Standing Committee on State Development

Nanotechnology in New South Wales

Ordered to be printed 29 October 2008

New South Wales Parliamentary Library cataloguing-in-publication data:

New South Wales. Parliament. Legislative Council. Standing Committee on State Development.

Nanotechnology in NSW : [report] / Standing Committee on State Development. [Sydney, N.S.W.] : the Committee, 2008. – 180 p. ; 30 cm. (Report / Standing Committee on State Development ; no.33)

Chair: Tony Catanzariti, MLC.
"October 2008".

ISBN 9781920788209)

1. Nanotechnology—New South Wales.
I. Title
II. Title: Nanotechnology in New South Wales.
III. Catanzariti, Tony.
IV. New South Wales. Parliament. Standing Committee on State Development. Report ; no. 33

620.5 (DDC22)

How to contact the Committee

Members of the Standing Committee on State Development can be contacted through the Committee Secretariat. Written correspondence and enquiries should be directed to:

The Director

Standing Committee on State Development

Legislative Council

Parliament House, Macquarie Street

Sydney New South Wales 2000

Internet www.parliament.nsw.gov.au

Email statedevelopment@parliament.nsw.gov.au

Telephone 02 9230 3504

Facsimile 02 9230 2981

Terms of reference

1. That the Standing Committee on State Development inquire into and report on nanotechnology in New South Wales, in particular:

    a. current and future applications of nanotechnology for New South Wales industry and the New South Wales community

    b. the health, safety and environmental risks and benefits of nanotechnology

    c. the appropriateness of the current regulatory frameworks in operation for the management of nanomaterials over their life-cycle

    d. the adequacy of existing education and skills development opportunities related to nanotechnology

    e. the adequacy of the National Nanotechnology Strategy in the New South Wales context

    f. the level of community understanding of nanotechnology and options to improve public awareness of nanotechnology issues.

2. That the Committee report by 31 October 2008.

These terms of reference were referred to the Committee by the Minister for Science and Medical Research, the Hon Verity Firth MP on 5 December 2008.

Committee membership

Hon Tony Catanzariti MLC	Australian Labor Party	*Chair*
Hon Melinda Pavey MLC	The Nationals	*Deputy Chair*
Hon Matthew Mason-Cox MLC	Liberal Party	
Rev the Hon Fred Nile MLC	Christian Democratic Party	
Hon Christine Robertson MLC	Australian Labor Party	
Hon Michael Veitch MLC	Australian Labor Party	

Table of contents

Tables and figures

Chair's foreword

The area of nanotechnology is as broad as science itself. Products developed using nanotechnology can range from an invisible sunscreen or stain resistant clothing to revolutionary construction materials to more efficient cancer treatments and the potential for repairing damaged spinal cords. The common element to nanotechnologies is size – the nanometre, one millionth of a millimetre.

Nanotechnology is an area of constant development. Many of the issues the Committee examined during this Inquiry were and are still being acted on by international, national and state agencies and departments. In this area of constant development and emerging new scientific information, the Committee can only comment on the information currently available, which is why some of our recommendations relate to future actions – how New South Wales should engage with the challenges and opportunities presented by nanotechnology.

With any new technology there are concerns over safety and responsible use of products made using that technology. Any research and development in the many areas of science and industry that will be affected by nanotechnology needs to be conducted in a way that minimises the risks involved. In this report, the Committee examines the potential risks associated with nanotechnology, and the framework in existence to regulate and monitor its development.

Any new regulatory frameworks for the management of nanomaterials over their life-cycle will be most effective if they are implemented nationally and applied consistently at the State and Territory level. The recommendations made by the Committee relating to the regulation of nanomaterials are therefore framed in the context of working towards a clear and consistent national response.

During this Inquiry the Committee considered the usefulness of a New South Wales Chief Scientist position, to determine research priorities and to take a lead role in exciting new areas such as nanotechnology. On behalf of the Committee I wrote to the then Minister for Science and Medical Research, the Hon Verity Firth MP, in May 2008 to bring her attention to the evidence received by the Committee during its public hearings. I am pleased that the Minister confirmed the establishment of a Chief Scientist position and believe it is a positive step for the State.

On behalf of the Committee, I extend my gratitude to the many people who contributed to this Inquiry, especially the staff of the various research institutions and industries involved in nanotechnology who welcomed us into their places of work and shared their expert knowledge with us.

I appreciate the efforts of my fellow Committee members in coming to grips with what is a fascinating, but complex, area of science. My thanks also go to the Committee secretariat for their efforts in supporting this Inquiry.

Hon Tony Catanzariti MLC

Committee Chair

Executive summary

Conduct of the Inquiry (Chapter 1)

The Inquiry was established on 6 December 2007, when the Committee adopted terms of reference provided by the then Minister for Science and Medical Research, the Hon Verity Firth MP.

Developments in and consideration of issues relating to nanotechnology have been occurring for some time. The Committee heard that around 2004 there was a critical breakthrough in international awareness of nanotechnology, due to an acceleration in the outputs of industry and products containing nanomaterials reaching the market in larger quantities, and the release of pivotal public reports on the issue, most notably the Royal Society and the Royal Academy of Engineering's report, *Nanoscience and nanotechnologies*. The Royal Society and the Royal Academy of Engineering are the United Kingdom's national academies of science and engineering respectively.

The strategic importance of nanotechnology to Australia's future was highlighted by the Prime Minister's Science, Engineering and Innovation Council (PMSEIC) in its March 2005 report, *Nanotechnology – Enabling technologies for Australian innovative industries*. Subsequently, the Australian Government commenced the National Nanotechnology Strategy (NNS) on July 2007. The NNS aims to establish an environment that will allow Australia to capture benefits of nanotechnology while addressing the issues impacting on successful and responsible development.

As part of the current NNS, a review is being conducted of the adequacy of the existing national regulatory frameworks to effectively address the impacts of nanotechnology. At the same time a number of international organisations, such as the International Standards Organisation (ISO) and the Organisation for Economic Cooperation and Development (OECD), are working to define protocols and guidelines for the responsible use of nanotechnology. Much of this work will take some years to complete.

The Committee received 26 submissions from a wide range of stakeholders, including universities, federally funded research entities, trade unions, private companies and business and consumer representative bodies. At an early stage in the Inquiry, the Committee also received a briefing from Dr Clayton Teague, the Director of the United States National Nanotechnology Coordination Office. He provided the Committee with an overview of the current situation regarding nanotechnology which enhanced the Committee's understanding of nanotechnology and helped identify some of the issues that were explored during the Inquiry.

A number of site visits were undertaken to inspect locations where nanotechnology was currently being researched or applied. Sites visited included the University of New South Wales' Centre for Quantum Computer Technology, the University of Wollongong's Intelligent Polymer Research Institute, and the Australian Nuclear Science and Technology Organisation (ANSTO)'s facility at Lucas Heights.

This report represents the Committee's examination of the information provided to it through the Inquiry process. The Committee acknowledges that nanotechnology is an area of both long-term consideration and constant development. Many of the issues the Committee examined were and are still being acted on by international, national and state agencies and departments. The Committee acknowledges that in this area of constant development and emerging new scientific information, it is

possible that important actions or significant new information may arise in the period from the end of Inquiry evidence gathering to the publication of this report, and beyond.

What is nanotechnology? (Chapter 2)

The word 'nanotechnology' is a convenient descriptive term used to refer to a broad range of enabling technologies that involve the manipulation of matter at the nanoscale to create new materials, structures and devices. It involves new developments in the fields of physics, chemistry, biochemistry, biotechnology, materials science and computer science technologies.

The area of nanotechnology is as broad as the area of science itself. The scope of a product developed wholly or in part by way of nanotechnology can range from an invisible sunscreen or stain resistant clothing to more efficient cancer treatments and the potential for repairing damaged spinal cords. The common element to nanotechnologies is size – the nanometre, one millionth of a millimetre.

Throughout the Inquiry the Committee heard that 'nanotechnology' should not be considered as a single entity, but that nanotechnology applications, products incorporating nanomaterials, and nanomaterials themselves should often be considered on a class-by-class or even case-by-case basis.

Nanomaterials

While the focus of nanotechnology is the creation and application of engineered nanomaterials within products and processes, it is important to note that nanomaterials exist naturally. It is also important to note that not all materials at the nanoscale exhibit novel properties.

Definition

Despite the difficulty in defining a field as broad as science itself, work is underway to develop an internationally accepted definition. This work is being undertaken by the International Standards Organisation (ISO).

The Committee believes that an agreed definition consistently applied is desirable in terms of regulatory consistency and clarity. However, it is important that any size-based definition does not effectively preclude materials that have a potential risk from appropriate regulatory scrutiny.

Regulation of nanomaterials (Chapter 3)

The unique properties exhibited by many nanomaterials raise the question of whether the existing regulatory frameworks for the management of chemicals and products incorporating chemicals are sufficient to cover the health, safety and environment concerns potentially posed by nanomaterials. This question of how nanomaterials can best be regulated over their life cycle is receiving considerable attention both nationally and internationally, and was a main area of examination during the Inquiry. The Committee believes there should be a national approach to the regulation of nanomaterials, as the existing regulatory frameworks are, appropriately, at the federal level.

A moratorium?

The Committee finds that it would be impractical to recommend or support a moratorium on nanotechnology or even nanomaterials, as both are broad descriptive terms rather than specific entities.

However, the Committee does find that there is a need for regulators to continue to monitor research and to identify specific causes for concern, and to respond accordingly to the risk identified. In some cases the appropriate response may very well be a prohibition on the use of a specific nanomaterial in a specific application or product.

Regulatory consistency and clarity

No national government has implemented specific regulations for the management of nanotechnology or nanomaterials. The issue of effective regulatory frameworks is currently being examined both in Australia and overseas. Evidence to the Inquiry showed that there is a need for regulatory consistency and clarity.

Current regulatory framework

The introduction of chemicals into Australia is regulated by four federal agencies. The agency that is responsible for dealing with a specific chemical's assessment and registration is based on the designated end-use of the product.

Chemicals in foods, such as additives and residues, are largely dealt with by Food Standards Australia New Zealand (FSANZ); agricultural and veterinary chemicals are largely managed by Australian Pesticides and Veterinary Medicines Authority (APVMA); medicines and medical devices are dealt with by the Therapeutic Goods Administration (TGA); and industrial chemicals are dealt with by the National Industrial Chemicals Notification and Assessment Scheme (NICNAS).

Review of the current regulatory framework

In 2007 the Australian Government commissioned an independent review of the effectiveness of the existing regulatory framework. The Centre for Regulatory Studies at Monash University undertook this review. The report of this review *A review of possible impacts of nanotechnology on Australia's Regulatory Framework* was submitted in September 2007 and publicly released in July 2008.

Evidence to the Inquiry showed there is limited scope for an individual State to implement an effective, comprehensive State-specific regulatory framework for nanomaterials. The more sensible and important approach for New South Wales is to ensure that it effectively contributes to, and influences, the national regulatory review.

The most frequent concern expressed about the current regulatory frameworks was the fact that nano versions of existing chemicals are not automatically assessed as new chemicals. The inclusion of nanomaterials in some sunscreens is an issue that has also raised concern and attention.

Addressing health and safety issues relating to the potential toxicity of nanomaterials in the workplace is the area that requires the most immediate attention – given that workers can be subject to continual exposure. The Committee was pleased to note the evidence it received of the amount of attention being given to this area. However, it also notes the acknowledgement that much more action is still required. The Committee believes that as much assistance as possible needs to be given to industry and workers in the interim until such time as all issues are addressed.

It is apparent that the development of the scientific knowledge and capacity to adequately assess nanomaterials and the development of agreed standard protocols by which to assess them is the most significant issue with respect to the regulation of nanomaterials.

It appears unlikely that any regulatory requirement for mandatory assessment of all nanomaterials is likely to be enacted until such time as an effective capacity to conduct those assessments is available.

The Committee supports the intention of the APVMA to require applicants to identify the presence of engineered nanomaterials. It is worthwhile to have industry become used to this type of reporting and allows regulatory agencies to consider whether an assessment under the current framework should be considered.

The Committee believes that NSW needs to have an effective voice in the review process whether that be while it is happening or following a position being put by the federal government. In either case, given the broad scope of the national regulatory review and the number of State agencies that are involved, the position of any NSW agency would be enhanced if it is part of a coordinated position.

The Inquiry provided a forum for those agencies that attended to present their views on what is required. This should be coordinated to ensure that any federal-State agency to agency consultation is consistent. All relevant State agencies should contribute towards developing a coordinated position.

Occupational health and safety

The Committee heard that the exact number of companies that manufacture or use engineered nanomaterials in NSW is unknown, with estimates putting it between 23 to 40. The Committee believes that there is merit in WorkCover visiting those companies and manufacturing sites of which it currently is aware and provide the best advice and guidance it can first hand. Such action would be in accord with the field study work proposed as part of the federal Nanotechnology OHS research and development program.

WorkCover should publicly advertise, through the appropriate media, its intention to assist companies as it becomes aware of them. WorkCover should call for companies to contact them to arrange for WorkCover to visit them and provide assistance.

For the purposes of this call, the definition of nanomaterials should be broad. The Committee heard that previous calls for information from companies manufacturing or using nanomaterials experienced under-reporting due to companies experiencing difficulties in applying the definition of nanomaterials. To overcome this, the Committee believes the call should apply to engineered nanomaterials of 300 nanometres or less in size in one or more dimensions.

Labelling of nanomaterials in the workplace

The Committee supports the view that workers should be advised of the fact that they are being exposed to engineered nanomaterials. A requirement for engineered nanomaterials to be identified by labelling would serve to alert and remind all that the ALARA approach should be in evidence.

Such a labelling requirement may need to sit beside, possibly as an interim measure, the existing regulations applying to hazardous substances, as in most cases there may be little or no data available by which to classify or assess the hazard.

The New South Wales Government should work in cooperation with federal agencies on the development of a national mandatory labelling scheme for engineered nanomaterials used in the workplace and, in the absence of a national scheme, NSW should proceed with investigating the development of its own mandatory labelling scheme.

Labelling of nanomaterials in consumer products

The Committee agrees that raising public understanding of issues regarding nanotechnology is essential. However, it does not believe that it is feasible to require that all products manufactured via a nanotechnology process be so labelled.

Currently certain classes of consumer products have labels that list all or some of their ingredients. Where these labelling mechanisms are in place, there is an opportunity for consumers to be informed of the presence of nanomaterials.

Labelling of nanomaterials in food

The Committee supports the view that consumers should be advised of the presence of nanomaterials in food products, particularly until more knowledge is gained on the risks that may be associated with them. The Committee recommends that an amendment should be sought to the national Food Standard Code to require labels to identify the presence of materials at the nanoscale.

Labelling of nanomaterials in sunscreens

Research into the potential risks of sunscreens containing nanomaterials is continuing. The Committee believes that there is a strong case for labelling requirements for sunscreens and cosmetics to indicate the presence of materials at the nanoscale. The Committee notes sunscreens are regulated by the TGA, and that the NICNAS now has responsibility for regulating standards for cosmetics.

The Committee recommends that, during the review of national regulatory frameworks, the NSW Government recommend that ingredient labelling requirements for sunscreens and cosmetics include the identification of nanoscale ingredients.

Nanomaterials in the workplace

The Committee recommends that WorkCover assist companies involved in the manufacture or use of nanomaterials. A mandatory reporting scheme would assist WorkCover in this regard.

A mandatory reporting scheme would help clear the current uncertainty about the scope of nanomaterials being used in workplaces. It would also assist in identifying areas of need for other related activities such as research.

The Committee believes that consideration of a reporting scheme and the necessary legislative amendments to support it should occur. The Committee recommends that the NSW Government work in cooperation with federal agencies on the development of a national mandatory reporting scheme for companies who use, manufacture, transport or dispose of nanomaterials, and that in the absence of a national scheme, NSW should proceed with investigating the development of its own interim mandatory reporting scheme.

Assessing the risks of nanomaterials (Chapter 4)

The ability to measure, characterise and assess the health, safety and environmental risks of nanomaterials is essential for the appropriate regulation and management of nanomaterials over their life-cycle. In a number of areas the scientific knowledge and technological capacity for doing this is not yet present. The challenge to create this knowledge and capacity is receiving attention at the national and international level. However, it appears that fully meeting this challenge is some years away.

Infrastructure and metrology requirements

From the evidence it received the Committee cannot state what the specific additional infrastructure requirements for the measurement and characterisation of nanomaterials will be in the short or long term. However, it is apparent that continued investment will be required. The Committee recommends that the NSW Government should actively seek, through the use of leverage funding, it being located within the State – to build on the current infrastructure strength and provide additional benefit to industry, research and development.

Toxicity of nanomaterials

The final development of internationally agreed protocols for toxicity assessment of nanotmaterials is some time away. Other research should and will continue concurrently. The OECD project has selected a representative sample of nanomaterials. It was suggested to the Committee that other materials in current use such as cadmium within quantum dots are also worthy of attention.

A number of participants suggested to the Committee that research efforts need to be sensibly prioritised and focussed on areas or materials that have the greatest relevance to Australian society. The current focus of research in Australia on zinc oxide and silver therefore seems appropriate.

Nanotoxicology research

The Committee agrees there is a need to create nanomaterial assessment capacity relevant to research and industry sectors in New South Wales. What is needed as a first step is determining exactly what are the nanotoxicolology research needs of most importance to our research and industry sectors.

Consultation with the industry and research sectors must occur to determine what areas of nanotoxicity research would be of most benefit to them. This work would be best undertaken within the Office of Science and Medical Research.

Once those research needs are identified it would be prudent to ascertain whether that research is currently being undertaken elsewhere nationally or internationally. If it is not, then it is the work that should be considered to be undertaken by a potential NSW network.

The Committee took the Government's indicative support for a toxicology network as an indication that it would provide financial support for the network to conduct the research. The Committee believes that providing financial support so that required research can be conducted is more important than establishing a State-based network.

Research as you develop

The Committee notes that the development of internationally accepted standard protocols will take some time. It also acknowledges that in the interim product developers are still expected to address potential HSE concerns, and that it is likely they would desire to do so as best as they can, in a cost-effective manner.

The Committee frequently heard that individual products containing nanomaterials can have those nanomaterials re-engineered to reduce or eliminate any associated toxicity. This has given rise to the equally frequent call that nanomaterial products will need to be assessed on a class by class or case by case basis.

Throughout the Inquiry the Committee acknowledged the obvious wisdom of introducing health, safety and environmental toxicity studies during the research and development stage of any product. The Committee supports this approach and seeks to encourage its adoption wherever possible.

The Committee supports the argument that any government funded grant for research and development with a view to commercialisation should include a requirement that a component of that funding or program relate to assessing the health, safety and environmental risks. This should apply when those risks have not yet been tested or confirmed and when such assessment would not be required under the current regulatory frameworks.

In supporting this approach, the Committee notes that not all products containing nanomaterials will be developed by way of government research and development funding, and that on the national scale relatively few research and development programs are wholly administered by the State. Nevertheless, where New South Wales agencies can encourage this approach, the Committee believes they should do so.

A national toxicology centre?

The Committee believes that if a proposal for a national nanotoxicology centre did emerge, then NSW would present as a strong candidate for its location. Notwithstanding its strong candidacy NSW would still need to put forward a sound case for its support of such a centre.

The Committee believes that the NSW Government should indicate its support for a national facility for the assessment of the toxicity of nanomaterials in products prior to their commercialisation. However, before it can do this more detailed discussion needs to occur.

Government approach to nanotechnology (Chapter 5)

The consensus of views expressed by participants in the Inquiry was that nanotechnology has the potential to fundamentally alter the way people live – to grow new industries and to transform existing areas such as healthcare, manufacturing, energy, electronics, agribusiness, environmental monitoring and protection, and communications. Given significant potential impact and opportunity, many governments have articulated their position on how they intend to support and develop nanotechnology so as to capture the benefits it offers, while addressing health, safety and environmental concerns.

New South Wales Chief Scientist

The Committee welcomes the decision of the Government to establish and appoint a NSW Chief Scientist. The Committee's view, which it expressed in its correspondence to the Minister, is that the establishment of the position would be a significant step forward in addressing nanotechnology related issues as well as science issues more broadly in New South Wales.

From the evidence received during the Inquiry it is clear that the importance of the development of research and development priorities is beyond dispute. The Committee welcomes the fact that the Chief Scientist will play a central advisory role in the development of these priorities.

The Committee again notes that an appointment to the Chief Scientist position has not yet been made. The Committee believes that once an appointment is made to the Chief Scientist position, that the development of research and development priorities be progressed as a matter of urgency.

The Committee agrees with the view that a strategic plan for securing research infrastructure is essential. However, before such a plan can be finalised the research and development priorities, which such infrastructure will support, must themselves first be agreed upon.
Once a plan for critical infrastructure is finalised, the Government may need to consider an extension of and increase in the amount of funding currently provided for under the Science Leveraging Fund.

Coordination of science and research

The Committee believes that there is a demonstrated need for greater knowledge, coordination and communication of the science and research being carried out by the various State departments and agencies. Similar to its comment on the previous section, the Committee notes that now that a structure has been put in place to achieve this, it is important that it be effectively supported.

The Committee also believes that once full knowledge of the science and research being conducted or partnered by government departments is realised, that this information must be continually updated and made widely available. The Committee believes that there needs to be a mechanism whereby industry, and the public, can at any time search and access knowledge on the research and research infrastructure capacity that exists within the State.

The Committee therefore recommends that a user-friendly, accessible and continually updated directory of research and research infrastructure capacity within New South Wales that is publicly available via an easily accessible website be maintained by a relevant Government agency or department.

New South Wales Nanotechnology Statement

Throughout the Inquiry the Committee was concerned that much of the information on nanotechnology provided in the public arena, particularly via print, was negative. Instances include calls by some for a moratorium, and reports of research indicating potential adverse impacts of specific nanomaterials.

Print and television are the main sources of public information on nanotechnology. While a host of broader information is available on various websites, it would appear that members of the public require a prompt in the first instance to decide to seek more information on nanotechnology.

A NSW Government Statement on Nanotechnology would serve to raise public awareness of nanotechnology and perhaps serve to balance the information that is being accessed by the public. It would be useful for any Government Statement to include reference to information sources that can provide a factual and balanced overview of the broad topic of nanotechnology.

The Committee notes that there is still much for the Government to consider before it could make a definitive statement on what may be its exact and complete approach to specific support for nanotechnology. However, the Committee believes that the NSW Government could adopt the approach of the Australian Government and elaborate its views from time to time.

The Committee recommends that the Government should issue a comprehensive statement on nanotechnology as soon as practicable. Among other things, the statement should refer to the current issues relating to nanotechnology; the activity being undertaken at the State and national level; and provide advice on where further information is available.

New South Wales Nanotechnology Unit

The Committee believes that there is a need for a specific area within the New South Wales Government to be the central information and contact point for nanotechnology. In Chapter 3 the Committee recommended that the NSW Government develop a whole-of-government position with respect to the current federal review of the regulatory frameworks.

This area, or NSW Nanotechnology Unit, would need to be a coordination point for all other NSW agencies that are currently dealing with issues relating to nanotechnology. The unit would need to hold or be aware of the latest information relating to nanotechnology, it should also actively promote nanotechnology opportunities to industry.

The Nanotechnology Unit should be responsible for establishing and maintaining a public website on nanotechnology to provide updated whole of government information and advice. The website should provide links to other State agencies and departments as relevant.

Community understanding and awareness of nanotechnology (Chapter 6)

Among Inquiry participants and nanotechnology commentators there is agreement that public understanding and awareness of nanotechnology is essential. It is also agreed that any information provided to the general public must be balanced and factual. Currently the level of detailed knowledge of nanotechnology among the general community remains low.

Throughout the Inquiry the Committee has heard that nanotechnologies, across a very broad range of disciplines and applications, are poised to have a significant impact on people's lives. Because of the breadth of areas to which nanotechnology can be applied, and because of the complexity of the science involved, there is a danger that people will react negatively to threats, real or imagined, of nanotechnology applications.

The Committee notes that the level of interest amongst the general public in nanotechnology is not overwhelmingly high. It may not be appropriate to attempt to raise awareness and understanding of nanotechnology to a very high level – but what is important is to ensure that information is available when needed.

The NSW Government and the scientific community have an obligation to ensure that information is readily available to the public, so that as interest and awareness in nanotechnology grows there is a source of authoritative, reputable and balanced information to access.

Accordingly, the Committee believes that the NSW Government, or the new NSW Nanotechnology Unit as recommended by the Committee in Chapter 5, should create and maintain a website that provides information, or links to information, on nanotechnology. The website would provide up to date, factual and balanced information on nanotechnologies, including the NSW Government's public statement on nanotechnology recommended by the Committee in Chapter 5.

The Committee also acknowledges the significant education and information role played by the university sector in New South Wales, which provides an opportunity for collaboration with the NSW Government in the production of authoritative and reliable information.

The NSW Government, specifically the Office of Science and Medical Research, should continue to take the opportunity to work with the Australian Office of Nanotechnology in their ongoing activities to raise awareness and understanding of nanotechnologies.

Summary of recommendations

Recommendation 1 *Page 48*

That the New South Wales Government recommend that nano-versions of existing chemicals are assessed as new chemicals, during the review of the national regulatory frameworks.

Recommendation 2 *Page 64*

That the NSW Government ensure that all relevant State regulatory agencies be involved in developing a coordinated and cohesive position on what amendments, if any, are required to the current regulatory frameworks in order to best regulate nanomaterials over their life-cycle.

Recommendation 3 *Page 69*

That WorkCover NSW work with those companies, or premises of which it is aware, that manufacture or use engineered nanomaterials of 300 nanometres or less in size in one or more dimensions, to promote workplace safety in the use of nanotechnology.

That WorkCover NSW advertise its intention to undertake this endeavour and call for companies manufacturing or using engineered nanomaterials of 300 nanometres or less in size to contact it to participate in this workplace safety endeavour.

Recommendation 4 *Page 72*

That the New South Wales Government work in cooperation with federal agencies on the development of a national mandatory labelling scheme for engineered nanomaterials used in the workplace, and that in the absence of a national scheme, NSW should proceed with investigating the development of its own mandatory labelling scheme.

Recommendation 5 *Page 74*

That the NSW Food Authority develop an application to seek an amendment to the national Food Standards Code to require that food labels identify the presence of nanoscale materials.

Recommendation 6 *Page 77*

That the New South Wales Government recommend that ingredient labelling requirements for sunscreens and cosmetics include the identification of nanoscale materials, during the review of the national regulatory frameworks.

Recommendation 7 *Page 79*

That the New South Wales Government work in cooperation with federal agencies on the development of a national mandatory reporting scheme for companies who use, manufacture, transport or dispose of nanomaterials, and that in the absence of a national scheme, NSW should proceed with investigating the development of its own interim reporting scheme.

Recommendation 8 *Page 84*

That the New South Wales Government actively seek, through the use of leverage funding, the establishment of additional metrology infrastructure within the State to build on the current metrology strength and to provide additional benefit to industry, research and development.

Recommendation 9 *Page 99*

That the Office of Science and Medical Research, through investigation and consultation, determine what are the nanotoxicology research needs of most importance to the industry and research sectors in New South Wales.

Recommendation 10 *Page 100*

That the New South Wales Government provide financial support to create enhanced nanotoxicology assessment capacity relevant to research and industry sectors in the State.

Recommendation 11 *Page 104*

That New South Wales Government agencies that provide funding grants for research and development of nanomaterials or products containing nanomaterials with a view to their commercialisation require that a component of that funding be used to assess the health, safety and environmental risks of the material or product when those risks have not yet been tested or confirmed.

Recommendation 12 *Page 107*

That the NSW Department of State and Regional Development enter into detailed discussions with the Commonwealth Scientific and Industrial Research Organisation, the Australian Nuclear Science and Technology Organisation and New South Wales Government agencies to explore the feasibility of and need for a specialised facility for assessing the toxicity of engineered nanomaterials, and the case for and benefit of it being located within New South Wales.

Recommendation 13 *Page 116*

That a user-friendly, accessible and continually updated directory of research and research infrastructure capacity within New South Wales that is publicly available via an easily accessible website be maintained by a relevant Government agency or department.

Recommendation 14 *Page 121*

That the New South Wales Government develop, publish and endorse a comprehensive statement on nanotechnology, referring, among other matters, to current issues relating to nanotechnology, activity being undertaken at the State and national levels, and advice on where further information is available.

Recommendation 15 *Page 128*

That the NSW Government establish a NSW Nanotechnology Unit within an existing department or agency to act as a coordination point for all other NSW agencies dealing with issues relating to nanotechnology, provide a central point for whole of government information on or enquires relating to nanotechnology, and proactively engage with industry in the promotion of nanotechnology.

Recommendation 16 *Page 131*

That the New South Wales University-Government working group, with representation from the vocational and technical education sector, examine the education, skill and knowledge requirements to support nanotechnology.

Recommendation 17 *Page 134*

That the Office of Science and Medical Research, in collaboration with the Department of Education and Training, examine and develop a strategy to ensure greater access for regional students to the Science EXPosed programme.

Recommendation 18 *Page 146*

That the NSW Government, or the new NSW Nanotechnology Unit as recommended by the Committee, create and maintain a website that provides information, or links to information, on nanotechnology.

Glossary and acronyms

AICS	Australian Inventory of Chemical Substances
ALARA	As Low As Reasonably Achievable
AMMRF	Australian Microscopy and Microanalysis Research Facility
AMWU	Australian Manufacturing Workers' Union
ANBF	Australian Nano Business Forum
ANSTO	Australian Nuclear Science and Technology Organisation
AON	Australian Office of Nanotechnology
APVMA	Australian Pesticides and Veterinary Medicines Authority
ASCC	Australian Safety and Compensation Council
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DECC	Department of Environment and Climate Change (NSW Government)
DIISR	Department of Industry, Innovation, Science and Research (Australian Government)
DSRD	Department of State and Regional Development (NSW Government)
FSANZ	Food Standards Australia New Zealand
HSIS	Hazardous Substances Information System
ISO	International Standards Organisation
MSDS	Material Safety Data Sheet
Nanometre	A unit of measurement. One thousand nanometres make up one micrometre, and one thousand micrometres make up one millimetre. One nanometre is one millionth of a millimetre.
NICNAS	National Industrial Chemicals Notification and Assessment Scheme
NMI	National Measurement Institute (Australia)
NNI	National Nanotechnology Initiative (United States Government)
NNS	National Nanotechnology Strategy (Australian Government)
NTSC	Nanotechnology State and Territory Committee
OECD	Organisation for Economic Cooperation and Development
OSMR	Office of Science and Medical Research (NSW Government)
OHS	Occupational Health and Safety
TC229	Technical Committee 229, a committee of the ISO established to develop standards in nanotechnology.
TGA	Therapeutic Goods Administration

Chapter 1 Conduct of the Inquiry

This chapter provides an overview of the manner in which the Inquiry was conducted and the structure of the report. It also provides a brief background to the context in which the Inquiry arose.

Terms of reference

1.1 On 5 December 2007 the Hon Verity Firth MP, the then Minister for Science and Medical Research,[1] wrote to the Standing Committee on State Development (the Committee) requesting that it conduct an inquiry into Nanotechnology in New South Wales and enclosing terms of reference. The Committee adopted the terms of reference on 6 December 2007. They are reproduced at page iv of this report.

Submissions

1.2 The Committee called for submissions through advertisements in the *Sydney Morning Herald,* the *Daily Telegraph, Australasian Science* and the *A to Z of Nanotechnology* website, www.azonano.com. The Committee also wrote to organisations with a likely interest in the Inquiry, including state and federal governments and agencies, trade unions, universities and business and consumer representative organisations.

1.3 The Committee received 26 submissions from a range of stakeholders, including universities, federally funded research entities, trade unions, private companies and business and consumer representative bodies. The Committee received a whole of government submission from both the New South Wales and the Australian governments. Three individual citizens also made submissions to the Inquiry.

1.4 A list of all submissions is contained in Appendix 1**.** The submissions may be accessed via the Committee website at: www.parliament.nsw.gov.au/statedevelopment.

Information gathering

1.5 Following adoption of the terms of reference for the Inquiry, the members of the Committee decided that it needed to increase its knowledge of the broad area of nanotechnology prior to the conduct of the public hearings.

International Conference on Nanoscience and Nanotechnology

1.6 The 2008 International Conference on Nanoscience and Nanotechnology (ICONN 2008) was held in Melbourne from 25 to 29 February 2008. As many of the themes and issues discussed at the conference were pertinent to the terms of reference of this Inquiry the Chair and a

[1] At the start of the Inquiry and up until 5 September 2008, the Minister for Science and Medical Research was the Hon Verity Firth MP. On 5 September 2008, the Hon Tony Stewart MP became the Minister for Science and Medical Research.

secretariat staff member attended the conference on 27 and 28 February. Many of the experts who presented at this conference also appeared as witnesses at the Inquiry's public hearings.

Briefing from Dr Clayton Teague

1.7 Following adoption of the terms of reference for the Inquiry, the Committee resolved that it should seek a briefing on the broad area of nanotechnology by an acknowledged expert on the subject. The Committee was fortunate that an opportunity arose for it to be provided with a briefing by Dr Clayton Teague, the Director of the United States National Nanotechnology Coordination Office. The Committee appreciates the efforts on the part of Dr John Miles from the National Measurement Institute and Dr Derek Van Dyk from the Office of Science and Medical Research (OSMR) in arranging Dr Teague's appearance.

1.8 On 29 February 2008 Dr Teague provided a presentation to the Committee entitled *An Introduction to Nanotechnology and the US National Nanotechnology Initiative*. Dr Teague then entered into a discussion with and answered questions from members of the Committee. Dr Miles and Dr Van Dyk were also in attendance and provided input. The Committee is very grateful to Dr Teague for his presentation as it enhanced the Committee's understanding of nanotechnology and helped identify some of the issues that were explored during the Inquiry.

1.9 The Minister for Science and Medical Research also attended this meeting and prior to Dr Teague's presentation gave a brief address to the Committee on her decision to request the Committee to undertake the Inquiry.

Site visits

1.10 The Committee conducted a number of site visits to inspect locations where nanotechnology was currently being researched or implemented. The Committee expresses its gratitude to all those persons who facilitated these visits.

Intelligent Polymer Research Institute

1.11 On 17 March 2008 the Committee visited the Intelligent Polymer Research Institute (IPRI) at Wollongong University. The Committee received a briefing on the ARC Centre of Excellence for Electromaterials Science (ACES) and the IPRI from Professor Gordon Wallace, Professor Sue Dodds and Professor William Price.

1.12 The Committee, accompanied by Professor Chee Too, conducted a tour of inspection of a number of laboratories, where research was being conducted in the following fields:

- Carbon nanotubes and grapheme – Dr Dan Li, Dr Jun Chen.
- Wet spinning – Dr Joe Razal.
- Ink-jet printing – Dr Rod Shepherd.
- Nanobionics – Dr Simon Moulton, Dr Michael Higgins.
- Energy – Dr Attila Mozer.

Bluescope Steel Ltd

1.13 On 17 March 2008 the Committee visited Bluescope Steel Ltd at the Port Kembla Steelworks. The Committee was met by Mr Mike Archer, Manager, External Affairs and Mr Jim Williams, Manager, Metallurgical Technology and Industrial Markets.

1.14 Mr Archer and Mr Williams guided the Committee on a tour of the steel slab casting process and plant. The Committee attended the Central laboratory and was met by:

- Mr Alan Thomas, General Manager, Engineering Technology & Environment
- Mr Jim Graham, Manager, Slabmaking
- Mr Chris Kilmore, Product Design Manager
- Mr Rama Mahapatral, Process Metallurgy Development Manager
- Professor Simon Ringer, University of Sydney.

1.15 The Committee was provided with a briefing on the fruition of long-term research resulting in the use of nanotechnology to revolutionise the steel slab casting process and its outputs.

Centre for Quantum Computer Technology

1.16 On 18 March 2008 the Committee visited the Australian Research Council (ARC) Centre of Excellence in Quantum Computing at the University of New South Wales. The Committee was met by Professor Bob Clark, Director, Centre for Quantum Computer Technology and Professor Michelle Simmons, Director, Atomic Fabrication Facility.

1.17 Professor Clark provided a brief presentation on the Centre for Quantum Computer Technology and nanotechnology. The Committee was then guided on a tour of the extensive facilities.

1.18 Following the tour the Committee was met by Professor Leslie Field, Deputy Vice Chancellor (Research). A general discussion on nanotechnology and scientific research and development ensued.

National Measurement Institute, Lindfield

1.19 On 18 March 2008, the Committee visited the National Measurement Institute facilities at Lindfield. The Committee was met by Dr Peter Fisk, General Manager of Physical Metrology and Dr John Miles, Nanometrology Manager. Dr Fisk provided an overview on the role of the NMI and Dr Miles provided a presentation on the nano-level characterisation and measurement work to be undertaken by the NMI as part of the National Nanotechnology Strategy (NNS). The Committee then inspected a number of the facilities at the Lindfield site.

CAP-XX (Australia) Pty Ltd

1.20 On 18 March 2008, the Committee also visited the premises of CAP-XX (Australia) Pty Ltd at Lane Cove. The Committee was met by Dr Phillip Aitchison, Vice President Research and Mr Warren King, Technical Advisor to the Board. Dr Aitchison and Mr King provided a brief introduction to CAP-XX and how nanotechnology is incorporated into its production process

for supercapacitors. The Committee was then guided on a tour of the production facilities, and then returned to the Boardroom where a general discussion on nanotechnology ensued.

Australian Nuclear Science and Technology Organisation (ANSTO)

1.21 On 12 May 2008 the Committee visited the ANSTO site at Lucas Heights and was met by Mr Andrew Humpherson, General Manager, Public Affairs. Mr Humpherson provided a brief presentation and overview of the ANSTO facilities, and then escorted the Committee on a tour of the site.

1.22 The Committee inspected the OPAL facilities and was met by Mr Tony Irwin, Reactor Manager, who provided an overview of the reactor. The Committee was then met by Professor Mike James, Principal Research Scientist, Bragg Institute who provided a presentation on nanotechnology. Professor James then guided the Committee on a tour of the Neutron Guide Hall. The Committee were joined by Dr George Collins, Chief of Research, ANSTO.

1.23 The Committee were also met by Mr Chris Barbe, Chief Technical Officer of Ceramisphere Pty Ltd. Mr Barbe provided a presentation on Ceramisphere, a fully owned subsidiary company of ANSTO aiming to commercialise technology to be used to produce ceramic nanosized particles that release an active ingredient at a controlled rate, with potential applications in drug delivery, surface protection, cosmetics and nutriceuticals.

Centre for Environmental Contaminants Research (CECR)

1.24 On 12 May 2008, the Committee also visited the CSIRO's CECR facilities at Lucas Heights and was met by Dr Simon Apte, Research Director, CECR and Dr Graeme Batley, Director, CECR. Drs Apte and Batley provided an overview of the CECR and nano-material toxicity research and answered questions from the Committee.

Public hearings

1.25 The Committee held five public hearings during the Inquiry. All hearings were held at Parliament House. A list of the witnesses who appeared is provided in Appendix 2 and transcripts of the public hearings can be found on the Committee's website at: www.parliament.nsw.gov.au/statedevelopment. A list of the documents tendered by witnesses at the hearings and accepted by the Committee can be found at Appendix 3.

