buyer beware principle. We say, "If you are going to consume this product you are responsible for ensuring whether or not it will hurt you, provided that the person selling it to you does not know it will hurt you". In the case of things like pharmaceuticals we want a standard that states, "We want proof that it is okay first." The precautionary principle that is used in Europe emphasises that side by stating, "We want to know that it is not harmful before we allow it", rather than, "We are willing to let you take the risk if you would like to pursue that product." Where that emphasis should be drawn is very much a social and political question about where we want to take risks.

The Hon. MATTHEW MASON-COX: Where would you draw the line in relation to those two examples?

Professor DODDS: My view is that if you put sunscreens into a package known as cosmetics, it makes it sound relatively trivial. We have in Australia a serious need for protection against skin cancers. I want to be sure that what the Cancer Council is telling us is a sunscreen is safe. We give as a public health message: This is the kind of thing you want to be concerned about in trying to protect yourself against damage. I want to know that it is safe. I am not saying it is not; I just do not know whether it has nanoparticles in it.

The Hon. MATTHEW MASON-COX: So you would want to see it go through a TGA-type process?

Professor DODDS: There will be levels of things and issues such as labelling. If I can completely control my exposure to something labelling may be sufficient. However, if it is something that I need and I cannot control my exposure to it, or a member of my family uses something and I am exposed to it when I share the washing machine with him or her, I think we should be more stringent. We have to know the application and the potential threat before we know where to regulate, and that is the problem.

Reverend the Hon. FRED NILE: One of the challenges, of course, is how do you test nanoparticles? Scientists test drugs and other things on mice et cetera.

Professor DODDS: Yes.

Reverend the Hon. FRED NILE: How would you test nanoparticles to establish that they are safe for human beings? You cannot test them on human beings, I do not think?

Professor DODDS: We actually will be. Regardless of whatever else we do, we will be testing them on human beings to some degree just by virtue of the things we have not yet established the tests for. We will actually find out 20 years down the track whether John and I suffer conditions that could be traceable to. But on the question of what constitutes good evidence, I think the gentlemen behind us are probably in a better position to actually assess. But I think that we can say, look, we can start by asking if researchers are working in an area.

Then we start by finding out whether or not there are risks associated with that material at that scale that they are using for that application, and then look at whether we have good reasons because of the specific application, like in cosmetics or in pharmaceuticals, to go further. We may ultimately want to do tests on human beings. I think the kinds of examples John gave earlier about people who are taking the risk and are the likely beneficiaries in the case of medical applications are a clear case of where we do that already. We test, effectively, poisonous substances on people in chemotherapy, but we want to make sure the people who are likely to be put at risk are also the people who are likely to get the benefit.

The Hon. CHRISTINE ROBERTSON: What is the potential to actually stifle innovation? We have the culture that the Government somehow will protect us from all things.

Professor DODDS: I think we need to disabuse people of the assumption that the Government will protect us from all things. But I also think that where we are providing substantial public resources to create both the infrastructure and the funding for research to be conducted in these areas, then we need to actually see it as partly a social responsibility to check for risks and to ask producers to ensure that they are actually not doing as we have seen in some other cases in the past of products being developed where information is known but not given out.

The Hon. CHRISTINE ROBERTSON: But the process for risk assessment needs to be concrete?

Professor DODDS: Yes.

The Hon. CHRISTINE ROBERTSON: We know that in the past there has been?

Professor DODDS: Yes.

The Hon. CHRISTINE ROBERTSON: But in the future there will be?

Professor DODDS: Yes.

The Hon. CHRISTINE ROBERTSON: Otherwise we have no change?

Professor DODDS: Yes.

The Hon. CHRISTINE ROBERTSON: Is this right?

Professor DODDS: Well I think that is where the engagement with the public so they know where the risks are, so they know who to start pressing to get closer regulation if they think that is required or to reduce regulation where they think it is unnecessary, is part of it. Part of it is also asking scientists to be responsible. And part of it is also asking the question about, okay, how do we get a community to actually take responsibility for the members of that community. Some of that is about having open discussion about what we want in the future to look like.

CHAIR: Are there any further comments either of you wish to make?

Professor WECKERT: Perhaps one thing. We have been concentrating on risks in the sense mainly of the potential toxicity of nanoparticles and so on. It seems to me, and perhaps this reflects my background in the ethics of information technology, that one issue that is going to be a big concern in the future is this issue I mentioned right at the beginning, namely, privacy and the issue of monitoring and surveillance. As nanoelectronics develops, all the computing devices we use, the sensing devices we use and so on, networking capabilities and whatnot are going to become much more powerful even than they are now. That raises some serious concerns about how much of our lives are actually going to be monitorable at any particular time. It is a different sort of risk but I think it is certainly a concern.

Professor DODDS: I agree with John that the privacy issue is a significant one and will be part of the convergence of information technology and nanotechnology. But I also think we need to attend to the risk because of our interest in technological development, leaving some really basic issues behind, the issues of social justice and the ways in which we use our resources. I think the promise of nanotechnology in things like clean water and cheap electricity is great. I hope that comes soon because I am seeing shirts and socks that are available that have nano properties that are creating huge profits, but I also think we have an obligation to check about the idea of the nanodivide and how do we ensure that in the funding and priority setting we actually attend to those who are least advantaged.

CHAIR: We thank you for attending this afternoon and for your evidence. We may have follow-up questions for you. We would appreciate it if you would provide those answers by 19 May.

(The witnesses withdrew)

BRIAN GREGORY PRIESTLY, Professorial Fellow, Monash University, School of Applied and Clinical and Public Health Sciences, and Director, Australian Centre for Human Health Risk Assessment, sworn and examined, and

PAUL FRANK ALBERT WRIGHT, Associate Professor Immuno Toxicology, Royal Melbourne Institute of Technology University, Key Centre for Toxicology and School and Medical Sciences, affirmed 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 were forwarded to the Committee Secretariat by Monday 19 May. Before we proceed to questions, would either or both of you care to make an opening statement?

Professor PRIESTLY: Perhaps I will just give you a brief resumé of my background and interest in nanotechnology. My background is in toxicology. It includes some experience in regulatory toxicology. For some nine years I was leading a group of toxicologists in the Commonwealth health portfolio with responsibility for evaluating environmental chemicals, pesticides and so on. For two years I was head of the laboratory's branch of the Therapeutic Goods Administration. Since leaving the Commonwealth the interests of my centre, the Australian Centre for Human Health Risk Assessment, cover a very broad aspect of environmental health risk assessment, water quality, air quality, contaminated sites and so on, but I have developed an interest in nanotechnology primarily because I was asked to provide advice from the nanotechnology industry in Victoria as to how it could be proactive in addressing some of the issues around occupational health and safety, and about addressing potential regulatory aspects of nanotechnology. So, I have developed an interest in that area.

I am currently associated with a number of expert committees that are dealing with nanotechnology. I have also been part of a development of a network of Australian toxicologists with interests in the adverse effects of nanomaterials in NanoSafe Australia. My colleague to my right is the coordinator of that particular group and I was one of the founding members of NanoSafe Australia. I guess I should make an apology to the Committee that I have not made a written submission to it, but I hope that by appearing here today I will be able to answer some of your questions.

Associate Professor WRIGHT: I am the coordinator of NanoSafe Australia, which is a research network of nanotoxicologists and nanosafety experts. I understand some of the questions relate particularly to this group, so I can provide more detail about that later. But I have other roles as well. I am an appointed member of the Management Committee of the Australian Research Council's Nanotechnology Network. That is a rather large group of over 900 individual members and 200 or so groups. I am there specifically to provide occupational health and safety advice directly to the management committee. I am also on the National Health and Medical Research Council's Advisory Committee on Health and Nanotechnology, of which Brian is the chairperson. I have collaborative projects with CSIRO in the area of nanosafety.

CHAIR: Could you provide a layman's description of the process for assessing the toxicity of nanomaterial, including the general time frame required for completing an assessment?

Professor PRIESTLY: Perhaps I will address that question. The time frame probably is influenced as much by the regulatory framework under which the product is being assessed. No doubt you have had some advice already on what are the regulatory aspects of chemicals in Australia. I know Professor Hodge spoke to you earlier and he had been involved in evaluating this regulatory framework. I understand his report has not yet been released, but I certainly have spoken to him about some aspects of that. The time frames are dependent upon which particular regulator is going to be looking at these products. In Australia you have a separate regulator for therapeutic goods, for medicines and medical devices. They have legislative time frames for their various assessments. There is an industrial chemicals regulator—NICNAS. It also has time frames for its assessment processes. There are the other agencies: the Australian Pesticides and Veterinary Medicines Authority, which

would look at any agricultural veterinary product uses, and Food Standards Australia New Zealand, which would look at any particular food aspects of use.

So there are different regulators and they have different time frames, but I guess the important difference between these is whether their assessments are what I would call hazard based or risk based. In many cases they are hazard based. They are designed to outline the toxicological properties of a material, the potential for it to cause adverse effects and the nature of the adverse effects that are likely to be associated with that. They all work with standardised protocols to require certain sets of data. As has been pointed out earlier, much of this is based upon studies done on experimental animals—rats, mice, et cetera. There are well-established protocols for assessing the toxicity of a chemical. Those that are only hazard based will not go beyond that. They will describe the characteristics of the material.

Those that are risk based will also attempt to assess the potential for exposure. That is a very important component of any risk assessment. What is the likely exposure scenario? How much, therefore, one can work out the likelihood that that exposure will be associated with a particular harm that has been identified in the hazard process. In the case of therapeutic goods, that is a pretty well complete process. There is information available about potential exposures. In the case of AGVET chemicals there is also some information about potential exposures. When you get down to some of the other areas, particularly in the industrial chemicals area, there is less information available at the time these assessments are made about potential exposure. So, these are primarily hazard based.

CHAIR: How much nanotechnology is put into pesticides these days? Do we know that?