1.26 The Committee would like to thank all those persons who participated in the Inquiry, whether by making a submission, giving evidence or attending the public hearings.

Context

1.27 Developments in and consideration of issues relating to nanotechnology have been occurring for some time. The Committee heard that around 2004 there was a critical breakthrough in international awareness of nanotechnology, due to an acceleration in the outputs of industry and products containing nanomaterials reaching the market in larger quantities, and the release of pivotal public reports on the issue, most notably the Royal Society and the Royal Academy

of Engineering's report, *Nanoscience and nanotechnologies*.[2] The Royal Society and the Royal Academy of Engineering are the United Kingdom's national academies of science and engineering respectively.

1.28 The examination of issues relating to nanotechnology is being undertaken by a number of governments and forums around the world.

1.29 The strategic importance of nanotechnology to Australia's future was highlighted by the Prime Minister's Science, Engineering and Innovation Council (PMSEIC) in its March 2005 report, *Nanotechnology – Enabling technologies for Australian innovative industries*. Subsequently, the Australian Government commenced the National Nanotechnology Strategy (NNS) on July 2007. The NNS aims to establish an environment that will allow Australia to capture benefits of nanotechnology while addressing the issues impacting on successful and responsible development.[3]

1.30 The NNS was originally funded to run for four years. However, it is now currently funded to 30 June 2009. The Australian Government decided that the NNS should be assessed as part of the Australian Government's Review of Australia's National Innovation System. The Innovation Review is to help assess whether the current approach to the NNS is the best way to achieve the Government's objectives in this area. The report of the Innovation Review, V*enturous Australia: building strength in innovation*, was released on 9 September 2008 and a government response to the recommendations of the report is anticipated before the end of the year.

1.31 As part of the current NNS, a review is being conducted of the adequacy of the existing national regulatory frameworks to effectively address the impacts of nanotechnology. At the same time a number of international organisations, such as the International Standards Organisation (ISO) and the Organisation for Economic Cooperation and Development (OECD), are working to define protocols and guidelines for the responsible use of nanotechnology. Much of this work will take some years to complete.

A point in a time of ongoing activity and development

1.32 This report represents the Committee's examination of the information provided to it through the Inquiry process. The Committee acknowledges that nanotechnology is an area of both long-term consideration and constant development. Many of the issues the Committee examined were and are still being acted on by international, national and state agencies and departments. The Committee acknowledges that in this area of constant development and emerging new scientific information, that it is possible that important actions or significant new information may arise in the period from the end of Inquiry evidence gathering to the publication of this report.

Structure of the report

1.33 Chapter 2 provides a brief introduction to what the term nanotechnology encompasses.

---

2 Ms Georgia Miller, Nanotechnology Project Coordinator, Friends of the Earth Australia, Evidence, 1 May 2008, p 45

3 Submission 23, Australian Government, p 12

1.34 Chapter 3 examines the regulation of nanomaterials. It examines the current regulatory frameworks in operation for the management of nanomaterials over their life-cycle; the on-going national review of the regulatory frameworks; the areas where eventual change to the current frameworks appear warranted; and what should occur in the interim.

1.35 Chapter 4 examines the potential health, safety and environmental risks posed by some nanomaterials. It examines the factors that contribute to the potential risks of nanomaterials; the activities being undertaken to develop the required knowledge and capacity to be able to adequately assess those risks; and potential opportunities and approaches for building this capacity.

1.36 Chapter 5 examines various government approaches to nanotechnology. It examines what other governments have done and what New South Wales is doing to foster and support the development of nanotechnology opportunities.

1.37 Chapter 6 examines the community's understanding and awareness of nanotechnology and what actions are required to ensure that the community is provided with factual, balanced and readily accessible information.

Chapter 2 What does 'nanotechnology' mean?

The word 'nanotechnology' is really nothing more than a convenient descriptive term used to refer to a broad range of enabling technologies that involve the manipulation of matter at the nanoscale to create new materials, structures and devices. It involves new developments in the fields of physics, chemistry, biochemistry, biotechnology, materials science and computer science technologies.

The area of nanotechnology is as broad as the area of science itself. The scope of a product developed wholly or in part by way of nanotechnology can range from an invisible sunscreen or stain resistant clothing to more efficient cancer treatments and the potential for repairing damaged spinal cords. The common element to nanotechnologies is size – the nanometre.

The nanometre

2.1 The nanometre is a unit of measurement. One thousand nanometres make up one micrometre, and one thousand micrometres make up one millimetre. One nanometre therefore is one millionth of a millimetre. The example often cited to put the nanometre size into perspective is that a human hair is 80,000 nanometres wide.

What is nanotechnology?

2.2 Throughout the Inquiry, participants were at pains to emphasise that there is no such thing as a nanotechnology. What all nanotechnologies do have in common is the engineering or manipulation of matter at the nanoscale. In evidence before the Committee, Professor Graeme Hodge from the Centre for Regulatory Studies at Monash University gave his view on the currency of the term 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.[4]

2.3 Nanotechnology involves the engineering of materials at the nanoscale, to take advantage of either their small size or the novel properties the material exhibits at the nanoscale. This engineering is generally described as involving either a 'top-down' or a 'bottom-up' technique.

[4] Professor Graeme Hodge, Centre for Regulatory Studies, Monash University, Evidence, 28 April 2008, p21.

2.4 The top-down technique involves the crushing, milling or etching of a larger material to produce either nano-sized versions of the material or the creation of nano-sized channels on the surface of the material.

2.5 The bottom-up technique involves the assembly of smaller sub-units (atoms or molecules) to produce a nanoscale product. The Australian Office of Nanotechnology (AON), in one of its public information fact sheets, provides the following descriptive examples of the bottom-up method:

> An example of the…bottom-up method, is a technique by which a thin mist of atoms is deposited onto a chosen surface. This builds up a 'sandwich' of different layers to conduct electrical currents in various ways to make electronic devices. This technique is being used to create the ultra-fast computer chips of tomorrow. In another approach, chemicals are mixed and then allowed to 'self-assemble' into the desired structures, much like growing salt crystals, or the way we grow our teeth. Indeed nanoscientists often seek to imitate nature, which has already designed strong, light and effective structures.[5]

2.6 At this point in time, and certainly for the purposes of this report, the main focus of nanotechnology is the creation of engineered nanomaterials and their application within products and processes.

What are nanomaterials?

2.7 While the focus of nanotechnology is the creation and application of engineered nanomaterials within products and processes, it is important to note that nanomaterials exist naturally. It is also important to note that not all materials at the nano-scale exhibit novel properties.

Naturally occurring

2.8 Nanoscale materials and effects are found in nature. Human and animal bodies use natural nanoscale materials, such as proteins and other molecules, to control the body's many systems and processes. A typical protein such as haemoglobin, which carries oxygen through the bloodstream, is 5 nanometres in diameter.

2.9 Scientists hope to imitate naturally occurring nanoscale processes. Researchers have copied the nanostructure of lotus leaves to create water repellent surfaces being used today to make stain-proof clothing, other fabrics and materials. Others are trying to imitate the strength and flexibility of spider silk, which is naturally reinforced by nanoscale crystals.[6]

2.10 Nanoscale materials are also generated by volcanic eruptions, bush fires and seaspray. Many natural digestible nanoparticles are present in our foods. An example is milk, which is made up

---

5 *Nanotechnology – working with the smallest things,* Fact Sheet, Australian Office of Nanotechnology, Department of Innovation, Industry, Science and Research, accessed via Australian Office of Nanotechnology website.

6 *Nanotechnology Big things from a Tiny world,* public information booklet, US National Nanotechnology Coordination Office

of whey proteins, which are about 3-6 nanometres in size, and casein, which is an assembly of proteins and minerals about 200 nanometres in size. The nanostructure of milk efficiently delivers nutrients and minerals to our bodies.[7]

Occurring as an unintended by-product

2.11 Materials at the nanoscale are also created as a by-product of industrial processes. Examples include combustion, welding, grinding and exhaust fumes of cars, trucks and motorcycles.

Engineered nanomaterials

2.12 It is the deliberate creation of engineered nanomaterials that is the basis of nanotechnology. As such any further reference to nanomaterials in this report, unless otherwise noted, will be a reference to engineered nanomaterials. While there are some common elements when discussing nanomaterials there are also important differences.

2.13 Nanomaterials have extremely small size as their overall defining characteristic. Nanomaterials can be nanoscale in one dimension (e.g. surface films), two dimensions (e.g. strands or fibres), or three dimensions (e.g. particles). They can exist in single, fused, aggregated or agglomerated forms with spherical, tubular, and irregular shapes.

Nanomaterials can exhibit novel properties

2.14 The reason why nanomaterials have received so much attention and become the focus of research and development is that they can display different properties from the bulk material from which they are derived. The two main reasons why materials at the nano scale can have different properties are increased relative surface area and new quantum effects.

2.15 Nanomaterials have a much greater surface area to volume ratio than their conventional forms, which can lead to greater chemical reactivity and affect their strength. Also at the nanoscale, quantum effects can become much more important in determining the material's properties and characteristics, leading to novel optical, electrical and magnetic behaviours.[8]

2.16 For example carbon nanotubes have far greater strength and conducting properties than other forms of carbon in the bulk form; while properly structured gold nanoparticles can absorb light and transform it into heat, something that gold at its bulk scale does not.

2.17 Nanomaterials introduced into processing and manufacturing have created materials and products that are:

- stronger
- lighter

---

7 Submission 19, CSIRO, p 16

8 NICNAS Information Sheet, *Nanomaterials,* September 2006, National Industrial Chemicals Notification and Assessment Scheme, Department of Health and Ageing, available via www.nicnas.gov.au

- chemical resistant
- more durable
- energy saving
- able to offer a previously unavailable functionality.[9]

Not all nanomaterials have novel properties

2.18 It is important to note that not all nanomaterials will exhibit novel properties. Most definitions and discussions of nanotechnology focus on the size range of approximately 1 to 100 nanometres. In this range novel properties are more likely. The submission from the CSIRO explained:

> For bulk materials, the number of molecules within any large particle is very much greater than the number of molecules at the surface of the same particle, and so the bulk properties of the material dominate. If the same material is prepared as very tiny particles, the numbers of molecules on the surface increases exponentially when particle size decreases to below 100 nanometres … surface area and other surface properties are thought to be implicated in any increased chemical and biological activities of nanoparticles, compared to an identical mass of the same material in the bulk form.[10]

2.19 However, the 1 to 100 nanometre range is not exclusive. Ms Georgia Miller from Friends of the Earth Australia explained that it was within this range that most, but not all, novel properties tended to occur:

> There is not a clear sort of 1 to 100 band in which these novel nanoproperties are exhibited. In some particles if may only be below 50 nanometres in size, in some it may be a bit more than 100 nanometres in size, but I guess the nanoscientist in particular picked the 1 to 100 nanometre range to describe nanoparticles because that is where you tend to see most novel properties that are of interest to industry.[11]

2.20 Most discussions on nanotechnology have focussed on the size range of approximately 1 to 100 nanometres. During the Inquiry the Committee heard evidence regarding work by the International Standards Organisation (ISO) towards developing an internationally agreed definition of nanotechnology. This is discussed at paragraph 2.31.

How nanomaterials are incorporated into products

2.21 Products that contain nanomaterials are commercially available to the general public. Generally, these nanomaterials would be present as either a thin film or coating made up of nanomaterials, or the nanomaterials would be one or more of the components of the product.

---

9 Submission 19, p 9

10 Submission 19, p 15

11 Ms Georgia Miller, Nanotechnology Project Coordinator, Friends of the Earth Australia, Evidence, 1 May 2008, p 49

2.22 In the second instance the nanomaterial can either be 'free' or 'fixed' within the product. Some nanomaterials are embedded (fixed) within a solid matrix or surface or form part of a composite solid material. In the case of 'free' nanomaterials this refers to nanomaterial components of products that are liquids, powders, solutions and suspensions.

2.23 The exposure risk to consumers, and concern regarding potential toxicity, is greater for products that contain free, rather than fixed, nanomaterials.

The potential toxicity of nanomaterials

2.24 Concerns have been raised about the potential toxicity of nanomaterials to humans and ecosystems. The potential toxicity of nanomaterials derives from either their small size and/or their novel properties.

2.25 The smaller a particle is the greater its bioavailability. Bioavailability is the potential for eluding the body's natural defences and being taken up by organs, cells and tissues. Some nanomaterials exhibit novel properties due to increased chemical reactivity – this increased reactivity can lead to greater toxicity for cells and living organisms.

2.26 Because of these concerns scientists have been leading the call for studies on nanomaterials' potential toxicity and altered bioavailability to organisms.[12]

2.27 It is acknowledged that there is an urgent need to conduct research and gain evidence regarding the toxicity of nanomaterials, and that the effective regulation of nanomaterials depends on this knowledge. Chapter 4 examines in more detail the potential risks of nanomaterials.

Nanotechnology infrastructure

2.28 The ability to undertake nanotechnology research and development is dependent on the ability to observe and measure at the nanoscale. Indeed the commencement and advance of nanotechnology is intrinsically linked to technological advances in microscopy.

2.29 The high cost of the infrastructure capable of observing and measuring at the nanoscale means that it is generally located within government-supported organisations or at universities, through the support of government funding. Many new products and applications are the result of industry-government-university partnerships.

2.30 The submission from the National Measurement Institute said that the capacity to measure at the nanoscale will be essential for both responsible development and regulation:

> The emergence of nanotechnology as a high-technology industry depends crucially on the provision of a suitable scientific, commercial and regulatory environment. A fundamental element of this environment is measurement. Metrology is the science of measurement and metrological infrastructure has underpinned all industrial revolutions. Nanotechnology will be no exception. Accurate and reliable measurements of physical, chemical and biological quantities are required at all stages

[12] Submission 19, p 13

of the nanotechnology value chain to truly understand and control the manufacturing process and ensure and demonstrate product quality.[13]

International definition of nanotechnology

2.31 Because nanotechnology covers such a diverse range of technologies, there are many definitions in existence coined by different organisations. Many of the submissions to the Inquiry included their definition of what nanotechnology means, and many of these included the comment that it is almost impossible to define nanotechnology other than in general terms. The submission from the CSIRO included a compilation of some of the definitions of nanotechnology and related terms.[14]

2.32 Despite the difficulty in defining a field as broad as science itself, work is underway to develop an internationally accepted definition. This work is being undertaken by the International Standards Organisation (ISO).

2.33 In 2005 the International Standards Organisation (ISO) established a new Technical Committee (TC229) to develop standards in nanotechnology. This was in recognition and anticipation of the expected dramatic increase in worldwide production of nanotechnology products. Australia is a participating member country in TC229.

2.34 The scope of TC229 is standardization in the field of nanotechnologies that includes either or both of the following:

- Understanding and control of matter and processes at the nanoscale, typically, but not exclusively, below 100 nanometres in one or more dimensions where the onset of size dependent phenomena usually enables novel applications.
- Utilizing the properties of nanoscale materials that differ from the properties of individual atoms, molecules and bulk matter, to create improved materials, devices, and systems that exploit these new properties.

2.35 There are four working groups tasked with developing standards for:

- Terminology and nomenclature
- Measurement and characterisation
- Health Safety and the Environment
- Materials specification.

2.36 Dr John Miles from the National Measurement Institute and head of the Australian delegation to TC229 told the Committee that reaching agreement on a definition for nanotechnology had been a long process subject to much debate.

---

13 Submission 23, Australian Government, Appendix 2, National Measurement Institute, p 1

14 Submission 19, Attachment 2

2.37 The two main points subject to debate was agreement on the nanoscale size range and agreement on whether or not the definition should include the unique properties that often emerge within this size range.

2.38 Dr Miles advised that he anticipated that the definition ultimately agreed to would be:

> A collective term for a range of technologies, techniques and processes involving the manipulation of matter at the nanoscale, that is, in a size range from approximately 1 to 100 nanometres.[15]

2.39 Dr Miles noted that the use of the word 'approximately' was the subject of considerable debate. Ultimately the view that prevailed was that the definition should not be so restrictive that it excluded objects lying just outside that range. He further noted that the definition itself would not incorporate the emergence of unique properties:

> In relation to the other issue regarding the emergence of unique properties, it has been agreed that that will appear as a note somewhere at the bottom, words something like: Emergent phenomena associated with size quantification and potentially other properties that are not regular extrapolations form larger size ranges will typically, but not exclusively, be exhibited at the nanoscale. This in my view is a cop-out, but anyway – it is a bit of a wishy-washy note.[16]

2.40 Dr Miles said that the non-inclusion of novel properties was of concern for some parties who had been using nanomaterials for a long time but did not want to be subject to new regulations based on such a definition:

> A lot of the push from the United States, which was arguing for the emergent phenomena, was that they did not want to consider what they were doing to be nanotechnology because they had been doing it for 50 years, and yet in this definition that I have read it will now be classified as nanotechnology, so they will have to go through all the nano regulations. That was upsetting a lot of them.[17]

2.41 For the ISO definition of nanotechnology to become a binding element of the Australian national regulatory framework it will have to be written into the relevant regulations. Mr Max Maffucci from Standards Australia described the process for adoption of international standards:

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

---

15 Dr John Miles, Clayton Laboratory and Nanometrology Manager, National Measurement Institute, Evidence, 1 May 2008, p 44

16 Dr Miles, Evidence, 1 May 2008, p 44

17 Dr Miles, Evidence, 1 May 2008, p 44

> In the particular case here, we have a very active role at the international level. I would assume that when it comes to adopting it as a national standard we will have what is called a combined procedure. At the same time as we ask the national committee to vote we will have a period for public comment instead of having two separate steps. Following that the document is published as an Australian Standard. We have the right to make changes to the international standard; we do not have to adopt it if there are reasons based on safety or health or whatever. We can add appendices and say that in a particular clause there is a different application in Australia. That is basically the process.
>
> …Standards Australia is an independent organisation, we are not a government body. Whatever we publish, even if we adopt international standards, is a voluntary document. They become regulatory only if they are referenced into some regulations.[18]

2.42 Dr Miles advised that he believed that federal regulatory bodies were looking towards ISO and Standards Australia documents to provide the basis for their legislative and regulatory response to nanotechnology.[19]

2.43 Whether the regulatory framework should, or could, include a size-based definition (even one with an approximate range) is a vexed question. The framework needs to be responsive and adaptive and able to manage risks appropriately. Dr Matthew Gredley, spoke of the need to be flexible and not constrained by the limits of any definition:

> …we are particularly aware of the concept that a company can engineer a nanoparticle at 105 nanometres and therefore be outside the definition. For us, not only is the definition important but it is the functionality and the use of the chemical that is important. Does that particle size change the risk characteristic compared to a conventional form? Therefore we would be interested in a particle of 105 nanometres as well as a particle of less than 100 nanometres. So we are not particularly tied to a definition.
>
> …A definition would help, but a definition has limitations. We want to be flexible enough to draw out information on materials that are still going to have a changed risk because of change to the particle size but are potentially outside that immediate definition.[20]

Committee comment

2.44 The Committee believes that an agreed definition consistently applied is desirable in terms of regulatory consistency and clarity. However, it is important that any size-based definition does not effectively preclude materials that have a potential risk from appropriate regulatory scrutiny. The regulatory framework for nanotechnology is considered in Chapter 3.

---

18 Mr Max Maffucci, Program Manager – International, Standards Australia, Evidence, 1 May 2008, p 39

19 Dr Miles, Evidence, 1 May 2008, p 39

20 Dr Matthew Gredley, A/g Reform Team Leader, National Industrial Chemicals Notification and Assessment Scheme, Evidence, 10 June 2008, p 43

Current and future applications of nanotechnology

2.45 The scope for future applications of nanotechnologies is immense. The Committee was told that it has led many of nanotechnology's proponents to describe it as the technological platform that will underpin the next industrial revolution.[21]

2.46 A number of submissions to the Inquiry provided lists of examples of current nanotechnology research and applications, demonstrating its broad scope. The submission from the NSW Government provided a summary of the overall scope of nanotechnology applications:

> In NSW and across Australia, research of materials/particles at the nanoscale is being undertaken in a variety of different scientific fields, including physics, materials science, chemistry, robotics, electronics, food science and biotechnology. In a number of fields, nanotechnology has made the transition from research to commercialisation.
>
> Many everyday consumer products and manufacturing processes either currently incorporate aspects of nanotechnology or are poised to do so. For example, nanoparticles and nanomaterials are currently found in sunscreens and cosmetics, food, paints, powders and coatings, sporting products, electronics, medical devices, pharmaceuticals and textiles. Applications of nanotechnology are also being incorporated into manufacturing processes such as in steel and plastics fabrications.[22]

2.47 The submission from the CSIRO advised that the industry sectors that are using or could benefit from using nanotechnologies include:

- biomedical devices and health
- electronics, information technology and communications
- packaging, logistics
- food and agribusiness
- automotive
- power, energy
- environment monitoring and maintenance
- mining, mineral exploration and mineral processing
- scientific instruments
- security, defence
- cosmetics
- sporting equipment
- clothing
- building and built environment

21 Ms Miller, Evidence, 1 May 2008, p 45

22 Submission 25, NSW Government, p 2

- consulting and training.[23]

2.48 The Committee heard evidence from the Joint Managing Directors of EnGenIC Pty Ltd who described the on-going development and approval process for their exciting drug delivery vehicle which is made from the material of bacterial cells and antibodies and is 400 nanometres in size:

> Basically, we have been able to manipulate bacteria so that when they divide in the centre to form daughter bacteria they also can split off little nanocells at their poles, and these little buds we call the EDV, which stands for engenic delivery vehicle. We have discovered that these little nanocells can be loaded with a wide variety of chemotherapeutics and because of their surface structures we can put targeting mechanisms, antibodies, on the surface and target them directly to cancer cells. They act like smart bombs. They are loaded up with a payload, they go into the body and they find the cancer cell and deliver the payload directly into that cancer cell.[24]

2.49 In the early stages of the Inquiry the Committee visited the Intelligent Polymer Research Institute (IPRI) at the University of Wollongong. The IPRI is conducting research into a number of nanotechnology applications. The Committee was pleased to note that Professor Gordon Wallace from the IPRI was the Chemistry Category winner in the recent and inaugural NSW Scientist of the Year Awards.[25]

2.50 Professor Wallace was recognised as a pioneer in nanobionics, which bridges nanotechnology and human biology and his successful work in using electrical stimulation to significantly enhance growth from nerve cells, offering potential for damaged hearing and spinal cords.

2.51 All those submissions that provided information on specific companies involved in providing services, processes or products based on nanotechnology also noted that there is no definitive list available. Similarly, there is no definitive list of currently available products that contain nanomaterials.[26] The fact that there is no current requirement to acknowledge nanomaterial content in products was a concern for some Inquiry participants. The issue of nanomaterial labelling is examined in Chapter 3.

Committee comment

2.52 Throughout the Inquiry the Committee heard that 'nanotechnology' should not be considered as a single entity, but that nanotechnology applications, products incorporating nanomaterials, and nanomaterials themselves should often be considered on a class-by-class or even case-by-case basis.

2.53 The evidence presented in this chapter clearly demonstrates the wide range of areas in science and engineering that will be affected by nanotechnologies. It is clear to the Committee that a

---

23 Submission 19, p 10

24 Dr Jennifer MacDiarmid, Joint Managing Director, EnGenIC Pty Ltd, Evidence, 1 May 2008, p 54

25 *Solar Power Expert Named Inaugural NSW Scientist of the Year,* media release, Department of State and Regional Development, 12 September 2008

26 For example, Submission 19, p 10

blanket approach cannot be adopted with respect to everything that is encompassed by the term nanotechnology. The recommendations of this report take into account this fact.

Chapter 3 Regulation of nanomaterials

The unique properties exhibited by many nanomaterials raise the question of whether the existing regulatory frameworks for the management of chemicals and products incorporating chemicals are sufficient to cover the health, safety and environment concerns potentially posed by nanomaterials. This question of how nanomaterials can best be regulated over their life cycle is receiving considerable attention both nationally and internationally, and was a main area of examination during the Inquiry.

A range of views on the appropriateness of the current frameworks and what should be done in the short and long term were put to the Committee by various participants in the Inquiry.

This chapter examines the current regulatory frameworks in operation for the management of nanomaterials over their lifecycle; the on-going federal review of the regulatory framework, the areas where eventual change to the current frameworks appear warranted, and what should occur in the interim.

A nanotechnology moratorium?

3.1 The most extreme form of regulation is prohibition. During the course of the Inquiry the Committee was aware of calls in the public arena for a moratorium on nanotechnology, either blanket or conditional. It took the opportunity to canvass the need and feasibility of implementing a moratorium with inquiry participants during the public hearings.

3.2 In its submission to the Inquiry the NSW branch of the Australian Manufacturing Workers' Union (AMWU) called for a moratorium on the research, development and production of nanotechnology while regulations are developed to protect workers and the public from potential harm.[27]

3.3 Mr David Henry, Occupational Health and Safety Officer from the AMWU, emphasised that the union is not about 'retarding or killing off industry', as the livelihood of its membership is dependent to some extent on this industry succeeding in Australia. However, the union must 'draw a line' when it finds that there are not what it considers appropriate controls in place to ensure the health and safety of its members.[28]

3.4 In evidence before the Committee, Mr Henry argued that if the current State legislation was strictly applied then a moratorium would occur by default:

> I drew the conclusion that if you were to strictly apply the New South Wales Occupational Health and Safety Act it would create a moratorium. Industry does not have the capacity to identify hazards, to assess risks, or to put in place adequate controls. Based on our own legislation you create a moratorium. Until such time as they are able to assess those risks and put in place adequate controls, the work should

27 Submission 4, Australian Manufacturing Workers' Union, p 7

28 Mr David Henry, Occupational Health and Safety Officer, Australian Manufacturing Workers' Union, Evidence, 1 May 2008, p 16

> not be taking place – the commercialisation and the use of these products should not be taking place.[29]

3.5 The Committee posed the question of how the government should respond to public calls for a moratorium. Mr Peter Dunphy Director, Hazard Management Group, WorkCover NSW, noted that WorkCover supported the responsible and safe development of nanotechnology. Mr Dunphy argued that 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.[30]

3.6 Mr Dunphy advised that WorkCover recognised the national and international importance of the issue of nanotechnology and has begun work on a range of activities in conjunction with other agencies. There is still more policy work to be undertaken before new or revised Occupational Health and Safety (OHS) legislation for nanotechnology can be considered. Until such time as more is known about the health and safety risks of nanotechnology, WorkCover supports the use of the ALARA – As Low As Reasonably Achievable – principle by industry:

> The ALARA principle approach requires industry to ensure workers' exposure to nanomaterials is kept to an absolute minimum and the use of risk management hierarchy of controls, starting with that process of elimination through to personal protective equipment.[31]

3.7 The issue of the ability of industry to implement the ALARA principle with respect to the range of nanomaterials, and the work being undertaken with respect to OHS is examined later in this chapter.

3.8 As noted in Chapter 2, 'nanotechnology' is essentially a convenient term encompassing a broad range of scientific development and technologies, and the products and processes that may be developed through a multitude of applications. It would be virtually impossible, and in some cases counter-productive, to try apply a moratorium to all things that fall under this general descriptive term.

3.9 Professor John Weckert, from the Centre for Applied Philosophy and Public Ethics at Charles Sturt University, was of the view that there was not much sense in seeking to apply a blanket moratorium at the State or federal level. In particular, a blanket moratorium on research could be counter-productive as it could stifle the production of the evidentiary basis for taking specific action:

---

29 Mr Henry, Evidence, 1 May 2008, p 16

30 Mr Peter Dunphy, Director, Hazard Management Group, NSW WorkCover, Evidence, 28 April 2008, p 18

31 Mr Dunphy, Evidence, 28 April 2008, p 2

> 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 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 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.[32]

3.10 Mr Kaustuv Mukherjee from the Department of State and Regional Development argued that any consideration of regulatory change or even moratoriums must be within a national rather than State-specific context. Mr Mukherjee was concerned at the prospect of any recommendation placing New South Wales businesses at a potential disadvantage in relation to other jurisdictions.[33]

3.11 Ms Elaine Attwood from the Consumers Federation of Australia also agreed that research should be exempt from any form of moratorium. Ms Attwood's view was that commercialisation of products should not proceed until the appropriate assessments have been carried out to confirm that there are no risks to the consumer. Within that stance, Ms Attwood allowed that not all products incorporating nanomaterials pose the same risk:

> There are already thing in the marketplace now – from memory…about 550 to 650 different things in the marketplace – that you can buy that may be using nanotechnology. As I said, some of those probably will not cause any problems at all – tennis racquets and things like that where it is all in the matrix would not be a worry – but when you come to food and packaging, and medical things it might be a different matter.[34]

3.12 The position of the Friends of the Earth, Australia is that there should be a moratorium on the commercial use of nanotechnology until a number of actions are met.[35] In discussion on the issue of a moratorium, Ms Georgia Miller, Nanotechnology Project Coordinator, suggested the Committee could consider a more pragmatic approach and focus on sectors or products where the known potential risk is greater:

> There is any number of ways that the moratorium could work, and I would encourage the Committee to think laterally in terms of thinking about your priorities for the industry's development but also in terms of making sure that we do not end up in a situation where this is the next asbestos, which is a risk that we run at the moment. A lot of people have said to me, "How could a commercial moratorium work? What about the electronics sector? What about tyres in cars that contain carbon black?" One pragmatic response to that, which is not a Friends of the Earth position but

32 Professor John Weckert, Professorial Fellow, Centre for Applied Philosophy and Public Ethics, Charles Sturt University, Evidence, 28 April 2008, p 43

33 Mr Kaustuv Mukherjee, Senior Manager, Innovation Statement, Industry Division, Department of State and Regional Development, Evidence 28 April 2008, p 19

34 Ms Elaine Attwood, Consumer Advocate, Consumers Federation of Australia, Evidence, 10 June 2008, p 16

35 Submission 9, Friends of the Earth Australia, p 17

> something you might want to think about, is what if you just say, "Let's leave the electronics sector. Let's leave the car tyres and let's look at this burgeoning number of products that are on the market that contain manufactured nanoparticles that our best knowledge now indicates will pose serious toxicity problems".[36]

3.13 Professor Andrew Cheetham from the University of Western Sydney argued that calls for a moratorium on the broad field of nanotechnology are likely to be inspired by an emotive response to the term. He likened concerns about nanotechnology to those held about nuclear science:

> 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 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 gamma radiation in your house – you do not want that to reflect on the rest of nanotechnology and all of the beneficial things.[37]

3.14 The Committee was advised of recent research that reported that one type of carbon nanotubes (long multi-walled carbon nanotubes) produce a reaction in test mice similar to that of asbestos. On the basis of this, the toxicity and potential implications of long multi-walled carbon nanotubes is an issue of priority for the Office of the Australian Safety and Compensation Council (ASCC). Dr Howard Morris told the Committee that at the moment the ASCC recommends that users of these carbon nanotubes should apply the best possible practicable methods to control exposure until more is known about the extent of the health hazards.

3.15 Dr Morris also stressed that these specific research findings are applicable only to long multi-walled carbon nanotubes and cannot be considered applicable to the diverse range of engineered nanomaterials that are being developed or are in use today.[38]

Committee comment

3.16 The public calls for a moratorium on nanotechnology often draw the link between asbestos and nanomaterials (or even nanotechnology). The Committee believes this is problematic as it is comparing the specific to the general.

3.17 The Committee finds that it would be impractical to recommend or support a moratorium on nanotechnology or even nanomaterials, as both are broad descriptive terms rather than specific entities. However, the Committee does find that there is a need for regulators to continue to monitor research and to identify specific causes for concern, and to respond

---

36 Ms Georgia Miller, Nanotechnology Project Coordinator, Friends of the Earth Australia, Evidence, 1 May 2008, p 52

37 Professor Andrew Cheetham, Pro, Vice-Chancellor Research, University of Western Sydney, Evidence, 28 April 2008, p 36

38 Dr Howard Morris, Program Manager, Nanotechnology Occupational Health and Safety Research and Development Program, Office of the ASCC, Department of Education, Employment and Workplace Relations, Evidence, 10 June 2008, pp 23-24

accordingly to the risk identified. In some cases the appropriate response may very well be a prohibition on the use of a specific nanomaterial in a specific application or product.

Regulatory consistency and clarity

Regulatory consistency

3.18 A number of submissions to the Inquiry voiced a concern that the Committee may recommend NSW-specific regulations for nanotechnology. For example, Professor Cheetham noted it would be difficult to implement a set of specific regulations for nanotechnology given its breadth of disciplines. He stressed that, particularly from a collaborative research perspective, whatever regulatory response relating to nanotechnology or nanomaterials is agreed upon it must be nationally consistent:

> What we do not want or what would not be 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.[39]

3.19 During the public hearings the Committee heard evidence from representatives from a number of New South Wales regulatory agencies. They agreed that national regulatory consistency was the ideal approach.[40] Mr Craig Lamberton, Department of Environment and Climate Change, noted that regulatory consistency was an accepted goal:

> Every government I have known, State or federal, has been very supportive of national uniformity improvements in cross-border trade efficiency and avoidance of duplicative processes in different States. It means that we have a common national approach.[41]

3.20 Mr Lamberton advised that work is currently underway on reviewing how environmental issues are regulated nationally. He noted that the environmental field was somewhat behind other regulatory regimes, such as occupational health and safety, which had developed a national framework and standards.

3.21 Throughout the Inquiry it was often noted that no national government in the world had yet implemented regulations for nanotechnology or nanomaterials. The one example of a nanotechnology-specific piece of legislation that was cited to the Committee was that of the City of Berkeley in California. That ordinance prevented the transportation of nanomaterials throughout its municipality. The Committee was advised that an unwitting effect of this

---

39 Professor Cheetham, Evidence, 28 April 2008, p 34

40 For example, Mr Dunphy, Evidence, 28 April 2008, p 2

41 Mr Craig Lamberton, Director Specialised Regulation, Department of Environment and Climate Change, Evidence, 6 June 2008, p 20

ordinance was that it impeded the interaction and collaboration between the various research institutions in the area.[42]

3.22 Friends of the Earth Australia advised that it was considering whether it made more sense to have a stand-alone nano-specific regulatory mechanism rather than amending the current framework. Friends of the Earth had not yet come to a position, it did however recommend, as a first step, that nanomaterials be assessed as new chemicals.[43]

3.23 Mr Clive Davenport, CEO of the Australian Nano Business Forum (ANBF), cautioned that if a regulatory framework was developed specifically for nanomaterials or nanotechnology it could lead to the situation where it might cause uncertainty:

> I think it is incredibly important that as products evolve they fit within that regulatory framework as distinct from having yet another party because as soon as you do that you might have products that people think, "That does not quite fit in that one, I will slot it into that one", and things go through the cracks. It is incredibly important that it fits right within the framework, but we do need to expand the framework.[44]

Regulatory clarity

3.24 In addition to regulatory consistency, the Committee heard that there was an equal need for regulatory clarity. The current environment in which concerns regarding nanomaterials have been publicly expressed combined with the fact that the regulatory framework for their management is not clear has caused some uncertainty among industry. The *NanoSafe Australia OHS Position Paper November 2007* outlines the reason why industry is seeking clarification:

> Although there may be gaps in Australian regulatory systems, the experience of related industries have made the nanotechnology industry acutely aware that there is no such thing as a "lawless" product, and that other legislative principles still apply. Even if nanotechnologies are not specifically regulated, legislation concerning the duty of care and specific product liabilities are issues the industry can not ignore. For example, tobacco and asbestos products were developed at a time of limited specific regulation, but this did not prevent the manufacturers of these products from becoming targets of liability suits due to adverse health effects caused by these products. These examples highlight the need for proactive regulation and consequently the nanotechnology industries have been calling for clarification of regulatory frameworks so that they can proceed in a more certain regulatory environment.[45]

3.25 Dr Miriam Goodwin, Senior Adviser from the Australian Nuclear Science and Technology Organisation (ANSTO), was also of the view that regulatory clarity will be an important requirement to realise the potential of nanotechnology businesses within the State. She

---

42 Professor William Price, Head, School of Chemistry, University of Wollongong, Evidence, 28 April 2008, p 27 and p 60

43 Ms Georgia Miller, Nanotechnology Project Coordinator, Friends of the Earth Australia, Evidence, 1 May 2008, p 50

44 Mr Clive Davenport, Chief Executive Officer, Australian Nano Business Forum, Evidence, 1 May 2008, p 10

45 *Current OHS Best Practices for the Australian Nanotechnology Industry*, NanoSafe Australia, November 2007, p 5

advised the Committee that there was a current perception among business that setting up a nanotechnology business is an area of potential risk while it is unclear what the eventual regulatory framework will be.[46]

3.26 The Committee also heard that there is uncertainty among the insurance industry regarding the underwriting of nanotechnology businesses. Ms Georgia Miller drew the Committee's attention to a 2004 report by the insurer Swiss Re:

> Swiss Re's concern was that the key parallel between risks associated with nanoparticles and risks associated with asbestos exposure may not only have the potential for serious harm but the potential for such harm to manifiest a long time after exposure, which makes it really hard for the insurance sector to calculate the risks that may be associated. If you are fairly sure that there is potential for long-term harm but you are not in a position to calculate that harm, that is a huge liability for the insurance sector and that has been their main concern.[47]

3.27 Other insurers have also published reports recommending a cautionary approach. The Allianz Group noted the requirement for sufficient funding of independent research or associated risks, international standards and nomenclature; and adequate regulation. Allianz indicated that its approach might range from assessing the risk of certain classes of business to making detailed individual risk assessments.[48]

3.28 In 2007 Lloyd's published a report noting that more information on the potential health risks posed by some nanomaterials is required. The report concluded that the insurance industry should lobby for regulatory clarity, and that at the present time its exposure to nanotechnology should be considered carefully:

> Lack of regulation is never helpful to liability insurers and the insurance industry should lobby for clarity.
>
> …There is a danger that nano technology could lead to unforseen and negative impacts but they could also lead to many positive impacts and these should be weighted up in deciding any regulation in future. However, as the insurance industry is often only exposed to the downside, it must protect its long term solvency for the benefit of society as a whole. Our exposure to nanotechnology must therefore be considered and examined very carefully.[49]

3.29 The then Minister for Science and Medical Research, Hon Verity Firth MP,[50] identified three general types of regulatory barriers that can face science and innovation in any jurisdiction:

---

46 Dr Miriam Goodwin, Senior Adviser, Research, Management and Policy, Australian Nuclear Science and Technology Organisation (ANSTO), Evidence, 28 April 2008, p 66

47 Ms Miller, Evidence, 1 May 2008, p 49

48 *Opportunities and risks of Nanotechnologies: Report in co-operation with the OECD International Futures Programme,* Allianz Center for Technology, p 5

49 *Risks: Lloyd's Emerging Risks Team Report: Nanotechnology Recent Developments, Risks and Opportunities,* Lloyd's 2007, p 32

50 At the start of the Inquiry and up until 5 September 2008, the Minister for Science and Medical Research was the Hon Verity Firth MP. From 5 September 2008, the Hon Tony Stewart MP became the Minister for Science and Medial Research.