Professor PRIESTLY: The information I have to date is that very little has come into that particular area of products. I know people are developing or considering the application of nanotechnology in that area, but I am not aware of any specific products that have come through in that area at this stage. That is not the case in the case of medicines for human use where there have already been quite a lot of products that could be defined as based upon nanotechnology, particularly in the drug delivery area, which have already been through the system. The point was made earlier on about sunscreens. The regulator for sunscreens is generally the Therapeutic Goods Administration because, when a product makes a therapeutic claim, it is treated as a medicine rather than as a cosmetic.

The Hon. CHRISTINE ROBERTSON: And it is taxed as a cosmetic.

Associate Professor WRIGHT: I will add a few comments to that. Yes, the time frame is a bit difficult to estimate at this moment because it is still in development, yet there are a few important steps in the process of assessing the toxicity of nanomaterial that I would like to mention. One of the very first important ones is to truly assess the potential life cycle of the nanomaterial right when it is produced through to formulation, manufacturing, its point of sale, its use and abuse as well as eventual disposal and, if it ends up there, the environment. That is one important step. Another is that more and more we are looking at toxicity testing in initially in vitro systems. By that I mean in cells and cell culture. While they are very simple systems, many of the cells that we use are actually of human origin. That means that we are extrapolating to the species of concern if we are worried about human health, but we also have animal cultures when necessary for looking at veterinary applications.

Because in vitro systems are so simple and a lot of the interplay between the cells and our body just is not looked at in that system, you do need to have at lease a few very important in vivo studies in the whole animal before you can risk exposing humans to compounds of potential concern, and, in this case, nanomaterials of concern. We are going along the lines of putting resources into where nanomaterials present a toxicity that is different to the bulk material because the bulk material is already covered by various applications legislation. So we should be concentrating our efforts where the nanomaterial behaves differently because of its small size. This is most likely when the nanomaterial is insoluble, penetrates into the body, and is persistent. So those three characteristics are very important to create a nanomaterial with a potential for toxicity greater or different than the bulk material we have always been using for many decades. So that is where I think we should be angling our research, in that area.

The Hon. MELINDA PAVEY: When you say research and what we should be putting our resources into, what level of resources is going into it now?

Associate Professor WRIGHT: It is interesting that the funding of toxicology research in Australia has been patchy at best compared to many other countries around the world. We are normally trying to shut the gate after the horse has bolted. There has been a problem and then the toxicologist has been called in to try to work out what the problem was. What I think we have here is actually a unique opportunity to be proactive and incorporate the screening for toxicity at the development stage of nanomaterials. Then we can ensure that the products and their applications are safer. But there is actually a benefit to the manufacturer as well because they can use the toxicity to re-engineer the nanomaterial to make it less toxic, so it is actually useful for them to produce a better product in the long run.

The Hon. MELINDA PAVEY: Are you promoting or thinking of a system where you would apply toxicology to particular products that are developed in this country.

Associate Professor WRIGHT: I think because there are so many different nanomaterials out there already and there are so many being developed right now, we have to concentrate on ones that are being used here in Australia first. But what we have to realise is that scientists, nanotechnologists, are making hybrid molecules of the various classes. Each of the classes of nanomaterials behaves quite differently. Some have very little inherent hazards and very little risk, and others have greater risk because they are a nanoparticle of concern. So we need to have the screening systems in place to check where the new materials fall: Are they one of risk, or are they not? We can take that into our development phase.

The Hon. MELINDA PAVEY: But are we just a very small player in an international world that is moving very fast on this?

Associate Professor WRIGHT: That is so if you take a volume perspective about nanotechnologies. But actually Australia is very good at playing the niche manufacturing market. The CSIRO is very big on doing this. In fact, with some of the carbon nanotubes that they synthesise there, the only other place in the world doing something like that is in Germany until this technology is rolled out further. I think we have some very good niche players here in Australia doing certain nanomaterial work that other countries are not really interested in yet. So we should be taking care of the safety aspects of the workers and the researchers working with those nanomaterials at this early stage to make sure that there is no problem further down the track.

Professor PRIESTLY: I could perhaps also make the comment that Australia has always been quite effective in inputting into international fora that deal with regulatory aspects of chemicals. At the OECD level and in other international agencies, Australia often has quite a significant role in developing common approaches to risk assessment.

The Hon. MELINDA PAVEY: That is particularly relevant on the agricultural front.

Associate Professor WRIGHT: Yes.

Professor PRIESTLY: Yes.

The Hon. MELINDA PAVEY: You focus on toxicology, but the carbon tubing you just mentioned, that involves nanos in a matrix, a non-floatable type of nano. Do you think that the research of dangers should be very much concentrated on the floating nano rather than those that become part of a matrix?

Associate Professor WRIGHT: Yes. This gets back to the life cycle and identifying the hotspots of where there is potential for exposure. Obviously aerosol or droplets in the air or dust moats in the air containing nanoparticles are of concern because you can breathe them in. However, there is potential to ingest them if they are in the air as well, or in the water supply. One cannot ignore the other routes of exposure to nanomaterials. I personally have involvement in carbon nanotube work with CSRIO because we recently completed an occupational workplace audit of a carbon nanotube facility. We understood there that not all carbon nanotubes are alike, either. In the class of carbon

nanotubes, they are all carbon, but when you make them, some of them still have some metal in them, such as iron. That makes them far more toxic than those that are made very clean. So within those two we have to differentiate between how you should be acting safely with them because one had a higher inherent toxicity than the other and one was more likely to turn into dust moats than the other. That is how we have to inspect—on a case-by-case basis—to see where the greatest risks lay.

Professor PRIESTLY: I think this also comes back to the idea of understanding the life cycle of these materials and, as Paul has pointed out, just where the greatest exposure potential is. One of the other issues that people often do not understand about nanoparticles is that they are not necessarily consistently present in a nano size form. They form aggregates and they can behave quite differently and they can change their surface characteristics and so on. So it is surface characteristics which are really very important. One of the issues that is important in terms of doing good quality research on nanoparticles is appropriate characterisation of those particles; otherwise you may not be dealing with what you think you are dealing with.

Associate Professor WRIGHT: I will just add that we are doing research on the toxicity of nano particles right now. These days, if one wants to publish this work in the international literature, you have to accompany it with this characterisation date to indicate that you actually looked at the particles before, during, and after the exposure to show that they were still nanoparticles all the way through, or they changed. Many nanoparticles stick together in clumps. That is why some of them are not really a problem because they clump together and they do not even float around in the air. We really need to assess on a class by class and in some cases case by case basis—to work out the risk and hazard involved.

The Hon. CHRISTINE ROBERTSON: So you are saying that the methodologies are available for investigating the possible toxicology?

Associate Professor WRIGHT: In part, yes, because the OECD effort that is happening internationally now is to see how their standard toxicity testing protocols can be applied to nanomaterials. As a person who actually does research in this area I can tell you that they are not immediately transferable. They are some of the things you have to take into account and the OECD has come across this. If you are trying to expose a live mouse to nanoparticles in the air, you have to make sure that the concentration in the area is constant. How do you measure that? The technology is almost a bit restricted here to carry out the toxicology tests properly at this point so we are seeing developments in this area right now internationally to improve that. In my area, I am looking at a lot of in vitro human cell based systems. These are just adult cells taken and put into culture. We can look at the effects and nanoparticles directly on them and link them to their surface characteristics. That way we can predict what the next nanomaterial that comes along might do.

This is the sort of research we need to do. It is a pronged effect where you have one angle looking at the current materials we have and the other is looking at this predictive experimentation so we can predict what the next nanomaterials might behave as. I can tell you now there are many products already on the market and people are developing an enormous number of nanomaterials right now. There are not enough toxicologists on the planet to test them all properly so we need to be sensible and intelligent about prioritising what we need to do.

Professor PRIESTLY: I will add another comment there. Most nanomaterials are based upon fairly simple materials that we already know quite a substantial amount about in terms of the chemistry in bulk form—and their toxicity, for that matter. In particular if the materials present in those particulates is dissolved and they get absorbed into the body, one would not necessarily expect the toxicity to be any different to material that has already been tested in its bulk form. What we do need to understand is that when the material is present as a nano size material and it stays that way, it gets into parts of the body we would not normally expect particulate matter to penetrate—and this is one of the potential problems with nanoparticles—and then you might start seeing unusual toxicity. It is understanding when that toxicity starts to change for any given basic material that is the key to understanding the risks.

The Hon. MICHAEL VEITCH: I have a question around both the CSIRO and the University of Technology, Sydney, which have indicated that some earlier research using

nanomaterials was flawed because of contaminants. Is this an ongoing problem with research on toxicology results?

Associate Professor WRIGHT: I think they were particularly thinking about some aquatic studies of fish exposed to nanoparticles. This was done by a very reputable international group. It turns out that the solvent they used to help soluble-ise the particles into the system and deliver them could possibly have caused the toxicity that they observed, not the nanoparticles themselves. As experimental toxicologists, we are very careful about everything we add to the system because we could interfere with the system we are trying to observe. Proper controls on experimentation will pick that up.

If your vehicle alone at that concentration causes the problem, obviously that was not the nanoparticles. Proper controls will pick that up. But it gets back to that added aspect now—that we must characterise the nanomaterials probably in our biological system. This is why the work now is very multidisciplinary. Toxicology is a multidisciplinary science, but now we are involving physicists and chemists in our experiments to understand the behaviour of the nanoparticles in our systems so that we can truly relate that this nanoparticle causes this toxicity for this reason. That is why we do mechanism-based research that you can extrapolate to other things in the future.

The Hon. MICHAEL VEITCH: My next question comes back to Associate Professor Wright's comment around occupational health and safety. Purely from a toxicological perspective, are the current OHS laws in the country sufficient to cover nanotoxicology?

Associate Professor WRIGHT: I think that the current systems need improvement. That is why the Australian Safety and Compensation Council has a very strong effort in occupational health and safety for nanotechnology now. In fact they have got us in Nanosafe Australia to evaluate the current evidence for the effectiveness of controls in the workplace with people using engineered nanoparticles. They also have a number of other efforts that they have put their funding into. They want to upgrade their systems as they stand. But I can say that we have a long-standing history of work with the ultrafine particles in the air from industry and mining.

They are the sorts of control measures that would be readily applicable straight to the nanotechnology situation. So what might be happening right now is that there is a nanotechnology facility making nanoparticles but not necessarily having the exhaust and filter system that mining site might have for processing certain things that also has ultra fines. So all we need to do is make sure that people are handling them are using the correct workplace controls. NanoSafe Australia has produced a position paper on best occupational health and safety practice in Australian nanotechnology and that has been published in the *Journal of Occupational Health and Safety Australia and New Zealand* recently. That was commissioned by Nanotechnology Victoria. So we have been very active in this area.

Reverend the Hon. FRED NILE: Earlier you said that there is an increasing requirement to test more and more nano items. How are you getting funded and will there be additional funding from somewhere, so you have additional staff to cope with this growing development in this area?

Associate Professor WRIGHT: That is a very important question because the issue is that funding is very poor. In fact, NanoSafe Australia is underfunded at the moment. It is a network of toxicologists contributing their time and knowledge together to help in activities like this.

Reverend the Hon. FRED NILE: Is it a voluntary organisation?

Associate Professor WRIGHT: It is voluntary but we are pairing up and making small groups to put in submissions for grant applications to the Australian Research Council and the National Health and Medical Research Council. But the trouble with those systems is that you only apply once a year and then you hear towards the end of the year. We are talking about timeframes that are almost too late for people in the workplace. One reason we formed NanoSafe Australia is because people started asking us as toxicologists, "Can you tell me what we are doing is safe? I don't want to get ill because of what I am doing." We recognised that we needed to form a group to at least educate those out there, whether it be government, industry or NGOs, about the best ways of reducing the risks for handling nanomaterials. So I think there should be more funding, I agree with you. Even if funding

was done on a State level through New South Wales, it is better than having none at all. New South Wales could take the lead.

Reverend the Hon. FRED NILE: Where are you based at the moment?

Associate Professor WRIGHT: I am based at RMIT University in Melbourne but the network includes people like Dr Maxine McCall of the CSIRO, North Ryde and Professor Brian Golsen of Macquarie University. We interact with them a lot. It truly is a nationwide network. I think any activity within this State would have to occur linked in with the network so that there was not needless repetition.

Reverend the Hon. FRED NILE: With the testing that you do, you mentioned testing on mice. We have this problem where the nano penetrates the skin and so on. How do you mirror what happens to a human being not just for the skin but the lungs? How can you test the impact on a mice's body inside and outside, or can you?

Associate Professor WRIGHT: If I can take that in two parts and deal with the mouse issue second. The first is the human skin issue; in our experiments we are now gearing up to use human skin explants from plastic surgery and you can use these in vitro.

The Hon. MELINDA PAVEY: So excess skin will go to some good?

Associate Professor WRIGHT: It is very good. In fact, we are looking at metal oxides in sunscreens with and without ultraviolet light. So we can do this in vitro in human skin left over from plastic surgery cut downs. So as much as possible we should look at the human situation if that is where we are finally trying to see the toxicity because there are some subtle differences between species. However, there are some general things that all mammals have. Doing the rodent work is important because you cannot expose a person in an experimental setting unless it is sunscreens and it is ethically approved. If you want to expose a person to carbon Nano tube it would have to be in a workplace situation.

What we need to have is some animal work with carbon nanotubes and realise that we must control the exposure very carefully. If I can just make one point about the skin. Professor Mike Roberts of the University of Queensland is internationally known in this area to penetrants of nanoparticles through the skin. He has found that human skin is more resilient, much more of a barrier than pig skin, which is more of a barrier than a mouse or rat skin. It is something to do with hairlessness and the skin cells are differently organised. So long as we understand that different species have their differences we can use some animal models where it is appropriate, but in some cases we need to go to the human situation to make sure we have not made a mistake when we extrapolate.

Professor PRIESTLY: Earlier I mentioned that a lot of regulation is hazard based and in order to define the hazards of any particular material there is a fairly well established set of protocols that one needs to go through in animal testing from short-term exposures through to very long-term exposures to assess the difference between acute and chronic hazards. Most of these sorts of studies are done by only one route of administration and that is usually the oral route because that is the easiest to do. It is much more difficult to do studies, particularly chronic studies, with the inhalation route of exposure but it is certainly possible and it is done to some extent with the base materials.

With regard to dermal exposures, yes, there are some studies that are done by that route as well but mostly it is the oral route. The idea is to get as much of the chemical into the body so that you can ascertain what are the target organs for toxicity, what are the outcomes you need to look for and then one extrapolates from the animal studies to what is likely to occur in humans. The more we understand how animals differ from humans in the way they handle chemicals, the better we can make that sort of extrapolation.

Reverend the Hon. FRED NILE: Will it make it more complicated for you? When we were at the University of New South Wales they were going to load something smaller than a nano to the atom and rearranging atoms and so on in their experiments. Will that create more problems in testing material?

Associate Professor WRIGHT: It depends on whether it is soluble or not, and when you get down to that level you are talking about particles bumping each other and brown in motion like a cup of tea, that sort of thing. At the nano level we have particles of a certain size that potentially can create a problem. The reason I am saying this is because if we have particles injected into our bloodstream very quickly they will be grabbed by our liver. Particles that are small enough will actually go through the filter of the kidney and into the urine. Anything that is that small, that is around five nanometres and smaller, is not such a problem because you could clear that from your body. Things above five nanometres and then to a size that our immune cells and our liver grab but then cannot get rid of, you start interfering with cell process and you get very sick. We have a size range here where we can get some toxicities in certain materials different to the bulk material. Anything smaller, not such an issue but right around this nanometre range, five and up to say about 300 nanometres could be a problem so we need to check these out.

The Hon. MATTHEW MASON-COX: To become toxicologists I presume you go to university? You do science courses, three years or four years, is it?

Associate Professor WRIGHT: Yes, three years science degree, one year honours and then a PhD, which is three to 3½ years.

The Hon. MATTHEW MASON-COX: That is a pretty long time frame. You indicated that there is a dire shortage of toxicologists, particularly in the nanotechnology area. Do you have any suggestions about how we address that?

Associate Professor WRIGHT: The thing about toxicology education is something in my own heart because I coordinate the world's only fully online masters of toxicology. We have students throughout the world. They do not have to come to Australia; they can study in Africa or wherever, and they can do projects where they are based. I think we have technologies that we can educate people with a bachelor of science degree and fast-track them into toxicology. But when it comes to doing the actual study and the screening you need good facilities that have high standard cell culture and in vitro testing systems, as well as a good animal house and animal testing systems. Those facilities need to be properly resourced. You normally see those in certain universities and some testing facilities, but we do not have many in Australia. There are only a couple that are good laboratory practice accredited. So there is a shortage but I think we can gear up for capacity building via a range of means.

Professor PRIESTLY: I suspect that the issue you are probably trying to get at is whether there is a need for some sort of a national institute which focuses on nanotoxicology in particular or whether it is better to spread out the research effort around groups of toxicologists who may be operating in different areas of the country with slightly different levels of interest and expertise in particular aspects of toxicology and coordinate that sort of effort. We have tended to go more for the idea of coordinating existing expertise but I know others in Australia have advocated the idea of developing an institute, very large scale, very large funds required in order to provide a focus for that sort of thing.

The Hon. MATTHEW MASON-COX: What is your view on that?

Professor PRIESTLY: Probably the model we are working with at the moment is as effective but I am not saying that if someone were not prepared to put in a lot of millions of dollars to develop an institute, that might be an effective way of doing things, too.

The Hon. MATTHEW MASON-COX: Do you have the industry coming to you regularly for toxicology reports on nanomaterial that they are working with? Do you work with industry?

Professor PRIESTLY: I have not had many direct approaches from small industries, but I have had approaches from consortia. For example, I think Associate Professor Wright earlier mentioned Nanotechnology Victoria, which is a consortium of industry, government, academic institutions in Victoria to try to promote the development of nanotechnologies in that particular State. They certainly consulted with me at a very early stage because they were keen to get on the front foot. Where we have gone to smaller type companies that may be involved in niche products, they are

generally not quite as communicative or as interested in working with people. Their resources are often too small to do that. But where I think we are getting far more corporation is with the large organisations like the CSIRO and its niche flagship program.

The Hon. MATTHEW MASON-COX: One concern we have is whether the current regulatory environment is adequate, and one key issue is the toxicology of nanomaterials being properly assessed. Is there a need to intervene, particularly when you have companies secretly dealing with what they deal with. We do not know what they are dealing with. What level of oversight does there need to be?

Associate Professor WRIGHT: If I can make a comment about the industry, the good companies realise that if they do this they have value added on their product by saying that there is an added safety aspect.

The Hon. CHRISTINE ROBERTSON: Are they paying you?

Associate Professor WRIGHT: Yes. There are some projects that we are developing now as part of the Cooperative Research Centre in Advanced Materials. While the money has not been signed over yet, we have been in discussions for the past six months with a couple of companies looking at the toxicity of nanomaterials and seeing how to design them better to make a better product. The CSIRO is definitely this way.

The Hon. CHRISTINE ROBERTSON: So it is healthy to have a mixture of government, industry and—

Associate Professor WRIGHT: Definitely. The industry must carry some of the burden because it will benefit from a useful nanomaterial, but the Government is important there to ensure that the right regulatory steps are in place. It is a dual effort.

The Hon. MATTHEW MASON-COX: Do we have the right regulatory steps in place, or would you change the system?

Associate Professor WRIGHT: We need to be a bit more careful with nanoparticles of concern that potentially are more toxic than things that are regulated now because I do not think these nanoparticles of concern are properly regulated.

The Hon. MATTHEW MASON-COX: How do you define that?

Associate Professor WRIGHT: Again I am saying that nanoparticles of concern are those which are insoluble, penetrate into the body and persist. We know that certain classes of them are like that, but many nanoparticles do not fall into that category. Water soluble ones, ones that are used, many used in nanofoods are not such a issue. They are just a way of getting the food better into your body because they are smaller particles and better absorbed.

The Hon. MATTHEW MASON-COX: How would you regulate nanoparticles of concern?

Associate Professor WRIGHT: I think that one has to incorporate a full life cycle analysis process into that. I will have to defer to Professor Priestly as the regulatory expert to see how that could be incorporated.