- The sheer volume of regulation can prohibit companies from experimenting with new processes or ways of doing things – particularly if companies are subject to regulations at the federal, state and local level.
- A regulatory regime that is purely focused on the goals of consumer and investor protection can inadvertently discourage innovation.
- The absence of regulation or clear regulatory frameworks can inhibit companies from developing new technologies or experimenting with new applications of existing technologies.[51]

Committee comment

3.30 The current review of the existing regulatory framework for the management of nanomaterials is examined later in this chapter. As will be shown, there is limited scope for an individual State to implement an effective, comprehensive State-specific regulatory framework for nanomaterials. The more sensible and important approach for New South Wales is to ensure that it effectively contributes to, and influences, the national regulatory review.

3.31 The following section examines the existing regulatory framework and the current review being undertaken at the federal level.

The current regulatory framework

3.32 The responsibility for regulating chemicals and products is shared among a number of federal agencies and their State and Territory counterparts.

3.33 In 2007 the Australian Government commissioned an independent review of the effectiveness of the existing regulatory framework. The Centre for Regulatory Studies at Monash University undertook this review. The report of this review *A review of possible impacts of nanotechnology on Australia's Regulatory Framework* (hereafter referred to as the Monash Report) was submitted in September 2007 and publicly released in July 2008.

3.34 The Monash Report, which is available from the Australian Office of Nanotechnology website at www.nanotechnology.gov.au provides a comprehensive explanation of the federal regulatory framework and the responsibilities and powers of the various federal agencies who regulate chemicals and products.

3.35 During the Inquiry the Committee heard evidence and received information from a number of federal and New South Wales regulatory agencies. The following sections briefly outline the role and powers of these agencies, and examine concerns that have been raised. Later in the chapter the Committee makes comment on the adequacy of the current regulatory framework.

[51] Answers to questions taken on notice, 30 June 2008, Hon Verity Firth MP, Minister for Science and Medical Research, pp 3-4

Introduction of chemicals

3.36 The introduction of chemicals into Australia is regulated by four federal agencies. The agency that is responsible for dealing with a specific chemical's assessment and registration is based on the designated end-use of the product.

3.37 Chemicals in foods, such as additives and residues, are largely dealt with by Food Standards Australia New Zealand (FSANZ); agricultural and veterinary chemicals are largely managed by Australian Pesticides and Veterinary Medicines Authority (APVMA); medicines and medical devices are dealt with by the Therapeutic Goods Administration (TGA); and industrial chemicals are dealt with by the National Industrial Chemicals Notification and Assessment Scheme (NICNAS), as shown in the table below:

Table 3.1 Australian chemical assessment and registration agencies

Chemical type	Responsible agency	Scope
Industrial chemicals	National Industrial Chemicals Notification & Assessment Scheme (NICNAS)	Assessment for OHS, public health and environmental risks of chemical entities
Agricultural and veterinary chemicals	Australian Pesticides & Veterinary Medicines Authority (APVMA)	Assessment for OHS, public health and environmental risks, and registration of products
Medicines and medical products	Therapeutic Goods Administration (TGA)	Assessment for public health risks, and registration of products
Food additives, contaminants and natural toxicants	Food Standards Australia New Zealand (FSANZ)	Assessment for public health risks and registration of products.

National Industrial Chemicals Notification and Assessment Scheme (NICNAS)

3.38 On 10 June 2008 the Committee heard evidence from Dr Marion Healy, Director NICNAS and Dr Matthew Gredley, Team Leader, Reform, NICNAS, regarding the role, powers and activities of NICNAS with respect to the regulation and management of industrial chemicals.[52]

3.39 Established in 1990 by the *Industrial Chemicals (Notification and Assessment) Act 1989*, NICNAS is Australia's regulator of industrial chemicals, located within the Department of Health and Ageing. The objective of NICNAS as set out in section 3 of its Act is:

> …to provide for a national system of notification and assessment of industrial chemicals for the purposes of: aiding in the protection of the Australian people and the environment by finding out the risks to occupational health and safety, to public health and to the environment that could be associated with the importation, manufacture or use of chemicals…and providing information, and making

[52] Dr Marion Healy, Director, National Industrial Chemicals Notification and Assessment Scheme, Evidence, 10 June 2008, pp 38-44; Dr Matthew Gredley, Team Leader, Reform, National Industrial Chemicals Notification and Assessment Scheme, Evidence, 10 June 2008, pp 38-44

recommendations about, the chemicals to Commonwealth, state and territory bodies with responsibilities for the regulation of industrial chemicals.

3.40 NICNAS is responsible for assessing industrial chemicals. Industrial chemicals are defined not by how or where they are made, but by how they are used. Examples of industrial chemicals are detergents, cleaning agents, varnishes and the chemicals used for photographic development and photocopying.

3.41 Chemicals may have more than one use. Not all chemicals are industrial chemicals. A chemical is not an industrial chemical if its use is described only as one or more of the following:

- As an agricultural chemical or as part of an agricultural chemical product
- As an veterinary chemical or as part of a veterinary chemical product
- If it is used therapeutically or as an ingredient in a therapeutic good
- If it is used as food for humans or animals, or it forms part of food for humans and animals.

3.42 However, if the use of a chemical can be described in the above list and it also has an industrial use then it is defined as an industrial chemical and is assessed by NICNAS.

3.43 The Committee was advised that NICNAS was set up as an assessment organisation. Its main function is undertaking assessment and providing national advice on assessments around the various aspects of the safety of industrial chemicals. With respect to the control measures that might be put in place to manage an industrial chemical, NICNAS has some regulatory powers but the majority of the regulatory powers are exercised at State and Territory level [53] by a range of agencies, including those concerned with OHS, environment, public health and transport.[54]

3.44 NICNAS assesses industrial chemicals that are *new* to Australia for their health and environmental effects before they are used or released to the environment. NICNAS also assesses those chemicals that have been in use in Australia, known as *existing* chemicals, on a priority basis in response to specific concerns about their health and or/environmental effects.[55]

3.45 A chemical is categorised as a new chemical if it is not currently listed on the Australian Inventory of Chemical Substances (AICS). There are about 38,000 chemicals listed on the AICS, however only a small percentage of these have been assessed by NICNAS. That is because the industrial chemicals that were in use in Australia when NICNAS was established in 1990 were automatically placed on the AICS. A Chemical is listed on the AICS on the basis of its chemical formula and CAS[56] number. There is no size definition, so there is no differentiation between a nanomaterial and the bulk chemical from which it is derived.

---

53 Dr Healy, Evidence, 10 June 2008, p 38

54 *The Monash Report*, p 24

55 National Industrial Chemicals Notification and Assessment Scheme, Information Sheet: *Nanomaterials*, September 2006, p 2

56 CAS stands for Chemical Abstract Service. The Chemical Abstract Service, a division of the American Chemical Society maintains a database of identifying numbers assigned to chemicals.

3.46 Currently nanomaterials will fall into both categories of new and existing chemicals. A chemical not listed on the AICS is generally regarded as new and must be notified as assessed for human health and environmental risks prior to introduction and use.

3.47 Nanoscale forms of chemicals already listed on AICS (i.e. with an identical chemical formula and CAS number) are currently considered to be existing chemicals. These nanoscale, existing chemicals can be selected for assessment if there is a potential risk of adverse health and or/environmental effects. As at 22 July 2008, NICNAS advised that it had not selected any nanoscale version of an existing chemical for assessment.

3.48 The Committee was advised that NICNAS in general does not have the power to ban chemicals but rather it recommends risk management actions to relevant regulators.[57] When a new chemical is notified to NICNAS it undertakes an assessment and then subsequently issues an assessment certificate. NICNAS can place conditions on the use of the assessed chemical and permitted uses can be annotated on the AICS.

3.49 With respect to existing chemicals that have already been assessed, a reassessment could be initiated where NICNAS believes that the risk of the chemical has changed, or NICNAS had placed conditions on the use of the chemical, which were subsequently exceeded. This is termed a secondary notification assessment.

3.50 With respect to existing chemicals that have not previously been assessed, NICNAS can select them for assessment under the Priority Existing Chemical (PEC) process, generally in response to specific concerns about their health and/or environmental effects.

3.51 The PEC and secondary notification reassessment processes involve a legislated six-month assessment step. The assessment process for new chemicals involves a 90-day assessment step. NICNAS advise that the assessment for new chemicals is the more complex process that includes exemptions, self-assessment and full assessment options depending on the specifics of the proposed volumes and uses of the chemical.

3.52 The level of assessment of chemicals undertaken by NICNAS is less intensive than those undertaken by the other federal chemical regulatory agencies. Dr Gredley explained that this is not unique to Australia:

> We are all using, if you like, a risk assessment approach that has been agreed to internationally. So the overall approach that applies to all chemical areas is the same. The regulatory scheme for industrial chemicals in Australia, as well as in most countries around the world, is a lighter touch than for therapeutics, agriculture and veterinary chemicals.[58]

3.53 NICNAS is generally differentiated from the other federal chemical regulatory agencies by virtue of it assessing chemical entities rather than products. However in 2007 a new objective under its Act was introduced resulting in NICNAS being able to make national standards for cosmetics imported into Australia.

Most chemical regulatory schemes around the world use a chemical's CAS number as the basis for their definition of a chemical.

57 Answers to written questions on notice, 22 July 2008, NICNAS, p 1

58 Dr Gredley, Evidence, 10 June 2008, p 40

3.54 NICNAS runs a company registration program for companies, as they are obliged to register with NICNAS if they are introducing chemicals into Australia.

3.55 Dr Healy outlined the principles by which NICNAS operates:

> We aim to use sound credible science and take the approach of having the minimum level of regulation that is required to achieve the health, safety and environmental outcomes that we are looking for and to avoid duplication. To ensure that our decisions are risk-based we operate fairly inclusive practices and try to have transparent and consistent approaches and certainly to have chemical safety information available.[59]

3.56 The Committee sought information from NICNAS on the circumstances under which companies using or introducing nano versions of chemicals would be obliged, or would be likely, to notify NICNAS. Any new chemicals, that is chemicals not already in use in Australia, including those in the nano form will be notified to NICNAS automatically.

3.57 However, with respect to nano versions of existing chemicals, while there is always an obligation to ensure safe use, there is no regulatory requirement that prevents their use at the moment. There is a general requirement under the legislation that if there are issues that change around the chemical, such as new information about toxicity, or if the proposed use changes dramatically then there is a general obligation on the introducers to come back to NICNAS.[60]

3.58 Dr Gredly outlined the activities NICNAS undertakes to ensure that chemical introducers are aware of their obligations:

> ..we run an active training and communication program and we have face to face training material on our website and the usual array of communication material to try to ensure to the best of our ability that people are aware of their obligations
>
> …We have a compliance group and we do a certain amount of desk-based auditing, as well as visiting the sites and there are various information sources we are able to utilise. For example we have a close relationship with Customs so that we have access to information about what chemicals are being imported.[61]

Current extent of industrial chemical nanomaterials

3.59 NICNAS could not advise the exact extent of nano forms of industrial chemicals being used in Australia. In 2006 NICNAS issued a voluntary call for information on nanomaterials in the Chemical Gazette. The results of that call, reported in the NICNAS Information Sheet, *Summary of call for information on the use of Nanomaterials (January 2007)*, found:

> Companies reported introducing approximately 21 types of organic (eg polymers) and inorganic (eg metal oxides) nanomaterials. Seventeen of the 21 nanomaterials are for commercial use, with four used for research and development purposes. The commercial applications can be classified mainly into surface coatings, printing, water

59 Dr Healy, Evidence, 10 June 2008, p 39

60 Dr Gredley, Evidence, 10 June 2008, p 41

61 Dr Gredley, Evidence, 10 June 2008, p 41

> treatment, catalysts, domestic products and cosmetics. The largest volume of nanomaterial in use (10,000 – 50,000 tonnes/year) is acrylic latex, which is used for surface coatings. Over half of the nanomaterials are used in volumes of less than 1 tonne/year and 4 out of the 17 nanomaterials are used in volumes of less than 0.1 tonnes/year. The largest group of nanomaterials reported was the metal oxides, which are used in surface coatings, water treatment, catalysts and cosmetics, printing and domestic products. There are several silica-based nanomaterials, which are used for water treatment, cosmetics, surface coatings and printing. All the nanomaterials are imported, principally in products (mixtures). Acrylic latex, zinc oxide, cerium oxide and silicon dioxide are also manufactured in Australia.
>
> Fifteen companies reported that they imported nanomaterials (or products containing nanomaterials) for commercial use, 4 companies reported that they manufacture nanomaterials for commercial use and 4 companies reported that they formulate products containing nanomaterials for commercial use.[62]

3.60 NICNAS conceded that the results are an under-reporting of the actual extent, due to the voluntary nature of the call and the difficulty some companies experienced in applying the definition of nanomaterials. Dr Healy said that it was reasonable to conclude that a relatively small number of nano industrial chemicals are in use:

> The call for information sheet…shows what a small number of nano forms are actually being reported and in what small volumes they are being imported into the country. There is something in the order of 38,000 chemicals on the national inventory, so even if this call is out by 50 per cent we are still talking about a very small number that are being used. That is not to say that we do not need to be careful and vigilant, but it is an area that is emerging rather than having emerged, I think it is fair to say.[63]

Concerns regarding the current system

3.61 The most frequent concern expressed about the current regulatory frameworks was the fact that nano versions of existing chemicals are not automatically assessed as new chemicals. This concern is examined at paragraph 3.164 and again at paragraph 3.210.

Australian Pesticides and Veterinary Medicines Authority (APVMA)

3.62 On 10 June 2008 the Committee heard evidence from Mr James Suter, A/Chief Executive Officer; Dr Philip Reeves, Principal Scientist; and Dr Jamie Nicholls, Regulatory Strategy Project Officer, APVMA, regarding the role, powers and activities of the APVMA in regulating agricultural and veterinary chemicals.[64]

---

62 NICNAS Information Sheet, *Summary of call for information on the use of Nanomaterials*, January 2007, p 2

63 Dr Healy, Evidence, 10 June 2008, p 44

64 Mr James Suter, A/Chief Executive Officer, Australian Pesticides and Veterinary Medicines Authority, Evidence, 10 June 2008, pp 27-33; Dr Philip Reeves, Principal Scientist, Australian Pesticides and Veterinary Medicines Authority, Evidence, 10 June 2008, pp 27-33; and Dr Jamie Nicholls, Regulatory Strategy Project Officer, Australian Pesticides and Veterinary Medicines Authority, Evidence, 10 June 2008, pp 27-33

3.63 The national regulatory scheme for agricultural and veterinary chemicals is a partnership between the Commonwealth, States and Territories. The Commonwealth is responsible for the evaluation, registration and review of such chemicals and their control up to the point of retail sale. Beyond this the legislative control reverts to individual States and Territories, which control the use of the chemicals.

3.64 The Commonwealth responsibilities are undertaken by an independent statutory authority, the Australian Pesticides and Veterinary Medicines Authority (APVMA), established pursuant to the *Agricultural and Veterinary Chemicals (Administration) Act 1992*. A suite of seven federal Acts is relevant but the centrepiece is the *Agricultural and Veterinary Chemicals Code Act 1994*, which establishes the Agricultural and Veterinary Chemicals (or AgVet) Code. The AgVet Code contains the operational provisions for registering agricultural and veterinary (AgVet) chemical products with the States having complementary legislation.[65]

3.65 Mr Suter gave an overview of the APVMA's role within the regulatory framework.[66] A National Registration Scheme was established in 1995 by an intergovernmental agreement. Under that agreement the Commonwealth, State and Territory parliaments agreed to establish a framework to regulate the manufacture, supply and use of AgVet chemicals in the country.

3.66 The chemicals the APVMA regulates fall into two statutorily defined classes: agricultural chemical products and veterinary chemical products. The definition of agricultural chemical products is extremely wide and includes herbicides, insecticides, fungicides, dairy cleansers used on farms, crop markers, urban pest control products, termiticides, insect repellents, swimming pool disinfectants, algaecides and household and home garden products used in pest and weed control. It does not include fertilizers.

3.67 Veterinary chemicals also have a wide statutory definition. They include any substance that is administered to an animal to prevent, diagnose, cure, or alleviate a disease, condition or infestation, or to modify its physiology. Typical examples are: vaccines, antibiotics, anaesthetics, endoparasiticides, ectoparasiticides, and some vitamins and minerals.

3.68 Mr Suter advised there are 5,657 registered agricultural products and 3,281 registered veterinary products. Mr Suter described the regulatory framework within which the APVMA operates as fairly complex:

> We are one of the Commonwealth-State cooperative bodies and we have a diverse range of stakeholders relating to the chemical industry, farmers, farm workers, the general community, consumers, State and Territory governments, and our international regulatory counterparts such as the United States Environment Protection Authority, or the United Kingdom Drugs Directory. We have a wide consultation regime with our stakeholders.[67]

3.69 The existing APVMA legislation has provisions for assessing the compositional form of both substances (active constituents) and AgVet chemical products. This means that the conventional form and the nanoform of a substance or an AgVet chemical product may be assessed as distinct chemical entities or chemical products. In situations where APVMA deem

65 *The Monash Report*, September 2007, p 22

66 Mr Suter, Evidence, 10 June 2008, p 27

67 Mr Suter, Evidence, 10 June 2008, p 28

it necessary, different risk assessment protocols may then be applied to the conventional form and the nanoform. An example might be the reformulation of an AgVet chemical product whereby a conventional form is replaced with a nanoform of the chemical in order to achieve an improved efficiency profile.

3.70 The APVMA does not conduct its (risk) assessments in-house. Rather, it outsources its public health and OHS assessments to the Office of Chemical Safety (Department of Health and Ageing) and outsources its environmental assessments to the Department of the Environment, Water, Heritage and the Arts (DEWHA).

3.71 The APVMA is involved in what is called international workshare with respect to assessments of new compounds which provides them with advance notice of the likelihood of applications being made to them:

> …if one of the major multinationals wants to release a new compound, whereas they require a separate assessment in say, Canada, the European Union, the United States and then here, we do various components of it. I suppose in this country the history is that we usually see these compounds come in much later when they are registered in the United States and the European Union because that is where the markets are. But these international workshares give us exposure, I suppose, to the technology that has been introduced into the bigger markets.[68]

3.72 The APVMA has a range of actions open to them to change the status of registered products should evidence emerge that the product poses undue hazard to human health or the environment. The APVMA can suspend, cancel, recall or declare a product a prohibited import, or change the conditions for its use. The trigger for such actions is evidence based. The APVMA considers its powers in this regard adequate, but notes that the exercise of these powers is reviewable in the Adminstrative Appeals Tribunal:.

> The tests for suspension, cancellation and recall are all pretty much the same. It is pretty much an evidence-based test for us, so we would need something before us to show that it can happen.
>
> …If it needs to be removed from the market, then we remove it. It might be sufficient, just, for example, to change the way the chemical is used, which results in a label change or it might be that we can say it is okay if further protective equipment is worn. If the question is: Could we get a nanoversion product off the market where there was a demonstrated health and safety concern? Yes, we would have the tools to do it, though I add the caveat that each time we exercise these tools the Administrative Appeals Tribunal has a right of review.[69]

Current extent of AgVet chemical nanomaterials

3.73 On the basis of the definition of nanomaterials currently being used by it, the APVMA advised that no chemicals currently registered by it contain nanomaterials.[70] Dr Reeves advised that he was aware of one report, from Friends of the Earth, that said the APVMA had registered one pesticide that contained a nanoemulsion, but stated that the product would only

68 Mr Suter, Evidence, 10 June 2008, p 31

69 Mr Suter, Evidence, 10 June 2008, p 32

70 Dr Reeves, Evidence, 10 June 2008, p 30

be considered a nanomaterial if the definition used was a nanomaterial with a dimension in one or more dimensions of 600 nanometres.

Concerns regarding the current system

3.74 No Inquiry participant expressed any specific concern with respect to the regulation of nano versions of AgVet products. However, it would be fair to assume that the general concern expressed regarding the need to assess nano-versions of existing chemicals (generally expressed with respect to NICNAS) would also apply to the APVMA.

Therapeutic Goods Administration

3.75 The Therapeutic Goods Administration (TGA) declined the invitation of the Committee to have representatives appear as witnesses and provide evidence before the Committee.[71] However, the TGA did provide responses, through the Australian Office of Nanotechnology, to written questions from the Committee.[72]

3.76 The TGA, a division of the Department of Health and Ageing, was established in 1991 pursuant to the *Therapeutic Goods Act 1989*. The objective of the Act is to provide a national framework for the regulation of therapeutic goods in Australia to ensure the quality, safety and efficacy of medicines and ensure the quality, safety and performance of medical devices.

3.77 The TGA regulates products rather than individual chemical entities, and in doing so adopts a risk management approach. The regulatory framework is designed to ensure public health and safety, while at the same time freeing industry from any unnecessary regulatory burden. The TGA carries out a range of assessment and monitoring activities to ensure therapeutic goods available in Australia are of an acceptable standard. At the same time the TGA aims to ensure that the Australian community has access, within a reasonable time, to therapeutic advances.[73]

3.78 Before a therapeutic good may be supplied in Australia, or exported from Australia, the good must – with the exception of legislated excluded or exempt goods – first be entered onto the Australian Register of Therapeutic Goods (ARTG). The Act's Regulations and Orders set out the requirements for inclusion of therapeutic goods in the ARTG, including advertising, labelling, product appearance and appeal guidelines. Some provisions such as the scheduling of substances and safe storage and disposal are covered by the relevant State and Territory legislation.

3.79 The ARTG is divided into three parts: a part for goods to be known as registered goods; a part for goods to be known as listed goods; and a part for medical devices. Listing on the ARTG is dependent on the TGA being satisfied that the good is safe and effective. The TGA uses risk evaluation criteria to determine whether a certain type of medicine must be registered or listed. The different classes of product that must be registered or listed are set out in the

---

71 Correspondence from Dr Rohan Hammett, National Manager, Therapeutic Goods Administration, to Committee secretariat, 22 May 2008

72 Answers to written questions on notice, 17 June 2008, Therapeutic Goods Administration

73 *Regulation of therapeutic goods in Australia*, April 2005, <www.tga.gov.au/docs/html/tga/tgainfo> (accessed on 22 May 2008)

Regulations. Once a product has been classified as either registered or listed this then determines the level of evaluation undertaken.

3.80 The assessment and evaluation process for registered medicines is rigorous. The Act requires substantive scientific data to be submitted with the application for evaluation by TGA experts prior to the product being entered on the ARTG. A change in the manufacturing process of a registered product, including the reduction of the particle size of the active ingredients to the nanoscale would trigger reassessment of the registered good on the basis of quality, safety and efficacy under the current regulatory framework.[74]

3.81 Examples of listed goods are sunscreens and complementary medicines. Listed goods are not subject to pre-market evaluation by the TGA prior to being entered on the ARTG (however the product sponsor must self-assess the product as being listable subject to legislated criteria). This is because these products have been determined to be low risk because, in general:

- They may only contain ingredients approved for use in listed medicines, usually well known, established ingredients, with a long history of use, such as vitamin and mineral products.
- The ingredients have well established quality and safety profiles.
- The products have commonly used manufacturing techniques.
- The products may only be used for indications consistent with low risk.
- They do not contain substances that are scheduled in the Standard for the Uniform Scheduling of Drugs and Poisons (SUSDP) or otherwise restricted.

3.82 Evaluation of listed goods by the TGA may occur only once the listed good has been supplied in Australia, and in response to, for example, safety concerns relating to human health.

3.83 The Act provides the TGA with a range of post-marketing monitoring powers in order to ensure the safety and efficacy of approved therapeutic goods is maintained once the good has been listed on the ARTG. The TGA has a number of enforcement options that may be used to deal with risks that are identified in therapeutic goods. These are detailed in the legislation and include the capacity to:

- Impose new conditions on the registration or listing or vary or remove existing conditions.
- Apply additional conditions to the manufacture of a product.
- Cancel the registration or listing of the product meaning it can no longer be supplied in Australia.
- Suspend or cancel a manufacturing licence.
- Require mandatory recalls of products.

3.84 The enforcement action will depend on the particular circumstances of the case with the dominant consideration being the protection of the health and safety of the public.[75]

---

74 *The Monash Report*, p 90

75 Answers to written questions on notice, 17 June 2008, Therapeutic Goods Administration

3.85 In reconsidering the registration or listing of a product, the TGA is required to provide the person concerned with reasonable opportunity to respond to the proposed cancellation of registration or listing of the product. The ability to cancel the registration or listing of a therapeutic good gives the TGA extensive power over the supply of therapeutic goods within the Australian market.

3.86 Under the Act, manufacturers or sponsors of registered or listed goods are required to notify the TGA of adverse events related to the product. Failure to notify the TGA of adverse events gives rise to a range of criminal and civil offences under the Act.[76]

3.87 Manufacturers of therapeutic goods in Australia and other manufacturers who supply therapeutic goods in Australia must also comply with manufacturing principles and assessment procedures established under the Act.

Current extent of use of nanomaterials

3.88 The TGA advised that therapeutic products containing nanomaterials in the form of metal oxides, liposomes, polymer protein conjugates, polymeric substances and suspensions have been registered in Australia and/or granted marketing authorisations in the US and EU under the current regulatory framework.[77]

3.89 Sunscreens are the most notable therapeutic good that contain nanomaterials. As at December 2005, 254 sunscreens with titanium dioxide and 68 sunscreens with zinc oxide had these materials in nanoparticle form.

Concerns with current framework

3.90 As noted previously the current assessment and registration process for registered medicines is rigorous. The inclusion of nanomaterials in some sunscreens (listed goods) is the issue that has raised the most concern and attention. This issue is examined in more detail at paragraph 3.297.

Food Standards Australia and New Zealand (FSANZ)

3.91 Food Standards Australia and New Zealand (FSANZ) declined the invitation of the Committee to have representatives appear as witnesses before the Committee. On 6 June 2008 the Committee received evidence from Dr Elizabeth Szabo, the Chief Scientist from the NSW Food Authority, who outlined the role, powers and activities of FSANZ and its relationship with its State and Territory counterparts.[78]

3.92 The regulation of food in Australia is regulated by the States under a uniform scheme. Domestic food regulatory policy is set by the Australia New Zealand Food Regulation

76 *The Monash Report*, p 90

77 Answers to written questions on notice, 17 June 2008, Therapeutic Goods Administration, p 1

78 Dr Elizabeth Szabo, Chief Scientist, NSW Food Authority, Evidence, 6 June 2008, pp 13-19

Ministerial Council, with a national *Food Standards Code* setting out quality, or composition, and labelling requirements. State legislation then adopts the Code into each jurisdiction's law. [79]

3.93 The national food regulator, the FSANZ, a statutory authority created under the *Food Standards Australia New Zealand Act 1991* located in the Department of Health and Ageing, develops and maintains the Code. The object of the Act is 'to ensure a high standard of public health protection' with the FSANZ's objectives in setting food regulatory measures being: the protection of public health and safety, provision of adequate information relating to food to enable consumers to make informed choices, and the prevention of misleading or deceptive conduct.

3.94 As the Australia New Zealand Food Regulation Ministerial Council is responsible for the development of domestic food regulation policy in the form of Policy Guidance, FSANZ would be required to seek Policy Guidance from the Ministerial Council before it started developing any new processes to deal with nanotechnology in food.

3.95 The New South Wales Food Authority was established in April 2004. It is responsible for food safety across the entire food industry, from point of primary production through to the point of sale to the consumer. Its main functions are compliance and enforcement activities, science and policy development, the investigation of incidents associated with foodborne illness, standards development and implementation, and consumer and industry education. Its key legislative tool is the *New South Wales Food Act 2003*, and its approach to risk management under the Act is science and evidence based.[80]

3.96 Food regulation in Australia is a joint activity between industry and government. The onus is clearly on industry to produce food that is safe and suitable. The role of government is to ensure that industry has the mechanisms in place to be producing safe and suitable food. Under the auspices of the Council of Australian Governments a nationally coordinated framework for food regulation was developed and adopted in November 2000. There are four elements to the framework: stakeholder input, policy development, standard setting, and implementation.[81]

3.97 With respect to policy development, the Australia New Zealand Food Regulation Ministerial Council (the Ministerial Council) develops domestic food regulation policy in the form of policy guidelines. It comprises all Ministers who have a responsibility for domestic food regulation from all the Australian States and Territories as well as representation from New Zealand. Each member of the council needs to bring a whole-of-government approach to policy decision making.

3.98 The Ministerial Council is supported by the Food Regulation Standing Committee which is responsible for coordinating the policy advice that is considered by the council. The membership of this Committee reflects the ministerial membership of the council. In this respect NSW is represented by three agencies: the Food Authority, NSW Health and the Department of Primary Industries.

---

79 *The Monash Report,* pp 23-24

80 Dr Szabo, Evidence, 6 June 2008, p 13

81 Dr Szabo, Evidence, 6 June 2008, p 13

3.99 With respect to standards setting, FSANZ is responsible for developing all domestic food standards based on science and technology data. In the implementation phase the Implementation sub committee has the role of ensuring there is a consistent approach to implementing and enforcing food regulation and standards nationally.

3.100 The key output of the whole regulatory process is the Australia New Zealand Food Standards Code (the Code). Each Australian State and Territory needs to embody that into its own legislation. In NSW this is done via the *Food Act 2003*. The NSW Food Authority and local councils have the responsibility for enforcing and policing the code, and all food that is offered for sale in Australia – and offered for sale in NSW – whether it is made in Australia or overseas has to comply with the Code.[82]

Process for modifying the Food Standard Code

3.101 Dr Szabo advised that the procedures for modifying the Australia New Zealand Food Standard Code are outlined in the FSANZ Act. The process begins with an application, which must include a specified minimum amount of supporting material. If a minor variation is sought consultation may occur only within government agencies. If it is a major or new variation a widespread public consultation process is followed.

3.102 Dr Szabo advised that the process can take between three to twelve months depending on the type of variation sought:

> The time consequences are that if it is a minor variation, an application could be processed within three months. If it is a more detailed, new or major variation, the timeframe shifts to about nine to twelve months. If in assessing and going through that consultation process FSANZ deemed that a variation to the code is necessary, they put a recommendation to their own board. If the board accepts that, then the ministerial council is notified. The ministerial council than has one opportunity to ask for a review and, depending on that review, they can ask for an amendment to the code or they can reject.[83]

Current extent of nanomaterials in foods

3.103 Dr Szabo advised that she was not aware of any manufactured nanomaterials that are currently present in foods. Dr Szabo added the caveat that it is difficult to determine if advances in traditional food processing technologies are resulting in the presence of nanoforms of existing ingredients:

> There are some traditional processing technologies we use – for example, heating in the form of pasteurisation – where we can produce nanoforms of particles. There are certain forms of milling where we turn something that is dry and leafy into a powder. Again, they can sometimes result in a nanoform being produced. To my knowledge, in that whole milling area there have been advancements to increase the proportion of nanoparticles that you might get from that kind of process. Again, it is very difficult to be able to determine whether particles that have come from those sorts of processes are being added to our food.[84]

82 Dr Szabo, Evidence, 6 June 2008, p 14

83 Dr Szabo, Evidence, 6 June 2008, p 14

84 Dr Szabo, Evidence, 6 June 2008, p 17

3.104 Dr Szabo informed the Committee of an application in the United States for a patent to cover the use of titanium dioxide and silicon dioxide in the nanoparticle form in chocolate in order to give the chocolate an enhanced appearance. Dr Szabo was not aware if any similar application had been made to the FSANZ. This example highlights the challenge that could face the FSANZ:

> This is an example that highlights an area of challenge for us. Titanium dioxide is a permitted food colour in the Food Standards Code and silicon dioxide is a permitted food additive. Our code is silent when it comes to the size of the particle so the debate would have to be had: would these two chemicals that are currently permitted in our code be viewed the same as their traditional form or would they be viewed as novel?[85]

3.105 The Committee was interested to know if the Food Authority was aware of any research available concerning the speed of uptake of titanium dioxide and silicon dioxide in the nanoform following ingestion. The Food Authority advised:

> …a search for literature in this area revealed one *in vitro* study with silicon dioxide in the nanoform and none with titanium dioxide. The research on silicon dioxide (authored by Chen and Mikecz in 2005 and published in the journal *Experimental Cell Research* Vol 305, pp51-62) showed that particles smaller than 70nm could enter a cell's nuclei and impair cell function. It is not known whether comparable effects occur *in vivo* particularly through the gastrointestinal route.[86]

Concerns regarding the current system

3.106 A challenge for the current system, if nanomaterials are increasingly incorporated into food and prompt the need for analysis and assessment, is the complexity of the food matrix. Dr Szabo explained:

> That is the second challenge with regard to this sort of example – the test methodology. We do have some analytical techniques that can measure materials at the nanoscale. Will they be appropriate for the measurement of food? Food is a very complex matrix and often when we take analytical techniques that have been developed in other areas and try to apply them to food, you can be faced with many challenges, such as the interference of food materials. The other aspect is that there are naturally occurring nanoparticles in food. Does the technology allow us to distinguish between something that was manufactured and something that naturally occurs? Again, that is an area of challenge.[87]

3.107 Dr Szabo said that she believed there were two potential regulatory gaps in the current system:

> Where we have a particular substance that is already listed in the code as permitted to be used, we do not make reference to its size in the nanoform. The challenge will be: Can we address its use through the novel standards that are available in the code? Would we view that as being the same as a traditional use, or would it stand the test of "novel"? Another potential gap is that the way we make reference to a number of

85 Dr Szabo, Evidence, 6 June 2008, p 15

86 Answers to questions taken on notice, 25 June 2008, Dr Szabo, NSW Food Authority

87 Dr Szabo, Evidence, 6 June 2008, p 15

> elements in the code has to do with weight: a gram for gram basis or a gram for volume basis. Whether this is equally applicable to the nanoparticle is something that we perhaps have to look at.[88]

3.108 Dr Szabo advised that the NSW Food Authority was awaiting the outcome of the federal review of the regulatory frameworks.

Occupational health and safety

3.109 The CSIRO advised that at present the greatest risk for human exposure to the potential toxicity of nanomaterials is from nanoparticle 'dust' that may be inhaled or, less likely, ingested or dermally absorbed. The risk is highest in the workplace during the manufacture of nanoparticles in dry form, and subsequent processing and handling of these materials.[89]

3.110 Currently there are no specific regulatory models anywhere in the world for occupational health and safety for nanotechnology.[90]

3.111 During the Inquiry the Committee heard evidence from the federal and State agency responsible for regulating occupational health and safety in the workplace.

Australian Safety and Compensation Council (ASCC)

3.112 On 10 June 2008 the Committee received evidence from Dr Howard Morris, Program Manager, Nanotechnology Occupational Health and Safety Research and Development Program, Office of the ASCC, Department of Education, Employment and Workplace Relations. [91]

3.113 While each State and Territory is responsible for regulating and enforcing occupational health and safety (OH&S) in workplaces in their jurisdictions, these actions are based on national codes and standards created by the ASCC. The ASCC is made up of government, employer and employee relations representatives.

3.114 The Office of the ASCC, which resides within the Australian Government Department of Education, Employment and Workplace Relations, supports the activities of the ASCC and provides advice on OH&S workers compensation matters and also undertakes standards reviews, development and implementation. The Office of the ASCC also coordinates the department's intergovernmental role in OH&S and workers' compensation through intergovernmental agencies, such as the Organisaton for Economic Cooperation and Development (OECD) and the International Labour Organisation (ILO).

3.115 The ASCC is a national body with legislative power, pursuant to the *Australian Workplace Safety Standards Act 2005*, to declare national OH&S standards and codes of practice. These

88 Dr Szabo, Evidence, 6 June 2008, p 18

89 Submission 19, CSIRO, p 16

90 Mr Dunphy, Evidence, 28 April 2008, p 1

91 Dr Morris, Evidence, 10 June 2008, pp 18-26

standards and codes are advisory only until adopted by jurisdictions into regulations or codes of practice. Two groups of standards/codes are likely to be particularly relevant to nanotechnology – those relevant to hazardous substances and those relevant to dangerous goods.[92]

3.116 Hazardous Substance Regulations are designed to protect workers from chronic health and safety issues arising from continued exposure to the substance. Immediate risks fall more under the category of Dangerous Goods, for example, if the risk is that the substance is highly flammable, explosive, highly toxic or highly acidic, the substance can cause acute injuries or pose an immediate risk to health and safety.[93]

3.117 For both Hazardous Substances and Dangerous Goods the respective regulations place specific obligations on manufacturers and importers of the substance or good and on industrial end-users (i.e. employers).

Hazardous substances (HS)[94]

3.118 The National Model HS Regulations apply to all workplaces in which hazardous substances are used or produced and to all persons with potential exposure to HS in those workplaces, and describe how HS should be controlled in the workplace.

3.119 Classification as an HS is on the basis of whether the substance is listed in the ASCC's Hazardous Substances Information System (HSIS), a database on the ASCC's website (some substances are included on the HSIS without hazard classification data). However if a substance is not on the HSIS (or on the HSIS without classification data), it is up to the manufacturer/importer to determine if the substance is an HS. This is done by using approved criteria. If a manufacturer/importer determines that a substance is an HS, it must notify the ASCC.

3.120 If a substance is an HS manufacturers/importers of substances supplied for use at work must identify the hazards associated with the substances they supply and provide adequate information on the substance to downstream users. This is done by labelling the substance and providing Material Safety Data Sheets (MSDS).

3.121 Hazardous substances are classified into categories (very toxic, toxic, harmful, corrosive, irritant, sensitiser and others) and types. The assigned classification determines what warning, descriptive or safety phrases should or can be used in labels or MSDS.

3.122 Regulatory standards are set for labels. Generally labels must identify the substance and provide basic information about its safe use and handling.

3.123 Material Safety Data Sheets describe the physical and chemical properties of the substance and provide advice on safe use, handling and disposal. The MSDS must include all information on known adverse health effects.

---

92 *The Monsah Report*, p 22

93 Submission 19, p 21

94 The following section provides a general overview only of the regulations concerning hazardous substances and does not touch on exemptions etc. allowed under the regulations.

3.124 Suppliers of hazardous substances are required to provide MSDS to all industrial endusers on the first occasion of supply and also on request. MSDS must be kept up to date by manufacturers/importers and be reviewed at least every five years and copies of updated MSDS are to be made public. An assessment of health risks as identified in the MSDS must also be revised whenever there is evidence to indicate that it is no longer valid or when there has been a significant change in the work to which the assessment related.

3.125 Industrial endusers have a duty to ensure the health risks of any work involving potential exposure to HS is assessed. Proper triggering of this requirement for nanomaterials or products incorporating nanomaterials depends on the adequacy of MSDS and labels if available, or if not, the available knowledge of industrial endusers regarding the health risks of nanomaterials.[95]

3.126 Industrial endusers must also ensure that employees' exposure to hazardous substances is either prevented or, if that is not practicable, adequately controlled so as to minimise health risks. They must comply with the relevant national exposure standards. In certain circumstances employers must provide health surveillance for employees exposed to hazardous substances.