The Hon. CHRISTINE ROBERTSON: You will have to change the definition or we will have another moratorium called. The word is very difficult to use.

Associate Professor WRIGHT: Which word?

The Hon. CHRISTINE ROBERTSON: Nanoparticles of concern.

The Hon. MATTHEW MASON-COX: It is like persons of interest.

Associate Professor WRIGHT: NanoSafe Australia raised that particular point, and I think the United States Environmental Protection Agency also came up with NPOC [nanoparticles of concern] as a term and NMOC [nanomaterial of concern] but this is in line—

The Hon. CHRISTINE ROBERTSON: And it is scientists, not politicians!

Associate Professor WRIGHT: No, I understand. But the other thing to realise is that not all nanoparticles are of the same risk. In fact, many are of very little risk at all.

Reverend the Hon. FRED NILE: Is that the chemical you were saying was insoluble—

Associate Professor WRIGHT: No.

The Hon. CHRISTINE ROBERTSON: No, not all solubles either.

Associate Professor WRIGHT: I will just run through the points again. The first point, many compounds are inherently toxic and we do regulate those. What we are concerned is where if you have a nanoparticle version, is it more toxic or a different sort of toxicity that is seen, they create an even bigger risk than the bulk material. So that is where we have to be on the forefoot here and look at those because there are a lot of nanoparticles that do not fall into that category.

Reverend the Hon. FRED NILE: You did say insoluble?

Associate Professor WRIGHT: Insoluble is most likely.

Reverend the Hon. FRED NILE: They penetrate into the body.

Associate Professor WRIGHT: Penetrate into the body and persist there. If you put those three characteristics together you are along the road to something that could create toxicity different to the bulk material.

Reverend the Hon. FRED NILE: Could we somehow separate that category?

Associate Professor WRIGHT: Yes, we could give it a term that is more palatable than the NPOC. What we are trying to say is it is a nanoparticle of concern—it has not yet been hung.

The Hon. CHRISTINE ROBERTSON: Not palatable, not dangerous? Palatable is fine but unfortunately that is not what I am talking about. I am talking about potential for use.

Associate Professor WRIGHT: Okay. As a toxicologist we are asked is this safe? Is this compound safe? No compound is safe, only safer uses of the compounds. And this is something that is part of the education process, and that is a very straightforward concept that we need to get out there in the public, and the Government is very important in doing that too.

Professor PRIESTLY: If I can just address the question I think that you are getting at about whether the existing regulatory framework is adequate to deal with nanomaterials or whether you need something more specific or more detailed? I guess, I am of the view that the existing framework is appropriate to deal with it because it is used to dealing with chemical hazards, and assessing those chemical hazards and translating that into risk assessments. What I think is needed is the recognition that some nanoparticulates may not necessarily come to full scrutiny under the existing framework because they are based upon existing chemicals.

Australia is no different to many other countries in terms of the way in which it sets up regulatory systems. It is focused on new types of materials. There are mechanisms for assessing existing materials, things have been around for a long time but which may have new uses, and there are existing frameworks within the Australian regulatory system to do that. Where there may be gaps—and this is where Professor Hodge's report would presumably be very illuminating—is where things may not necessarily get picked up and assessed with the degree of scrutiny you would like to see if they are based upon existing relatively safe materials, and something has changed.

Associate Professor WRIGHT: I agree.

CHAIR: Do you want to make any further comment?

Professor PRIESTLY: I was going to make some sort of comment about the discussion you were having about a community perception of risk around nanomaterials. It is an area in which I am particularly interested from a research point of view but I think probably we have not the time to go into it in great detail. Clearly it is something the Committee has recognised as being very important as communicating with the community, and involving and engaging with the community on these particular issues, and recognising the dangers of not effectively communicating with the community on something that is a new technology, and I think you have had the comparison drawn with things like GMOs. I would hope that that is not going to occur with nanotechnology.

CHAIR: We hope it does not either but there is always a risk, but any suggestion would be greatly appreciated. I thank you both for your contributions and support to the Committee and for travelling to Sydney. It is much appreciated.

(The witnesses withdrew)

(Short adjournment)

WILLIAM EVAN PRICE, Professor, Head of the School of Chemistry, University of Wollongong, sworn and examined.

CHAIR: Would you like to make an opening statement?

Professor PRICE: Yes. In addition to the submission by the University of Wollongong I want to make a few general comments. Firstly, the University of Wollongong has interests in both research and development associated with nanotechnology, as well as education, and international recognition for those particular things. That was the primary reason we wanted to put in a submission to this inquiry, and also I guess because we believe this is a very rapidly moving area and we wanted to ensure the debate moved forward and was fairly balanced in the light of other scientific issues in the past few years that have tended to become slightly polarised.

If I might summarise where my interests lie, we have a number of international research strengths in materials science and engineering that may be classified as nanotechnology. We have the Intelligent Polymer Research Institute, which a number of you visited, and I thank you for that. They are world leaders in conducting polymers and intelligent materials. Gordon Wallace is the director of that particular team. They have about 40 or 50 people working in that team. They are funded by a wide range of sources, both government and industry, and nationally and internationally. Currently the group is a recipient of Australian Research Council funding for the Centre of Excellence for Electromaterials Science.

The main themes we are pursuing there are solar energy—both conversion of the energy and storage—mainly using intelligent plastics. In addition to that we have a very large arm in the bionics area, which is headed by Professor Graeme Clark, of bionic ear fame. Most of the work currently in that area is on spinal cord injury recovery and trying to grow artificial nerve fibres. As well as that, at the university we also have an institute that looks at superconducting and electronic materials, which is led by Professor Shi Dou. Again, they have a very good reputation in that area. Both these groups are moving to a new campus mid-year. The Innovation Campus was partially funded through the State Government. There will be about 100 to 120 people working in this particular area.

That is the research side. On the teaching side, we have a bachelor of nanotechnology degree, which is now five years old. It is not necessarily a large intake—maybe 15 to 20 very high calibre students. I think I mentioned in our submission that it is quite different from some of the other undergraduate courses in the area in that we unashamedly focus on our research strengths, so it directly feeds into our research institutes. The emphasis is on a multidisciplinary approach from first year and also to give students exposure to that cutting-edge research from year one. As part of that they actually work alongside those groups at the bench, so most students by the end of either their first year or their second year would already be working within those areas, perhaps on a summer scholarship or doing part-time work. They are learning the whole area as they go through the undergraduate process. We also have a number of general subjects within the nanotech area that are aimed not just at the nano students but are more current issues. They include ethical, occupational health and safety and social matters. They are taken by a broad range of students across the campus.

CHAIR: Thank you.

The Hon. CHRISTINE ROBERTSON: Your submission calls for a coordinated approach to commercialisation. What specifically do you think is required and how can the New South Wales Government meet that need? I would also like you to answer at the same time the question relating to your submission notes, which state that with regard to the health, safety and environmental risks, any potential risks will emerge from the particular form and interaction between materials, and that health and safety studies should therefore occur in step with the particular application being researched. I think that is a very logical progression for commercialisation, but do you have any ideas about how you would ensure that these in-step processes occurred before commercialisation?

Professor PRICE: You are not talking about the choice of which things to commercialise but the regulation of safety and other aspects.

The Hon. CHRISTINE ROBERTSON: Yes, I have moved from the university a bit because you are talking about commercialisation. I guess the process that is important to the Committee is whether we can be assured that before commercialisation all the processes have been put in place for the research into the safety issues at the same time as the research into whether the thing is going to create what it does.

Professor PRICE: Perhaps I could answer that in a couple of ways. Part of that addresses question 7 on the list I have here, which is about what we employ in the university in terms of occupational health and safety, and then I will move on to the more general question. At the university level we clearly use the risk management approach, which is legislated under State law—WorkCover and so forth—and therefore we use all the available information on the particular materials that we use even though that information may be incomplete for some of the new materials. We are working in a very controlled environment, normally with very small amounts of material. Clearly if there are some unknowns about a particular material we adopt a cautionary principle. I think from a research point of view it is a very controlled area, so the occupational health and safety risks are fairly small.

What the submission meant by trying to do it hand-in-hand as something is commercialised is that you cannot necessarily know everything about all new materials straightaway. Therefore, if you have new material there is no point in trying to do lots of biological and toxicological tests if that material then does not make the grade and never even gets close to commercialisation. The point there was more the fact that you need to target where you are going to put the effort into some of those areas as they move towards the commercialisation end of things.

The Hon. CHRISTINE ROBERTSON: Okay. Thank you for that. Also the coordinated approach to commercialisation, which was the question I was supposed to be asking. I just diverted off to the other one.

Professor PRICE: That was more connected to if the New South Wales Government wants to take an active role in this area, that if, say for example, there is a new start-up company or a commercial partner working with a research institution or research organisation, what are the mechanisms by which that company is going to establish itself within New South Wales as opposed to anywhere else. I guess I am thinking more in terms of the incentives.

The Hon. CHRISTINE ROBERTSON: So rather than a co-ordinated approach you are talking more about structures in order to encourage because a co-ordinated approach seems to imply some directions would be set that the New South Wales Government would like to go in research. Is that not an issue for researchers?

Professor PRICE: If, for example, the New South Wales Government wanted to promote particular areas for which start-up companies could commercialise their particular products, there may be priority areas that the Government chooses. I think that is what I was leaning towards. I am not necessarily saying that may necessarily be the best idea. It is a very diverse area, the nanotechnology area, and we cannot be experts in everything and we also cannot be world leaders in everything so it would be a question of trying to find where we are leading the field and therefore trying to pick winners which also matches the priorities of the Government as far as public benefits.

The Hon. CHRISTINE ROBERTSON: Like the clean coal project, as an example?

Professor PRICE: Perhaps, yes, that might be one.

Reverend the Hon. FRED NILE: The university itself is not responsible to test products for commercialisation. It is the role of the university to do research. Would they not go down to NanoSafe or somewhere else?

Professor PRICE: It is the university's responsibility to ensure that any materials or any experiments that we conduct are carried out in a manner that minimises the risk to the workers and the people exposed.

Reverend the Hon. FRED NILE: I understand that. I am talking about the commercial product. You are not involved.