3.127 In addition industrial endusers must obtain a MSDS and ensure that it is available and readily accessible to employees. If there is no MSDS, equivalent information must be obtained from other sources. They must ensure that all hazardous substance containers are labelled and keep a register of all hazardous substances used or produced in the workplace. They must provide instruction and training to employees on health risks and use of control measures for the hazardous substance.

Dangerous goods[96]

3.128 The dangerous goods regulatory framework applies only to hazards caused by the storage and handling of dangerous goods in the workplace. Individual jurisdictions are responsible for setting requirements for dangerous goods not encountered in the workplace. The objectives of the Dangerous Goods National Standard are to ensure the effective control of the storage and handling of dangerous goods and combustible liquids so as to protect the safety and health of persons and to prevent damage to property and the environment.

3.129 Generally, for the purposes of the framework, dangerous goods are goods named in the Australian Dangerous Goods Code or which satisfy criteria in the Code. Manufacturers/importers are responsible for determining whether a good is a dangerous good, and if so, classifying it before it is supplied for use at a workplace.

3.130 If a substance is a dangerous good then particular obligations are imposed on manufacturers, importers and suppliers. Obligations are also imposed on designers and installers of plant and equipment where the goods are stored and handled.

---

95 *The Monash Report*, p 46

96 The following section provides a general overview only of the regulations concerning dangerous goods and does not touch on exemptions etc. allowed under the regulations.

3.131 For example, manufacturers/importers should:

- If the dangerous good is to be stored/handled at another premises, ensure the good is packaged, contained and labelled in accordance with the Code.
- If for workplace supply, ensure the dangerous good is labelled with 'other information' to protect the health and safety of persons.
- Provide a MSDS.

3.132 Occupiers are obliged to ensure a manifest is prepared recording the total quantity of dangerous goods on premises and to notify the relevant Authority when there is likely to be large amounts of such goods stored.

3.133 The National Standard requires the person managing or controlling the storage and handling of dangerous goods to take such precautions and exercise such care as is practicable to protect the safety and health of persons and prevent damage to property and/or the environment from the risk arising from the dangerous goods. This is done by using principles of hazard identification, risk assessment and risk control to establish the safety requirements to be adopted. Practicable care means practicable having regard to, among other things, the state of knowledge about the hazard or risk and ways of removing or mitigating it.

3.134 Health risk assessment is generally in accordance with the guidelines for assessment for hazardous substances in the workplace.

3.135 As for hazardous substances, MSDS for dangerous goods must be kept up to date by suppliers and reviewed and revised at intervals not exceeding five years. Occupiers are also required to review their risk assessments of dangerous goods on their premises at least every five years or if there is a change in circumstances such that the previous assessment is no longer valid. Occupiers are also required to report incidents to the relevant authority.

WorkCover NSW

3.136 On 28 April 2008, the Committee received evidence from Mr Peter Dunphy, Director, Hazard Management Group, WorkCover NSW.[97]

3.137 Mr Dunphy said that the current State legislation is designed to cover all workplaces and all risks and emerging technologies:

> WorkCover believes that 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,

[97] Mr Dunphy, Evidence, 28 April 2008, pp 1-20

> substitution, engineering controls, administrative controls and personal protective equipment. Then of course there is ongoing review of those controls.[98]

3.138 The Committee also heard that in many cases some workplaces have long experience in addressing some of the risks associated with nanomaterials. For example there are well established methods to prevent exposure to welding fume, which contains some nanoparticles as part of the fume.[99]

3.139 Mr Dunphy did note that WorkCover understands that while the current regulatory framework is sufficient to manage the risk of nanomaterials, there are current difficulties in applying the legislatively embodied risk management principles due to the lack of knowledge and infrastructure:

> 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 measurement 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 classification is that it is not as simple as it would be for one type of chemical or material.[100]

3.140 Until more is known about the health and safety risks of nanomaterials, WorkCover supports the use of the As Low as Reasonably Achievable (ALARA) principle by industry. The ALARA 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 the process of elimination through to personal protective equipment.

3.141 The Committee heard that WorkCover was presently trying to work paractically with industry in terms of assisting them in their risk assessments, until such time as guidance material about codes of practice and potential recommendations in terms of a national standard are developed.[101]

Current extent of use of nanomaterials in NSW workplaces

3.142 The current extent of the use of nanomaterials in NSW workplaces is unclear. The submission from the NSW Government noted there is little specific information about the nature or scale of use of nanotechnology within NSW industry, and that the lack of industry statistics is an important issue.

3.143 The NSW Government submission said the Department of State and Regional Development confirmed that there were at least 23 companies within NSW that use nanotechnology within their products.[102] Dr Peter Binks, Chairman of the Australian Nano Business Forum (ANBF)

---

98 Mr Dunphy, Evidence, 28 April 2008, p 1

99 Dr Morris, Evidence, 10 June 2008, p 18

100 Mr Dunphy, Evidence, 28 April 2008, p 2

101 Mr Dunphy, Evidence, 28 April 2008, p 10

102 Submission 25, NSW Government, p 3

believed that that figure was conservative.[103] In addition to companies, nanomaterials are being handled in a number of universities.

Concerns expressed regarding the current situation

3.144 The primary concern with the current situation is not the regulatory framework itself but the lack of knowledge and capacity to enable industry to adequately meet their legislative and duty of care obligations.

3.145 Dr Howard Morris advised that the obligations, covering dangerous goods, hazardous substances and explosives, that exist for other chemicals also apply to nanomaterials. In general the OHS regulatory framework is sufficiently robust and flexible to be able to cover potential implications from engineered nanomaterials.

3.146 However, the Office of the ASCC, as part of its review of the current regulatory system, did identify the following potential regulatory issues:

- A number of issues are associated with our currently limited knowledge of the potential hazardous nature of engineered nanomaterials. Knowledge about this is rapidly developing as research findings become available. A clear issue is that we need to understand the hazards to be able to classify the materials accurately, and subsequently to provide appropriate information for users on labels, and material safety data sheets (MSDS). Identifying the chemicals present and the hazards they pose also determines the need for other regulatory requirements, such as the need to notify relevant authorities when certain materials are being used, handled or stored, or the need for routine health surveillance of workers.
- A further major issue is our current capability of undertaking reproducible workplace exposure measurement of engineered nanomaterials. This is an issue for all countries with nanotechnologies. Measurement capability is also needed to measure exposures against workplace exposure standards, and determining appropriate workplace exposure standard for engineered nanomaterials is a further issue.
- Then we also have a restricted picture of how effective conventional controls are in preventing exposure to engineered nanomaterials. However, recent research is indicating that conventional aerosol controls will be effective in preventing exposures to engineered nanomaterials in a number of situations.
- A further issue is the relationship between "reasonably practicable" and "precautionary approach" in the context of OHS legislation and nanotechnology, and this needs to be examined.[104]

3.147 As mentioned at the start of this chapter, Mr David Henry from the AMWU argued that if the current NSW OHS legislation was strictly applied it would result in a default moratorium on the development and production of products containing nanomaterials.[105]

---

103 Dr Peter Binks, Chief Executive Officer, Nanotechnology Victoria and Chairman, Australian Nano Business Forum, Evidence, 1 May 2008, pp 4-5

104 Answers to written questions on notice, 2 July 2008, Dr Morris, p 5; see also Dr Morris, Evidence, 10 June 2008, p 22

3.148 The submission from the CSIRO gave an example of where it could be argued that manufacturers, due to a lack of knowledge, would be in breach of the current regulations:

> It is not uncommon at present to be given an MSDS for a substance in the bulk or coarse form for a substance supplied at the nanoscale. The manufacturer in this case is making the assumption that the safety information pertaining to the coarse form of the product is the same as the nano form and we know this is not necessarily correct. It it can be shown that the safety information is different for the two forms then it could be argued that the manufacturer is in breach of the Hazardous Substance Regulations.[106]

3.149 Another concern raised was that workers at present may not even be aware that they are being exposed to potential risk:

> …it is a concern to us that outside the research labs in terms of the broader workplace exposure – so, for example, for workers who are involved in manufacturing paints that may have nanoparticles additives, or cosmetics, fabrics or building materials – a lot of those workers would not even know whether or not they are handling nanoparticles let alone have any safety measures in place.[107]

Committee comment

3.150 Addressing health and safety issues relating to the potential toxicity of nanomaterials in the workplace is the area that requires the most immediate attention – given that workers can be subject to continual exposure. The Committee was pleased to note the evidence it received of the amount of attention being given to this area. However, it also notes the acknowledgement that much more action is still required. The Committee believes that as much assistance as possible needs to be given to industry and workers in the interim until such time as all issues are addressed. These issues are considered in more detail later in this chapter.

The environment

3.151 As with occupational health and safety, the responsibility for regulating and enforcing environmental legislation in each jurisdiction rests with the individual States and Territories. This has resulted in varying degrees of harmonization across the jurisdictions – notwithstanding the efforts of the intergovernmental Environment Protection and Heritage Council (EPHC) to progress a national approach in many of these areas.[108]

3.152 The Australian Department of Environment, Water, Heritage and the Arts (DEWHA) administers a number of Commonwealth environmental and heritage laws, the most significant of which is the *Environment Protection and Biodiversity Conservation Act 1999*. While the objective of the Act is to provide for the protection of the environment, especially those

105 Mr Henry, Evidence, 1 May 2008, p 16; see also Answers to written questions on notice, Mr David Henry, 5 May 2008, pp 1-2

106 Submission 19, p 22

107 Ms Miller, Evidence, 1 May 2008, p 48

108 *The Monash Report,* p 23

aspects of the environment that are matters of national environmental significance, the *Monash Report* notes the Act appears to have limited relevance to nanotechnology.

3.153 For the purposes of its study the Monash Report chose to focus on the environmental regulatory framework of one jurisdiction – Victoria. During this Inquiry the Committee heard evidence from the NSW Department of Environment and Climate Change (DECC).

Department of Environment and Climate Change (DECC)

3.154 On 6 June the Committee received evidence from Mr Craig Lamberton, Director, Specialised Regulation; Ms Therese Manning, Ecological Risk Specialist; and Ms Philippa Mallen-Cooper, Manager, Chemicals Policy, Department of Environment and Climate Change.[109]

3.155 The DECC has a broad role in nature conservation, biodiversity and management of the State's resources and in improving its response to climate change. The element of the Department's role that is most relevant to the Inquiry is its regulation of environment protection, chemicals in particular. The Department regulates chemicals, radiation, dangerous goods – a range of situations where chemical-related things interact with the environment.[110]

3.156 State and Territory Environment Ministers, through the EPHC, are currently working on a national chemicals environmental management (NCEM) framework with a view to developing a national framework and series of standards.[111]

3.157 Mr Lamberton said that NSW has comprehensive and strong legislation for the regulation of chemical products over their entire life cycle to control risks to the environment:

> All of our legislation is about addressing the hazard to the environment. "Hazard" is broadly defined, so it could include nanoparticles. We regulate the cleanup of contaminated sites, in theory it could be a nanoparticle that needed to be cleaned up, although we have no experience of that yet. We regulate emissions from industry, be it air or water, and regulation of waste. We have regulations to control the life cycle of chemicals and standard producer responsibility. The producer has responsibility beyond just selling its product to the public, particularly for its ultimate disposal. We have regulations that cover pesiticide use and environmental hazardous chemicals where, again, we can regulate the entire life cycle of a chemical product to control its risk to the environment.[112]

3.158 While it had the required regulatory tools DECC advised they do not have enough information as yet on the likely downstream impacts of nanomaterials that they might encounter:

> What we need to do is go back a step, which is where we are all at the learning phase I think, and work out what types of materials are they, what sort of structures are they, are they likely to aggregate in the environment or are they likely to stay in their stable

109 Evidence, 6 June 2008, pp 20-26

110 Mr Lamberton, Evidence, 6 June 2008, p 20

111 Ms Mallen-Cooper, Evidence 6 June 2008, p 23

112 Mr Lamberton, Evidence 6 June 2008, p 20

> nanoform? There are a lot of questions we need to think about before we know how we can apply the tools that we have…we do need to know what we are dealing with. As yet I do not think we have got that clearly. We need more information.[113]

3.159 DECC advised that it is has a long-term relationship with the CSIRO centre for Environmental Contaminants Research (CECR). The Department was also involved in organising and sponsoring a conference for the Society of Environmental Toxicology and Chemistry (SETAC) one of the focus of that being nanotechnology. While the Department is not doing any research itself it is keeping abreast of developments:

> A lot of work that seems to be needed is being done overseas. It would seem not such a good idea to repeat that work. As I said, we are encouraging the CSIRO to keep going with its project and keeping up with that. But we have not initiated any additional research. We are keeping a watching brief on the international literature and talking to our colleagues, doing conference stuff and working with the United Kingdom. We are developing linkages and keeping up with the literature, but not doing any on the ground research.[114]

3.160 DECC is not concerned about the risks posed by disposal of nanomaterials through regulated disposal via landfills, given the strength of landfill technology. Rather it is the issue of the uncontrolled release of nanomaterials into the environment that is their primary concern.[115]

Current extent of nanomaterials in the environment

3.161 As noted earlier, the DECC has not had to deal with any environmental issue relating to nanomaterials. Representatives from DECC noted that the Department had limited information about the extent of nanotechnology within NSW, including what manufacturing facilities exist, what processes are being used and what nanomaterials are being imported.[116]

Concerns regarding the current regulatory system

3.162 The DECC advised that it was supportive of a national assessment of nanomaterials before they find their way into products that will be in the environment. Specifically DECC is in favour of chemicals being assessed on the basis of its physio-chemical form and properties, not assessed on the basis of its chemical name:

> …the current federal legislation again defines things by the chemical nature – the carbon example – not necessarily its physiochemical form. We believe that needs to be either clarified with the existing legislation if it can do that, and if not, change it. But either way the policy should be that chemicals should be assessed in the form in which they are going to be used not just their pure chemical nature. It may be that carbon has already been assessed, but carbon in a new form, such as a nanoparticle, should be assessed at the entry stage into Australia, by the NICNAS.[117]

---

113 Ms Mallen-Cooper, Evidence, 6 June 2008, p 22

114 Ms Therese Manning, Ecological Risk Specialist, Department of Environment and Climate Change, Evidence 10 June 2008, p 23

115 Mr Lamberton, Evidence 6 June 2008, p 22

116 Ms Mallen-Cooper, Evidence, 6 June 2008, p 22

117 Mr Lamberton, Evidence 6 June 2008, p 22

3.163 DECC argued that assessment at the national entry level would assist in avoiding the realisation of adverse environmental effects down the track:

> We are somewhat strongly supportive of a national assessment of these substances, before they find their way into products that will be in the environment and, for that matter, foodstuffs and others, so that as regulators we know what we should be looking for in each of these individual products. Some of them will be quite benign and I am sure they will provide only benefits to our society. Some of them potentially could have significant downsides. They should be assessed before they are let loose and we discover them in five or ten years' time – at which stage, of course, it is quite difficult to undo the damage.[118]

Committee comment

3.164 The Committee notes the view put forward by representatives from the DECC that the current regulatory framework should be amended so that nano-versions of existing chemicals are assessed as new chemicals. Therefore, the Committee recommends that the New South Wales Government strongly support this position when it provides input into the review of the national regulatory frameworks. This issue is further examined later in this chapter.

Recommendation 1

That the New South Wales Government recommend that nano-versions of existing chemicals are assessed as new chemicals, during the review of the national regulatory frameworks.

Consumer products

3.165 The New South Wales Office of Fair Trading administers State product safety and information laws. The *Fair Trading Act 1987* requires that certain goods must comply with safety requirements before they can be sold, and certain information about a product must be supplied with that product when it is sold. The Office of Fair Trading has powers to remove unsafe goods from sale, this includes recalling dangerous products, or issuing a public warning of a particular defect or that a product may be dangerous.

3.166 The New South Wales Office of Fair Trading declined the invitation to have representatives appear as witnesses before the Committee. Ms Lyn Baker, the Commissioner for Fair Trading advised that the Office was awaiting developments at the national level:

> There are two potential regulatory issues relating to nanotechnology that are relevant to the statutory responsibilities of the Office of Fair Trading; namely, metrology and product safety. I am advised that the National Institute of Metrology implements the Australian nano-metrology program and that the Australian Competition and Consumer Commission is maintaining a watching brief for the product safety implications of nanotechnology. No action is taking place at State level.

[118] Mr Lamberton, Evidence, 6 June 2008, p 21

> It can be expected that any regulatory activity concerning nanotechnology will be undertaken at a national level, in line with the commitments made by the Council of Australian Governments to introduce national regulatory frameworks for product safety, trade measurement and consumer policy generally.[119]

3.167 On 10 June 2008 the Committee received evidence from Ms Elaine Attwood, consumer advocate from the Consumers Federation of Australia, and a member of the Standards Australia Nanotechnology Committee, and from Mr David Vaile, Law Faculty, University of New South Wales with respect to consumer issues relating to nanotechnology.[120]

3.168 Ms Attwood tendered to the Committee a statement of conclusions taken from a report prepared for the Consumers Council of Canada. Ms Attwood said that the conclusions provide in her opinion the best statement of what consumers are looking for with respect to nanotechnology:[121]

> Consumer Attitudes and Identified Needs
>
> From initiatives that have been carried out it would appear that Canadians and citizens in many countries have a common set of attitudes about the technology and opinions about what is needed. These include:
>
> 1. The need for greater transparency and disclosure about which products contain nanomaterials and how industry is using and plans to use the technology.
>
> 2. Limited trust in government or industry to manage any potential risks associated with nanotechnologies and the materials produced.
>
> 3. The need for pre-market testing to ensure that the nanomaterials do not pose a risk to human health or the environment.
>
> 4. A requirement for third-party testing by an independent certifying agency to verify the safety of the products.
>
> 5. The need for research to be carried out to determine the longer term risks and impacts on human health and the environment.
>
> 6. Greater engagement of the public in shaping how the technology is developed, managed and regulated.
>
> 7. Public wariness is of potentially negative, unintended and long-term consequences of new technologies.
>
> 8. Less support for the use of nanomaterials in high exposure applications such as cosmetics and food or in nano sensors that could affect their privacy.[122]

---

119 Correspondence from Ms Lyn Baker, Commissioner for Fair Trading, 29 May 2008

120 Ms Attwood, Evidence, 10 June 2008, p 11; Dr David Vaile, Cyberspace and Law Reform, University of New South Wales, Evidence, 10 June 2008, pp 9-17

121 Ms Attwood, Evidence, 10 June 2008, p 11

122 Tabled document, Ms Elaine Attwood, *Nanotechnology and its impact on consumers*, 10 June 2008, p 1

Current extent of nanomaterials in consumer products

3.169 It is impossible to state the extent of consumer products that contain nanomaterials, as there is no requirement for manufacturers to acknowledge nanomaterial content. Ms Attwood said that she believed there were approximately between 550 to 650 products currently in the marketplace.[123]

Concerns regarding the current regulatory system

3.170 Ms Attwood said that the two issues of most importance from a consumers' perspective were safety and labelling. She argued that the public needed to be educated on the topic of nanotechnology and that in her opinion the single, most effective means of getting information to the consumer is by the use of labelling.[124]

Committee comment

3.171 The Committee raised the issue of labelling products to identify the presence of nanomaterials throughout the course of the Inquiry. This issue is examined later in this chapter.

The review of the national regulatory framework

3.172 The Australian Government advised that as part of the National Nanotechnology Strategy (NNS), it was actively reviewing the existing regulatory frameworks to ensure they appropriately address the impacts of nanotechnology. Funding of $3.3 million over two years has been provided to the relevant agencies to undertake this work.[125]

3.173 That submission noted that the NNS recognises that health, safety and environment (HSE) issues associated with nanotechnology will also likely impact State and Territory regulatory frameworks. It advised that in this context there are well-established mechanisms for interaction between the Australian Government and States/Territories on HSE issues, and that these will be used to consult with the States/Territories. The submission cited as examples of these mechanisms the ASCC for occupational health and safety, and Ministerial Councils related to the environment, transport and health.[126]

3.174 At the public hearing on 4 August 2008, Mr Craig Pennifold, Head, Innovation Division, Department of Innovation, Industry Science and Research (DIISR) advised the Committee on the status of the regulatory review. Mr Pennifold commenced by referring to two key documents that were released by the Australian Government in July:

> On 11 July 2008, Senator Kim Carr, Minister for Innovation, Industry, Science and Research, released two documents supporting policy and regulatory activity by the Commonwealth Government. The first is a review of possible impacts of

123 Ms Attwood, Evidence, 10 June 2008, p 16

124 Ms Attwood, Evidence, 10 June 2008, p 12

125 Submission 23, Australian Government – Department of Innovation, Industry, Science and Research, p 8

126 Submission 23, p 5

> nanotechnology on Australia's regulatory frameworks, which we refer to as the Monash Report.[127] The second is the Australian Government Approach to the Responsible Management of Nanotechnology, which we refer to as the objectives paper. Both of these documents can be accessed through the website of the Australian Office of Nanotechnology. Together they provide a clear blueprint for how the Commonwealth Government will be addressing key issues relating to nanotechnology and its regulations.[128]

The Objectives Paper (Australian Government Approach to the Responsible Management of Nanotechnology)

3.175 The Objectives Paper has three high-level objectives, namely to: (1) protect the health and safety of humans and the environment, (2) foster informed community debate, and (3) achieve economic and social benefits from the responsible adoption of nanotechnology.

3.176 The introduction to the Objectives Paper states that there has so far been no demonstrated need for a specific regulatory system for engineered nanomaterials. With respect to the objective of protecting the health and safety of humans and the environment, the document states:

> Appropriate consideration of risks to human health and safety and the environment is an integral part of the development and application of nanotechnology.
>
> This will be achieved by continuing to:
>
> - use an evidence based approach to making decisions about nanotechnology
> - use existing regulatory frameworks to deliver an efficient and effective response to the health, safety, and environmental impacts of nanotechnology
> - ensure that regulatory schemes are reviewed to assess their ongoing ability to deal with the impact of nanotechnology, and regulatory or procedural changes implemented as necessary
> - apply a precautionary approach consistent with Australia's international obligations, including the Rio declaration, and
> - ensure information about the health, safety and environmental impacts of nanotechnology is based on scientific research.[129]

The Monash Report – six regulatory gaps

3.177 The tender to undertake the review of the possible impacts of nanotechnology on Australia's regulatory frameworks was awarded to members of the Monash Centre for Regulatory Studies in January 2007. The final report, the Monash Report, dated September 2007, was submitted

---

127 *A Review of Possible Impacts of Nanotechnology on Australia's Regulatory Framework, Final Report*, September 2007, Monash Centre for Regulatory Studies, Faculty of Law, Monash University

128 Mr Pennifold, Evidence, 4 August 2008, p 1

129 *Australian Government Objectives for the Responsible Management and Oversight of Nanotechnology,* July 2008

to the Government in October 2007.[130] Prior to its public release, the Committee's attention was drawn to the value of the report.[131]

3.178 The review concluded that while there is no immediate need for major changes to the regulatory regimes, there are many areas of those regimes which potentially will need amending, and this will be a long term effort across multiple regulators and regulatory agencies as nanoproducts arise and as new knowledge on hazards, exposure and monitoring tools become available.

3.179 It also noted that all regulatory frameworks applying to conventional products also applied to nanomaterials, and applied equally throughout the product lifecycle. Many regimes also had significant latent potential to restrict the availability or use of nanomaterial based products as our knowledge of specific HSE effects increases.[132]

3.180 One of the report's authors, Professor Graeme Hodge, told the Committee that the framework itself is robust, however to apply the framework so as to address the challenges posed by nanomaterials will depend on acquiring new knowledge and tools. Professor Hodge said that there are six areas that will more than likely require amendment.[133]

'New' or 'Existing' substances or products

3.181 With respect to this area, the Monash Report concluded:

> The most significant potential gap concerned the uncertainty as to whether new nanoforms of conventional products would be considered as 'different' to traditional products. Existing regulation is often on the basis of the naming of particular substances or articles for prohibition (in the case of hazardous pesticides for example) or for permission (in the case of, say, a therapeutic good [or an industrial chemical]). To the degree we are uncertain if future nanoforms of conventional products will be considered the same as the named conventional entity, uncertainty will also exist in the application of such regulations to nanomaterials. And insofar as nanoforms are different to their conventional counterparts, revisions are likely to be required to most frameworks to ensure clarity.[134]

Regulatory triggers based on weight or volume

3.182 With respect to this area the Monash Report concluded:

> Many regulatory triggers currently exist on the basis of a threshold weight or volume. For nanomaterials, such thresholds may not be meaningful because: current production levels of nanomaterials are low; our present scientific knowledge does not support the appropriateness of these threshold levels for nanomaterials; and there are

130 Submission 1, Monsah Centre for Regulatory Studies, p 1

131 Submission 9, p 12

132 *The Monash Report*, p 5

133 Professor Graeme Hodge, Monash Centre for Regulatory Studies, Evidence, 28 April 2008, p 22

134 *The Monash Report*, p 5

> in any case real difficulties in simply measuring the presence of nanomaterials currently.[135]

Triggers requiring knowledge of presence and/or risks posed by presence of nanomaterials

3.183 With respect to this area, the Monash Report concluded:

> In some instances, appropriate regulation requires particular knowledge of either the presence of nanomaterials and/or the risks posed by the presence of nanomaterials. Current public awareness and scientific knowledge is such that these triggers are unlikely to be met. The current federal regulatory framework for foods, as administered by Food Standards Australia New Zealand (FSANZ), for instance, stipulates that articles and materials are not to be in contact with food if such contact is 'likely to cause bodily harm' – and yet current deficiencies in knowledge are such that we simply do not know the effects of some engineered nanomaterials on human health.[136]

Triggers reliant on risk assessment protocols or conventional techniques

3.184 With respect to this area, the Monash Report concluded:

> Australia's current regulatory regimes often rely on risk assessment protocols as a means of ensuring human or environmental safety of products or applications. However, if these protocols are not appropriate for determining the potential risks of nanomaterials, current regulatory arrangements may not be adequate for protecting human or environmental health. For example, it is uncertain whether current risk assessment methodologies being employed by various regulatory agencies are suitable for goods that contain nanomaterials. Such uncertainties reduce confidence in the results of assessments.[137] Those regulatory frameworks which have human and environmental risk assessments as part of their regime will also face difficulties given it is not known whether current toxicology testing techniques are suitable for nanomaterials.[138]

Research and development exemptions

3.185 With respect to this area, the Monash Report concluded:

> There have always been specific exemptions relevant to research and development uses of conventional materials and this will continue for nanomaterials. But these exemptions may be of greater significance for potentially hazardous nanomaterials and their products.[139]

---

135 *The Monash Report,* p 5

136 *The Monash Report*, p 5

137 *The Monash Report,* p 6

138 *The Monash Report,* p 94

139 *The Monash Report,* p 6

Triggers reliant upon international documents

3.186 With respect to this area, the Monash Report concluded:

> A number of the regulatory frameworks incorporate or allow applicants to rely on international documents or documents produced by bodies other than the regulator. This is a potential regulatory gap if those documents themselves do not adequately address HSE concerns raised by nanomaterials.[140]

Review activity and potential outcomes

3.187 The Committee heard that each of the regulatory agencies at the Commonwealth level were working its way through the *Monash Report* and assessing how the particular regulatory triggers apply to them and what needs to be done as a result.

3.188 The Committee heard evidence from a number of these regulatory agencies on what activities they had undertaken or were planning as part of the review, and is some cases indications were given of likely outcomes. The Committee also heard from other stakeholders on the regulatory and other changes that they believe are necessary.

Occupational health and safety – Australian Safety and Compensation Council and WorkCover NSW

3.189 The Committee supports the view that addressing nanomaterial OHS issues in the workplace is the area that most urgently requires action. The Committee was pleased to hear evidence of the action being undertaken and planned.

3.190 In support of the National Nanotechnology Strategy, the Office of the ASCC under the auspices of the federal Department of Education, Employment & Workplace Relations (DEEWR) has implemented a nanotechnology occupational health and safety research and development program. This program has Australian government funding up to the end of the 2008-2009 financial year to examine and address nanotechnology OH&S issues.[141]

3.191 The program manager, Dr Howard Morris, said the objective of the program is to help ensure the effective control of exposure to the expanding range of engineered nanomaterials that are now being produced and made available and also to help the increasing number of research laboratories in workplaces where the nanomaterials are being used.[142]

3.192 There are four areas of work within the program:

- Reviewing the Australian OHS regulatory framework in relation to nanotechnology.
- OHS support for Australian nanotechnology businesses and research laboratories.
- Evaluation and development of workplace controls for preventing (or minimising) exposures to engineered nanomaterials in the workplace.

---

140 *The Monash Report*, p 94

141 Dr Morris, Evidence, 10 June 2008, p 18

142 Dr Morris, Evidence, 10 June 2008, p 18

- Undertaking, commissioning and coordinating Australalian nanotechnology OHS research.[143]

3.193 As part of the program, a Nanotechnology OHS Reference Group has been established. It has a broad membership including representatives from State and Territory health and safety regulators, the Australian Council of Trade Unions, the Australian Chamber of Commerce and Industry, NICNAS and the Australian Office of Nanotechnology. In evidence, Dr Morris outlined the role of the group:

> Broadly speaking, the group will support the implementation of the national nanotechnology occupational health and safety research and development program and provide support for a coordinated national approach to the management of occupational health and safety in nanotechnology. It will provide a forum to develop national positions, which may be proposed to the ASCC for endorsement…It will be looking to facilitate a coherent, consistent approach across Australian stakeholders, for example, across the States and Territories.
>
> The group will look to support the work of member organisations in managing nanotechnology occupational health and safety, for example New South Wales WorkCover. It will aim to prevent duplication of, for example, the research and other programs that are underway in Australia. It will certainly examine key issues such as the regulatory framework and manage occupational health and safety regulations. It will promote effective sharing of information. Finally it will provide advice on prioritisation for projects and research focus in the program and identify new projects for consideration.[144]

3.194 The focus of the program will be on the management of engineered nanomaterials in the workplace. However, its outcomes should also be applicable to the management of nanoparticles that are produced incidentally and have existed previously in the workplace:

> …we will be looking to help manage engineered nanomaterials in the workplace…there have been a lot of nanoparticles around in the air, combustion products produced as incidental nanoparticles and processes for a long, time, but specifically the work that I will be focussing on is looking to assist with the management of engineered nanomaterials. The information on, for example, control methodologies, which is known, can be applied to the control of engineered nanomaterials. Conversely, what we find out from looking at engineered nanomaterials should also then be applicable to processes which produce nanoparticles incidentally.[145]

3.195 The Office of the ASCC has conducted a preliminary review of the national OHS regulatory framework. During his appearance before the Committee on 10 June 2008, Dr Morris advised that the Office of the ASCC intended to present a position paper on the overall national framework to the Nanotechnology OHS Reference Group at its first meeting in mid July.

---

143 Answers to written questions on notice, 2 July 2008, Dr Morris, p 6

144 Dr Morris, Evidence, 10 June 2008, p 20

145 Dr Morris, Evidence, 10 June 2008, p 20

3.196 Dr Morris suggested that the next step would be for the State and Territory OHS regulators to examine the paper and identify where there may be implications for their respective regulations and codes of practice for nanotechnology.

3.197 As well as the work on the review of the regulatory framework, the Committee was informed of the activity and focus of research in support of the other three areas of work within the program.

3.198 The program commissioned work to undertake an up-to-date review and evaluation of research on the toxicology of engineered nanomaterials. This will update information in the previous review document of the Office of the ASCC, *The Potential OHS Implications from Nanotechnology*, which was published in July 2006 and has been available on the ASCC website. It was anticipated that the new review report would be completed by the end of August and subsequently placed on the ASCC website. The report is to include a critical examination of the similarity of the properties of carbon nanotubes and asbestos.

3.199 The program also aims to commission or support toxicology research in Australia on topics of specific interest to Australia. This will also add to global knowledge and enable Australia to become involved in and contribute to the essential international collaborative work and derive benefits from those programs, for example through the OECD's Working Party on Manufactured Nanomaterials program.

3.200 The program has also established a Nanotechnology OHS Measurement Reference Group to bring together regulators, researchers and hygienists with expertise in measurement of nanoparticles in the workplace to develop Australian capability in this area by evaluating techniques and providing guidance to industry researchers and relevant practitioners on best practice measurement techniques.

3.201 The program commissioned a review of the evidence of the effectiveness of conventional workplace exposure controls for nanomaterials. This was anticipated to be completed by the end of August 2008, and then subsequently published.

3.202 In terms of actively disseminating relevant OHS information, new nanotechnology OHS webpages were published on the ASCC website in March 2008. These webpages are to be regularly updated.

3.203 The program also plans to establish or support field studies work by an expert team or teams to assess and provide advice for organisations. This will include a survey of controls that are being used in nanotechnology organisations in Australia.

3.204 The Office of the ASCC advised of research undertaken by workers from the Queensland University of Technology that identified the emission of nanoparticles from some laser printers. The Office intends to provide funding for a third stage of the project, which aims to characterise workplace exposures, examine the effect of ventilation on exposures, and develop guidance material.[146]

146 Answers to written questions on notice, 2 July 2008, Dr Morris, p 6

National Industrial Chemicals Notification and Assessment Scheme

3.205 NICNAS has identified nanomaterials as an important emerging issue for some time and has been involved in work in this area for some number of years.[147] The Committee acknowledges that the public information provided by NICNAS on nanomaterials and nanotechnology via its information sheets and available on its website are useful resources.

3.206 At the public hearing on 10 June 2008, NICNAS advised that in their own review of their current regulatory framework that there were a number of questions that they were actively exploring:

> What is a manufactured nanomaterial?…How do we assess the risks or potential risks that might be associated with nanomaterials? Then there is the management of those risks and the stakeholder engagement. They are the questions that we see that we need to address and they are the ones that we are actively working on. We have a number of strategies to try to address those questions.[148]

3.207 With respect to stakeholder engagement NICNAS advised that it had formed a nanotechnology advisory group involving industry and the community. Industry is involved because it provides data for new chemicals and bottom end materials and the community because it is empowered to nominate chemicals of concern that NICNAS should be assessing. Therefore both groups need to be aware of the implications and characteristics of nanomaterials.

3.208 Subsequent to the public hearing NICNAS provided the following response to the Committee's request for information on the progress of its review and any indicative outcomes to date:

> …NICNAS considers that its regulatory framework (the *Industrial Chemicals (Notification and Assessment) Act 1989* [the ICNA Act] and associated regulations and administrative processes) is able to accommodate the assessment of nanomaterials…
>
> The current limitations on the assessment of nanomaterials, either under the current NICNAS processes or any redesigned process, is the current lack of comprehensive physico-chemical and hazard data on these chemicals.
>
> To address these issues, NICNAS is actively participating in the OECD Working Party on Manufactured Nanomaterials, which is running projects to develop testing protocols suited to nanomaterials, and to characterise and test a representative set of nanomaterials.[149]

3.209 NICNAS views the OECD work as particularly important and believes the results of that will lead it to the answers in the long-term for nanomaterials.[150]

---

147 Dr Gredley, Evidence, 10 June 2008, p 40

148 Dr Gredley, Evidence, 10 June 2008, p 42

149 Answers to written questions on notice, 22 July 2008, NICNAS, p 5

150 Dr Gredley, Evidence, 10 June 2008, p 40; Dr Healy, p 42

Assessment of nanomaterials as new chemicals

3.210 As noted previously, the position that nano versions of existing chemicals should be assessed as new chemicals is supported by a number of Inquiry participants. The basic underlying argument is hard to rebuff: chemicals are assessed and regulated accordingly in order to address their inherent characteristics and risks – if a nano version of a chemical has different characteristics and presents different risks then it should be assessed and regulated according to its specific risks.

3.211 Friends of the Earth Australia, while still considering whether specific legislation for nanomaterials is required, believe that this requirement is the first step that should be taken:[151]

> If you have substances that behave in novel ways, we think you need to subject them to new assessment. You cannot grandfather them, if you like, under the existing assessment of the larger particles.[152]

3.212 In support of its position, Friends of the Earth draw attention to 2004 report of the United Kingdom's Royal Society and Royal Academy of Engineering, which recommended that nanomaterials should be treated as new chemicals and be subject to new safety assessments prior to their inclusion in consumer products.[153]

3.213 As noted previously the NSW Department of Environment and Climate Change also supported national assessment of chemicals on the basis of their physio-chemical properties.

3.214 Dr Diana Bowman, one of the authors of the Monash Report, told the Committee that this question of whether nanoforms of existing chemicals need to be assessed anew is one that is currently being grappled with around the world. Dr Bowman cited an example which highlighted the complexity of what might on first glance appear to be a simple decision:

> 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 nanometres or 20 nanometres – 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…You can now look up a CAS 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 CAS 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.[154]

151 Ms Miller, Evidence, 1 May 2008, p 50

152 Ms Miller, Evidence, 1 May 2008, p 48

153 cited in Submission 9, p 3

154 Dr Bowman, Evidence, 28 April 2008, p 24

3.215 It was pointed out that if a decision was made by NICNAS to require new assessments of new nano-versions of existing chemicals, then the question of workload ultimately arises:

> 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.[155]

3.216 The Committee asked NICNAS in writing that if the decision was made to assess all nano-versions of existing chemicals whether this would present a resource problem:

> NICNAS is a cost-recovered agency, whereby new chemicals assessments incur a fee and assessors can be brought into the organisation as the workload demands
>
> NICNAS is addressing its infrastructure needs by:
>
> - Participating in the OECD Working Party on Manufactured Nanomaterials to access data on nanomaterials and information on assessment protocols
> - Participating in the HSE Working Group and associated projects under the NNS to share information and build technical capacity with other Australian regulators
> - Increasing awareness amongst industry and community to collect data on the introduction of industrial chemicals.[156]

Therapeutic Goods Administration

3.217 As discussed previously the TGA has a comprehensive assessment, regulation and post-marketing surveillance regime. It is particularly robust with respect to registered therapeutic goods. The Committee issued a written request for advice on the progress of the TGA's review of its regulatory framework and on any indicative outcomes.

3.218 The TGA advised that to date their system has proven to be effective in managing therapeutic products incorporating a range of new and emerging technologies, including nanotechnologies. They further advised there is currently no evidence from post-marketing surveillance that regulatory arrangements prior to marketing are insufficient to identify hazards associated with therapeutic goods that incorporate nanotechnologies.

3.219 Nevertheless the TGA is committed to ensuring its system remains valid in the face of increased number and sophistication of nanotechnologies:

> The TGA is conducting a thorough review of its regulatory guidelines and a scientific review of the literature in particular with respect to therapeutics incorporating nanotechnologies. Present indications are that although it is possible that nanomaterials may elicit novel toxic effects (compared to conventional materials) there is no reason to believe that nanomaterials may pose hazards not addressable by a rational scientific approach under the TGA's regualotry framework.

---

155 Professor Hodge, Evidence, 28 April 2008, p 24

156 Answers to written questions on notice, 22 July 2008, NICNAS, p 4

> Nevertheless the TGA recognises that nanotechnologies and other emerging technologies will continue to present significant scientific and policy challenges now and into the future. The best response to such challenges is the maintenance and continued development of high quality scientific expertise within the agency together with ongoing interaction with sponsors, researchers, regulators and policy makers throughout Australia and internationally. The TGA will continue to closely monitor developments around nanotechnology internationally to ensure a rapid response to any new issues identified.[157]

3.220 The Committee also specifically inquired, with respect to ingredients in listed medicines, whether the TGA considered nanomaterial ingredients as "well-known established" ingredients on the basis of the knowledge of the bulk form of the material.

3.221 The TGA pointed out that while different regulatory arrangements apply to registered and listed goods, both commodities are evaluated for quality and safety. Nevertheless the TGA is reviewing this matter as part of its review:

> The TGA has considered additional safety concerns that may be associated with potential differences in toxicological profiles between nanoparticulate and conventional (bulk) materials where the physical and chemical properties have warranted such consideration, for instance in the case of some sunscreen ingredients.
>
> The impacts of a potential increase in the number of nanotechnologies on this class of products is under further review as part of the TGA initiatives under the National Nanotechnology Strategy.[158]

Australian Pesticides and Veterinary Medicines Authority

3.222 The Acting CEO of the APVMA, Mr James Suter, saw the need to review the APVMA's current regulatory framework as pressing:

> We have developed our own roadmap of activities to progress the regulation with nano forms of technology for AgVet. We realise that this technology is moving at a pretty fast pace and there is a pressing need for us to ensure that we have our regulatory processes in place to receive applications for nanomaterials. It is a bit challenging in that, as I understand it, there is not yet an internationally agreed and accepted definition of nanomaterial. Given that it is an emerging technology, there are some knowledge gaps around it.[159]

3.223 As part of its internal review APVMA advised has created a dedicated staff position to review its current procedures for making applications to register AgVet products, to review its current regulatory framework and data requirements, to undertake a stock-take of existing registered products with the AgVet industries, and staff training.

3.224 Dr Reeves advised that, at the preliminary stage of their review, they believe that the existing regulatory framework, albeit with minor amendments, will be suitable for nanomaterials. Two

---

157 Answers to written questions on notice, 17 June 2008, Therapeutic Goods Administration, pp 1-2

158 Answers to written questions on notice, 17 June 2008, Therapeutic Goods Administration, pp 2-3

159 Mr Suter, Evidence, 10 June 2008, p 28

aspects of the existing regulatory framework will be worthy of special consideration – the risk assessment protocols and the regulatory triggers.

3.225 With respect to ensuring that regulatory triggers are suitable for nanomaterials, the APVMA believe that one amendment to the regulations may be necessary;

> …currently there is a situation where the regulations allow trial work without regulatory approval for quantities of veterinary chemicals of up to three kilograms or agricultural chemicals up to six kilograms. Clearly, if we are dealing with nanoforms of those materials, we would want to revisit those trigger points.[160]

3.226 Under the intergovernmental agreement that established the National Registration Scheme for AgVet products, any amendment process to the regulations cannot be undertaken by the APVMA is isolation, but must involve the participation of the State, Territory and Australian Governments.

3.227 The APVMA also noted that in the conduct of toxicity and residue assessments prior to assessment, reliance can be made on international documents such as the Joint FAO/WHO Meeting on Pesticide Specification (JMPS) which include standards of composition. In the past these documents have not dealt with the characterisation of pesticides containing nanomaterials.[161]

3.228 With respect to risk assessment protocols, the APVMA, like all other regulatory agencies, highlighted the need for the development of the knowledge and capacity to adequately assess nanomaterials and from that develop standard protocols. Again, like other regulatory agencies, it particularly noted the project being undertaken by the OECD:

> Of particular interest to the APVMA is the work of the working party for manufactured nanomaterials, which is testing a representative set of industrial chemicals. Much valuable information on the safety of nanomaterials will be generated by using predictive modelling by that project and similar projects.[162]

3.229 Dr Reeves said that their current legislation provided for assessing nanomaterial ingredients in AgVet products:

> In practical terms this means that the conventional form and the nanoform of an active constituent of an AgVet chemical product may be assessed as distinct chemical entities of chemical products. Different risk assessment protocols may then be applied to the conventional form and the nanoform, if that is necessary. We expect that this scenario will arise quite often, especially in situations where product formulations are altered by replacing a conventional form with the nanoform of the chemical in order to achieve an improved efficacy profile.[163]

3.230 The APVMA is revising its application requirements with a view to requiring applicants wishing to register a product advising on the application form whether the product contains

---

160 Dr Reeves, Evidence, 10 June 2008, p 29

161 Answers to questions taken on notice, 29 June 2008, APVMA, p 2

162 Dr Reeves, Evidence, 10 June 2008, p 29

163 Dr Reeves, Evidence, 10 June 2008, p 28

an engineered nanomaterial. Nomination of the presence of an engineered nanomaterial will not automatically require a differential assessment, but will flag to the APVMA the need to consider that decision.

Committee comment

3.231 It is apparent that the development of the scientific knowledge and capacity to adequately assess nanomaterials and the development of agreed standard protocols by which to assess them is the most significant issue with respect to the regulation of nanomaterials.

3.232 It appears unlikely that any regulatory requirement for mandatory assessment of *all* nanomaterials is likely to be enacted until such time as an effective capacity to conduct those assessments is available. As is discussed in Chapter 4, the OECD project that the regulatory agencies believe will provide the basis for this capacity is a long-term effort.

3.233 The Committee supports the intention of the APVMA to require applicants to identify the presence of engineered nanomaterials. It is worthwhile to have industry become used to this type of reporting and allow regulatory agencies to consider whether an assessment under the current framework should be considered.

Completion of the federal review

3.234 The Committee was interested to learn when the review by the various federal regulatory agencies would be completed and how and when the respective States and Territories could have input into the process and the ultimate outcome. A number of New South Wales agencies from whom the Committee heard evidence had limited information on how the review relevant to their area was progressing and were eagerly awaiting an opportunity to feed into the process.

3.235 Mr Craig Pennifold, from the federal Department of Innovation, Industry, Science and Research told the Committee that the federal regulatory agencies were now working through the *Monash Report*:

> Each of the regulatory agencies at the Commonwealth level is now working its way through that report. We really commissioned it as some internal work for regulators who wanted to get on the front foot with these issues. Now we are progressing our way through each of those and each of the agencies has a work plan in place to address how those particular triggers apply to them and what needs to be done as a result.[164]

3.236 Mr Pennifold said the overall process will be a long-term effort across multiple regulators and agencies. He noted that much of the research that will be necessary for effective regulation will be fairly medium to long term:

> …now we have identified where the gaps might be, there are certainly some areas where there is a lack of scientific knowledge. We will look at not only a national level but also an international level as to how we might best fill those gaps. In evidence before the Committee the CSIRO ha been engaged within a project in the OECD

[164] Mr Pennifold, Evidence, 4 August 2008, p 13

> where this is the sort of activity that is happening on a global scale and a number of countries are trying to work together to start looking at these toxicity and other issues that are facing everyone in this area of nanotechnologies.[165]

3.237 In the more immediate term an overall plan for what needs to be done on a national scale is to be developed by 30 June 2009:

> The work that our regulatory agencies undertake is already underway. So we will draw that together over the course of the current year. Then we will provide advice to Government about what else needs to be done. You would be aware that funding for the current NNS expires as at 30 June 2009 and Minister Carr has asked that the review of the national innovation system look at this issue of platform or enabling technologies to determine what should be the best approach to take after that date.[166]

3.238 With respect to consultation and liaison between the federal and State agencies regarding regulatory framework amendments or changes, Mr Pennifold expected it would occur on two levels, through the Nanotechnology State and Territories Committee (NSTC) and through existing liaison mechanisms:

> I think there are two levels. We have the committee I referred to at quite a high level, which deals with what I suppose you would call the coordinating agency in each jurisdiction. Below that each of the regulators has quite a significant relationship with their counterparts in each State. This is where the complexity of the regulatory system comes in. We would expect that they would be working with their State counterparts, whether it be in workplace safety, food or wherever the situation lies.[167]

3.239 Based on the evidence it received it appears uncertain to the Committee exactly how New South Wales agencies will be provided with an opportunity for involvement in the review process. The Committee views such involvement as important, particularly given the views expressed in evidence to the Committee.

3.240 The Committee acknowledges the broad range of inclusive activity being coordinated by the Office of the ASCC, with respect to the review of occupational health and safety regulatory framework. However, at the time they gave evidence to the Committee both the NSW Food Authority[168] and the NSW Department of Climate Change and Environment had not been involved in, or received any indication of the reviews being conducted by their relevant federal counterparts.

3.241 Both State agencies expected that consultation would occur after the reviews at the federal level were completed. DECC envisaged it would occur following a national whole-of-government position:

> The Commonwealth is currently doing its own review of nanotechnology, which we have not yet been party to yet. We are quite interested to see what comes from that.

---

165 Mr Pennifold, Evidence, 4 August 2008, p 15

166 Mr Pennifold, Evidence, 4 August 2008, p 15

167 Mr Pennifold, Evidence, 4 August 2008, p 13

168 Dr Szabo, Evidence, 6 June 2008, p 17

> We hope they will take on board the recommendations we have discussed this morning in terms of earlier assessment.
>
> They are currently doing a study of regulatory adequacy in Australia for managing nanoparticles. That is broad in scope. I think they are still developing that. When the Commonwealth has developed a whole-of-government position on that, it will then consult with its State and Territory counterparts across agencies.[169]

Committee comment

3.242 The Committee believes that NSW needs to have an effective voice in the review process, whether it be while it is happening or following a position being put by the federal government. In either case, given the broad scope of the national regulatory review and the number of State agencies that are involved, the position of any NSW agency would be enhanced if it is part of a coordinated position.

3.243 The Inquiry provided a forum for those agencies that attended to present their views on what is required. This should be coordinated to ensure that any federal-State agency to agency consultation is consistent. All relevant State agencies should contribute towards developing a coordinated position.

Recommendation 2

That the NSW Government ensure that all relevant State regulatory agencies be involved in developing a coordinated and cohesive position on what amendments, if any, are required to the current regulatory frameworks in order to best regulate nanomaterials over their life-cycle.

3.244 The Committee believes that one government agency or department should be given the lead role in coordinating this position. In Chapter 5 the Committee examines how the Government can best approach the responsible development of nanotechnologies, which includes the question of the need for a specific agency or unit to take responsibility for nanotechnology issues.

The regulatory interim

3.245 The *Monash Report* found that, in view of the low state of nanomaterial knowledge, the path ahead will be a long term effort as regulators and regulatory agencies improve their understanding of nanomaterials and adjust regulatory arrangements in the light of this understanding.[170]

3.246 The important question, and one that is causing concern to many, is what should or can occur in the period until this scientific knowledge and the capacity to adequately assess, and thus

169 Ms Mallen-Cooper, Evidence, 10 June 2008, p 25

170 *The Monash Report*, p 6

regulate nanomaterials, becomes available. The Committee believes that some actions are required in this regulatory interim.

The As Low As Reasonably Achievable approach in the workplace

3.247 In its submission to the Inquiry the NSW branch of the Australian Manufacturing Workers' Union (AMWU) calls for a moratorium on the research, development and production of nanotechnology while regulations are developed to protect workers and the public from potential harm.[171] The submission included the following recommendations,[172] each of which the Committee was requested to consider on its merits:[173]

- The formation of a tripartite oversight body for the purpose of ensuring workers health and safety when working with nanotechnology.
- Research and development of monitoring systems for nano-particles in workplace environments that can provide accurate information on worker exposure in real time.
- The development of hazard identification, assessment and control mechanisms.
- The development of exposure standards that are lower than those currently applied to larger toxic materials.
- Enact health and safety legislation specifically addressing nanomaterials.
- Enforce the exposure standards using an active inspectorate.
- Regulate nano manufacturers, labs, suppliers and importers. Such regulation must retroactively cover all nanomaterial products already on the market.
- Register nano manufacturers, labs, suppliers and importers.
- Develop labels for nano materials used in the workplace and as end products.
- Mandate the monitoring of workers potentially exposed to nanoparticles.
- Research into the health effects of nanoparticle exposure on humans.
- Prohibit the marketing of untested or unsafe uses of nanomaterials and requiring product manufacturers and distributors to bear the burden of proof.

3.248 The submission from the NSW Government said that until more is known about the health safety and environment risks of nanotechnology, the Government supports industries adopting the ALARA precautionary approach.

3.249 The Committee sought information on what was being done to support, encourage or assist industries in adopting the ALARA approach. WorkCover NSW advised:

171 Submission 4, p 7

172 Submission 4, p 3

173 Mr Henry, Evidence, 1 May 2008, p 19

> WorkCover supports the "as low as reasonably achievable" approach, which was agreed to by jurisdictions at the August 2007 Australian Safety and Compensation Council meeting, while efforts continue with research and development activities. The use of the "as low as reasonably achievable" approach seeks to minimise worker exposure to nanomaterials. This approach is entirely consistent with the current New South Wales regulations and uses a hierarchy of risk controls (incorporating elimination, substitution, engineering controls, administrative controls and the use of personal protective equipment).
>
> WorkCover is working proactively to develop networks with industry stakeholders in order to facilitate the sharing of information between industry and regulators (such as the commitment to the "as low as reasonably achievable approach by jurisdictions and the Australian Safety and Compensation Council).[174]

3.250 The submission from the AMWU was strongly critical of the proposal that, until such time that workplace exposures can be established, industry should control exposure through the application of the ALARA approach:

> The problem with this proposal is there is no way to monitor the exposure of workers to nanoparticles or for that the exposure in the working environments. There is also no known safe level of exposure.
>
> Due to the limited knowledge of the health and safety impacts of occupational exposure to nanotechnology, it is currently impossible to carry out a precise, quantitative risk assessment.
>
> It is difficult to apply OHS legislation to nanotechnology due to the identified difficulties in undertaking a risk assessment and developing a risk management plan. An effective gap analysis of how existing legislation applies to nanotechnology will not be possible until further knowledge of measurement procedures and exposure levels is gained.[175]

3.251 The submission from the CSIRO pointed out that in most instances the elimination option is unlikely to be considered for nanomaterials. It considered that in the absence of a complete understanding of the toxicity of various nanoparticles, a prudent approach is to consider all nanoparticles as potentially hazardous until research provides definitive data. Any potential exposure should be limited to levels that are as low as is reasonably practical to achieve.[176]

3.252 Dr Howard Morris advised the Committee of recent research regarding the toxicity of long multi-walled carbon nanotubes (this research is discussed later in the next chapter). The findings give solid grounds for caution. Dr Morris noted that it was his understanding that in Australia at present multi-walled carbon nanotubes are handled in a significant number of university laboratories.

3.253 At the moment he said it is recommended that users of these materials should apply the best possible practicable methods to control exposure until more is known about the extent of the health hazards:

---

174 Answers to written questions on notice, 12 September 2008, WorkCover NSW, pp 5-6

175 Submission 4, p 7

176 Submission 19, p 20

> I agree that there will be expense involved in establishing these controls. However, at the moment we would suggest that organisations use the best practicable means to control. By 'practicable' we mean considering factors such as current understanding of how effective controls are and what they cost, and taking them into consideration. [177]

3.254 In November 2007, NanoSafe Australia produced a report on best occupational health and safety in Australian nanotechnology. The report, which was commissioned by Nanotechnology Victoria (NanoVic), included details on engineering controls available at the time.

3.255 Professor Wright, while of the view that the current OHS system needs improvement, noted that Australian industry has a long-standing history of working with ultra-fine particles in the air in industrial and mining environments. He argued that some of control measures used in these industries would be readily applicable to nanotechnology manufacturing sites:

> 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 sites might have for processing certain things that also has ultra-fines. So all we need to do is make sure that people [that] are handling them are using the correct workplace controls.[178]

3.256 Mr Henry argued it was important to be able to identify companies whose workers are exposed to nanomaterials. He argued that a specific unit within WorkCover should be assigned to regulate these workplaces

> At this stage, given the infancy of the industry, it has not developed any sort of register to identify it. We certainly believe it is a worthy task to identify those companies. We have gone one step further.
>
> Once we have identified them we need to have some of regulation about the companies – not so much interfering in the products that they are making or the way in which they are making them as long as it is done safely. Look at the hazardous substance industry and the way it is being looked at specifically by WorkCover with its own unit and its own funding. We believe that model could be adopted in the nanotechnology industry, particularly in the short-term to medium-term whilst research is being done.[179]

3.257 The Committee asked Mr Henry whether the AMWU saw any merit in WorkCover conducting preliminary inspections of all nanomaterial manufacturing sites in NSW, given that health and safety issues can be dependent upon a number of variables including the specific nanomaterial(s) being handled and the specific manufacturing process involved. Mr Henry acknowledged there could be some benefit, but not as a substitute for strict application of the intent of the current legislation:

> Yes, as previously stated the union is of the view that should the OHS legislation be applied it would go a long way to protecting workers. Given the lack of research in

177 Dr Morris, Evidence, 10 June 2008, pp 24-25

178 Professor Wright, Evidence, 28 April 2008, p 51

179 Mr Henry, Evidence, 1 May 2008, p 16

> this field it is hard to imagine what advice WorkCover may provide but the basics of risk management would be a start.[180]

3.258 WorkCover advised that it is developing internal capacity to practically assist businesses through initiatives such as training for new inspectors. It has developed training materials and the first programs were delivered to new Inspectors in January 2008.[181]

3.259 WorkCover further advised that it was working proactively to develop networks with industry stakeholders in order to facilitate the sharing of information between industry and regulators. The intention of identifying and monitoring companies that manufacture and sell nanotechnology products is to further understand the activities of industry and identify ways WorkCover can support industry with advice and guidance.

3.260 WorkCover is also currently developing an audit tool that will be available for use by other jurisdictions. The audit tool is comprised of an information document that outlines the OHS audit scope for nanotechnology research and manufacturing organisations and is called the 'Audit Framework'. It sets out the entire range of risk issues to be considered when attempting to develop and implement an OHS Management System at the enterprise level.[182]

Committee comment

3.261 The Committee heard that the exact number of companies that manufacture or use engineered nanomaterials in NSW is unknown, with estimates putting it between 23 to 40. The Committee believes that there is merit in WorkCover visiting those companies and manufacturing sites of which it currently is aware to provide the best advice and guidance it can first hand.

3.262 Such action would be in accord with the field study work proposed as part of the federal Nanotechnology OHS research and development program referred to earlier at paragraph 3.203.

3.263 WorkCover should publicly advertise, through the appropriate media, its intention to work with nanotechnology companies as it becomes aware of them. WorkCover should call for companies to contact them to arrange for WorkCover to visit them and provide assistance.

3.264 For the purposes of this call, the definition of nanomaterials should be broad. The Committee heard that previous calls for information from companies manufacturing or using nanomaterials experienced under-reporting due to companies experiencing difficulties in applying the definition of nanomatereials. To overcome this, the Committee believes the call should apply to engineered nanomaterials of 300 nanometres or less in size in one or more dimensions.

---

180 Answers to written questions on notice, 5 May 2008,Mr Henry, p 3

181 Answers to written questions on notice, 12 September 2008, WorkCover NSW, p 6

182 Correspondence from Mr Stephen Higham, Manager, Strategic Policy Unit, WorkCover NSW, 23 September 2008

Recommendation 3

That WorkCover NSW work with those companies, or premises of which it is aware, that manufacture or use engineered nanomaterials of 300 nanometres or less in size in one or more dimensions, to promote workplace safety in the use of nanotechnology.

That WorkCover NSW advertise its intention to undertake this endeavour and call for companies manufacturing or using engineered nanomaterials of 300 nanometres or less in size to contact it to participate in this workplace safety endeavour.

Development of voluntary codes by industry

3.265 The Committee heard evidence of industry, both here and overseas, developing and promoting their codes of practice in order to fill what they saw as a regulatory void.

3.266 The Australian Nano Business Forum (ANBF) brought what it calls the *Responsible Nano Code* to Australia in November 2006. This self-regulatory code was developed by industry in the United Kindgom.[183] The ANBF used this as a basis for developing a voluntary code of behaviour which it promotes to industry.

3.267 Dr Peter Binks, said that the reason why the ANBF commenced work on developing a voluntary industry code was the recognition that while the review of the regulatory framework was underway, industry's duty of care remained in place:

> So the regulatory apparatus in going through its process and going through as quickly as it can to try to put laws in place and it will take a considerable time to do that, but when you are running companies like I am and you are producing nano products and you have employees who could potentially be exposed to those you have a real duty of care and you have the responsibility to put a regime in place that protects your employees, your contractors, your customers – everyone – from any possible influences. What we started to do about three years ago in Australia was to say: Well, there are certain things that we are going to do. We are going to put in place some labelling of our own so that we can indicate where there are products that contain nano materials. We are going to have safety protocols, which we gather from everyone who has worked in the field, cull them together and say, look, that seems as good as we can do in advance of the regulations.[184]

3.268 In the United States in June 2007 DuPont in partnership with Environmental Defense publicly released a risk governance framework entitled *NANO Risk Framework*. The framework is publicly available for use by other companies. The framework is a six-step process and the document sets out how to potentially manage the risks associated with the production of nanoparticles. The document does not make an assessment of the potential risk

183 Mr Davenport, Evidence, 1 May 2008, p 4

184 Dr Binks, Evidence, 1 May 2008, p 9

of specific nanoparticles, but assumes that all nanoparticles are unsafe until the science proves otherwise.[185]

3.269 Some critics of industry-developed codes argue that they are developed as a defence against future litigation if adverse health effects are discovered later, i.e. the defence being that companies could argue that they did all that was reasonably foreseeable to protect their workers in the absence of specific regulation.

3.270 Critics of the DuPont code argued that it would become a default regulatory framework and that it would take the initiative away from government.[186] The submission from the AMWU expressed concern about the validity of industry-developed codes. The AMWU was critical because they were voluntary rather then obligatory, and argued that such initiatives often delay or weaken essential regulation.[187]

3.271 Dr Binks said that he was not advocating a voluntary code of behaviour for industry as the most appropriate way to regulate nanomaterials. He noted that it was the best that industry had at the moment until required laws are developed. Dr Binks said he believed that industry codes of behaviour can have a life beyond regulations:

> Our experience – and we see this with other codes – is that the hard kind of black-letter law is never quite enough. You still need to go a bit further and say: How do we actually behave in these circumstances when something changes? We think we will always need behaviours which support laws.[188]

Committee comment

3.272 As a general position, the Committee is supportive of the development of voluntary industry codes during periods of regulatory uncertainty. The Committee believes that WorkCover NSW should continue to keep abreast of any such codes and review them to identify strengths and weaknesses.

Labelling

3.273 The issue of labelling was raised throughout the Inquiry. To many, labelling to indicate the presence of nanomaterials was seen as the minimum requirement that should be set in the absence of any other regulatory action. It was also the general consensus that it was an extremely complex question to resolve with many tensions that need to be balanced.

3.274 Some factors that contribute to the complexity of this question include the broad scope of applications that fall under the term nanotechnologies; the lack of an agreed definition of nanomaterials that would be used in any labelling regime; and defining the purpose of any labelling requirements.

---

185 Dr Bowman, Evidence, 28 April 2008, p 24

186 Dr Bowman, Evidence, 28 April 2008, p 24

187 Submission 4, pp 7-8

188 Dr Binks, Evidence, 1 May 2008, p 10

3.275 However, from the evidence it received the Committee believes that there is a case for the implementation of labelling requirements to identify the presence of engineered nanomaterials in certain areas.

Nanomaterials in the workplace

3.276 Mr David Henry said that it was a concern that currently many workers are oblivious to the potential risks they may be facing from handling engineered nanomaterials:

> I suppose that goes to what has been said previously that there is a major issue around labelling – an issue that everyone is recognising – but there is no labelling. If there is no labelling how would people know that the products they are handling and dealing with have a potential risk associated with them?[189]

3.277 Nanotechnology Victoria and the ANBF have been calling for design of a labelling scheme to identify the presence of nanoscale materials. In the absence of legislative requirements for labelling, NanoVic implemented its own scheme:

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

3.278 As mentioned earlier in this report, the CSIRO were of the view that it was prudent to consider all nanoparticles as potentially hazardous until research provides definitive data to the contrary. And that any potential exposure should be limited to levels that are as low as reasonably practical to achieve.

Committee comment

3.279 The Committee supports the view that workers should be advised of the fact that they are being exposed to engineered nanomaterials. A requirement for engineered nanomaterials to be identified by labelling would serve to alert and remind all that the ALARA approach should be in evidence.

3.280 Such a labelling requirement may need to sit beside, possibly as an interim measure, the existing regulations applying to hazardous substances, as in most cases there may be little or no data available by which to classify or assess the hazard.

3.281 It is beyond the Committee to specify how a requirement for mandatory labelling of engineered nanomaterials used in the workplace should be implemented. On the weight of the

189 Mr Henry, Evidence, 1 May 2008, p 15

evidence it has received it believes it is something that should be investigated as a matter of urgency.

3.282 The Committee is of the view that a mandatory labelling scheme would be most effective at the national level. However, in the absence of a national scheme, New South Wales should proceed with investigating the development of its own mandatory labelling scheme for engineered nanomaterials used in the workplace.

Recommendation 4

That the New South Wales Government work in cooperation with federal agencies on the development of a national mandatory labelling scheme for engineered nanomaterials used in the workplace, and that in the absence of a national scheme, NSW should proceed with investigating the development of its own mandatory labelling scheme.

Labelling of consumer products

3.283 Ms Elaine Attwood from the Consumers Federation of Australia told the Committee that it is incumbent upon the Government to educate the public on nanotechnology. Ms Attwood said that from a consumer's point of view information can be gleaned from many different sources, and all have a part to play. To Ms Attwood's mind there is no doubt that the single most effective means of getting information to the consumer is by the use of labelling.[190]

3.284 In evidence Ms Attwood argued that all products produced through a nanotechnology process should be labelled as such. The aim being to provide consumers with a choice – not necessarily about immediate health risks to themselves but if they have concerns about the entire life-cycle impact of the product.[191]

3.285 Mr David Vaile from the University of New South Wales argued that the concept of consent or informed choice is used as a way of enabling people to decide to cross into some sort of activity or use some sort of product. At this stage with so little known about the nature of nanotechnology's future applications and potential complications and interactions, Mr Vaile argued that a higher standard of choice is appropriate and that this would support a high standard of labelling.

3.286 Mr Vaile was critical of the view that labelling should not be considered because of the concern that consumers might respond negatively to the label. He countered that this is really a question of education rather than an argument for not labelling if it is otherwise appropriate.[192]

190 Ms Attwood, Evidence, 10 June 2008, p 12

191 Ms Attwood, Evidence, 10 June 2008, p 13

192 Mr Vaile, Evidence, 10 June 2008, pp 13-14

3.287 Dr Peter Binks said that it was the position of NanoVic and ANBF that consumers should have the right to know of the presence of nanomaterials in a product so that they can make choices on the basis of that information:

> One of our strong beliefs is that, coming back to your point about public awareness, where there are concerns about a particular material we think that consumers have the right to know if the material is present and can make a choice around that, so we want materials that are out there to have some indication as to whether or not they have nanoscale materials if people are concerned about them.[193]

3.288 Dr Binks acknowledged that given the broad range of nanomaterial application, development of an all-encompassing scheme would be a huge task. Dr Binks noted that to understand where labelling requirements will make the most sense will depend on the ability to classiy nanomaterials and their hazards.[194]

Committee comment

3.289 The Committee agrees that raising public understanding of issues regarding nanotechnology is essential. However, it does not believe that it is feasible to require that all products manufactured via a nanotechnology process to be so labelled.

3.290 Currently certain classes of consumer products have labels that list all or some of their ingredients. Where these labelling mechanisms are in place, there is an opportunity for consumers to be informed of the presence of nanomaterials.

Labelling of food

3.291 The national Food Standards Code regulates the requirements for the labelling of food. Traditionally, labelling requirements are used to provide information to consumers so that they can make more healthy food choices (via nutrition information panels), or to warn consumers if a food contains a known allergen. Labelling is also used to provide instructions on safe storage and use by dates.

3.292 Dr Elisabeth Szabo advised that in recent cases where new, non-traditional, labelling requirements were implemented an amendment to the Food Standard Code was required:

> Recently, where we have departed from information sharing with the consumer regarding the safety of the food product, we have been looking at GM labelling, whether the food contains genetically modified material. There are labelling requirements for irridation. More recently there have also been labelling requirements with regard to country of origin. Each of these went through the rigours of seeking an amendment to the Food Standards Code. They went through an assessment, and that also would have involved a regulatory impact statement, that is, a statement of the costs and benefits.[195]

3.293 Dr Szabo advised that New South Wales could, if it wished, act independently and require labelling to identify the presence of nanomaterials. However the benefit and effect of taking

193 Dr Binks, Evidence, 1 May 2008, p 11

194 Dr Binks, Evidence, 1 May 2008, p 11

195 Dr Szabo, Evidence, 6 June 2008, p 16

such action would be limited, as the requirement would hold only for twelve months and only to food produced in New South Wales.[196]

3.294 On 4 August the Committee received a presentation from Dr Craig Cormick, from the Australian Office of Nanotechnology, on the results of the latest survey into Australian community attitudes about Nanotechnology.[197] The survey explored issues where people could express possible concern about aspects of nanotechnology. Dr Cormick advised that food stood out as an issue of concern for people.[198]

3.295 In response to the question of whether food labelling should provide information about any nanotechnology used, 21 per cent of respondents expressed mild concern and a further 28 per cent expressed great concern.

Committee comment

3.296 The Committee supports the view that consumers should be advised of the presence of nanomaterials in food products, particularly until more knowledge is gained on the risks that may be associated with them. The Committee recommends that an amendment should be sought to the national Food Standard Code to require labels to identify the presence of materials at the nanoscale.

Recommendation 5

That the NSW Food Authority develop an application to seek an amendment to the national Food Standards Code to require that food labels identify the presence of nanoscale materials.

Concerns regarding sunscreens

3.297 The class of consumer products upon which nanomaterials are most prevalent are cosmetics. Given their direct application to the skin they were often cited as an area of greatest potential concern. Illustrative of this is the concern that was raised with respect to sunscreens (which are therapeutic goods) that contain nanomaterials.

3.298 Zinc oxide and titanium dioxide have been used as sunscreens for many years. In December 2005, there were 1200 sunscreens authorised by the TGA as listed goods on the ARTG for supply in Australia. Of those 228 contained zinc oxide, 363 contained titanium dioxide and 73 contained both.

3.299 One disadvantage of zinc oxide and titanium dioxide is that they are visible, giving the skin a white colour when applied. By using the zinc oxide or titanium dioxide in nanoparticle form it becomes colourless and more appealing to users. The sun-screening properties of the chemical is neither enhanced nor decreased.

196 Dr Szabo, Evidence, 6 June 2008, p 16

197 *Australian Community Attitudes Held About Nanotechnology – Trends 2005-2008*

198 Dr Craig Cormick, Australian Office of Nanotechnology, Evidence, 4 August 2008, p 3

3.300 This ability to render these chemicals colourless has provided the opportunity to include them in a range of cosmetic and skincare products – with the result that an increasing number of skincare products now have SPF factors associated with them.[199]

3.301 As at December 2005 around 254 sunscreens with titanium dioxide and 68 sunscreens with zinc oxide had these materials in nanoparticle form. Titanium dioxide has been used in this way since 1990 and zinc oxide nanoparticles since 1999.

3.302 In 2005 a theoretical concern was raised that if zinc oxide or titanium dioxide in nanoparticle form are absorbed into skin cells they could possibly interact with sunlight to increase the risk of damage to these cells.

3.303 In response to this the TGA, in January 2006 conducted a review of scientific literature in relation to the use of nanoparticulate zinc oxide and titanium dioxide in sunscreens. They provided public information, available via the TGA website, on the outcome of this review in February 2006 entitled: *Safety of sunscreens containing nanoparticles of zinc oxide or titanium dioxide.* That publication advised:

> [The review of scientific literature concluded that] There is evidence from isolated cell experiments that zinc oxide and titanium dioxide can induce free radical formation in the presence of light and that this may damage these cells (photo-mutagenicity with zinc oxide). **However, this would only be of concern in people using sunscreens if the zinc oxide and titanium dioxide penetrated into viable skin cells. The weight of current evidence is that they remain on the surface of the skin and in the outer dead layer (stratum corneum) of the skin.**
>
> …The Therapeutic Goods Administration is monitoring the emerging scientific literature in this area and working cooperatively with international agencies to monitor these issues and ensure that appropriate action is undertaken if any risks are identified.[200]

3.304 Research is continuing into the toxicity of zinc oxide nanoparticles and long-term exposure risks. An in vitro study on the toxicity of a range of nanoparticles, including zinc oxide, to human immune cells was presented at the International Conference on Nanoscience and Nanotechnology (ICONN) in Melbourne. That study found that zinc oxide nanoparticles were more toxic to the immune cells than nanosilver nanoparticles, diesel exhaust particles and silica dioxide particles. The study found that a high dose of zinc oxide nanoparticles were needed to cause a response in immune cells and that this would only occur if the particles accumulated to toxic concentrations.

3.305 In evidence before the Committee Dr Maxine McCall advised that the CSIRO was planning to conduct research to assess the effect of long-term exposure to zinc oxide nanoparticles in sunscreens:

> It is very hard to do long-term studies and they are quite expensive. You cannot really do them on humans, not in a controlled way anyway. So we have planned an 18

199 Dr Maxine McCall, Nanosafety Theme Leader, CSIRO, Evidence, 1 May 2008, p 34

200 *Safety of sunscreens containing nanoparticles of zinc oxide and titanium dioxide,* February 2006, Australian Government, Department of Health and Ageing, Therapeutic Goods Administration, <www.tga.gov.au> (accessed 25 May 2008)

> months experiment where we will be applying the sunscreens with nanoparticles in them to mice. Eighteen months is a reasonable period of time in the life cycle of a mouse, and so we will be monitoring chronic exposure and impact on health in those experiments.[201]

3.306 In evidence Dr McCall discussed the experiments done in the past to determine whether nanoparticle sunscreens penetrate the surface of the skin, which showed that there was little or nor penetration. Dr McCall noted that some overseas bodies have declared these studies provide a guide but can not be considered conclusive:

> Some recent research in the United Kingdom – a project called Nanoderm – has declared that these studies give a guide…but they have also stated that the experiment is not really representative of human skin that has sunscreens applied to it when they are going around their normal duties, such as going down to the beach, working as a landscape gardener, kids running around in the sun, surf, sand etc.[202]

3.307 In its submission to the Inquiry the CSIRO also referred to an Opinion published in December 2007 by the European Commission on the Safety of Nanomaterials in Cosmetic Products which concluded that the standard device for estimating skin absorption is not ideal and that, at present, there is inadequate information on nanoparticle uptake in physiologically normal and compromised human skin.[203]

3.308 On 10 June 2008 the Committee heard evidence from Professor Michael Roberts from the University of Queensland. Professor Roberts has recently conducted research into the penetration of nanoparticles in sunscreen into the skin.

3.309 While Professor Roberts' research has not yet been cleared for publication, in general terms the research found that skin penetration by zinc oxide nanoparticles can occur in specific circumstances. Professor Roberts emphasised that the research does not indicate there is any hazard or toxicity associated with this – the research concentrated on the question of penetration. Rather, the findings challenged/refuted the current view that penetration to the viable epidermis did not occur.[204]

3.310 The Committee was interested to know if the TGA was involved in or provided support to the current research into nanoparticles in sunscreens and if it was aware of any emerging risks. The TGA advised that it was continuing to monitor the scientific literature and that its view of the safety of these sunscreens had not changed:

> The TGA is not directly involved in research into the potential dermal penetration and toxicity of nanoscale zinc oxide and titanium dioxide in sunscreens, however, it is aware of such research occurring both nationally and internationally.

---

201 Dr McCall, Evidence, 1 May 2008, p 33

202 Dr McCall, Evidence, 1 May 2008, p 34

203 Submission 19, p 16

204 Professor Michael Roberts, Director, Research Unit, University of Queensland, in-camera evidence, 10 June 2008 (published with permission and by resolution of the Committee 20 October 2008)

> The TGA is continuing to monitor the scientific literature with respect to nanoparticulate titanium dioxide and zinc oxide and safety issues associated with their use in sunscreens.
>
> At the present time the weight of evidence in the scientific literature supports the original conclusions drawn in the 2006 review…
>
> …the Committee may also note that despite the widespread and long history of use of sunscreens containing titanium dioxide and zinc oxide particles of nanoscale dimension no significant adverse reports of safety have been associated with these products.[205]

Committee comment

3.311 Research into the potential risks of sunscreens containing nanomaterials is continuing. The Committee believes that there is a strong case for labelling requirements for sunscreens and cosmetics to indicate the presence of materials at the nanoscale. The Committee notes sunscreens are regulated by the TGA, and that the NICNAS now has responsibility for regulating standards for cosmetics.

3.312 The Committee recommends that, during the review of the national regulatory frameworks, the NSW Government recommend that ingredient labelling requirements for sunscreens and cosmetics include the identification of nanoscale materials.

Recommendation 6

That the New South Wales Government recommend that ingredient labelling requirements for sunscreens and cosmetics include the identification of nanoscale materials, during the review of the national regulatory frameworks.

Register of nanomaterial manufacturers or users

3.313 The submission from the NSW Government acknowledged that the lack of industry and economic information on nanotechnology is an important issue for New South Wales, as it is for Australia and the international community.[206]

3.314 In 2006, NICNAS issued a voluntary call for information on the use of nanomaterials by industry.[207] As it was a voluntary call NICNAS acknowledged that gaps in the information were likely to exist. NICNAS advised that it was considering a repeat of this call, incorporating a request for confirmation whether industry and researchers have physico-chemical and toxicological data on the nanomaterials they are handling. This repeat call is being designed in consultation with industry and researchers.[208]

205 Answers to written questions on notice, 17 June 2008, Therapeutic Goods Administration, p 3

206 Submission 25, p 3

207 NICNAS Information Sheet, *Summary of call for information on the use of Nanomaterials,* January 2007, <www.nicnas.gov.au>

208 Answers to written questions on notice, 22 July 2008, NICNAS, p 4

3.315 Similarly, the APVMA advised that it intends making a call for information from industry within the next few months. The APVMA, in order to be prepared advised that it would need to widen its call for information to include research organisations.

3.316 Currently WorkCover undertakes a number of monitoring activities to further develop its understanding of industry activity in New South Wales.[209] The availability of accurate information on the extent of nanomaterials being used in the workplace would assist WorkCover:

> The way 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 those 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. Any of the data that is available is useful for us to plan those interventions and to plan our prevention activities.[210]

3.317 The NSW Government submission referred to a Voluntary Reporting Scheme launched by the UK Government in September 2006, and noted that it was to be assessed in 2008 to determine whether the introduction of compulsory reporting measures for manufactured nanomaterials was necessary. According to a review of the scheme it had met with a poor response from industry.[211]

3.318 The NSW Government submission noted that it was possible that regulations may be necessary:

> While voluntary actions can provide a valuable and timely starting point for addressing concerns in the short term, it is possible that regulations may be necessary to provide a level playing field and meet community expectations about safety, accountability and transparency.[212]

3.319 The Committee wished to explore whether a mandatory reporting scheme was required. In response WorkCover advised:

> Mandatory reporting, or the creation of a simple registry may assist WorkCover and other relevant agencies build an understanding of industry activity. However, implementation of mandatory reporting would need to consider the costs and benefits of such a system for workers and industry, in line with the requirements of the New South Wales Better Regulation Office. WorkCover believes that any such mandatory reporting system would be most effective at the national level, which is in line with WorkCover's support for a whole of government approach to nanotechnology.
>
> If a mandatory reporting system were put in place then WorkCover would be interested in companies who use, manufacture, transport or dispose of nanomaterials.