Professor PRICE: It is not necessarily the university's role unless it took it upon itself to be the sole partner commercialising a particular product.

Reverend the Hon. FRED NILE: You could agree to then conduct those tests for the company and be paid by that company for carrying out that role?

Professor PRICE: I guess so but I do not think that our particular institution would normally feel that we have the particular expertise to go down that path.

The Hon. MICHAEL VEITCH: You were talking about, and your submission talks about, the bachelor of nanotechnology that the university runs. What is the UAI acceptance for that this year?

Professor PRICE: There are two. We have what is called an advance program where there are additional opportunities for students. That has a UAI of 90-plus and the normal four-year bachelor of nanotechnology has a UAI of 85. Probably 75 per cent of the intake is in the 90-plus.

The Hon. MICHAEL VEITCH: Is that undergraduate degree oversubscribed?

Professor PRICE: No, it is not. We would have a target of between 15 and 20. If we wanted to increase that substantially, we would have to change the structure of it. Because it is actually a lot of research focus, clearly it is quite labour-intensive. At the moment this year's intake was about 16, so we have probably got about 50 to 55 in the overall program and we are fairly comfortable with that at this stage in the development of the course.

The Hon. MICHAEL VEITCH: The issue you raised in your submission about students having strong backgrounds in chemistry, physics and mathematics, is that a big problem for students coming into the nanotechnology undergraduate program?

Professor PRICE: No, it is not, because we attract people who have that particular background. I was just using it. Nanotechnology is really a new name for a core part of the scientific endeavour with a particular focus but it really is building on the enabling sciences and also it has a very multidisciplinary approach, so I think it is a bit of a misnomer that it is something which is completely new. It is based upon the foundations of basic science and engineering.

The Hon. MICHAEL VEITCH: One of the issues for New South Wales, as I see it, if New South Wales is to harness the opportunity that is nanotechnology for the future, workforce development and attraction of skilled workforce is a problem. How is the University of Wollongong meeting those issues? Are you striking any problems in locating suitably qualified and trained staff to assist in delivering the courses?

Professor PRICE: Probably not, no. We tend to attract staff both for the educational side and the research side on a global basis, so we have extremely good researchers and academics. They are not necessarily all from the local area but it is very much a global market.

The Hon. MICHAEL VEITCH: It has been suggested to the Committee that the New South Wales Government should establish a ministry, which has the sole responsibility for research, science, innovation and development and that such a ministry should be supported by the creation of the New South Wales chief scientist. Do you see any merit in this proposal?

Professor PRICE: I can see it being an attractive idea but it would need to have influence across a broad range of government and it would also need to have funding. I would need to look at the detail there.

The Hon. MICHAEL VEITCH: Do you have a view as to what background would make up a chief scientist in New South Wales?

Professor PRICE: You would probably need someone who has a very distinguished career in science but also a global perspective so that they can actually see where the opportunities are

internationally and where the State can be world leaders, and that is quite a difficult thing in this particular area when it is moving so fast.

CHAIR: Just going back a couple of paces. Christine Robertson asked about commercialisation. How important do you think it is to the New South Wales Government and for the economy in New South Wales that we do get involved in commercialisation?

Professor PRICE: In this particular area or in general?

CHAIR: In nanotechnology?

Professor PRICE: I think that in this area there are opportunities, which arise where you get either small groups who have a particular idea and it is quite difficult for them to move it on to the next stage. The difficulty is you either have to go to a large multi-international company to take it the next stage and then there is the danger of everything going offshore rather than the establishment of a small start-up company within the State, which can then grow and give jobs within the State. It is all about competition on a global scale. You have to be in there first, you have to be able to test the intellectual property and then take it to the next stage to actually get a product and then grow that market and produce jobs.

The Hon. CHRISTINE ROBERTSON: So grants from research to product stage?

Professor PRICE: Or trying to find ways to encourage small companies to set up here and perhaps find partnerships with international ones but base them here rather than the whole idea going off-shore.

The Hon. MICHAEL VEITCH: It has also been suggested to the Committee that there should be an institute of nanotechnology. Do you have a view on that?

Professor PRICE: I am not sure where that came from but another one that has been around for a few years is the Institute of Mathematics, and that has been quite a good vehicle to promote the whole idea of maths, enabling and so forth. One of the difficulties with the idea of the institute of nanotechnology goes back to the point I made; that is, to treat it as a separate thing instead of being part of the spectrum of the science that is engineering may not necessarily achieve the aims. It is a truly multidisciplinary area and it is extremely diffuse but I do not necessarily know about treating it independently of everything else.

The point about the commercialisation and also the idea of an institute is that it is not just that you are going to use this type of technology in new areas and small start-up companies; these new materials are going to be used across the board, in manufacturing, where these new materials can enhance properties and each particular thing. It is not just going to be a new industry called nanotechnology. It is going to be used across the whole board—manufacturing, health and so forth.

Reverend the Hon. FRED NILE: We saw an example where they were strengthening steel products?

Professor PRICE: Exactly.

Reverend the Hon. FRED NILE: So it was still the original product.

Professor PRICE: Yes.

Reverend the Hon. FRED NILE: In your submission you argue that it is important that any modifications to regulations do not unnecessarily hamper research. Can you indicate what type of regulatory modification would potentially hamper research?

Professor PRICE: One of the examples that we were thinking about there was in California, where the city of Berkeley introduced legislation in 2006 or 2007 and unwittingly they stopped the process of interaction between some of the institutions within the city boundaries because they tried to restrict the transfer of research samples from institution to institution. They actually slowed down the

process by which research samples could be tested and characterised at these other institutions, so they actually slowed down the process of collaboration.

Reverend the Hon. FRED NILE: Was that on the basis that it was dangerous to transport nano materials?

Professor PRICE: That was the implication. They put a lot more hurdles in the way. I am not trying to say—

The Hon. MATTHEW MASON-COX: Sounds like the city of Randwick. Is that your suggestion?

Professor PRICE: No, I think one of the things about this city of Berkeley is that it has about four world-class institutions within the city boundaries and they were used to research collaboration. They had a large infrastructure so a research sample from one institution would be transferred over to do various tests and things and they found that it actually slowed things down and there were hurdles put in the way. I do not necessarily think that was the idea behind the legislation. That was just one example.

The Hon. MICHAEL VEITCH: So you would like us to introduce it here is that what you are saying? Sorry, I am being facetious.

The Hon. CHRISTINE ROBERTSON: We had a discussion earlier about the competition in the academic world and now you are giving us an example of the opposite.

Professor PRICE: We do like to talk to each other. It is not as bad as you think.

The Hon. MATTHEW MASON-COX: It was certainly good to go to Wollongong University to see some of the exciting research you are doing there and some of the potential applications of that. I could not help getting excited about nanotechnology and certainly after a few other site visits it is very exciting. I notice in your submission that the University of Wollongong through ACIS has an education program as its mandate?

Professor PRICE: Yes.

The Hon. MATTHEW MASON-COX: Part of that is you are developing an interactive exhibit for your new science centre?

Professor PRICE: Yes.

The Hon. MATTHEW MASON-COX: That is the new building—

Professor PRICE: Exactly.

The Hon. MATTHEW MASON-COX: As you mentioned, there is a great deal of school education opportunities for the next generation to excite them about science and get them interested?

Professor PRICE: Yes.

The Hon. MATTHEW MASON-COX: I think that is a great idea. Are there any suggestions you might make in that regard?

Professor PRICE: I will tell you a bit more about what we actually do within the education program. Part of the focus is on giving broader training to own staff and early career researchers to make sure they have got the full benefit of understanding of the broad implications of nanotechnology, both in terms of ethics, occupational health and safety and a whole range of things. The other thing we do is through the schools we get people onto campus and show them exciting things. We try and excite them and also emphasis the fact that it is building on the basic enabling sciences—that is one thing. We have an ethics program as part of the education—I think Sue Dodds might have mentioned that this morning.

As far as the science centre is concerned we are currently finalising the first stage of that. It is going to be done in two stages. One stage is going to be using what is called an iTone, which is a sort of lens where somebody sits inside it and gets the full 180 degrees—a bit like the IMAX theatre cinema experience. That is very good for visualising things at the molecular level and also we can put animations on there to show how nano-structured materials can actually improve the properties and how that leads to applications. The second stage, which will need additional funding, is going to be an interactive exhibit at the science centre. That has got perhaps an 18 months or two year lead time and that will have things that flash and bang and things that people can interact with and there is a lot more information about the type of materials and the application and future.

The Hon. MATTHEW MASON-COX: Is that funding shortfall going to be provided from other sources?

Professor PRICE: The first stage is currently being funded through the science centre and through the University and through ACIS itself. The plan is that we are going to appoint a project officer for this particular thing and they will be going out to try to raise the funding to achieve stage two.

Reverend the Hon. FRED NILE: From the corporate world?

Professor PRICE: Yes, could be. The model we are using is one that has been used a lot by the science centre in Wollongong, whereby they go out and look for sponsors from the coal industry if it is in that particular direction and so forth.

Reverend the Hon. FRED NILE: Your submission suggested that the State Government can play an important role in building up public confidence in nanotechnology, particularly opening up opportunities for informed public discussion on social, economic and health benefits, risks and the potential impacts of nanotechnology. Can you suggest some practical examples of what you would like the Government to do?

Professor PRICE: Yes, that is a good question. It was maybe put in there because I am sort of wanting to make sure—the whole issue is a difficult thing in trying to both inform and build confidence in some of these new areas. Clearly some other things we mentioned before in terms of education and the next generation, there may be opportunities with the Board of Studies to try and use nanotechnology more as a case study as to how you can use the enabling sciences to do really good things as well as future applications. Maybe there is a role that the State Government can play in terms of trying to promote the value of research and development in these types of areas possibly through awards like the eco-wards for science and there could be some which are focused on the nano area perhaps.

Reverend the Hon. FRED NILE: Who would make that decision for the Government because they would not be experts in nanotechnology?

Professor PRICE: That is true. It would depend upon the basis they were being selected on, in terms of whether there was going to be financial support or other support. Maybe you would need an appeal review or a subcommittee advising on particular applications.

Reverend the Hon. FRED NILE: There is some indication that the University of New South Wales receives some financial support from the defence department. Do you have any relationship at your university in that area?

Professor PRICE: You are saying that the University of New South Wales has contracts with the Department of Defence?

Reverend the Hon. FRED NILE: Yes, it has some relationship but we are not sure exactly what.

Professor PRICE: We have joint contracts with the Defence Science and Technology Organisation [DSTO]. In the past we have had contracts with the United States army and navy but they were mainly on specific materials or specific projects.

CHAIR: In your submission you argue that New South Wales would be best served by selecting particular niche nanotechnology to be supported through research commercialisation. Can you elaborate on that? In particular, what should be the basis for selecting one nanotechnology over another?

Professor PRICE: I think that follows on from what I was saying before. I guess the idea of having to select niche areas goes back to the point that if there was financial support available then you would need to be able to choose from a wide number of possibilities and again try and prioritise what was most in the public interest—be it in health, water or whatever. I think you would need to prioritise the particular applications and the goals of those applications.

CHAIR: Would that come from direct interest in nanotechnology areas that the private sector may be working on?

Professor PRICE: How do you mean?

CHAIR: To try and prioritise all these areas that you are talking about. I take the Reverend the Hon. Fred Nile's point that the Government would not be the vehicle.

Professor PRICE: I was not implying they would be, no.

CHAIR: Would the industry itself be responsible or who else would do the prioritising?

Professor PRICE: I think again looking at nanotechnology in isolation is not perhaps helpful. It is more to do with what support the State Government can provide for the commercialisation of any new technology and whether that is deemed to be a priority for the State Government.

Reverend the Hon. FRED NILE: Perhaps they should survey the commercial area or commercial interests as to what they see as the priorities and the Government could select from those?

Professor PRICE: I am sure that is true. I do not know whether quite a few of the new areas are necessarily going to be at the commercial stage. It may be you will have to survey a mixture of both industry and institutions.

The Hon. CHRISTINE ROBERTSON: The New South Wales Government has got a strategic plan for innovation.

Professor PRICE: Yes.

The Hon. CHRISTINE ROBERTSON: I have to tell I have just flicked past it so I am not very conversant. Would you perceive the sorts of issues listed there as the kind to be targeted? Have you read it?

Professor PRICE: I am aware of it but I have not read it in detail. I think those are the kind of things I would imagine, yes. It is fair to say the Commonwealth Government is the one that predominantly funds research and development but other state entities have entered into that arena a lot more than New South Wales has.

The Hon. MICHAEL VEITCH: Following on from your comments regarding picking one nanotechnology over another for commercialisation, do you think that lends itself towards New South Wales needing to have a nanotechnology strategy?

Professor PRICE: There is the national nanotechnology strategy and I guess that the State Government needs to work out how it is going to be part of that. Whether it actually needs its own is another matter.

CHAIR: Is there something other than what we have been discussing that you would like to comment on before we close?

Professor PRICE: I do not think so but thank you for your time.

CHAIR: I wish to thank you for your attendance this afternoon and contributing to this inquiry. I would also like to thank you again for your hospitality when we visited Wollongong?

Professor PRICE: It was a pleasure. Thank you for coming down.

(The witness withdrew.)

MIRIAM WINIFRED GOODWIN, Senior Advisor, Research, Management and Policy, Australian Nuclear Science and Technology Organisation, Private Mail Bag 1, Menai, and

GEORGE ANDREW COLLINS, Chief of Research, Australian Nuclear Science and Technology Organisation, Private Mail Bag 1, Menai, affirmed and examined:

CHAIR: Dr Goodwin and Dr Collins, if you should consider at any stage that any evidence you wish to give or document 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 wish to take any questions on notice today, the Committee would appreciate it if the answers to those questions were forwarded to the Committee secretariat by Monday 19 May 2008. Would one or both of you like to start with an opening statement?

Dr COLLINS: Thank you for inviting us along to the Committee's hearing today. The Australian Nuclear Science and Technology Organisation [ANSTO] is an Australian Government organisation, but for 50 years we have been here in Sydney and we are very much a part of the New South Wales research community and an important part of the New South Wales research infrastructure. Although we are a national research organisation, just because of the location we have very strong links with local researchers in New South Wales and many of our customers, clients and industries we work with are in New South Wales. Also, for 50 years we have operated a research reactor, Australia's only nuclear reactor. For 49 years and 4 days it was HIFA [High Flux Australian Reactor] until it closed down last year and in November 2006 OPAL [Open Pool Australian Light Water], which is truly a world-class research reactor here in the southern part of Sydney at Lucas Heights.

Even though, I guess, the public knows ANSTO and our research reactor for the production of nuclear medicines and radiopharmaceuticals, a very important part of the scientific use of the reactor is the production of neutrons. Those neutrons form beams which are used to explore the structure of materials. The structure could be at the atomic scale, the molecular scale and, importantly for the Committee's interest, the nanoscale. The investment that has been made in OPAL and, in particular, the instruments that are scattered around it at some distance sometimes at the end of guides where these neutrons come out are very important tool for the characterisation of nanomaterials. They very much complement the sort of instruments that are at the Australian Synchrotron in Melbourne and also the sort of instrumentation in electromicroscopy and microanalytical tools that exist in the various modes at the Australian Microscopy and Microanalysis Research Facility.

So ANSTO in the provision of these neutron beams and the instruments that go with them—and some of those instruments are indeed world-class—has a very important role to play in helping other researchers, other people developing nanomaterials to understand the structure, in other words, how the molecules are arranged in these nanostructures, but also the function, in other words, how they behave at different temperatures, different pressures. With the neutrons we can probe right through at different temperatures and pressures and get an understanding of what is going on there. ANSTO's interest in nanotechnology goes beyond just the fact that we run a facility where we want researchers coming from all around the country and, indeed, all around the world to use. I guess it is going to be prominently New South Wales in the first instance because they get closer contact with us and we have strong relationships. But, as I said earlier, we are a national facility and have collaborations throughout the country.

As well as using those facilities, ANSTO itself does its own research and develops its own materials. We have capabilities that can help facilitate the construction of various nanostructure materials. Indeed, our own research has done that. I am sure other people have spoken to you about the wonders of material properties at the nanoscale. It is both when the material is in a nanoparticulate form, nanoparticles, but also it can be bulk materials where the structure of those materials is arranged at the nanoscale so that the ways of various molecules are connected together. It is engineered in a particular way to give different properties. The key about nanomaterials is that it is the molecules on the surfaces or at the grain boundaries, at the interaction between one segment of the material and another, that have the major influence on the properties of that material rather than the bulk, which is, I guess, more influencing in the conventional materials we know.

One particular technology that ANSTO has invested in and is now a spin-out company from ANSTO is called CeramiSphere. Here we take silicon or silica, almost the stuff of sand, and we change the nanostructure in the form of having various pores in them, pores that are designed that can trap active molecules, whether that be a drug or perhaps something designed to add corrosion resistance to a coating. It can trap it and then release it at a defined rate, which could be days or months. That is mucking around with the nanostructure of that material, the holes that exist in it, these very tiny nano-sized holes. But also in this material we can actually make it in different sizes, depending on the application. Sometimes it is almost just fractions and millimetres; other times it is right down to a few nanometres. So in that particular technology we have nanostructure in the way the holes are all in there, but we also have nanoparticles because we make them, depending on how we want them to be. So we have those nanoparticles.

Just while there is the really good side of all these great properties bestowed on materials by engineering on the nanoscale, the fact that they are different means they behave differently than their big cousins. So we are concerned about the way these particles or these nanostructure materials behave in the environment or, I guess even more importantly, in our bodies. So in helping understand nanotoxicity, ANSTO is applying its radiolabelling technology. The same as we use when we are making radiopharmaceuticals to track the progress of disease or what is happening in your body, we can label the nanoparticles with that and do studies about how those particles behave in the environment or in living beings. So we are working with others in that area, and it is another part of ANSTO's interest or facilities or capabilities that can be applied for nanotechnology. An important part of ANSTO's mission is to make the public aware of our capabilities, our science and technology. For that reason we are really excited and pleased to have made a submission and be invited to take part in this inquiry. We look forward to your questions.

CHAIR: Your submission argues that New South Wales has the potential to be a leading location for research and development of nanotechnology using the state-of-the-art research facilities and capabilities that are located within the State. Can you advise what might need to be done to realise this potential or, conversely, the barriers to New South Wales realising its potential?

Dr GOODWIN: Going through the submissions the Committee has received, it is actually quite exciting to see how much there is going on in New South Wales in the nanotechnology area. So, to some extent, you have a fabulous foundation in the work the Committee has undertaken for leading nanotechnology in this State to the next level. If we look at the potential to be a leading location, as Dr Collins has highlighted, we have one of the world's best research reactors in this city, in this State. That is an important part of being able to be a leading centre for nanotechnology because of what that research reactor can do, what it can do with neutron beams in nanotechnology. One can see a number of companies that have already been set up in the nanotechnology area. There are universities very active in this area. For example, your previous witness was speaking on that subject. So there is a lot of exciting potential there.

If we look at though what might be done to improve matters further and to realise potential further, I think one of the things is the perception that New South Wales is not as committed to nanotechnology as some of the other States have presented themselves as being. So there is a real issue here around perception, around awareness and around being able to draw together the various threads of activity and building on that and helping turn around the perception. One way to do that, for example, would be to show greater support to the facilities that are trying to attract users of those facilities. We are one of those, of course, at ANSTO, but there are a number of other facilities. There is potential across the State to try to bring people together and give them a greater awareness of what is going on, what could be done, what is out there.

Regulation clarity is an issue that a number of people have obviously raised in your submissions. That has to be seen as being some form of barrier. Certainly in discussions I have been having with people, there is a perception that this could be emerging as an area of potential risk to be setting up in a business because of some of these concerns about regulation. So clarity there will be an important thing to realising the potential. I think we would have to say that it is a good State otherwise for setting up businesses and that gives us a good potential to be able to move forward if people feel confidence that we have the capabilities and expertise. One of the issues has to be confidence and simple awareness of what is out there.