---

209 Mr Dunphy, Evidence, 28 April 2008, pp 11-12; Answers to written questions on notice, 12 September 2008, WorkCover NSW, p 2

210 Mr Dunphy, Evidence, 28 April 2008, p 7

211 Answers to written questions on notice, 12 September 2008, WorkCover NSW, p 2

212 Submission 25, p 7

> WorkCover does not currently have the legislative power to require companies involved with nanotechnology to report on their activities.[213]

Committee comment

3.320 Earlier in this report the Committee recommended that WorkCover assist workplaces involved in the manufacture or use of nanomaterials. A mandatory reporting scheme would assist WorkCover in this regard.

3.321 A mandatory reporting scheme would help clear the current uncertainty about the scope of nanomaterials being used in workplaces. It would also assist in identifying areas of need for other related activities such as research.

3.322 The Committee agrees that a mandatory reporting scheme would be most effective at the national level. However, the Committee was not advised of the progress toward the implementation of a national mandatory reporting scheme. The absence of a national reporting scheme would not make a State scheme ineffective, and if designed properly and in consultation with federal agencies it could become the blueprint for the national scheme. Until such time as the national scheme is implemented, NSW should examine the feasibility of, and requirements for, implementing its own interim mandatory reporting scheme.

Recommendation 7

That the New South Wales Government work in cooperation with federal agencies on the development of a national mandatory reporting scheme for companies who use, manufacture, transport or dispose of nanomaterials, and that in the absence of a national scheme, NSW should proceed with investigating the development of its own interim reporting scheme.

[213] Answers to written questions on notice, 12 September 2008, WorkCover NSW, p 2

Chapter 4 Assessing the risks of nanomaterials

The ability to measure, characterise and assess the health, safety and environmental risks of nanomaterials is essential for the appropriate regulation and management of nanomaterials over their life-cycle. In a number of areas the scientific knowledge and technological capacity for doing this is not yet present. The challenge to create this knowledge and capacity is receiving attention at the national and international level. However, it appears that fully meeting this challenge is some years away.

This chapter examines the factors that contribute to the potential risks of nanomaterials, the activities being undertaken to develop the required knowledge and capacity to be able to adequately assess those risks, and potential opportunities and approaches for building this capacity.

Measurement and characterisation

4.1 The propensity for some nanomaterials to change their characteristics during their lifecycle means that the capacity to characterise and measure them throughout their different stages is essential for accurate assessment of risk. Accurate measurement is also required for establishing that products and materials meet industry and international trade standards. During the Inquiry the Committee repeatedly heard that there will be an increasing need for infrastructure for the characterisation and measurement of nanomaterials.

4.2 Dr John Miles, Chief Research Scientist with the National Measurement Institute (NMI) summarised the basic underlying importance of measurement by way of a simple statement:

> "If you can't measure it, you can't make it and you can't regulate it."[214]

4.3 In evidence to the Committee, Dr Miles said that measurement infrastructure has underpinned almost all industrial revolutions and that nanotechnology will be no different:

> Nanotechnology promises to be the next significant new technology, with diverse benefits and considerable economic potential. It is important to recognise that technology at the nanoscale is not simply a matter of applying established classical physics to smaller dimensions. The nanoscale is the area of quantum physics and new engineering and manufacturing techniques will need to be developed. Consequently new methods of measuring and testing will be required to demonstrate that a product or manufacturing process meets specified demands or conforms to environmental and safety standards. I think it is well known that a metrological infrastructure has underpinned almost all industrial revolutions, and nanotechnology will be no exception. Nanometrology is the science of measurement at the nanoscale and accurate and reliable measurements of physicial, chemical and biological quantities will be required at all stages of the nanotechnology value chain.[215]

---

214 Tabled document, National Measurement Institute, *Written statement by Dr John Miles*, 1 May 2008, p 6

215 Dr John Miles, Chief Research Scientist, National Measurement Institute, Evidence, 1 May 2008, p 38

4.4 Dr Miles explained the role of the NMI in supporting nanometrology:

> Essentially the way this is done in most economic nations is by a national measurement institute [NMI]. Most major economic nations have a national measurement institute, and Australia has one. The main role of that institute is to establish, maintain and disseminate physical standards. Australia's National Measurement Institute, therefore has a cricitally important role in establishing internationally accepted measurement infrastructure for nanotechnology in Australia.[216]

4.5 Associate Professor Paul Wright, Coordinator of NanoSafe Australia, told the Committee that appropriate characterisation of nanoparticles is essential when conducting good quality toxicology research:

> These days, if one wants to publish this work in the international literature, you have to accompany it with this characterisation data to indicate that you 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.[217]

4.6 Dr Simon Apte, Research Director with CSIRO Land and Water, also told the Committee that the biggest challenge in the nanotechnology area is the physical and chemical characterisation of particles. He said that access was required to large instruments such as the Australian synchrotron (based in Melbourne) and techniques that are available at the nuclear reactors at Lucas Heights. He also said that as not all characterisation techniques are available in Australia, it is important to partner with overseas research organisations. His department has strong links with the University of Birmingham in the United Kingdom, to which they send a lot of their materials for characterisation.[218]

4.7 Based on the evidence it received during the Inquiry the Committee accepts that the capacity to accurately measure and characterise at the nanoscale is essential for the effective and safe regulation and development of nanomaterials and nanotechnologies.

Current and future measurement infrastructure capacity

4.8 New South Wales is home to a number of significant facilities that have a nanometrology capacity. The National Measurement Institute's nanometrology capacity is based at its campus at Lindfield. The nuclear reactor at Lucas Heights provides unique and extensive measurement capacity.[219]

---

216 Dr John Miles, Evidence, 1 May 2008, p 38

217 Associate Professor Paul Wright, Coordinator, NanoSafe Australia, Evidence, 28 April 2008, p 50

218 Dr Simon Apte, Research Director, Centre for Environmental Contaminants Research, CSIRO, Evidence, 10 June 2008, p 4

219 See, Dr George Collins, Chief of Research, Australian Nuclear Science and Technology Organisation, Evidence, 28 April 2008, p 65

4.9 In addition the University of Sydney is the headquarters of the Australian Microscopy and Microanalysis Research Facility (AMMRF). The AMMRF is a national grid of equipment, instrumentation and expertise in microscopy, microanalysis, electron and x-ray diffraction and spectroscopy providing nanostructural characterisation capability and services to all areas of nanotechnology and biotechnology research.[220]

4.10 The AMMRF was established in 2007 under the federal Government's National Collaborative Research Infrastructure Strategy (NCRIS). Co-investment by the NSW Government in AMMRF through the Science Leveraging Fund (SLF) is $4 million.[221]

4.11 The AMMRF operates in nodes located in major capital cities across Australia. NSW is a major stakeholder in the AMMRF with two of the founding nodes based at the University of Sydney and at the University of New South Wales. The AMMRF offers a complete, modern suite of instruments accessible to all Australian publicly funded researchers on merit basis and a nominal fee schedule. Industry based researchers can also access the facilities for proprietary research at commercial rates.

4.12 The location of these facilities within New South Wales provides the obvious benefit of providing easier access for NSW firms. However, as noted previously, the Committee was advised that not all necessary characterisation techniques are available in New South Wales or even Australia.

4.13 If nanotechnologies expand as forecast it is reasonable to assume that nanometrology capacity may need to expand to meet this increased need.

4.14 Objective 3 of the Australian Government Objectives for the Responsible Management and Oversight of Nanotechnology states, in part, that it will support nanometrology as an essential resource for providing industry and regulators with world class measurement facilities that support the development, management and monitoring of nanotechnology.

4.15 Funding for nanometrology under the National Nanotechnology Strategy was originally $6.25 million over four years. Subsequently it was reduced to $3.12 million over two years. In evidence, Dr John Miles from the National Measurement Institute told the Committee that the funding provided to them is designed to begin the process of establishing a much-needed infrastructure in Australia.[222]

4.16 Dr Miles said that the need to strengthen nanometrology infrastructure, particularly with respect to nanoparticles, was identified in 2006:

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

220 Submission 18, Australian Microscopy & Microanalysis Research Facility (AMMRF), p 7

221 Submission 18, p 8

222 Dr Miles, Evidence, 1 May 2008, p 42

> This was in fact recognised in the federal Government's options for a nanotechnology strategy and went into its National Nanotechnology Strategy document that recommended that NMI establish and coordinate a national nanometrology program, covering physical standards and also establish a nanoparticle laboratory [facility].[223]

4.17 The Nanoparticle Facility will disseminate nanoparticle standards via a cost-recovery testing and calibration service. It will also conduct proficiency testing, run training courses, publish standard operating procedures, participate in international comparisons and support regulatory frameworks.[224]

4.18 Dr Miles advised that in the long term, the nanometrology program needs to extend to the provision of traceability, international acceptance and expertise to the entire spectrum of nanoscale measurements including electrical, optical, magnetic, mechanical, chemical and biological measurements.

4.19 The Committee was interested to discover what consideration was being given to the anticipated future need for additional metrology infrastructure. Mr Craig Pennifold advised the Committee that the current funding ran to 30 June 2009, and that what would occur beyond that was still to be determined:

> The current funding for the overall strategy which includes funding for the National Measurement Institute to undertake this activity continues through to 30 June 2009. The information I have is that that will enable the NMI to finalise the design and begin to build an atomic force microscope, which will provide traceability for dimensional nano scale measurements in Australia. So we will be able to look at the nano scale.
>
> The NMI's atomic force microscope will become the national reference instrument from which other standards will be developed. It will enable them to establish a small scientific team to implement the nano metrology program, to interact with Australia's nanotechnology community and to support regulatory frameworks. So the issue for what will take place 30 June 2009 will be part of Government's response to what happens to the funding of the overall national nanotechnology strategy.[225]

4.20 The submission from the AMMRF argued that further significant investment into infrastructure is required. The AMMRF made the following recommendation:

> Australia must continue to invest in advanced microscopy and microanalysis infrastructure because the current and future challenges for science and technology all exist at the limits of spatial resolution and chemical sensitivity of many characterisation techniques. Future investment in time-resolved aberration-corrected transmission electron microscopy (TEM) and focussed ion beam platforms would benefit nanotechnology R&D and fill a gap in capability in NSW.[226]

---

223 Dr Miles, Evidence, 1 May 2008, pp 41-42

224 Tabled document, National Measurement Institute, *Written statement by Dr John Miles*, 1 May 2008, p 7

225 Mr Craig Pennifold, Head, Innovation Division, Department of Innovation, Industry, Science and Research, Evidence, 4 August 2008, p 17

226 Submission 18, p 2 and p 17

4.21 The AMMRF note that the cost of a TEM is approximately $7.5 million. It offers the ability to track chemical reactions, materials transformations, and other temporal phenomena at the atomic scale, providing unprecedented information for, for example, designing green catalysts for industry and ultra-strong, ultra-light alloys for transport systems.[227]

4.22 Dr George Collins, Chief of Research at ANSTO, argued that while continued investment is important to ensure that all facilities remain internationally competitive, it should be selective and driven by careful consideration of the tools that are required. He said there is no point in duplicating facilities that are available elsewhere or creating facilities that do not have strong existing or strong future demand from within Australia.[228]

Committee comment

4.23 From the evidence it received the Committee cannot state what the specific additional infrastructure requirements will be in the short or long term. However, it is apparent that continued investment will be required. If, and when, the federal government proposes the establishment of additional metrology infrastructure, the NSW Government should actively seek, through the use of leverage funding, it being located within the State – to build on the current infrastructure strength and provide additional benefit to industry, research and development.

Recommendation 8

That the New South Wales Government actively seek, through the use of leverage funding, the establishment of additional metrology infrastructure within the State to build on the current metrology strength and to provide additional benefit to industry, research and development.

The potential toxicity of nanomaterials

4.24 As mentioned in Chapter 2, the potential toxicity risks of nanomaterials derive from either their small size and/or the novel chemical properties that they may exhibit. The smaller a particle is, the greater its bioavailability. Bioavailability is the potential for eluding the body's natural defences and being taken up by organs, cells and tissues. Some nanomaterials exhibit novel properties due to increased chemical reactivity – this increased reactivity can lead to greater toxicity for cells and living organisms.

4.25 The potential toxicity of a nanomaterial can be due to a number of factors. It is important to note that two nanomaterials derived from the same bulk chemical can have different potential toxicity depending on these factors. In its submission the CSIRO provided a list of the physical and chemical properties of nanoparticles that may be implicated in toxicity and altered bioavailability:

227 Submission 18, p 16

228 Dr Collins, Evidence, 28 April 2008, p 69

- size (particle diameter)
- number
- shape
- chemical composition
- internal structure
- aspect ratio (ratio of length to width of the nanoparticle)
- contaminants
- surface area
- surface charge
- surface coating
- aggregation state
- chemical and photo-reactivity
- oral digestibility.[229]

4.26 Nanomaterials may enter the human body by inhalation, ingestion, or by absorption through the skin. The likelihood of this occurring is influenced by the manner in which human exposure occurs. Most initial concerns about the potential toxicity of nanomaterials relate to free rather than fixed nanomaterials. That is, if the nanomaterial is embedded within a solid matrix then the risk of human exposure is very low.

4.27 In their submission, Friends of the Earth Australia point out that the large number of variables influencing toxicity means that it is difficult to generalise about health risks associated with exposure to nanomaterials. It argues that each new nanomaterial must be assessed individually and all material properties of each nanomaterial must be taken into account.[230]

4.28 Discussion regarding nanomaterials tends to focus on the approximate size range of between 1 to 100 nanometres as it is within this range that novel chemical properties tend to occur. Friends of the Earth argue that focussing on the 1 to 100 size range will be inadequate for the purposes of health and safety assessments. They note that when a particle is below approximately 300 nanometres it can enter cells, and when below 70 nanometres it can enter the cell nucleus.[231]

4.29 Associate Professor Wright said that nanoparticles within the range of 5 to 300 nanometres could pose a problem, however whether a problem would arise depends on whether the nanoparticle is not cleared by the body, and that in turn depends on the characteristics of the particular nanoparticle:

---

229 Submission 19, CSIRO, p 14

230 Submission 9, Friends of the Earth Australia, p 8

231 Ms Georgia Miller, Nanotechnology Project Coordinator, Friends of the Earth Australia, Evidence, 1 May 2008, p 49

> 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.[232]

4.30 The potential toxicity of a nanomaterial can change according to the way it behaves during manufacturing processes or exposure:

> One of the other issues that people often do not understand about nanoparticles is that they are not necessarily consistently in a nano size form. They form aggregates and they can behave quite differently and they can change their surface characteristics and so on.[233]

4.31 This potential for nanomaterials to change means that good quality toxicity research needs to be able to characterise and measure nanomaterials before, during and after exposure.

Nanomaterials of concern

4.32 While there are significant gaps in understanding the toxicity of many nanomaterials, there are certain characteristics that indicate whether a nanomaterial is more likely to be of concern. The Committee heard that a nanomaterial is more likely to be of concern if it:

- is insoluble
- penetrates into the body
- persists within the body (accumulates) in its nanoform[234]
- is fibre- like in shape.[235]

4.33 Conversely, nanomaterials that do not exhibit these characteristics, those that are soluble and digestible, would not be expected to exhibit toxicity different to that of the bulk material from which it is derived:

> In particular, if the materials present in those particulates is dissolved and they get 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.[236]

---

232 Associate Professor Paul Wright, Immuno Toxicology, Royal Melbourne Institute of Technology (RMIT) University, Evidence, 28 April 2008, p 53; see also, Answers to written questions on notice, 20 May 2008, Professors Paul Wright and Brian Priestely, pp 7-8

233 Professor Brian Priestly, School of Applied Clinical and Public Health Sciences, Monash University, and Director, Australian Centre for Human Health Risk Assessment, Evidence, 28 April 2008, p 50

234 Associate Professor Wright, Evidence, 28 April 2008, p 54; see also p 55

235 Dr Howard Morris, Assistant Director Research, Office of the Australian Safety and Compensation Council Evidence, 10 June 2008, p 20

4.34 Professor Brian Priestly elaborated on the risk associated with unsoluble, persistent nanoparticles:

> 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 problems with nanoparticles – and then you might start seeing unusual toxicity.[237]

4.35 Associate Professor Wright said that toxicity research should focus on these nanomaterials of concern:

> 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 these 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 decades. So that is where I think we should be angling our research, in that area.[238]

4.36 Associate Professor Wright noted that many different nanomaterials are currently being developed. He advocated a screening system where new nanomaterials are assessed early to identify whether they pose a toxicity risk. This information could then be used to inform decisions on whether development should continue or be amended:

> But what we have to realise is that scientists, nanotechnologists, are making hybrid molecules of the various classes. Each of the classes of nanomaterials behave 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 the development phase.[239]

4.37 Dr Howard Morris, Nanotechnology Occupational Health and Safety Research and Development Program Manager with the Office of the ASCC, said that while information about how hazardous nanomaterial might be is limited, new research results are being published quite frequently across the world increasing the knowledge base. Dr Morris also noted that some materials, due to their insolubility or the fact that they are fibre-like are known to be of more concern.[240]

4.38 Dr Morris advised the Committee of the results of two recent scientific publications which reported toxicity similarities between long multi-walled carbon nanotubes and asbestos:

> They basically reported that one type of carbon nanotubes, which is long multi-walled carbon nanotubes with dimensions that are similar to asbestos fibres, can produce

236 Professor Priestly, Evidence, 28 April 2008, p 50

237 Professor Priestly, Evidence, 28 April 2008, p 50

238 Associate Professor Wright, Evidence, 28 April 2008, p48

239 Associate Professor Wright, Evidence, 28 April 2008, p 49

240 Dr Morris, Evidence, 10 June 2008, p 20

> reactions that might subsequently progress to mesothelioma in a similar way to asbestos when they are injected into the peritoneal or abdominal cavity of mice.[241]

4.39 Dr Morris said the toxicity and potential implications of long multi-walled carbon nanotubes was an issue of priority for the Office of the ASCC. In presenting this information to the Committee, Dr Morris highlighted issues that needed to be taken into account when considering the implications of the research, which were illustrative of the complexity of toxicity assessment of nanomaterials:

- The findings are applicable only to long multi-walled carbon nanotubes, and not to the diverse range of engineered nanomaterials that are being developed or in use today.
- Whether processes that use these long multi-walled carbon nanotubes produce airborne concentrations of the materials that can then be breathed in by workers. Research has identified such concentrations in some nanotechnology facilities but not others – it is process dependent.
- There is a clear need for immediate research on rodents to establish whether after they have been breathed in, as opposed to being injected, the carbon nanotubes end up in the lungs.
- A previous report indicated that carbon nanotubes may tend to fracture across the fibres rather than along the fibre, which is the case with asbestos. This might lead to reduced toxicity.
- Carbon nanotubes have a tendency to agglomerate and tangle, which also might serve to reduce the likelihood of discrete long fibres being present.

4.40 Dr Morris concluded that while more research was needed there was now enough information to conclude that long multi-walled carbon nanotubes were a concern:

> So will long multi-walled nanotubes get to the mesothelium and be there is sufficient quantity for a sufficient time to lead to possible mesothelioma? This will depend on a heap of factors and we certainly need more information on this process and what can happen to inform us on this matter. We certainly have enough information to suggest that users and manufacturers of the material should use the best possible controls to prevent exposure to long multi-walled carbon nanotubes.[242]

4.41 It is acknowledged that there is a clear need for ongoing research to determine the risks posed by engineered nanomaterials. The following section examines the techniques used to assess the toxicity and hazard of nanomaterials during their life-cycle.

Assessing the hazard and risk of nanomaterials

4.42 The hazard of a nanomaterial is its inherent toxicity - the adverse effects it will have if it enters the human body or the environment. Risk is a product of hazard and exposure. If exposure to the hazard is denied or minimised to a satisfactory level then it does not become a risk.

---

241 Dr Morris, Evidence, 10 June 2008, p 23

242 Dr Morris, Evidence, 10 June 2008, p, 24

4.43 The full assessment of the toxicity of a nanomaterial cannot be undertaken by one technique or process. The toxicity posed by a nanomaterial to human health can be quite different to the toxic impact it may pose to the environment, and different assessment techniques are required. Similarly, the potential toxicity of an engineered nanomaterial in its pristine state can be quite different to when the nanomaterial is used within a process or incoroporated into a product.

4.44 Associate Professor Wright explained that it is important to assess and identiy the potential life cycle of a nanomateial:

> One of the very first important [steps] 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.[243]

4.45 Toxicology has always been a multidisciplinary science. This is even more so the case with respect to nanomaterials. Associate Professor Wright said that physicists and chemists were now increasingly involved in toxicity experiments.[244]

4.46 Associate Professor Wright outlined the basic process for assessing the toxicity of a nanomaterial:

> More and more we are looking at toxicity testing in initially *in vitro* [in test-tubes]. 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 we are extrapolating to the species of concern if we are worried about human health, but we also have animal cultures where 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 least a few very important *in vivo* [in the body] studies in the whole animal before you can risk exposing humans to compound of potential concern, and, in this case, nanomaterials of concern.[245]

4.47 Generally the results of toxicology research on animals are used to indicate, or extrapolated to, the probable toxicity to humans. However, there are some differences between species, which must be taken into account. In some cases it is necessary to go to the human situation to verify results. Associate Professor Wright gave an example:

> 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 mouse or rat skin….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 sitauion to make sure we have not made a mistake when we extrapolate.[246]

---

243 Associate Professor Wright, Evidence, 28 April 2008, p 48

244 Associate Professor Wright, Evidence, 28 April 2008, p 51

245 Associate Professor Wright, Evidence, 28 April 2008, p 48

246 Associate Professor Wright, Evidence, 28 April 2008, p 52

4.48 Professor Priestly described the general process involved in determining the indicative hazards of a particular material via animal testing:

> …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 exposure through to very long-term exposures to assess the differences 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.
>
> …the idea [of the oral route] 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.[247]

4.49 With respect to the infrastructure requirements for conducting toxicology research, Associate Professor Wright told the Committee that there is a shortage at present:

> …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 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.[248]

4.50 The CSIRO noted that in addition to the need for information on the human and environmental toxicities of nanomaterials before they are incorporated into products, there is also a need for toxicity information on products that contain them:

> The toxicity profile of a nanoparticle incorporated into a product may be quite different from that of a pristine nanoparticle before it is incorporated. Research on product toxicity is appropriately conducted by independent research laboratories (Government or commercial) with funding from the company marketing the specific product. Depending on the end use of the product, the HSE tests may be quite expensive and the creation of contestable grant programs would be helpful in assisting small companies to fast-track products for commercialisation[249]

4.51 Adding to the complexity of assessing the toxicity hazard in the workplace is the fact that the process employed to manufacture or use a nanomaterial can affect its toxicity. In evidence to the Committee, Associate Professor Wright related his experience from an occupational workplace audit he had conducted on a carbon nanotube facility, which highlighted the need to assess them on a case-by-case basis:

---

247 Professor Priestly, Evidence, 28 April 2008, p 52

248 Associate Professor Wright, Evidence, 28 April 2008, p 53

249 Answers to written questions on notice, 14 July 2008, CSIRO, p 5

> 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 was more likely to turn into dust motes than the other. That is how we have to inspect – on a case-by-case basis – to see where the greatest risks lay.[250]

4.52 The process for assessing the toxicity of a nanomaterial to human health is quite distinct to assessing that nanomaterial's toxicity to the environment. Within the Nanosafety research conducted by the CSIRO are two programs – one on environmental effects and one on human health effects. Dr Nicola Rogers, Senior Research Scientist with CSIRO Land and Water, explained the need for two distinct programs:

> Those effects are often very different, particularly when we are looking at aquatic organisms that are surrounded by the water that carries the nanoparticles. So, that would be the primary route of exposure. Whereas, to humans the primary route of exposure is through airborne exposure into the lungs or on the skin through dermal absorption, and those are quite different routes. So, from that respect it is very useful scientifically to separate the two streams of research. Zinc and silver are quite good examples in that respect. They are quire toxic to aquatic organisms but less toxic to humans on a weight-for-weight basis.[251]

4.53 The Centre for Environmental Contaminants Research (CECR) of CSIRO Land and Water has been examining the potential aquatic toxicity of zinc oxide particles, cerium oxide nanoparticles and silver nanoparticles. Dr Rogers advised the Committee that their research found that the aquatic toxicity of zinc oxide nanoparticles was the same as bulk zinc oxide as both were equally soluble (both dissolving to ionic zinc).[252] However, Dr Rogers placed a caveat on this information, demonstrating the complexity of toxicity assessment for nanomaterials:

> I put one caveat on that: we have not tested formulated zinc oxide products as yet. The formulations – the coatings – may well change the amount of dissolution of the particle. There may be different toxicities for different formulations of zinc oxide particles. That is an illustration of how complex this area can become because there are many different formulations. We are thinking of things like sunscreens in terms of zinc oxide formulations.[253]

4.54 As noted in Chapter 3, the development of standard protocols for the assessment of the toxicity of nanomaterials is seen as a major milestone in the road to effective regulation of nanomaterials. The development of standard protocols and generic models is being undertaken internationally and within Australia.

---

250 Associate Professor Wright, Evidence, 28 April 2008, p 49

251 Dr Nicola Rogers, Senior Research Scientist, CSIRO, Land and Water, Evidence, 10 June 2008, p 4

252 Dr Rogers noted that because of the known toxicity of zinc it is already highly regulated in the aquatic environment

253 Dr Rogers, Evidence, 10 June 2008, p 1

OECD Working Party on Manufactured Nanomaterials

4.55 Throughout the Inquiry the Committee heard that the issue of understanding the toxicology and eco-toxicology of nanomaterials is being examined at the international level. In particular the Committee's attention was drawn to the Organisation for Economic Cooperation and Development's Working Party on Manufactured Nanomaterials.

4.56 The OECD is to conduct a project to characterise and test a representative set of nanomaterials and from that develop toxicity testing protocols suitable for use with those nanomaterials. The Committee was advised that OECD testing methods recommended for international usage tend to become default-accepted standards.[254]

4.57 The OECD initiated the project in recognition of the global need to understand the toxicity of various nanomaterials – the current lack of understanding being identified as a potential barrier to the development of the nanotechnology industry globally.

4.58 The OECD intends to investigate fourteen nanomaterials as part of the testing program. They are:

- fullerenes (C60)
- single walled carbon nanotubes (SWCNTs)
- multi-walled carbon nanotubes (MWCNTs)
- silver nanoparticles
- iron nanoparticles
- carbon black
- titanium dioxide
- aluminium oxide
- cerium oxide
- zinc oxide
- silicon dioxide
- polystrene
- dendrimers
- nanoclays.[255]

4.59 The above nanomaterials were selected on the basis of current known usages across the world and on the interests of industry. The broad plan is for member countries to sponsor research and investigation into one or more of the nanomaterials.

---

254 Dr Apte, Evidence, 10 June 2008, p 7

255 Answers to questions on notice, 12 June 2008, Dr Simon Apte, CSIRO Land and Water, List of OECD priority materials, p 1

4.60 The Committee heard that the estimated cost of participating in the scheme as a primary sponsor for one nanomaterial would be in excess of $US10 million over the lifetime of the program. Australia has expressed an interest in co-sponsoring the programs on zinc oxide and silver nanoparticles.

4.61 Dr Simon Apte, who was part of the Australian delegation to OECD workshop on the sponsorship program, explained why zinc oxide and silver nanoparticles were of particular interest to Australia:

> Zinc oxide was seen as a potentially important nanoparticle for industrial usage in Australia – with the interest in cosmetics and sunscreen being one application – and silver is seen globally as one of the nanoparticles that is being used quite a lot as an antibacterial product…We envisage that there will be a lot of consumer usage of silver-based nanoproducts, so I think it is important for us to understand the potential dangers of these materials.[256]

4.62 The CSIRO has already conducted, and continues to conduct, substantial research into zinc oxide and silver nanoparticles. Involvement in the OECD project would give Australia the opportunity to input into and influence the outcome of the OECD protocols.[257]

4.63 Dr Apte explained that the OECD project will be a bold undertaking, the complexity of which has meant that no end-date for the project has been set:

> Referring to the timelines, primary sponsors were asked to develop a dossier plan of what they were going to test, how they were going to test it, and what methods they would use. That is due to go to the OECD in March 2009. Testing will start in about April 2009 and there will be a check-up to see how the program is proceeding in about March 2011. Material from this program will be published before then, but that is the official date to check progress on the whole thing. There is no determined end date of the whole program because we really do not know how difficult it will be. It is a bold undertaking that will involve the development of relevant test methods and their application.[258]

4.64 Part of the OECD project will involve determining if standard protocols are applicable. The Committee heard evidence that that the standard toxicity testing protocols used for bulk materials are not immediately transferable to nanomaterials, primarily due to technological constraints in terms of measurement capabilities.[259]

4.65 In addition to the aim of the protocol project, coordination and monitoring of international research will be enhanced by the development, under the auspices of the OECD Working Party on Manufacture Nanomaterials, of an Environment Health and Safety Research Database, the objectives of which are to:

- Develop a global resource, which identifies research projects that address safty issues associated with manufactured nanomaterials.

---

256 Dr Apte, Evidence, 10 June 2008, p 3

257 Dr Rogers, Evidence, 10 June 2008, p 7

258 Dr Apte, Evidence, 10 June 2008, p 3

259 Associate Professor Wright, Evidence, 28 April 2008, p 50

- Assist those who are planning research in these areas to identify research needs, while avoiding duplication.
- Provide opportunities for researchers to identify scientists working in similar fields, and possibly lead to collaboration and networking.
- Link to other relevant databases so as to ensure the OECD database is a global and comprehensive resource.

4.66 The Committee was advised that Australian researchers will have the opportunity to list their projects once the database is publicly launched later in 2008. NICNAS is the agency responsible for coordinating the Commonwealth's input into the OECD Working Party.[260]

CSIRO NanoSafety research theme

4.67 In 2007 the CSIRO established a new 'Niche Manufacturing Flagship', focusing on nanotechnology. The Flagship will use nanotechnology to create a new wave of niche industries and add value to existing high-value segments of the manufacturing sector. Its goal is to support the development of niche manufacturing businesses based on nanotechnology, to be worth in excess of A$3 billion per year by 2020.[261]

4.68 Integrated into the business plan of the Flagship is a NanoSafety research theme to ensure that research and product development is carried out in a safe and socially responsible way. The CSIRO notes that as the task to determine safe work practices, dose-related toxicity for humans, and impact on ecosystems for a specific nanoparticle is immense, the NanoSafety theme will initially focus on nanoparticles of interest to the Flagship. Currently the focus is on metal oxides, particularly zinc oxide, and on special multi-walled carbon nanotubes that have properties suitable for spinning into yarns.

4.69 The CSIRO advise that although work will be focused on these two nanomaterials, the capabilities and bioassays developed will be applicable to subsequent investigations of other nanoparticles, and will be transferable to other laboratories.[262]

4.70 The submission from the CSIRO advised of the following timeframes for its NanoSafety research theme:

- Robust measurement and characterisation methods developed for nanomaterials and their physico-chemical properties by 2010.
- Ecotoxicological information on the toxicity of metal oxide nanoparticles and carbon nanotubes in soil and water matrices generated and disseminated by 2010.
- Generic environmental assessment protocols for nanomaterials developed by 2012.
- Inexpensive and high-throughput bio-assays developed to monitor and assess the effects of human exposure to nanoparticles by 2013.

260 Answers to written questions on notice, 10 June 2008, Mr Craig Pennifold, Australian Office of Nanotechnology, Department of Innovation, Industry, Science and Research, pp 4-5

261 Submission 19, p 12

262 Submission 19, p 18

- Models developed to evaluate and predict toxicity and biological response based on physico-chemical properties by 2018.[263]

4.71 The CSIRO said that the data generated by the NanoSafety research theme would be communicated to the federal Nanotechnology HSE Working Group.[264]

Committee comment

4.72 The final development of internationally agreed protocols for toxicity assessment of nanomaterials is some time away. Other research should and will continue concurrently. The OECD project has selected a representative sample of nanomaterials. It was suggested to the Committee that other materials in current use such as cadmium within quantum dots are also worthy of attention.[265]

4.73 A number of participants suggested to the Committee that research efforts need to be sensibly prioritised and focussed on areas or materials that have the greatest relevance to Australian society.[266] The current focus of research in Australia on zinc oxide and silver therefore seems appropriate.

Support for toxicology research

4.74 A point that was universally agreed by all participants in the Inquiry is that more toxicology research into nanomaterials is urgently required. This raises the questions of firstly, what is the current impetus for such research and, secondly, whether the support it receives is likely to meet projected needs.

4.75 Generally, government (federal) or industry provides the funds for toxicology research or assessment. Government funding is provided to address identified areas of need, while industry provides funds in order to have a chemical or product assessed, in accordance with legislative requirements.

4.76 As noted in Chapter 3, under the current regulatory frameworks, industry or companies are required to provide assessment data on the chemical they might want to introduce or the product they might want to have registered. Whether this currently applies to a specific nanomaterial depends on the requirements of the framework under which the chemical or product is regulated. If the regulatory framework is amended to require new assessments of nanomaterials, industry would effectively contribute more to health safety and environmental research.

263 Submission 19, p 19

264 Answers to written questions on notice, 14 July 2008, CSIRO, p 5

265 Professor Michael Roberts, Director, Research Unit, University of Queensland, Evidence, 10 June 2008, p 37

266 See for example, Professor Roberts, Evidence, 10 June, 2008, p 36; Associate Professor Wright, Evidence, 28 April 2008, p 51

4.77 The Committee was interested to learn how federal funding for nanomaterial toxicology research was prioritised. It was advised by the Australian Department of Industry, Innovation, Science and Research (DIISR) that funding comes from three areas:

> Funding in the nanotoxicology area comes from the competitively awarded Australian Research Council (ARC) grants, National Health and Medical Research Council (NHMRC) and the amounts provided by the CSIRO as part of its Niche Manufacturing Flagship progam.
>
> The ARC supports the highest-quality fundamental and applied research and research training through national competition across all disciplines, with the exception of clinical medicine and dentistry. The NHMRC supports health and medical research.
>
> NHMRC has identified nanotechnology as an issue of emerging importance for the 2007-2009 triennium, and currently funds nanotechnology research through its annual research, people, and infrastructure support schemes. The NHMRC can inform major stakeholders of relevant outputs from the research it funds as needs arise.[267]

4.78 The NHMRC has an advisory committee on health and nanotechnology (ACHN). The advisory committee's chairman, Professor Brian Priestly, advised that it was established in part to provide advice to the NHMRC on research gaps to which it might direct funding.[268]

4.79 As noted in Chapter 3, the Nanotechnology OHS Research and Development Program is also undertaking, commissioning and coordinating Australian nanotechnology OHS research.[269]

4.80 Associate Professor Wright argued that with respect to an emerging and growing sector such as nanotechnology, the timeframes associated with traditional funding bodies such as the NHMRC can be problematic:

> …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.[270]

4.81 Professor Michael Roberts is currently undertaking research into the toxicology of silver. The research is being funded by way of a grant from the United States Air Force. Professor Roberts believed that it was important to encourage international funding back to Australia in areas where it has competence and skills.[271] This would assist in compensating for the limited funding available in Australia.

---

267 Answers to written questions on notice, 10 June 2008, Mr Pennifold, p 4

268 Answers to written questions on notice, 20 May 2008, Professor Brian Priestly and Associate Professor Paul Wright, p 6

269 Answers to written questions on notice, 2 July 2008, Dr Howard Morris, Assistant Director Research, Office of the Australian Safety and Compensation Council, p 6

270 Associate Professor Wright, Evidence, 28 April 2008, p 51

271 Professor Roberts, Evidence, 10 June 2008, p 36

Networks

4.82 Throughout the Inquiry it was emphasised that toxicity assessment of nanomaterials requires input and knowledge from a broad range of scientific expertise. The importance of collaboration and coordination at a national and international level cannot be underestimated. This has led to the creation of formal and informal networks of practitioners.

4.83 In evidence to the Committee, Dr Simon Apte from the Centre for Environmental Contaminants Research at the CSIRO emphasised the need for the development and maintenance of research networks:

> One of the really nice trends in the area is that everybody in the field recognises the need to partner because we simply do not have all the techniques under one roof to do all the work we need on nanomaterials: I mentioned earlier the challenge in physical characterisation. So, we are seeing the development of international networks. We are part of the European Nanonet framework. There is also a NanoSafe Australia network of researchers, there is a lot of sharing of data because it is such a new area. That is really what we have to pursue, the development and maintenance of these research networks. Certainly in Europe and the United States funds are available for these sort of knowledge networks. It is seen as a very important piece of research. So, I think the same applies in Australia.[272]

NanoSafe Australia

4.84 The NanoSafe Australia network is a group of Australian toxicologists and risk assessors who have formed a research network to address the issues concerning the environmental health and safety (EHS) of nanomaterials. Its mission is to support government, industry and non-government organisations (NGOs) in their efforts to understand the health and safety issues surrounding nanotechnology products and their manufacturing processes, and to provide quality data for the appropriate risk assessments of nanomaterials.[273]

4.85 NanoSafe Australia was established in early 2006, following approaches to the Australian Centre for Human Health Risk Assessment (ACHHRA) by Nanotechnology Victoria Pty Ltd (NanoVic). NanoSafe's coordinator, Professor Paul Wright, said that one reason the network was formed was because people starting asking for guidance on the best ways for reducing the risks for handling nanomaterials. Professor Wright advised that it was a national network, including members from New South Wales.[274]

4.86 An example of the work of NanoSafe Australia is the document *Current OHS Best Practices for the Australian Nanotechnology Industry* that was released in November 2007. The Committee acknowledges the value of this document, which is linked to most Australian OHS nanotechnology webpages.

---

272 Dr Apte, Evidence, 10 June 2008, p 5

273 *Current OHS Best Practices for the Australian Nanotechnology Industry,* NanoSafe Australia Network, November 2007, p 2

274 Associate Professor Wright, Evidence, 28 April 2008, p 51

4.87 Associate Professor Wright noted that NanoSafe was under-funded. Members of its voluntary organisation were making small groups to apply for grants from the ARC and the NHMRC. However, Professor Wright believed that the current funding base was poor.[275]

A NSW Network?