The Hon. MATTHEW MASON-COX: I am interested in your comment about the New South Wales Government being perceived to be a little less interested than perhaps Victoria and Queensland, to name two States. What do you think the New South Wales Government could do in terms of supporting nanotechnology investment and research?

Dr GOODWIN: I think this has been a fabulous start, for example.

The Hon. MATTHEW MASON-COX: We talk a lot. What practical or on-the-ground measures would you like to see this Committee recommend the New South Wales Government take?

Dr GOODWIN: One thing, for example, is if you have a wealth of information about capabilities, that could be brought together and that would give people a much more consolidated picture of what is going on in New South Wales. If it had Government imprimatur and support, that would help turn around the perception. I do want to emphasise that is a perception I have picked up. I would not say that is necessarily a factual comparison. Factual comparisons are very difficult to do. If there was something that did bring the various elements together regarding nanotechnology in New South Wales, you could help turn the perception around.

The Hon. MATTHEW MASON-COX: Such as an office of nanotechnology?

Dr GOODWIN: An office of nanotechnology, some form of directory, maybe some form of workshops or site visit admissions, things like that where people could actually get a handle on the breadth of things that are underway. If it happens under the Government banner, that would be one way of turning around those perceptions.

The Hon. MATTHEW MASON-COX: I note that you said you have a number of corporations involved in your facility. How does that come about? Do you approach them in order to gain access to that sort of funding base or do they approach you looking to gain access to the research base?

Dr COLLINS: Are you talking about businesses that come to us seeking assistance?

The Hon. MATTHEW MASON-COX: Yes.

Dr COLLINS: We do actively seek to support businesses as part of our mission. In truth, a lot of our business is caused by people using us, knowing us and then extending beyond that. One example I might pick up is that over the last few years we have done almost service work for a number of manufacturers of medical devices in the Sydney region. That is because we have a particular technology that all knee implants need. They were being sent overseas to be pressed in this way in a particular heat treatment. We have that facility. So we were doing a lot of them locally. That led on to "You have this capability. What other capabilities do you have in research?" That research includes the way we structure coatings that are put onto those prostheses. So what started as a straight metallurgical service becomes a research activity, which can lead into nanotechnology-related things.

One of the issues about nanotechnology is that it is a fuzzy boundary between materials that you are dealing with in a more standard conventional sense when they cross over into what might be called a nanotechnology regime. That may be another barrier—not a barrier particular to New South Wales but it is a barrier in the sense of making the public understand. Fore example, just because you have particles in steel at 1 micron and you make them .9 of a micron, you could say, "Well, that's now nanotechnology." But it is not really changing the structure of the steel that much. So I think a very important role is education both for the community as a whole and also for the potential users—the corporations, the businesses we deal with. In all our interactions we do see our role as reaching out and spreading the knowledge, as well as trying to gain people to come and use the facility.

Reverend the Hon. FRED NILE: We know that the Australian Nuclear Science and Technology Organisation [ANSTO] is a Commonwealth project—Commonwealth land—but you said that you were interacting with a lot of New South Wales industry and Sydney industry. As you have the only reactor, would it be possible for the State Government to establish some centre to work in partnership with ANSTO and, if we did have an office or institute, to be correlated or located with ANSTO?

Dr COLLINS: Certainly. We have good interactions with a number of New South Wales government departments in our environment area. We are working with the Department of Environment and Climate Change and looking at various things, and that is not in nanotechnology, that is just understanding processes in the environment, so having some joint activities with New South Wales is something we appreciate very much. We are already engaged in discussions with the Office of Science and Medical Research and the Department of State and Regional Development on a number of initiatives where we have worked together.

Reverend the Hon. FRED NILE: I think that would be a big leap forward for New South Wales.

The Hon. CHRISTINE ROBERTSON: I understand that the process you have of working with several government departments is because they have specific issues that they want to address with you. I am concerned that the innovative projects that come from individual departments could disappear if we set up a central scientific structure. Would it be better if you worked only with one department or would you perceive it better if there were a coordination role, so that you actually had one point of contact that would put you through to the other departments? You are a very important component of the whole process, but it is how the government departments contact and work with you that is of relevance, so I want your feedback on what you think about structuring this?

Dr GOODWIN: Direct relationships are very efficient, but also it is often the best way of getting the research out to the users. If I think for example about collaboration, the Department of Environment and Climate Change is one we have identified. The Department of Primary Industries would be another example where, if you are working directly with departmental officers, they are the people who are using the knowledge that you have potentially jointly created. There is a greater benefit in that they can actually directly apply what it is that they have gained from us, what it is we have built together, and that is one of the very strong things, especially in our environmental research area.

A central point is very good where people do not know who to go to for advice, if they want to get an idea of the breadth of potential, an idea of who is doing what—contacts, coordinating, multi-facility activities, multi-department activities—but you would not want to get in the way of that direct researcher to researcher and researcher to research user interaction because that does so much to make sure that the value of the research is actually delivered.

The Hon. CHRISTINE ROBERTSON: This, of course, is about the fact that many of the submissions have actually pointed towards wanting a chief science officer, so it is how to best structure that process for the future.

Dr GOODWIN: They need not be contradictory. You certainly can have that high-level role, but nonetheless continue to have people working in the field together directly.

Dr COLLINS: We have a variety of interactions and, depending on the agencies, they can be at the scientific level as Miriam spoke about, but if there were going to be something more formal like the Reverend Nile spoke about then of course we would want some high-level coordination as well. There are already a number of places where we look for that, not directly nanotechnology, but for example in our support of the nuclear medicine community in the Sydney region. That relationship has not always worked well and recently some of the practitioners set up a coordinating group. Originally I think it started under the former Minister Knowles and that led to almost an investigation on their part, or they were challenged to work out how they could relate to ANSTO better, ANSTO being a major supplier of the products that they need to use in their nuclear medicine work.

We recently—I took part in it as well—had a meeting with Minister Firth about that and one of the suggestions was could the New South Wales Government provide within the Office of Science and Medical Research or the department some coordinating role so that those linkages between ANSTO and that particular community, which are linked through the public hospital system already to the Government—the words were to ensure that the relationship never broke up again because it is working well now. I think that the Government can play a role in facilitating those relationships and

helping perhaps when times get tough in the relationship if there is some central coordination. We have our contacts in the department that we go to and we talk to when we do find there are issues.

The Hon. CHRISTINE ROBERTSON: So in the brave new world where there is quite considerable talk about having more coordination in the New South Wales Government's contribution, where would you see yourselves? I recognise that you want to be participants in the research, but obviously to do that you have to be politicians too, so where do you see yourselves—at the table of an advisory organisation, or at the table with academics, or in which part of the process?

Dr GOODWIN: That is an interesting question for an organisation like ANSTO because we have advisory functions in terms of the Commonwealth primarily, that is, but also we are a research organisation, we undertake research like an academic undertakes research and we have facilities that are used by others such as academics from elsewhere, so I think we would have to look at what structure came into being to really get an idea of where we could best—

The Hon. CHRISTINE ROBERTSON: You might not have time; you might have to put your foot in the door.

Dr COLLINS: We would want to talk at least.

The Hon. CHRISTINE ROBERTSON: You want the right to talk?

Dr GOODWIN: Yes.

Dr COLLINS: We do not want to exclude ourselves from the activities that are happening in our local research community because we feel very much part of it.

The Hon. MICHAEL VEITCH: In the submission that we received from the Australian Microscopy and Microanalysis Research facility they argue that Australia and New South Wales need future investment in next generation nanostructural analysis infrastructure, such as transmission electron microscopy to enable tomorrow's science and technology. Do you agree with that?

Dr COLLINS: Access to state-of-the-art characterisation and analytical infrastructure is important. As I said in my opening statement, recently Australia has made some significant investments. We have OPAL and its neutron-scattering instruments; we have the Australian Synchrotron; and we have the various facilities, both in fabrication, but I guess what we are talking about today is characterisation, from the National Collaborative Research Infrastructure Strategy [NCRIS], which New South Wales has been part of. NCRIS has contributed to the facilities at ANSTO, at the Australian Synchrotron and of course with the Australian Microscopy and Microanalysis Research facility [AMMRF].

Continued investment is important to ensure that all the facilities remain internationally competitive, but we would say that investment should be selective and driven by careful consideration of the tools that are required. There is no point in duplicating facilities that are available elsewhere or in creating facilities that do not have either strong existing or strong future demand from within Australia and I guess, in consideration today, New South Wales. So our attitude, for example, to funding or seeking funding for new instruments on OPAL is to at this stage get all the instruments we have got—there are nine in the first set—up and running and then to continue to talk to the community and judge their demand for new facilities and new instruments.

I think the same should apply to high-level transmission electron microscopy. We have to demonstrate the need for these tools. I make a point to distinguish what a microscope can do from what tools such as a synchrotron and neutron beams can do. A microscope looks at one particular spot, so it is very good at looking at a particular spot on a particle or a particular particle, where the actions of neutrons and x-rays from a synchrotron are to average over a number of particles, so you get a more global view of the material and its properties. The two things are very complementary.

Scientists are always keen to have better tools and I would say we are at this stage blessed with the investments that have been made in recent years. Speaking as a scientist, I would say it is our responsibility to the community—it is their money that has been invested—to show that we can make

good on investments that have been made, as well as think about future investments, but I would put the urgency on making good investments that have been made before we need new investment in new tools.

The Hon. MICHAEL VEITCH: Do you have any trouble obtaining the workforce required to operate the tools?

Dr COLLINS: We have been successful in recruiting from around the world, including recruiting back Australian scientists who have spent some time overseas. The actual operation of the tools is an interesting sort of scientist because they are scientists who have their own research interests and are very good at using the particular tool, whether it be a microscope, a synchrotron or a neutron beam to understand that particular material's problem, but they have also got to be willing to help others and the others' research interests might not be exactly as their own. So managing what we call instrument scientists is an interesting problem.

At ANSTO we have two sorts of scientists. We have normal researchers and instrument scientists and they look at each other from different points of view. Some say, "The instrument scientists can look after any sort of research they like; whatever comes there they can do it", but they will look back at the ANSTO researchers and say, "Wow, they get lots of resources to look at particular mission-directed research". You do have to have both sorts of researchers. At the moment we are very happy with the calibre of the people we have attracted and we can see also the calibre of people attracted, for example, to the Australian Synchrotron in Melbourne. They have attracted some of our people.

The Hon. CHRISTINE ROBERTSON: Poaching?

Dr COLLINS: Yes.

The Hon. MICHAEL VEITCH: Is their scope to expand ANSTO's current involvement in nanoparticle research for biosafety purposes?

Dr COLLINS: I mentioned the use of radiolabelling and we have used it ourselves for those ceramispheres I mentioned. We did biodistribution of where the nanoparticles—we were trying to target different organs—ended up and we did that by radiolabelling them. Since then we are now in a project with the Australian Institute for Biotechnology and Nanotechnology in Queensland and we are, I guess, more systematically looking at how you label different particles. The key is that some particles—you can take the structure of a clay, for example, and substitute one element for a radiolabelled element and radiolabel it that way.

Other times you connect, using a molecule as a connector, the radioisotope to the particle. So it is a little bit horses for courses and there is some development work required for different sorts of nanoparticles. We have the capability. How much it can be used depends on the urgency of the problem and also the resources that are available, so for us to expand broadly we would need extra resources in terms of people and funds. An alternative is to be able to, which we seek to do with some of our technology, transfer that to other researchers, so that the tools that we develop in this program, for example, are transferable to other researchers where therefore we only need to advise and help them. I think that would be the way the expansion could occur.

The Hon. MELINDA PAVEY: In relation to ANSTO working with the industry and universities in New South Wales on materials and process technology that incorporates nanomaterials, and that you are developing novel materials with potential application in the four areas of solar cells, optics, optoelectronics and protective coatings for abrasion and corrosion resistance, can you describe the potential applications in terms of their potential benefits?

Dr COLLINS: While the universities may be in New South Wales, some of these industries are not only located in New South Wales but extend to other parts of the country, and some of this work is done through collaborations we have in cooperative research centres, which we find are very, very good vehicles for taking our technologies, our capability, linking it with other research organisations and directing it towards research supported by the industrial participants of those cooperative research centres. For example, in the cooperative research centre for polymers, we are

working with several partners about developing solar cells, so what we are really doing there is helping develop polymer-based solar cells. Some of this work is with our friends at the University of Wollongong and the polymer researchers there and interestingly ANSTO has longstanding materials expertise in ceramic materials and we actually use nanoparticle-size ceramics to add to the polymers to make it more photoactive.

Of course, the key in polymer-based solar cells is not simply reducing the cost but also the weight and helping to make them more efficient. We can also put them into coatings on the surface of solar cells to upgrade efficiency. It is about structuring the nanostructure of that material so when the light interacts more goes in than comes out. Similarly, we mentioned coatings on lenses. Again, it is about structuring the reflective coatings on the lenses to be more efficient. Part of that is not only the coating but also the technology we are using. We have a technology we are trialling that can follow the shape of the lens on both sides at once, rather than the current method of using one side at a time. A key movement forward in a lot of medical areas is not only a structural device, such as an orthopaedic implant, but also an electroactive device. The one we all know well is the cochlear implant. We are going on to other sensors that work in the body and devices like the cochlear implant that stimulate nerves using nanomaterials as part of the coating on that surface where the interaction occurs between the body and the particle or within the device itself. That is another area of ANSTO's work.

The final issue referred to was corrosive resistance. We are working with colleagues at the University of New South Wales in the School of Chemical Science and Engineering developing materials to be used as barriers with better antifouling properties, for example, in membrane filters. There is a range of areas where we have part of the solution and we combine with others and industrial end users to create a new product or process that incorporates our skills and understanding of this nanotechnology.

Reverend the Hon. FRED NILE: How do you handle the testing for safety in regard to toxicity and so on? Do you have a unit that does that?

Dr COLLINS: We mentioned two subsidiaries in our submission: CeramiSphere Pty Limited and Australian Membrane Technologies Pty Limited. They have carriage of this because at the moment they are fully owned subsidiaries. We are keen to help other people, but with those two we have a particular responsibility. CeramiSphere is a nanostructure material but also exists in a nanoparticulate form. That is the major area of concern with nanotoxicity when there are particles of that size. The studies we have done range from invitro toxicity. These particles are the same material as sand, so the material is not in itself toxic. It is also biodegradable; over time it will degrade in the body. I do not suggest that anyone eat lots of sand to test it. We can do the tests with the nanosized materials and they are quite biodegradable. We have done that using the standard testing methodology for dissolution.

We have also done work on toxicity with cells. That has shown that the toxic dose is more than 100 times larger than the dose given if this technology were being used. We have not in this particular material seen any difference between the toxicity of 50 nanometre-sized particles up to 60 micro particles. That is three orders of magnitude in size of the particle. In that case, it seems that size does not matter. These are in-cell tests, so they are invitro, not invivo; that is, in the test tube rather than in animals. We are planning a full-blown toxicity study as part of the pre-clinical trials for people who want to use this technology in a medical application. The chief technology officer of the little start-up company said, "The estimated cost of this is $600,000, which is a lot of money for a small start up. Of course, any help from the State Government is very welcome." I have his line in the transcript.

I mentioned silica, but some of the other materials used in ceramics have been used for a long time in a nano form, whether that be in colloids or in other ways. They are generally handled in solution or in some aggregated form. The concern comes when these particles are free in the air. In a lot of the work we do they are well bound up, either in a solid form or in a solution. In the membrane technology that we are using for water remediation—which is coated with a nanoparticulate surface as part of the manufacturing process—the colloid that exists stays as a gel and the particles are not coming off free. They are in a semi-solid form; that is, a jelly-type material. That reduces the potential

for them being dealt with. We are doing a number of tests as they become available and recognised. We are also using good and safe practices in their manufacture.

The Hon. MATTHEW MASON-COX: I refer to your library of molecular nanoparticles. You mentioned in your submission that the greatest importance is the need for basic research to determine the molecular characteristics of nanoparticles that dictate the interaction with biological systems. I think another party referred to them as nanoparticles of concern; that is, the ones that interact with us. Do you have some sort of ballpark figure for the research that you think needs to be done into nanoparticles of concern, the likely cost of that research and time frame and Australia's role in that, and particularly ANSTO's role as you see it?

Dr COLLINS: ANSTO's support of this was in radio labelling. That work identified a number of potential nanoparticles of concern and added them to the research program, both with regard to the particles themselves and also their size ranges. Clay-based particles are already used fairly widely in the automotive, paper, paint, flame retardant, cosmetic and toiletries industries. They are particles of interest in this case. An interest can become a concern—

The Hon. CHRISTINE ROBERTSON: "Interest" is a much better word.

Dr COLLINS: A particle of interest can become a particle of concern. I call it a particle of concern once it is shown to have deleterious—

The Hon. CHRISTINE ROBERTSON: Once it is crook.

Dr COLLINS: Yes. The other class of particles we are looking at are carbon nanotubes, which have very interesting shapes and therefore can do all sorts of interesting things in their interaction with living cells. Of course, the scope of doing things is very broad and we have to be selective. The library at the moment consists of three: Two clay-based particles and nanocomposites—because they contain more than one material—and the carbon nanotubes. Some international work is being done with the Argonne National Laboratory in Chicago. I mentioned the connection with our friends in Queensland.

The potential to broaden the work is in the area of developing the techniques that can then be transferred to others. The potential for ANSTO to do everything—particularly when it comes to full-scale animal testing—is limited. We must develop techniques that do not require animal testing, where we can use invitro tests. At the moment, the team would like to think of themselves as being leaders in the country, but they cannot do everything. The key will be to spread those techniques around. I know that the CSIRO is doing different labelling and it will be important to share the results of that work was we do it at the growing number of nanotechnology meetings in the country.

The Hon. CHRISTINE ROBERTSON: The control of that information would be a Federal issue.

Dr COLLINS: At the moment the information is in the scientific literature, so it is publicly available.

The Hon. CHRISTINE ROBERTSON: But it is an Australia-wide issue, not a statewide issue.

Dr COLLINS: Yes.

The Hon. MICHAEL VEITCH: What disposal arrangements does ANSTO have for the by-products of the experiments?

Dr COLLINS: We follow all the various regulations as set down by the State. They are obviously different for radioactive material as opposed to bioactive material. We follow the standard practices. ANSTO has a very sophisticated waste management section.

The Hon. MICHAEL VEITCH: I wonder why.

The Hon. CHRISTINE ROBERTSON: Because of people like you.

Dr COLLINS: We are very happy to be kept honest.

Reverend the Hon. FRED NILE: Is there some possibility of deactivating or decontaminating radioactive material?

Dr GOODWIN: There has been something of relationship there. The capability we have that you now see in something like CeramiSphere started with our work on radioactive waste forms. It is not a decontamination but a related set of techniques. We have built a platform of techniques or ways of doing things that is now being applied in the nanotechnology area.

Reverend the Hon. FRED NILE: So it is no longer dangerous.

Dr COLLINS: The radiation is still there, so the material must be treated carefully. The word we use is "immobilised"—it is not free to get out into the environment. It is similar to what I said about nanoparticles not being free to get out into the environment; they are being held in some solid or monolith form. Members might have heard from the University of Western Sydney about our most blue-sky project. We were working with some French collaborators to provide a nanotechnology coating on the outside of a radioactive waste form in a monolith. If the radiation ever came out from the material the coating would react and change its properties to provide a further encapsulation or barrier. That is blue-sky work with nanotechnology. The main work at ANSTO is about controlling the structure, whether it be atomic or molecular, of a particular waste form to deal with the radioactive waste.

CHAIR: Do you have any further comment you would like to make?

Dr COLLINS: We are happy to welcome you to visit our site at Lucas Heights and to see some of the tools we have for both characterising and creating nanomaterials.

CHAIR: Thank you for that offer and for your time. We will send some questions.

The Hon. MELINDA PAVEY: Thank you for contributing to New South Wales.

(The witnesses withdrew)

(The Committee adjourned at 5.15 p.m.)