4.88 The submission from the NSW Government noted that NSW has a significant toxicology research capability, both on the human and environmental scale. The submission said it was evident that there is an opportunity and need to coordinate this capacity, possibly through a network, to create assessment capacity relevant to research and industry sectors in the State.[276]

4.89 In evidence before the Committee the Hon Verity Firth MP, Minister for Science and Medical Research, indicated that the establishment of a network of toxicology expertise was worthy of serious consideration. Minister Firth said that New South Wales' strong medical research sector could perhaps incorporate such a network.[277]

4.90 A number of clinical research networks are currently facilitated through the Office for Science and Medical Research. The Minister said she saw no reason why this model could not be used for research into the toxicity of certain nanomaterials:

> Yes, a network idea we think is a very good one. We already have a sort of network process in New South Wales in terms of our science and medical research sector. So we have a number of clinical research networks facilitated and supported through the Office of Science and Medical Research, and this presents a framework that draws on the contribution of specific strengths from different research groups in order to contribute to a specific health issue such as cardiovascular disease, mental health, or, in this case, toxicity of certain nanoparticles. It is definitely a model that we have used in other areas of expertise, so I cannot see why that could not be translated. We can look at that.[278]

4.91 The Committee explored the concept of a State-based toxicology research group during the Inquiry. From the evidence it has received the Committee would assume that not all the expertise or infrastructure required for researching toxicity of nanomaterials currently exists within the State. Professor Michael Roberts argued that our population and resources dictate the need to cooperate nationally:

> I think the way ASCEPT[279] works, it has individual State chapters. I cannot see why we do not use those chapters. For instance, I am working with people in Perth, Adelaide, Melbourne and with some people in Sydney because we have a complementary and alternative medicine centre grant. We work across all those States. I do not think we should be seen as a State-based thing but, rather, a national thing. There are people in other States who have better expertise in areas than I do, which is

275 Associate Professor Wright, Evidence, 28 April 2008, p 51

276 Submission 25, NSW Government, p 4

277 Hon Verity Firth MP, Minister for Science and Medical Research, Evidence, 6 June 2008, p 7

278 Hon Verity Firth MP, Evidence, 6 June 2008, p 11

279 Australasian Society of Clinical and Experimental Pharmacologists and Toxicologists

> why we work together. We are a small country in population terms, and we have to maximise our resources by working together, not trying to work in silos.[280]

4.92 Associate Professor Wright from NanoSafe Australia said that, while he was based in Melbourne, the network was nationwide and included toxicologists from New South Wales. Professor Wright advised that any activity with NSW should be linked in with NanoSafe in order to avoid needless repetition.[281]

4.93 While it was generally agreed that national, and international, coordination was needed to avoid duplication of effort, the Committee also heard that in a frontier area such as nanomaterials research, some duplication was beneficial:

> To an extent, some duplication is good, especially in a frontier area like nanomaterials. So, we really are looking for some agreement between different laboratories to give us some comfort that the research is going in the right area.[282]

Committee comment

4.94 The Committee agrees there is a need to create nanomaterial assessment capacity relevant to research and industry sectors in New South Wales. What is needed as a first step is determining exactly what are the nanotoxicolology research needs of most importance to our research and industry sectors.

4.95 Consultation with the industry and research sectors must occur to determine what areas of nanotoxicity research would be of most benefit to them. This work would be best undertaken within the Office of Science and Medical Research.

4.96 Once those research needs are identified it would be prudent to ascertain whether that research is currently being undertaken elsewhere nationally or internationally. If it is not, then it is the work that should be considered to be undertaken by a potential NSW network.

Recommendation 9

That the Office of Science and Medical Research, through investigation and consultation, determine what are the nanotoxicology research needs of most importance to the industry and research sectors in New South Wales.

4.97 The Committee took the Government's indicative support for a toxicology network as an indication that it would provide financial support for the network to conduct the research. The Committee believes that providing financial support so that required research can be conducted is more important than establishing a State-based network.

280 Professor Roberts, Evidence, 10 June 2008, pp 35-36

281 Associate Professor Wright, Evidence, 28 April 2008, p 52

282 Dr Apte, Evidence, 10 June 2008, p 5

Recommendation 10

That the New South Wales Government provide financial support to create enhanced nanotoxicology assessment capacity relevant to research and industry sectors in the State.

Research as you develop

4.98 The Committee heard that traditionally toxicology research has occurred after the development stage, and once a problem has been identified. It was put to the Committee, by a number of participants, that the advent of nanotechnology provides an opportunity to build safety assessment research into the development stage. While benefiting consumers and the environment, such an approach would benefit industry in producing a better product:

> 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 [research] 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.[283]

4.99 In evidence to the Committee the Australian Manufacturing Workers' Union clarified its stance with respect to its call for a moratorium on the development and commercialisation of products containing nanomaterials. Essentially if evidence exists that a product/material does *not* pose a risk then the union would not oppose the commercialisation of such products.

> We believe that the companies should be focusing on research with respect to health, safety and environmental issues relating to their products. Once companies are in a position to give it a tick and say, "We understand the implications of our products, how they are to be treated and how they should be handled safely", it is fair enough that we do not have any objection to the commercialisation of those products.[284]

4.100 The Consumers' Federation of Australia also held the view that there should be pre-market testing of nanomaterials to ensure they do not pose a risk to human health or the environment.[285] Ms Attwood spoke to the Committee about the definition of the precautionary principle that she argued was most widely accepted by civil societies, public interest and environmental organisations. With respect to nanotechnology it, in part, states:

---

283 Associate Professor Wright, Evidence, 28 April 2008, p 49

284 Mr Henry, Evidence, 1 May 2008, p 17; see also Answers to written questions on notice, 5 May 2008, Mr David Henry, Occupational Health and Safety Officer, Australian Manufacturing Workers' Union, p 3

285 Ms Elaine Attwood, Consumers' Federation of Australia, Evidence, 10 June 2008, p 11

> This would include prohibiting the marketing of untested or unsafe use of nanomaterials and requiring product manufacturers and distributors to bear the burden of proof. Simply put, "no health and safety data, no market."[286]

4.101 Professor John Weckert said that in Europe there was a greater emphasis on conducting health and safety research prior to product development, this emphasis lessens the requirement for regulatory remedies, particularly retrospective action:

> 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 they 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 regulations.[287]

4.102 The CSIRO Niche Manufacturing Flagship on Nanotechnology has formally adopted this approach of integrating HSE research into the development process. The submission from the CSIRO included the following comments from Dr Andrew Maynard, Chief Science Adviser given in testimony to a United States House of Representatives Committee on Science and Technology:

> Building a top-down strategic nanotechnology EHS research plan around these goals, challenges and elements, is essential to providing a framework for generating the information that regulators, industry, consumers and others need to develop and use nanotechnologies as safely as possible.
>
> As an example of what is possible, Australia recently announced the formation of an AU$36.2 million initiative to develop nanotechnologies for niche markets – the Niche Manufacturing Flagship. What sets this initiative apart is an integrated approach to EHS research from the start, an approach that will lead to products that have been researched and designed with safety in mind. And while the Niche Manufacturing Flagship approach represents just one component on an effective strategic research framework, in the long run, it is products arising from programs like this that are most likely to be embraced by consumers and industry alike.[288]

4.103 Integrated into the business plan of the Flagship is a NanoSafety research theme to ensure that research and product development is carried out in a safe and socially responsible way. The goal of the NanoSafety research theme is to assess and understand the impacts on human health and the environment of nanomaterials and products containing them, which are used or developed in other Flagship projects.[289]

---

286 Ms Attwood, Evidence, 10 June 2008, p 17

287 Professor John Weckert, Centre for Applied Philosophy and Public Ethics, Charles Sturt University, Evidence, 28 April 2008, p 41

288 Submission 19, p 7

289 Submission 19, p 18

4.104 Research at the Australian Nuclear Science and Technology Organisation (ANSTO) has given rise to two fully owned subsidiary companies that are developing products containing nanomaterials: Ceramishphere Pty Ltd and Australian Membrane Technologies Pty Ltd.

4.105 Ceramisphere aims to commercialise technology that can be used to produce ceramic nanosized particles that release an active ingredient at a controlled rate, over time ranges from hours to months. Applications include drug delivery, surface protection, cosmetics and nutriceuticals. Ceramishphere offers potential for targeted delivery of drugs and other molecules to the precise location in the body where they are needed.

4.106 Australian Membrane Technologies aims to commercialise nano-particulate membrane technology for sewage and wastewater treatment, and also the culture of various microbes for biotechnology applications.[290]

4.107 The two subsidiaries, in conjunction with ANSTO, have conducted and continue to conduct health, safety and environment testing as part of the product development stage.[291] Dr George Collins, Chief of Research, pointed out the cost of conducting health and safety testing required for products with a registered medical application in mind:

> [With respect to Ceramisphere] 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.[292]

4.108 The Chief Scientist of the NSW Food Authority said that, given the investment cost in developing food technologies, in the past companies have taken the approach to engage with the relevant regulator early in the development stage, even when not explicitly required to do so:

> If they were applying it in an area where they would have to amend the code, yes, there are pre-market requirements…But they might equally make the decision that that is a grey area and that they are best to engage with a regulator early in the process, rather than when the food is on the market. A lot of these technologies require a significant investment on behalf of the company. It has been our experience that companies come to us before they travel down a particular path.[293]

4.109 In evidence to the Committee Associate Professor Wright said that 'good' companies have realised that they can value-add to their products by being in the position to state that safety aspects have been assessed. Associate Professor Wright added that, in his role with the Cooperative Research Centre in Advanced Materials, he had been in discussions with a couple of companies regarding the toxicity of some nanomaterials and investigating how to design

---

290 Submission 17, Australian Nuclear Science and Technology Organisation, p 2; Answers to written questions on notice, 10 July 2008, Australian Nuclear Science and Technology Organisation, p 3

291 For description, see, Answers to written questions on notice, 10 July 2008, Australian Nuclear Science and Technology Organisation, p 3; and Dr Collins, Evidence, 28 April 2008, p 71

292 Dr Collins, Evidence, 28 April 2008, p 71

293 Dr Elizabeth Szabo, Chief Scientist, NSW Food Authority, Evidence, 6 June 2008, p 19

them better to make a better product. He noted this approach accords with that adopted by the CSIRO.[294]

4.110 However, the Committee was told that toxicologists are more likely to receive approaches from larger organisations and consortia to undertake toxicology assessment of nanomaterials that are being developed. Smaller companies are generally not as communicative or interested in seeking toxicology assessment due to resource issues.[295]

4.111 The NanoSafety Research Theme, being conducted as part of the CSIRO's Nanotechnology Niche Manufacturing Flagship, is focused in New South Wales. The CSIRO laboratories that work on human health studies are based at North Ryde and the laboratories doing most of the work on environmental studies are based at Lucas Heights.

4.112 Dr Maxine McCall, the NanoSafety Theme Leader, suggested to the Committee that the existence of this expertise within the State might provide an opportunity to build on that strength to meet the potentially significant increase in demand for toxicity testing:

> I think most people focus on opportunities in manufacturing based on technology development, but associated with this we have opportunities in other areas that might not be considered. One of those is that right now we are trying to develop tests to look at the toxicity of nanomaterials. Clearly, there is a booming industry just waiting to happen to do the standardised testing that will be required downstream by regulators
>
> …New South Wales could look at the potential opportunities and get in at the beginning. If you are in at the beginning – it is a suggestion to consider. We do not have to focus totally on technology development opportunities but the associated service industries that are with them.[296]

4.113 Dr Simon Apte told the Committee that with respect to eco-toxicity testing the NSW Government has been proactive in that area for a number of years. There are a number of centres with international renown and reputation in the State, and one or two eco-toxicity companies have started up, drawing on the expertise of people who were working in the area.

4.114 However, Dr Apte argued that the development of standard and accepted protocols would be a prerequisite for the creation of an eco-toxicity service industry:

> If I set up a company now and a client said to me, "I want these materials tested" it would be a matter of I say, "Well, we haven't got any standard protocols. We can do our best job and you just have to trust me that everything is okay." But I do not think many clients would be comfortable with that approach. We really need those defined protocols, accepted test methods, in place before we can really start to spin up an industry in this area.[297]

294 Associate Professor Wright, Evidence, 28 April 2008, p 54

295 Associate Professor Wright, Evidence, 28 April 2008, pp 53-54

296 Dr Maxine McCall, Nanosafety Theme Leader, CSIRO, Evidence, 1 May 2008, p 37

297 Dr Apte, Evidence, 10 June 2008, p 6

Committee comment

4.115 The Committee notes that the development of internationally accepted standard protocols will take some time. It also acknowledges that in the interim product developers are still expected to address potential HSE concerns, and that it is likely they would desire to do so as best as they can, in a cost-effective manner.

4.116 The Committee frequently heard that individual products containing nanomaterials can have those nanomaterials re-engineered to reduce or eliminate any associated toxicity. This has given rise to the equally frequent call that nanomaterial products will need to be assessed on a class by class or case by case basis.

4.117 Throughout the Inquiry the Committee acknowledged the obvious wisdom of introducing health, safety and environmental toxicity studies during the research and development stage of any product. [298] The Committee supports this approach and seeks to encourage its adoption wherever possible.

4.118 The Committee supports the argument that any government funded grant for research and development with a view to commercialisation should include a requirement that a component of that funding or program relate to assessing the health, safety and environmental risks. This should apply when those risks have not yet been tested or confirmed and when such assessment would not be required under the current regulatory frameworks.

4.119 In supporting this approach, the Committee notes that not all products containing nanomaterials will be developed by way of government research and development funding, and that on the national scale relatively few research and development programs are wholly administered by the State. Nevertheless, where New South Wales agencies can encourage this approach, the Committee believes they should do so.

Recommendation 11

That New South Wales Government agencies that provide funding grants for research and development of nanomaterials or products containing nanomaterials with a view to their commercialisation require that a component of that funding be used to assess the health, safety and environmental risks of the material or product when those risks have not yet been tested or confirmed.

4.120 With respect to support for the safe and responsible commercialisation of products incorporating nanomaterials, the Committee can, from the evidence it received, describe the capacity that would be present in an ideal situation:

- Health, safety and environmental (HSE) research would occur early on and during the research and development stage and that the development path of a product or material would be guided by the results of that research.

[298] See for example, Hon Christine Robertson, Evidence, 10 June 2008, pp 49-50; and 4 August 2008, p 19

- The technological capacity for HSE assessment would be readily accessible to industry.
- The use of this capacity by industry would be cost-effective.
- The assessment would be undertaken by an independent body, and the results of these assessments made available to increase overall knowledge of nanomaterial HSE impacts.

4.121 The following section examines a proposal for a specialised national centre for nanotoxicology that was raised with the Committee during the Inquiry.

Dedicated national toxicity testing and assessment centre

4.122 The Committee heard evidence from Dr Suzanne Smith from the Institute of Materials Engineering Science, ANSTO on 10 June 2008. During her evidence Dr Smith spoke at length to the Committee about the concept of a national facility that provided toxicity assessment capacity where products or materials in the research and development stage could be assessed prior to further development or commercialisation.[299]

4.123 Dr Smith spoke about the use of technology based on radiolabelling nanoparticles with radioisotopes to track nanoparticles *in vitro* and *in vivo*. During her discussion, Dr Smith emphasised that the benefit of assessment conducted early in the development process is reduced cost to business and ultimately to the consumer. Dr Smith also noted that such a facility could provide a service to overseas as well as local clients.

4.124 Dr Smith summarised the role of a facility in the risk assessment of nanotechnologies:

> [It] should support both industry and non-industry researchers. It could serve to develop technologies for the risk assessment of new materials, transfer of technology to industry, research and regulatory bodies, and train staff and students in each of these communities. A national facility that is transparent in its processes, and is seen to have "no conflict of interest", could become the source of information vital to the development of nanotechnology at national and state levels.[300]

4.125 In many respects the aims of and rationale for such a national facility is similar to those behind the New South Wales Government's decision to establish the NSW Clinical Trials Business Development Centre that was announced in May 2008. The centre, based on the existing strength of the medical research sector, is designed to make NSW an international hub of clinical trials activity and to bring a greater share of the $10 billion global clinical trials industry to the State.[301]

---

299 Dr Suzanne Smith, Evidence, Research Programme Leader, Nuclear Solutions, Institute of Materials Engineering, Australian Nuclear Science and Technology Organisation, 10 June 2008, pp 45-51; see also Correspondence from Dr Suzanne Smith, ANSTO, 27 June 2008

300 Correspondence from Dr Suzanne Smith, ANSTO, 27 June 2008, p 5

301 Hon Verity Firth MP, Evidence, 6 June 2008, p 9; and *NSW set to capture greater share of global clinical trials industry,* Media Release, Hon Verity Firth MP, 15 May 2008

4.126 Professor Brian Priestly told the Committee that he was aware that others in Australia have advocated the idea of developing a specialised institute for nanotoxicology.[302] The issue is whether there is a need for such an institute as opposed to the practice of spreading the research effort among various groups in a coordinated fashion. This question of need would be determined by the scale of demand, which, while potentially significant, cannot be accurately forecast at this stage. The ultimate level of demand would depend, in part, on any amendment to the current regulatory framework requirements.

4.127 Professor Priestly noted that while a case could be made for a centralised institute it would require substantial funding that would more than likely need to come from the federal level:

> We favour support for individual scientists and groups working to exploit their expertise in specific areas (eg. immunotoxicology, dermal penetration, occupational health & safety assessment). The work of these scientists would certainly be enabled by the establishment of suitable networks (eg. NanoSafe Australia). However, we recognise that a case could be made to centralise the research effort through funding of a specialised institute. By comparison, funding an institute would require a substantially larger funding commitment, probably at a national level.[303]

4.128 Mr Craig Pennifold told the Committee that no firm proposal regarding the establishment of a dedicated national toxicology testing and assessment facility had been put forward to the federal government for consideration. Mr Pennifold noted that the need for greater access to toxicology testing and assessment would be an issue that would emerge as the Government examines how it needs to respond to the areas identified in the Monash Report.

4.129 Mr Pennifold further noted that, as such a facility would require major expenditure, any proposal would require a business case and then proceed through the budget process. Further, any proposal would need to identify if the need would best be met by a central facility or a 'hub and spokes' model. Mr Pennifold said that such a proposal could emerge from the current review:

> We might develop it internally. It could come through from a State or States, through the regular process we have with them. We may well look at it in terms of where we go in responding to the Monash Report, if the regulators point out to us that there is a major failing in this area and that we might need to do something. Certainly it is true that the regulations we have on human health and safety require that toxicology work is done. For example, the TGA requires that work to be done rather than necessarily to be done in Australia. That is why you would need to look at the business case as to exactly what needs to be done and how you would [best] go about meeting that need.[304]

4.130 The Minister for Science and Medical Research advised that such a proposal had not been the subject of discussion at the Nanotechnology State and Territories Committee (NSTC). While it could be the subject of discussion at that forum at a later date, more preliminary examination was required:

---

302 Professor Priestly, Evidence, 28 April 2008, p 47

303 Answers to written questions on notice, 20 May 2008, Professor Priestly and Associate Professor Wright, p 4

304 Mr Pennifold, Evidence, 4 August 2008, p 16

> More detailed discussion between CSIRO, ANSTO and DSRD need to occur in the first instance, followed by more in-depth consultations with other Government agencies such as NSW Health, WorkCover NSW and NSW Department of Environment and Climate Change.[305]

Committee comment

4.131 The Committee believes that if a proposal for a national nanotoxicology centre did emerge, then NSW would present as a strong candidate for its location. Notwithstanding its strong candidacy NSW would still need to put forward a sound case for its support of such a centre.

4.132 The Committee believes that the NSW Government should indicate its support for a national facility for the assessment of the toxicity of nanomaterials in products prior to their commercialisation. However, before it can do this more detailed discussion, as suggested by the Minister for Science and Medical Research, needs to occur.

Recommendation 12

That the NSW Department of State and Regional Development enter into detailed discussions with the Commonwealth Scientific and Industrial Research Organisation, the Australian Nuclear Science and Technology Organisation and New South Wales Government agencies to explore the feasibility of and need for a specialised facility for assessing the toxicity of engineered nanomaterials, and the case for and benefit of it being located within New South Wales.

[305] Answers to questions taken on notice, 27 June 2008, Hon Verity Firth MP, Minister for Science and Medical Research, p 2

Chapter 5 Government approach to nanotechnology

The consensus of views expressed by participants in the Inquiry was that nanotechnology has the potential to fundamentally alter the way people live – to grow new industries and to transform existing areas such as healthcare, manufacturing, energy, electronics, agribusiness, environmental monitoring and protection, and communications. Given significant potential impact and opportunity, many governments have articulated their position on how they intend to support and develop nanotechnology so as to capture the benefits it offers, while addressing health, safety and environmental concerns.

The previous two chapters discussed how health, safety and environmental concerns are currently being examined. This chapter examines what other Governments have done and what New South Wales is doing to foster and support the development of nanotechnology opportunities.

Support for nanotechnology equals support for science

5.1 As stated in Chapter 2, nanotechnology is a term that refers to a broad set of enabling technologies that are based at the interface of scientific disciplines such as physics, chemistry, biochemistry and biotechnology, materials science and information and computer science.

5.2 Therefore, when discussing the provision of underlying support for nanotechnology, this in practical terms evolves into discussing the support for scientific research, innovation and development generally.

5.3 Throughout the Inquiry, participants from the university research sector commented that the New South Wales Government has not positioned itself as strongly as other State Governments in engaging the research, development and innovation sectors. Similarly it was argued that New South Wales was not well positioned to respond strategically to tackling significant research issues or to compete effectively in attracting major federally funded infrastructure to the State.[306]

5.4 Participants referred to the Victorian and Queensland Governments, and to a lesser extent the South Australian Government, as having attracted disproportionate amounts of federal research and infrastructure funding on the back of a firm strategic plan and investment commitment. The NSW Government has itself acknowledged that its share of Australian Government supported research and development (R&D) resources had declined over recent years.[307]

306 See: Professor Leslie Field, Deputy Vic-Chancellor (Research), University of New South Wales, Evidence, 1 May 2008, pp 21-22; Submission 10, UNSW, pp 5-6; Professor Andrew Cheetham, Pro Vice Chancellor Research, University of Western Sydney, Evidence, 28 April 2008, p 31; Professor William Price, Head, School of Chemistry, University of Wollongong, Evidence, 28 April 2008, p 63

307 *NSW Government Statement on Innovation*, 2006, p 6

5.5 Inquiry participants commented that New South Wales' position had declined compared to other States over the years. However, many of these participants also noted that support had improved recently, with particular reference to actions undertaken by the then Minister for Science and Medical Research, the Hon Verity Firth MP.[308][309]

5.6 Inquiry participants from the university research sector, most notably the University of New South Wales,[310] made a number of recommendations in their submissions to improve the state of research, science, innovation and development. During the Inquiry the Committee heard of recent, in some cases very recent, actions undertaken by the Government that aim to address the substance of the issues raised in submissions. The following sections examine some of the issues raised and the Government's response to them.

Government departmental structure

5.7 Professor Leslie Field, Deputy Vice Chancellor (Research) at the University of NSW, argued that the importance of actively engaging the research and development and innovation sector requires that it be the sole responsibility of a Minister and a dedicated Ministry.[311]

5.8 The current Government department primarily responsible for supporting research, science, innovation, technology and development is the Department of State and Regional Development (DSRD). Within the DSRD are the Office of Science and Medical Research (OSMR), the Industry Division and the Innovation Unit. The DSRD and the OSMR are each a portfolio responsibility of a different Minister. Each Minister also had additional Ministerial portfolio responsibilities.

5.9 Minister Firth argued that the current structure was adequate. She said it was important to note that the current structure parallels the structure in place at the federal level, specifically the Department of Innovation, Industry, Science and Research.[312] The Executive Director of the OSMR also noted that the current structure mirrors those in Victoria and at the federal level.[313]

Committee comment

5.10 The Committee accepts the view, given in evidence, of the Minister for Science and Medical Research that the current structure is adequate. As noted earlier, a number of actions have

308 See: Professor Field, Evidence, 1 May 2008, p 21; Dr George Collins, Chief of Research, Australian Nuclear Science and Technology Organisation, Evidence, 28 April 2008, p 68; Dr Peter Binks, Chief Executive Officer, Nanotechnology Victoria, Evidence, 1 May 2008, p 5

309 At the start of the Inquiry and up until 5 September 2008, the Hon Verity Firth MP, was the Minister for Science and Medical Research. On 5 September 2008 the Hon Tony Steward MP was appointed Minister to that portfolio.

310 Submission 10, pp 2-6

311 Professor Field, Evidence, 1 May 2008, p 21

312 Hon Verity Firth MP, Minister for Science and Medical Research, Evidence, 6 June 2008, p 3

313 Ms Kerry Doyle, Executive Director, Office of Science and Medical Research, Department of State and Regional Development, Evidence, 28 April 2008, p 6

been undertaken to improve support for science and innovation. Some time must be allowed to see if these actions address the concerns raised during the Inquiry.

Creation of a New South Wales Chief Scientist

5.11 The submission from the University of NSW recommended the establishment of a Chief Scientist position. The Committee examined this proposal with other Inquiry participants from the university research sector during the public hearings. All participants with whom the proposal was raised supported the creation of a NSW Chief Scientist position. At the public hearing on 28 April 2008 the Committee was advised that the establishment of a Chief Scientist position was under consideration by the Government.[314]

5.12 On 22 May 2008, the Chair, on behalf of the Committee, wrote to the Minister for Science and Medical Research drawing her attention to the published proceedings of the Inquiry within which the issue of a Chief Scientist had been raised. The Committee, while supportive of Chief Scientist position, was concerned that it should not, unintentionally, act to narrow the research undertaken across government agencies:

> During the public hearings some members of the Committee were concerned to ensure that, if a Chief Scientist position was established, the position, and whatever structure may be associated with it, functioned in such a way that *all* government departments were able to optimise the research potential within those departments to ensure a continuance of public sector evidence-based practice in New South Wales.
>
> Should the Government consider establishing such a position, the Committee's initial view is that it should be concerned with setting science priorities for Government, and with coordinating and advocating for the science that occurs in Government, rather than being involved in day-to-day operational matters. Such a position would benefit from the coordination of the agencies conducting significant science efforts in Government.[315]

5.13 On 23 July the Minister for Science and Medical Research advised the Committee in writing, though the Chair, that a NSW Chief Scientist and Scientific Engineer position was approved by Cabinet on 24 June 2008.

5.14 The Minister advised that the views expressed by the Committee in its correspondence together with input from universities, medical research sector and NSW Government agencies contributed to the development of the scope of the position. The position will be part-time, with the feasibility of the part-time nature of the position being reviewed and reported on before the end of two years.[316]

Committee comment

5.15 The Committee welcomes the decision of the Government to establish and appoint a NSW Chief Scientist. The Committee's view, which it expressed in its correspondence to the

---

314 Ms Doyle, Evidence 28 April 2008, p 6

315 Correspondence from Committee Chair, to Hon Verity Firth MP, 22 May 2008

316 Correspondence from Hon Verity Firth MP, to Committee Chair, 23 July 2008

Minister, is that the establishment of the position would be a significant step forward in addressing nanotechnology related issues as well as science issues more broadly in New South Wales.

5.16 At the time of the adoption by the Committee of this report, an appointment to the position of NSW Chief Scientist had not been announced. The Committee urges the Government to make an appointment as soon as is practicable.

Development of research and development priorities

5.17 In evidence to the Committee, Professor Field from the University of NSW highlighted the current lack of a strategic plan for research and development in New South Wales:

> In terms of long-term strategic objectives, we do not as a State have clearly articulated plans for tackling the big research issues, particularly in science and technology, into the future compared to other States. This means we do not tend to position ourselves terribly well to deal with the issues. We can talk about things like energy, like water resources, like environmental issues, manufacturing sustainability, climate change – all of these things are the sorts of issues where it would be good to have a State perspective, a State strategy, as to how we might tackle these things, and I do not see that State vision coming at the present time. This is one recommendation we made, that a chief scientist should coordinate or somebody, a person of that ilk, should coordinate, a body of that type.[317]

5.18 In 2006 the then Premier, the Hon Morris Iemma MP, released the *NSW Government Statement on Innovation*. The statement indicated that work would continue on research and development priorities in NSW. The Committee was advised that the duties of the Chief Scientist will include playing a central role in the development of research and development priorities as required by the Innovation Statement. The Chief Scientist will work with universities and the research sector more broadly to encourage greater alignment between their activities and State priorities.

5.19 Professor Andrew Cheetham from the University of Western Sydney emphasised the importance of determining the priorities to support the intent of the Innovation Statement:

> 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 centres, 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.[318]

5.20 Professor Field said it was his experience that when competing to attract major federally funded research facilities the business case in support of such bids is at a disadvantage if it can

317 Professor Field, Evidence, 1 May 2008, p 21

318 Professor Cheetham, Evidence, 28 April, p 31

not show that it fits in with the State's strategic research plan. To do that, it requires a firm statement from the State Government to which it can refer.[319]

5.21 Professor Field said that when setting priorities the best strategy is to identify areas of strength, or areas that are strategically important to develop capacity in, and put the focus on those areas.[320]

Committee comment

5.22 From the evidence received during the Inquiry it is clear that the importance of the development of research and development priorities is beyond dispute. The Committee welcomes the fact that the Chief Scientist will play a central advisory role in the development of these priorities.

5.23 The Committee again notes that an appointment to the Chief Scientist position has not yet been made. The Committee believes that once an appointment is made to the Chief Scientist position, that the development of research and development priorities be progressed as a matter of urgency.

Development of a long-term strategic plan to address critical research infrastructure

5.24 Scientific research relies on complex infrastructure. The submission from the University of NSW argued that a strategic plan is required if New South Wales is to secure the infrastructure it requires now and in the future:

> Cutting-edge research areas such as nanotechnology rely on complex infrastructure. Such programs are not short-term – they take many years to establish and the benefits will flow over the space of decades rather than months. The infrastructure is typically expensive to purchase and install, and requires an on-going and long term commitment to properly maintain. *The management of critical research infrastructure requires long-term strategic planning at all levels of Government, industry, and research organisations.*
>
> The necessity for long-term planning permits the government to position the State for many national initiatives which require strong support from State Governments. It is absolutely clear that major research initiatives must align strongly with state priorities before they will be considered seriously by Commonwealth and external agencies.[321]

5.25 New South Wales established the Science Leveraging Fund (SLF) in order to leverage and attract funding from the Commonwealth for infrastructure and technical capacity through to New South Wales. The SLF is a $40 million four-year fund, which runs until 2009-2010. It allocates $10 million a year. The Committee was advised that approximately $22 million had

319 Professor Field, Evidence, 1 May 2008, p 22

320 Professor Field, Evidence, 1 May 2008, pp 25, 26

321 Submission 10, p 6

been invested in research infrastructure that relates to nanotechnology.[322] SLF investments are made only in areas where NSW has specific strengths.[323]

Committee comment

5.26 The Committee agrees with the view that a strategic plan for securing research infrastructure is essential. However, before such a plan can be finalised the research and development priorities, which such infrastructure will support, must themselves first be agreed upon.

5.27 The Committee notes that once a plan for critical infrastructure is finalised, the Government may need to consider an extension of and increase in the amount of funding currently provided for under the Science Leveraging Fund.

Engagement with research and development sectors

5.28 The Committee heard that in comparison to other States, again notably Victoria and Queensland, the New South Wales Government had been less proactive in actively engaging the research and development and innovation sector.[324]

5.29 Minister Firth pointed out that New South Wales universities have the highest expenditure of any State on research and development, totalling $1.18 billion. Nevertheless the Minister said that strengthening the strategic alliance between the State Government and the university sector was important and that she had set closer engagement with the university sector as a primary priority:

> At my direction, the Office for Science and Medical Research has convened a university-government working group that will be chaired by the OSMR with which there has already been consultation on things like the Chief Scientist and the New South Wales Medical Research Plan. It is of primary importance that the university sector and the New South Wales State Government policy are aligned where relevant in order to effectively contribute to the New South Wales innovation system and economy.[325]

5.30 The Minister also referred to the establishment of the Innovation Council, the Skills Council and the Manufacturing Council to secure high-level industry and academic advice.[326] The decision to establish a Chief Scientist position also entailed the creation of a Ministerial Advisory Council for Science Engineering and Medical Research, which the Chief Scientist will chair.

322 Dr Derek Van Dyk, Director, Science, Officer of Science and Medical Research, Department of State and Regional Development, Evidence, 28 April 2008, p 5

323 Dr Van Dyk, Evidence, 28 April 2008, p 13

324 Professor Field, Evidence, 1 May 2008, p 21

325 Hon Verity Firth MP, Evidence, 6 June 2008, p 4

326 Hon Verity Firth MP, Evidence, 6 June 2008, p 2

5.31 The University-Government Working Group has a role of supporting the activities of the Chief Scientist in relation to strategies and projects to achieve greater alignment between universities and State Government priorities.

Committee comment

5.32 The Committee notes the relatively recent steps taken by the Government to strengthen the engagement between it and the research and development sectors. Now that these new engagements structures have been put in place it is important that they be effectively maintained and that use be made of them.

Improving knowledge and coordination between government science agencies

5.33 In addition to the Department of State and Regional Development (DSRD), a number of other government portfolios carry out science and research, including the departments of Environment and Climate Change, Primary Industries, Health, Lands, Commerce and the New South Wales Food Authority.[327]

5.34 During the Inquiry the Committee experienced some difficulty in securing information on the research and development activities relating to nanotechnologies that were being carried out across all State agencies and departments. The Committee saw a need for establishing a process or structure that would enable greater awareness and coordination across all Government departments.

5.35 The Committee heard that a Science Agencies Group had recently been established to achieve just this:

> At my direction DSRD has established and chairs the science agencies group, which is a cross-government forum of New South Wales agencies carrying out science and research to achieve greater communication and coordination of common issues across New South Wales government, and, in particular, to develop whole-of-governement science priorities, communicate New South Wales government and agency research activity excellence and contribution, and of course engage with Commonwealth funding programs.[328]

5.36 The Science Agencies Group meets quarterly. The Minister advised that, by ensuring that all agencies are aware of the science being carried out, this will create opportunities for collaboration and reducing inefficiencies.[329]

Committee comment

5.37 The Committee believes that there is a demonstrated need for greater knowledge, coordination and communication of the science and research being carried out by the various State departments and agencies. Similar to its comment on the previous section, the

327 Hon Verity Firth MP, Evidence, 6 June 2008, p 2

328 Hon Verity Firth MP, Evidence, 6 June 2008, p 2

329 Hon Verity Firth MP, Evidence, 6 June 2008, p 10

Committee notes that now that a structure has been put in place to achieve this, it is important that it be effectively supported.

5.38 The Committee also believes that once full knowledge of the science and research being conducted or partnered by government departments is realised, that this information must be continually updated and made widely available.

Improving knowledge of and accessibility to research and research infrastructure

5.39 Industry access to research and research infrastructure is essential. Awareness of the capacity that exists is a prerequisite to industry deciding to seek access and make use of that capacity. The Committee heard that the approach to the take-up by industry of nanotechnology, which is consistent with the overall approach to technology uptake, was primarily through the running or supporting of awareness events such as industry forums.[330]

5.40 The submission from Protech Pty Ltd, a private research organisation working in the area of food, cosmetic and pharmaceutical development, said there was a need for a clear understanding of the availability of relevant research infrastructure or capacity.[331]

Committee comment

5.41 The Committee believes that there needs to be a mechanism whereby industry, and the public, can at any time search and access knowledge on the research and research infrastructure capacity that exists within the State.

5.42 The website for the Office of Science and Medical Research contains two fully searchable research directories: *The State of Research: NSW Health and Medical Research Directory* and *The State of Research: NSW Science Directory*. The website states that they provide a comprehensive overview of publicly funded scientific and medical research in NSW:

> The research directories detail the breadth of research currently being undertaken in NSW within universities and associated research centres, health and medical research organisations, hospital-based research organisations, Centres of Excellence, CSIRO divisions, Cooperative Research Centres headquartered in NSW, and independent research institutions. The fully searchable directories are useful for local, interstate and international scientists, researchers, government and business.[332]

5.43 The Minister's Foreword to the NSW Science Directory notes that the database is fully searchable and continually updated. However, the Committee notes that the Minister appearing in the foreword ceased in that capacity in April 2007.

5.44 If properly maintained and promoted the research databases would provide a mechanism for providing information on research and research infrastructure in NSW. The Committee was

---

330 Mr Kaustuv Mukherjee, Senior Manager, Innovation Statement, Industry Division, Department of State and Regional Development, Evidence, 28 April 2008, p 4

331 Submission 24, Protech Pty Ltd, p 2

332 <www.osmr.nsw.gov.au/research_directories> (accessed 29 September 2008)

advised that the OSMR website is being significantly redesigned.[333] The Committee believes that the Research Directories should be maintained and strengthened.

Recommendation 13

That a user-friendly, accessible and continually updated directory of research and research infrastructure capacity within New South Wales that is publicly available via an easily accessible website be maintained by a relevant Government agency or department.

Support for attracting and retaining researchers

5.45 Professor Michelle Simmons from the University of NSW suggested to the Committee that when determining whether a research area is, or should be, one of strength for the State that the answer will depend on the human capital present:

> I think research in the long term is undertaken by individuals, and individuals build their research to strengthen their excellence. To select an area randomly and say let us build an area when you do not have the right people there can be a disaster. I really believe that you should fundamentally support the areas where you have research excellence with either individuals or a group of individuals in a certain area.[334]

5.46 Professor Robert Clark also emphasised the importance of supporting researchers as opposed to a narrowly defined research priority:

> I would also add that research in most areas is a rapidly dynamically changing field. People follow their creativity and ask questions that take them into new areas. What is the niche area today may suddenly not be a niche area tomorrow. People may move on to something that is more relevant or productive or whatever. I think it is dangerous to anchor yourself to that. I think that you need to be guided by the researchers. I think that supports what Michelle is saying. Research is a funny thing. You cannot quite put your finger on it. It is not prescriptive, thank God, and it leads you in directions that inquiring minds take you – young inquiring minds, generally. Unexpected surprises can happen along the way. I think we should be guided by the researchers themselves, where they are going, what we are strong at.[335]

5.47 Professor Field suggested other States are doing more to attract research talent, and in some cases are attracting researchers from New South Wales. In particular they pointed to State-level fellowships as the reason for this.[336]

5.48 The Minister for Science and Medical Research said that the need to attract research talent is an on-going issue. The Minister noted that the most important requirement is to have good

333 Hon Verity Firth MP, Evidence, 6 June 2008, p 11

334 Professor Michelle Simmons, Director, Atomic Fabrication Facility, UNSW, Evidence, 1 May 2008, p 26

335 Professor Robert Clark, Director, Centre for Quantum Computer Technology, UNSW, Evidence, 1 May 2008, p 26

336 Professor Field, Evidence, 1 May 2008, p 22; Professor Simmons, p 29

capital and research infrastructure in place. The Minister said that since 2006 there had been over $150 million in Government funding in capital infrastructure.

5.49 In addition the Minister referred to a number of initiatives that serve to attract, reward and promote researchers:

- The Young Tall Poppy Science Awards
- NSW Scientist of the Year Awards[337]
- NSW Life Sciences Research Awards.[338]

5.50 The Committee also notes the announcement by the Minister in August 2008 of the opening of nominations for the NSW-Gangwon Technology Collaboration Grants that offer up to $100,000 a year to assist joint projects involving researchers from NSW and the South Korean province of Gangwon.[339]

Committee comment

5.51 The Committee believes that the presence of strong research infrastructure and a clear articulation of the State's research priorities are the essential elements in attracting research talent to New South Wales. The Committee also notes the recent initiatives of the Government to attract, reward and promote researchers.

5.52 Other States have apparently recognised the benefit of establishing fellowship schemes in order to attract and retain researchers. The Committee is not in a position to say that New South Wales does need to implement a similar scheme. However, on the basis of the evidence it received it believes the Office of Science and Medical Research should examine whether there are other opportunities through which it can attract and retain researchers within New South Wales.

A New South Wales Nanotechnology Statement

5.53 In acknowledgement of the potential for nanotechnology to have an impact on the way society lives, a number of national and state governments have issued public statements or position papers on nanotechnology. A number of Inquiry participants suggested that the NSW Government should also issue a public statement.

5.54 For example, the United Kingdom Government released its *Statement by the UK Government About Nanotechnologies*. This 41-page document serves as a useful public education and awareness tool and provides detail on what the UK Government is doing with respect to the issues relating to nanotechnology. The Statemement is comprised of the following sections:

- UK Government's vision for nanotechnologies.
- What are nanotechnologies?

337 Hon Verity Firth MP, Evidence, 6 June 2008, p 5

338 Hon Verity Firth MP, Evidence, 6 June 2008, p 9

339 *Nominations Called for Technology Grants,* media release, Hon Verity Firth MP, 8 August 2008

- How the UK Government is looking to promote the opportunities of nanotechnologies.
- How the UK Government is looking to ensure appropriate control of the potential risks of nanotechnologies.
- National coordination.
- UK participation in international fora.

5.55 In February 2008 the Victorian State Government released its *Victorian Nanotechnology Statement: Taking Leadership in Innovations in Technology*. The document notes that Victoria has over half of the growing national base of nanotechnology-related businesses. It clarifies the primary focus of the Victorian Government in the area of nanotechnology – industry stimulation and development and the attraction of investment. It states that the actions of the Government in securing sustainable benefits from nanotechnology for its businesses and the community will be organised around five key priorities. Under each priority it describes current and future actions. The five key priorities are:

- Industry uptake.
- Forging global connections.
- Skills and education.
- Responsible development.
- Building platforms for the future.

5.56 Professor Andrew Cheetham commented that while the document contained a lot of what could be called motherhood statements and did not carry details on specific funding or proposals, it did have some substance and importantly had set out the vision of what the Government wished to achieve.[340]

5.57 The Australian Government's National Nanotechnology Strategy commenced in July 2007. Originally, the activities under the NNS were funded for four years. In early 2008 its funding and timeframe were reduced to 30 June 2009. The rationale was that the NNS would be assessed as part of the Australian Government's Review of the Australian National Innovations System. The outcome of the Innovation Review is to inform whether the current approach to a NNS is the best way to achieve the Government's objectives in this area.

5.58 The submission from the Australian Nano Business Forum (ANBF) said that the decision to assess the NNS as part of the Innovation Review was perceived by both industry and by international partners as indicating that "Australia is no longer in nanotechnology". The submission said that it hoped that actions and public positions would be forthcoming to dispel this perception.[341]

340 Professor Cheetham, Evidence, 28 April 2008, p 31

341 Submission 8, Australian Nano Business Forum, p 7

5.59 In June the Committee was advised that while the Australian Government's plans to move forward in the area of nanotechnology are explained in the NNS, the Government may choose to elaborate its view from time to time.[342]

5.60 The Australian Government did this on 11 July 2008 when it released the *Australian Government Approach to the Responsible Management of Nanotechnology*. That document outlines the approach of the Government to capturing the benefits of nanotechnology while addressing health, safety and environmental concerns. It sets out three high-level objectives intended to provide a comprehensive framework for research into and the application of nanotechnology, namely to:

- Protect the health and safety of humans and the environment.
- Foster informed community debate.
- Achieve economic and social benefits from the responsible adoption of nanotechnology.

5.61 In evidence to the Committee Mr Craig Pennifold from the federal Department of Innovation, Industry, Science and Research said that the document was released because, as the process of examining of how to deal with nanotechnology was developing, the point had been reached where more public information was warranted:

> We saw a number of issues emerging through our community engagement activities. We closely monitor what is happening internationally and we also had in train the sort of work coming through what we call the Monash Report. We thought we had reached the point where it would be useful for the Government to start articulating what the next stage of the strategy would be and how we would go about promoting it…This was released and represented the Government's view at the time. As we learn more and go on, the Government may choose to issue some more information. It underlines that the Government is very keen about the responsible management of nanotechnology. We have those three objectives and certainly there are many parts of the community that will focus on one of those three, but at a Government level we need to take all of those issues into account.[343]

5.62 A number of Inquiry participants suggested that New South Wales should develop its own public position on nanotechnology.[344] Dr John Miles from the National Measurement Institute suggested that NSW needed to consider its position with respect to nanotechnology as other States had done:

> I would urge you, along with I think some of the other people who have been at this inquiry, to consider New South Wales' position in relation to Victoria and Queensland. Coming from Victoria, I am very proud of my State and they have in fact done marvellous things in nanotechnology, as has Queensland, and I think it is

342 Answers to written questions on notice, 10 June 2008, Mr Craig Pennifold, Australian Office of Nanotechnology, Department of Innovation, Industry, Science and Research, p 6

343 Mr Craig Pennifold, Head, Innovation Division, Department of Innovation, Industry, Science and Research Evidence, 4 August 2008, p 14

344 Submission 13, University of Newcastle, suggested the development of a NSW Nanotechnology Strategy that addresses the specific needs of NSW industry and business

> somewhat behove of New South Wales, which is obviously one of if not the major State in Australia, to actually bite the bullet on nanotechnology. [345]

5.63 Dr Peter Binks, CEO of Nanotechnology Victoria and Chairman of the ANBF, said that the Committee's Inquiry itself was an important step in elevating awareness of nanotechnology and in prompting discussion among stakeholders. He suggested that the release of a Government position would build on this:

> I guess what I would ask for is that you continue that leadership. I actually think that New South Wales does need to have a position on nanotechnology and say, "Nanotechnology is potentially part of our future, particularly if it can be managed responsibly." It is something that we should encourage and facilitate our researchers, industries, our politicians and our levels of government to think of as part of the equation going forward, as we start to prepare the economy to the next 20 to 30 years. That does not necessarily mean investing money but simply the leadership that you give by saying, "This is something we are aware of and we think may have benefit. It needs to be managed carefully and is incredibly important to all the stakeholders around here."[346]

5.64 Minister Firth said that in new areas like nanotechnology it is essential to ensure that the public is well informed. The Minister said that she was always in favour of providing more information rather than less.[347]

Committee comment

5.65 Throughout the Inquiry the Committee was concerned that much of the information on nanotechnology provided in the public arena, particularly via print, was negative. Instances include calls by some for a moratorium, and reports of research indicating potential adverse impacts of specific nanomaterials.

5.66 As will be discussed in Chapter 6, print and television are the main sources of public information on nanotechnology. While a host of broader information is available on various websites, it would appear that members of the public require a prompt in the first instance to decide to seek more information on nanotechnology.

5.67 A NSW Government Statement on Nanotechnology would serve to raise public awareness of nanotechnology and perhaps serve to balance the information that is being accessed by the public. It would be useful for any Government Statement to include reference to information sources that can provide a factual and balanced overview of the broad topic of nanotechnology.

5.68 The Committee notes that there is still much for the Government to consider before it could make a definitive statement on what may be its exact and complete approach to specific support for nanotechnology. However, the Committee believes that the NSW Government

---

345 Dr John Miles, Clayton Laboratory and Nanometrology Manager, National Measurement Institute, Evidence, 1 May 2008, p 44

346 Dr Binks, Evidence, 1 May 2008, p 6

347 Hon Verity Firth MP, 6 June 2008, p 11

could adopt the approach of the Australian Government and elaborate its views from time to time.

5.69 The Committee believes that the Government should issue a comprehensive statement on nanotechnology as soon as practicable. Among other things, the statement should refer to the current issues relating to nanotechnology; the activity being undertaken at the State and national level; and provide advice on where further information is available.

Recommendation 14

That the New South Wales Government develop, publish and endorse a comprehensive statement on nanotechnology, referring, among other matters, to current issues relating to nanotechnology, activity being undertaken at the State and national levels, and advice on where further information is available.

A New South Wales Nanotechnology Unit

5.70 Just as other national and State governments have seen the need to issue public statements on nanotechnology, some have also seen the need to establish or support nanotechnology units or departments. The roles of these units vary and some include coordination of policy and public awareness, coordination of research and development, and/or provision of support for industry uptake.

Australian Office of Nanotechnology

5.71 The Australian Office of Nanotechnology (AON) was established as part of the National Nanotechnology Strategy (NNS). The AON is comprised of eight officers from the Department of Innovation, Industry, Science and Research (DIISR). It is charged with implementing the NNS, which aims to facilitate a whole of government approach to nanotechnology. Specifically it covers coordination, policy and public awareness activities.

5.72 The AON is primarily responsible for coordinating government policy around the objectives of the NNS, and through it has distributed funds to other departments and to regulators.[348] The AON and the NNS are currently funded up to 30 June 2009.

United States National Nanotechnology Initiative

5.73 In the United States, the National Nanotechnology Initiative was initiated in 2001. It is a multi-agency program aimed at accelerating the discovery, development, and deployment of nanometre-scale science, engineering, and technology. The NNI is coordinated program involving nanotechnology related activities of 26 US federal agencies.

348 Mr Pennifold, Evidence, 4 August 2008, p 1

5.74 The NNI is managed within the framework of the National Science and Technology Council (NSTC), which coordinates science, space and technology policies. The Nanoscale Science, Engineering and Technology (NSET) subcommittee of the NSTC coordinates planning, budgeting, program implementation and review of the NNI.

5.75 The National Nanotechnology Coordination Office (NNCO) acts as the primary point of contact for information on the NNI; provides technical and administrative support to the NSET, including support in the preparation of multi-agency planning, budget and assessment documents; and develops, updates and maintains the NNI website.

Nanotechnology Victoria

5.76 Nanotechnology Victoria (NanoVic) is a government-supported entity that was established in 2003. It is a venture between three Victorian universities, Monash University, Swinburne University of Technology, and RMIT University. With $12 million funding from the Victorian Government and commitments to match from the Members, NanoVic's role is to pursue commercialisation of nanotechnologies for Australian industry. Its major research programs consist of product development activities for biotechnology or for the materials, manufacturing and environmental activities.

5.77 NanoVic's mandate includes:

- The management of research and technology development activities across Member institutions and other parties.
- The commercialisation of research to provide benefits to Victorian industry.
- To act as a focal point for education and public awareness activity in Victoria.[349]

5.78 The NanoVic website provides a broad range of information on nanotechnology. The CEO of NanoVic said the website aims to provide information for multiple purposes:

> The NanoVic website receives about 550 visits per day, with about half coming from Australia. A significant portion of the enquiries relate to education; we also receive approaches from companies interested in existing or new products. The website aims to provide information for multiple purposes: nanotechnology education, nanotechnology applications for industry, NanoVic's own products and people, issues in nanotechnology, and links and key papers.
>
> The NanoVic Blog provides a separate forum for discussion of interesting and unusual aspects of the technology, and attracts over 1,000 visitors per day.[350]

5.79 Ms Georgia Miller from Friends of the Earth Australia was complimentary about the work done by NanoVic and the information provided on its website. However, she did not think that it was a key model for how a Government should provide information to the public. This was basically because NanoVic's primary role is to promote nanotechnology industry development:

---

349 <www.nanovic.com.au> About Nanovic, (accessed 24 September 2008)

350 Answers to written questions on notice, 21 May 2008, Dr Peter Binks, Chief Executive Officer, Nanotechnology Victoria, p 3

> We would like to see, for example, information coming from a group that did not have a clear link to promoting the industry's expansion. But in terms of the range of things that they cover and their efforts to include some pod casting and links to a whole range of other group's websites and information on a lot more activities happening in Australia, there are definitely some useful elements on their website.[351]

New South Wales

5.80 During the Inquiry the Committee sought to explore whether there was a need for the establishment of a lead agency or unit with a responsibility for coordinating and dealing with issues relating to nanotechnology.

5.81 Dr Derek Van Dyk from the Office of Science and Medical Research noted that the primary function of NanoVic was to promote industry uptake of nanotechnology, and that in New South Wales the function of promoting, coordinating and ensuring uptake through industry of research and technology development is the responsibility of the Department of State and Regional Development (DSRD).[352]

5.82 Mr Kaustuv Mukherjee said that the approach taken by the DSRD to promote industry uptake of nanotechnology was consistent with its overall approach to the uptake of new technologies. The primary approach consists of running awareness events:

> It is primarily running or supporting a series of awareness events staring 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 Nano Business Forum.[353]

5.83 Mr Mukherjee described the process by which a company interested in developing a nanotechnology could approach the Department for information on industry assistance. There are two pathways for approach the Government for assistance. The more usual point of contact is via attendance at a specialised forum specific to the technology involved. Alternatively a company could contact the Department, in phone or person, such inquiries being referred to the specialised person(s) handling the subject of the inquiry. Mr Mukherjee elaborated:

> 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 those divisions. The approach is to apply specialist expertise to

351 Ms Georgia Miller, Nanotechnology Project Coordinator, Friends of the Earth Australia, Evidence, 1 May 2008, p 51

352 Dr Van Dyk, Evidence, 28 April 2008, p 4

353 Mr Mukherjee, Evidence, 28 April 2008, p 4

> the extent that it is available in the department. Therefore, such a nanotechnology-related inquiry would generally come to Ms Doyle's area [OSMR] which is engaged with nanotechnology and policy development, or it would come through to me as I am responsible for nanotechnology within the Industry Division.[354]

5.84 Mr Mukherjee advised that the Department does not have a specific nanotechnology assistance program. In fielding an inquiry the Department would assess what assistance could be offered through its general assistance programs:

> We provide assistance that is available under our general assistance programs, some of which have been mentioned[355]…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 or promoting Australian-developed technologies, in particular, to international markets.[356]

5.85 Mr Mukherjee said that to date the Department has run a series of seminars or events relating to nanotechnology. A number of businesses engaged in nanotechnology have attended, but those businesses were still at an early stage in determining their future plans. Mr Mukherjee said that a number of businesses have been assisted through the Department's existing programs, and that no businesses have sought specific assistance beyond what is available through those programs. Mr Mukherjee said that compared to other technologies they had received a relatively small number of inquiries relating to nanotechnology.

5.86 The Executive Director of the OSMR emphasised that the Department takes a broad capacity building approach in terms of research and development in New South Wales rather than an uncritical approach to it. In terms of support, it looks for areas where the State already has research strengths.[357]

5.87 When exploring the issue of whether New South Wales needs to establish a lead agency with respect to nanotechnology, it was accepted that benefits would accrue from a coordinated approach:

> 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 [not only] 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

354 Mr Mukherjee, Evidence, 28 April 2008, p 7

355 See reference to BioBusiness Program and Australian Technology Showcase; Ms Doyle, Evidence 28 April 2008, p 5

356 Mr Mukherjee, Evidence, 28 April 2008, p 7

357 Ms Doyle, Evidence, 28 April 2008, p 17

> thereby supporting the economic development and industry commercialisation of our nanotech in New South Wales.[358]

5.88 However, the Executive Director of the OSMR cautioned that they were some time away from being able to identify what type of formal structure, if any, might be required. Ms Doyle also noted that if specific unit or body was established, a decision on its location within the structure of Government might depend on the what the role of the unit would be:

> 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 very much taken a lead role, but as you have 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.[359]

5.89 On 6 June 2008 the Minister for Science and Medical Research, the Hon Verity Firth MP, appeared before and gave evidence to the Committee. In her opening statement the Minister provided details on the structure and administration of government support to scientific research, development, innovation and commercialisation.[360]

5.90 The Committee sought the Minister's views on whether she saw a case for establishing a specific Nanotechnology Unit, so that the State would be seen to be more responsive to the area of nanotechnology and be better able to deal with industry interested in the area.[361]

5.91 Minister Firth said that she saw one of the purposes of the Committee's Inquiry was to elicit information that would indicate and provide a basis for determining any specific actions that should be taken by New South Wales. The Minister emphasised the need for strong national coordination in nanotechnology, and, in this respect, noted the role of the Nanotechnology State and Territory Committee (NSTC). The DSRD is represented on that committee by officers from both the Industry Division and from the OSMR.[362]

5.92 While noting the commitment to the national process, the Minister agreed that there is potential for a more coordinated approach towards nanotechnology within the State:

> There is obviously a strong case for better coordination, which again is one of the reasons why we are having this inquiry. The first step is the network, setting up the expert group about nanotechnology. I think NanoVictoria has done excellent work. I have been talking off line to the Minister in Victoria about it. He was very interested in this inquiry, our setting it up and any results we get from it. I am happy to keep consulting on this question. I am happy to hear what you have to say about it. I am happy to talk to industry and stakeholders about it. We obviously need a more

358 Dr Van Dyk, Evidence 28 April 2008, p 3

359 Ms Doyle, Evidence, 28 April 2008, p 4

360 Hon Verity Firth MP, 6 June 2008, pp 1-2

361 Hon Verity Firth MP, Evidence, 6 June 2008, p 6

362 Hon Verity Firth MP, Evidence, 6 June 2008, p 6

> coordinated response. We are committed to the national process, but we want to make sure that New South Wales is also aware of what it needs to do.[363]

5.93 On the question of adopting a model similar to NanoVic, which was established primarily to pursue commercialisation of nanotechnologies, the Minister noted that the Government needs to focus on its strengths:

> I think it will depend on where our strengths lie. New South Wales does not have to be strong in everything. We need to be strategic about how we approach our science and medical research, where Government funding goes and so forth. We need to pitch to our strengths. We need to make sure that we have the human capital to be able to respond to those strengths.[364]

5.94 The Committee notes that many of New South Wales' strengths in terms of research, such as engineering, solar energy, robotics and quantum computing, and in infrastructure located within the State have a nanotechnology aspect to them.

Committee comment

5.95 The broad area of nanotechnology is a current issue for federal and State governments, and specific matters are currently being examined by various of their respective agencies and departments. Within those agencies and departments someone or some area, either through design or by default, has assumed responsibility for dealing with nanotechnology.

5.96 As noted throughout the Inquiry a significant issue with respect to nanotechnology at present is that of information and knowledge. There are known gaps in scientific knowledge with work underway to address them; and results of research are increasingly being reported. There is information available from a variety of sources, some of it designed to serve as an interim guide until further knowledge is acquired. Similarly there are gaps in information and data on the extent of nanotechnologies as there are currently no mechanisms in place to fully capture that information.

5.97 The ability to have an ongoing awareness of the current state of information and knowledge regarding nanotechnologies and to be able to easily access that information would be of benefit to government, industry and the community. On a number of occasions the Committee were told that the decision to conduct this Inquiry realised a benefit in serving to focus attention on nanotechnology. Ms Mallen-Cooper from the Department of Environment and Climate Change commented on the benefit of being able to access the information generated by the Inquiry:

> Gathering all that information in the one place is really helpful for a regulatory agency like ours, to know who to talk to in all the different sectors and to know all the things they are doing.[365]

---

363 Hon Verity Firth MP, Evidence, 6 June 2008, p 7

364 Hon Verity Firth MP, Evidence, 6 June 2008, p 7

365 Ms Jane Mallen-Cooper, Manager, Chemicals Policy Unit, Department of Environment and Climate Change Evidence, 6 June 2008, p 26

5.98 Dr Miriam Goodwin said there was a need to raise awareness of the facilities that are available and the potential that they can offer to industry. Actively promoting the facilities that exist, and being able to put people in contact with each other, could dispel negative perceptions of New South Wales as a location for development of nanotechnology applications:

> 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 that 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 greater awareness of what is going on, what could be done, what is out there.[366]

5.99 The establishment and promotion of a Nanotechnology unit might also serve the purpose of raising knowledge of the extent of industry use of nanotechnologies. In evidence to the Committee Mr Kaustuv Mukherjee said that many companies do not identify themselves as existing or potential users of nanotechnology:

> …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, …because many companies do not relate to the term and therefore do not put up their hand as existing users or potential users of nanotechnology…[367]

5.100 The Committee believes that there is a need for a specific area within the New South Wales Government to be the central information and contact point for nanotechnology. In Chapter 3 the Committee recommended that the NSW Government develop a whole-of-government position with respect to the current federal review of the regulatory frameworks.

5.101 This area, or NSW Nanotechnology Unit, would need to be a coordination point for all other NSW agencies that are currently dealing with issues relating to nanotechnology. The unit would need to hold or be aware of the latest information relating to nanotechnology, it should also actively promote nanotechnology opportunities to industry.

5.102 The Nanotechnology Unit should be responsible for establishing and maintaining a public website on nanotechnology to provide updated information and advice. The website should provide links to other State agencies and departments as relevant.

5.103 In setting up this body, the NSW Government should have reference to the Victorian approach in establishing NanoVic. The success of the Victorian approach to commercialisation of nanotechnology through NanoVic has been evident throughout this Inquiry.

---

366 Dr Miriam Goodwin, Senior Advisor Research Management and Policy, Australian Nuclear Science and Technology Organisation, Evidence, 28 April 2008, p 66

367 Ms Mukherjee, Evidence, 28 April 2008, p 19

Recommendation 15

That the NSW Government establish a NSW Nanotechnology Unit within an existing department or agency to act as a coordination point for all other NSW agencies dealing with issues relating to nanotechnology, provide a central point for whole of government information on or enquires relating to nanotechnology, and proactively engage with industry in the promotion of nanotechnology.

Education and skills development

5.104 Advancements in nanotechnology applications will present both a challenge and an opportunity with respect to education and skills development. The challenge will be to have the education and skills development capacity required to support the needs of the area as it develops. The opportunity provided by nanotechnology is its potential to attract greater interest in science careers among secondary school students.

5.105 There was a general consensus among Inquiry participants that if nanotechnology applications increase as forecast there will be an increased need for education and skills training to provide the workforce to support these industries.

5.106 However, the need to increase the State's and the nation's skill base is not an issue restricted to nanotechnology. Professor Andrew Cheetham from the University of Western Sydney said that a general skills shortage in terms of academics was emerging. He referred to a comment made some years ago by the Chief Scientist in Queensland, that Australia would need about another 70,000 PhD qualified people by 2020. Professor Cheetham said that it appears that claim would prove about right given the number of academics who will be retiring in the next 5 to 10 years.[368]

Tertiary, vocational and technical training

5.107 A number of universities in New South Wales offer education courses in nanotechnology. Some, for example the University of NSW, University of Technology Sydney, University of Wollongong and the University of Western Sydney, offer specific programmes in nanotechnology. Others, such as the University of Newcastle, offer courses in nanotechnology as components of a Bachelor of Science programme.[369]

5.108 The submission from the Australian Nano Business Forum singled out both the University of Western Sydney and University of Technology Sydney as having well developed undergraduate nanotechnology programmes, which address future skills requirements in NSW.[370]

368 Professor Cheetham, Evidence, 28 April 2008, p 35

369 Submission 13, p 3

370 Submission 8, Australian Nano Business Forum, p 5

5.109 Throughout the Inquiry the Committee heard that nanotechnology was not a discipline in its own right. Professor Andrew Cheetham, Pro Vice Chancellor Reseach, University of Western Sydney explained how its course in nanotechnology was applied:

> 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.[371]

5.110 The submission from the University of Wollongong described how education courses needed to allow students to cross the traditional discipline boundaries:

> [The program] focuses on the University's research strengths in Materials Chemistry and provides a stream of quality graduate[s] for research and other employment opportunities. Nanotechnology researchers principally come from conventional discipline areas of chemistry, materials science, physics and biology. While these areas remain important, the multidisciplinary nature of nanotechnology also demands a new type of science education: one that blends these conventional areas and allows graduates to cross the discipline boundaries.

5.111 The University said its programme differs from other undergraduate courses in that it focused on giving students exposure and access to cutting edge researchers from year one. The programme also integrates an introduction to the emerging societal and ethical implications of nanotechnology.[372]

5.112 Professor William Price, Head of the School of Chemistry, advised that the course had been running for five years. As the course unashamedly focuses on the University's research strengths and directly feeds into its research institutes, entrance to the course is competitive with about 15 to 20 very high calibre students taken on each year.[373]

5.113 A number of submissions noted the need to explore the need for courses in the TAFE sector in order to provide a skilled workforce for this emerging sector.[374] The submission from the NSW Government also noted the need to find out more about the skill and knowledge requirements for technician and operator staff:

> As nano-industries expand, there will be an increasing demand for highly trained technicians and operators. As such, there is a need to find out more about the skill and knowledge requirements for technician and operator staff in this area. There is also a need to ensure that appropriate units of competency and qualifications are available to facilitate the training requirement at both the university and vocational educating and training levels.
>
> National training packages are designed and developed by industry to meet industry needs. Developers of training packages will need to be mindful of the growing need

371 Professor Cheetham, Evidence, 28 April 2008, p 33

372 Submission 12, University of Wollongong, p 2

373 Professor Price, Evidence, 28 April 2008, p 57

374 Submission 14, Australian National University, p 14; Submission 11, University of Western Sydney, p 2

> for specialist training for technicians and operators, and develop or revise appropriate units of competency. TAFE NSW is currently re-aligning its functions to ensure it can provide rapid service to industry in NSW to support existing and emerging skills needs.[375]

5.114 The submission from the University of Western Sydney included a copy of the report *Nanotechnology in South West Sydney: pathways for cluster development* (December 2007). The report was prepared for the UWS Nanotechnology Network. The report included a survey of industries in Western Sydney of the likely demand for people competent in nanotechnology.

5.115 Professor Andrew Cheetham said that the survey found there was a rise in demand for nano-competent people, notwithstanding the fact that many of the industries surveyed were not exactly sure of how they might incorporate nanotechnology applications into their current processes. Professor Cheetham said that a much more detailed analysis of needs is required:

> 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 expected.[376]

5.116 Professor Cheetham noted that education with respect to nanotechnology will need to be incorporated across the spectrum of training courses:

> For example, the production line worker will need to know about health and safety issues, et cetera, if they are using nano scale materials…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.[377]

5.117 In its submission to the Inquiry the University of Newcastle said that the approach to education and training in nanotechnology was in need of coordination. It argued for the establishment of an educational framework, possibly via a NSW Institute of Nanotechnology, for nanotechnology:

> The approach to education and training in nanotechnology is patchy and ad hoc…in the absence of an overarching State nanotechnology body there is little oversight of course content or training outcomes. The development of a NSW Nanotechnology Strategy coupled with the establishment of a NSW nanotechnology educational framework (possibly via a NSW institute of nanotechnology) would facilitate the development of new nanotechnology educational programs across the State. Such an Institute would be able to coordinate efforts in nanotechnology teaching and skills training across the education sector and would be able to stimulate new programmes in regional centres. In addition, there is a serious lack of nanotechnology research and training infrastructure across the education sector, which could be addressed by funding from such an institute.[378]

---

375 Submission 25, NSW Government, p 8

376 Professor Cheetham, Evidence, 28 April 2008, p 35

377 Professor Cheetham, Evidence, 28 April 2008, p 35

378 Submission 13, p 3

5.118 The concept of an Institute did not meet with support among other Inquiry participants.[379] However, Professor Cheetham said there was benefit in a coordinating training across the entire spectrum:

> If it were something that coordinated training across the spectrum…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.

5.119 Professor Cheetham suggested there was a need for the issue to be considered by a fully representative group:

> 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.[380]

Committee comment

5.120 It is clear that the increased uptake of nanotechnology by industry and research will require the provision of increased and new education and training. What the exact training needs will be are not clear at present, and much information that will be required for skills development at the vocational level is not yet known.

5.121 Most of the educational knowledge in nanotechnology resides in the universities that offer courses and have research strengths in nanotechnology. The Committee agrees that there is a need to find out more about the knowledge requirements for supporting nanotechnologies across the research to workforce spectrum.

5.122 The Committee believes that future training needs should be considered by the recently established University-Government working group, with representation from the vocational and technical education sectors.

Recommendation 16

That the New South Wales University-Government working group, with representation from the vocational and technical education sector, examine the education, skill and knowledge requirements to support nanotechnology.

Increasing interest in science among secondary school students

5.123 When discussing the need to provide a skilled workforce to support nanotechnology or any new technology, Inquiry participants pointed to the need to have more students become

379 Professor Price, Evidence, 28 April 2008, p 60; Professor Cheetham, Evidence, 28 April 2008, p 36

380 Professor Cheetham, Evidence, 28 April 2008, p 36

interested and pursue a career in science. Many Inquiry participants said that examples of nanotechnology applications provide valuable opportunities to get students interested in science.

5.124 Professor Michelle Simmons from the University of New South Wales believes that interest in science had dropped over the last decade as the approach taken was wrong:

> …over the last decade or so people have tried to dumb down science and make it very glitzy and not go into the detail. I think this has put a lot of students off from an early level, so teaching them science in a way that is real, showing them what is cutting edge and having programs that get out to schools at an early age, say from age 10, is crucial.[381]

5.125 The submission from the University of Wollongong noted the opportunity provided by nanotechnology applications to create more interest in the enabling sciences:

> There are great opportunities for students to learn basic science at schools and at tertiary level by using Nanotechnology as an exciting vehicle for multidisciplinary science. The Board of Studies for example could use it to catalyse more interest in the enabling sciences at school and among teachers. What is critically needed is better marketing and advertising of these areas to schools. This is needed to maintain and boost numbers in this emerging field to meet future demand for practitioners with these skills.[382]

5.126 The submission from the NSW Government noted that nanotechnology will fit in with the current curriculum and also provide opportunities to enhance it:

> At secondary schools level, the curriculum in NSW schools is organised into eight learning areas. The learning areas of science and technology both provide opportunities for students to learn about nanotechniology.
>
> In the study of science in years 7-12, students are required to consider and explore how some common technologies relate to interactions within underlying scientific principles. In engaging in this study, students describe and discuss benefits of using a range of technologies including biotechnology and the ways in which technology has increased the variety of made resources. Nanotechnology provides one avenue for students to engage in and explore this aspect of NSW syllabuses. As further examples and applications of nanotechnology emerge, so will the opportunity for students to engage in discussions related to this emerging technology.[383]

5.127 The Committee was told of a number of initiatives where nanotechnology is being used to promote science to secondary schools. Professor William Price said that the University of Wollongong actively sought to have schools visit the campus in order to show students exciting things while emphasising the fact that these were building on the basic enabling sciences.[384]

---

381 Professor Simmons, Evidence, 1 May 2008, p 28

382 Submission 12, p 2

383 Submission 25, p 8

384 Professor Price, Evidence, 28 April 2008, p 61

5.128 The submissions from both the Australian Nuclear Science and Technical Organisation (ANSTO) and the Australian Microscopy & Microanalysis Research Facility (AMMRF) included details of activities they undertake to expose students to cutting edge technology.[385]

5.129 The University of Western Sydney produced a DVD resource for secondary schools entitled *Sci High* that was sent to about 250 schools in the region. Professor Cheetham said that based on anecdotal evidence it was well received, but unfortunately due to a lack of resources it had not been able to do a detailed study of its effect on and reception by the students.[386]

5.130 St Helena's Secondary College in Victoria, with funding assistance from NanoVic and the Victorian Government, developed a secondary teaching resource on nanotechnology. The Committee was told that it is currently being developed into a curriculum resource for use in all States.

5.131 Dr Craig Cormick, from the Australian Office of Nanotechnology, said the decision to develop a resource stemmed from discussions over recent years with the Australian Science Teachers Association. Teachers have been looking for resources on nanotechnology as students, particularly at the upper secondary level have expressed interest in the area.

5.132 Dr Cormick said that the AON was working with education departments in each State with a view to developing a full resource:

> What we are doing at the moment is working with the Australian Science Teachers Association and curriculum developers in each State are developing that so that it will fit each State's curriculum. We are developing that now at the first level and by August/September we hope to have the first draft of that completed whereby we will be able to trial it within the States. We are working with the education departments in each State and based on that trialling we will develop a full resource that can be used in each State at the upper secondary level teaching nanotechnology.[387]

5.133 At the hearing on 6 June 2008, the Committee suggested to the Minister for Science and Medical Research that a useful role of a NSW Chief Scientist would be involvement in encouraging students, particularly form country areas, to do science and mathematics. Minister Firth said that she was very aware of the need to promote science and mathematics in schools:

> It is interesting that when you talk to the uni sector they are very aware of this. They say they often feel as if they need to spend the first year catching all the children up on mathematics. This is not about lack of curriculum opportunities in secondary school, but it is almost a societal thing; the importance we place on science and mathematics and children being more allured to the things they consider more trendier or hipper.[388]

5.134 Minister Firth said that the Office of Science and Medical Research has a strong emphasis on trying to encourage children in year 9 and 10 to get excited by science so that they pursue it in

---

385 Submission 18, Australian Microscopy and Microanalysis Research Facility, p 15; Submission 17, Australian Nuclear Science and Technology Organisation, p 8

386 Professor Cheetham, Evidence, 28 April 2008, p 34

387 Dr Craig Cormick, Manager, Public Awareness, Australian Office of Nanotechnology, Evidence, 4 August 2008, p 10

388 Hon Verity Firth, MP, Evidence 6 June 2008, p 5

year 11 and 12. The Minister referred to Science EXPosed, an annual event held at Parliament House, the Hyde Park Barracks and the Mint. The aim of the event is to have hands on demonstrations activities to excite an interest in science among students.[389]

5.135 The Committee was interested to determine the participation rate of students from country areas in Science EXPosed. The Committee was advised that during the 2007 Science EXPosed program, 1638 school children participated, and that almost one third or 570 of those were from regional NSW.[390]

5.136 However, the Committee notes that of those regional schools listed as attending the 2007 Science EXPosed, the majority came from the Hunter or Illawarra regional areas. It would appear that school children from regional centres distant from Sydney are disadvantaged.

Committee comment

5.137 The need to increase the number of secondary school students pursuing careers in the enabling sciences is clear. The Committee notes the evidence of initiatives undertaken by universities and other organisations to achieve just this. Wherever it is able to the Government should support and encourage such initiatives.

5.138 The Committee notes that the primary Government initiative for providing exposure to exciting technology is via the annual Science EXPosed event. However, school children from regional centres distant from Sydney are disadvantaged in terms of access to this event.

5.139 The Committee believes that school children in regional areas should, where possible, have access to the same kinds of opportunities as urban school children. Therefore, the Committee recommends that the Office of Science and Medical Research, in collaboration with the Department of Education and Training, examine and develop a strategy to ensure greater access for regional students to the Science EXPosed programme.

Recommendation 17

That the Office of Science and Medical Research, in collaboration with the Department of Education and Training, examine and develop a strategy to ensure greater access for regional students to the Science EXPosed programme.

389 Hon Verity Frith MP, Evidence, 6 June 2008, p 5

390 Answers to questions taken on notice, 30 June 2008, Hon Verity Firth MP, Minister for Science and Medical Research, p 2

Chapter 6 Community understanding and awareness of nanotechnology

Among Inquiry participants and nanotechnology commentators there is agreement that public understanding and awareness of nanotechnology is essential. It is also agreed that any information provided to the general public must be balanced and factual. Currently the level of detailed knowledge of nanotechnology among the general community remains low.

This chapter examines information provided on the current level of public awareness and knowledge of nanotechnology. It also examines the activities undertaken at the federal and State level to engage the general community on issues relating to nanotechnology

Current level of awareness and knowledge

6.1 The awareness of the term 'nanotechnology' is increasing among the Australian community. However, detailed knowledge of what nanotechnology means and how it is applied is low.

6.2 On 4 August 2008 the Committee received a presentation from Mr Craig Cormick, Manager, Public Awareness, Australian Office of Nanotechnology on the results of the latest survey of community knowledge of and attitudes towards nanotechnology.[391] The report *Australian Community Attitudes Held About Nanotechnology – Trends 2005 to 2008*, can be accessed via the Australian Office of Nanotechnology website, accessed via www.innovation.gov.au.

6.3 The survey was conducted via a national random telephone poll of 1,100 people over the age of 18. Households living in metropolitan, regional and rural areas were surveyed. Earlier surveys had been conducted in 2005 and 2007, and the report tracks the trends in community attitudes over that period.

6.4 Nanotechnology gained only 1% of unprompted mentions when respondents were asked about developments in science and technology. When prompted, awareness of the term nanotechnology has risen from 51% to 66% between 2005 and 2008, while no knowledge of the term nanotechnology has dropped from 49% to 34% over that period.

391 Mr Craig Cormick, Manager, Public Awareness, Australian Office of Nanotechnology, Evidence, 4 August 2008, pp 2-7

6.5 Of those people who said they were aware of the term nanotechnology, their level of personal knowledge was explored through the following questions:

Table 6.1 Among people aware of nanotechnology – level of personal knowledge

	2005	2007	2008
Have heard of the term nanotechnology, but don't know what it means	28	34	29
Know what nanotechnology means but don't know how it works	19	22	29
Know in detail what nanotechnology means and how it works	4	6	8
Don't know/can't say	1	1	-

6.6 Dr Cormick said that two areas of nanotechnology applications stood out for the community as providing the most important potential benefits. These were firstly, improved medical treatments and preventions, and secondly, improved technologies for the environment.[392]

6.7 Dr Cormick said that the community has very different attitudes towards the different applications of nanotechnology. He said people are less concerned with the science involved than they are with how it will be used:

> When you ask the question, "What do you think of nanotechnology?" the answer you get will be quite different once you start breaking it down to applications. Again, it is not about the science of nanotechnology: in most people's minds "What are you doing with it?" is the question; and once you define what you are doing with it the question then comes into either health or safety issues, depending on what you are doing with it. When we talk about health and medical applications or environmental applications there is much less perception of risk. When you start talking about food applications you see it rates much lower, so a higher perception of feeling there is any risk concerned.
>
> Also, we point out that the three different questions there relating to food rate very differently. People are much more supportive on nanotechnology in food packaging than they are in food and much more likely to be supportive if there is a benefit from the nanotechnology in the food rather than, say, a cosmetic appearance benefit from it.[393]

[392] Dr Cormick, Evidence, 4 August 2008, p 4

[393] Dr Cormick, Evidence, 4 August 2008, p 5

6.8 The 2008 survey also included an examination of any underlying community concerns regarding nanotechnology:

Table 6.2 Concerns regarding nanotechnology

	Not concerned	Unsure	Only mildly concerned	Greatly concerned	Total concern
The complexity of nanotechnology makes it difficult to understand	56%	11%	29%	5%	34%
Because nanotechnology is so new there might be problems for public safety or worker safety	29%	13%	51%	8%	59%
The general public is not being kept well informed about nanotechnology	39%	14%	37%	11%	48%
Nanotechnology regulation and safeguards are not keeping up with the development of nanotechnology	17%	49%	20%	4%	24%
Food labelling should provide information about any nanotechnology used	33%	13%	21%	28%	49%

6.9 The survey results concluded with the overall perception of nanotechnology in terms of risk versus benefit:

Table 6.3 Overall perceptions of nanotechnology: trends 2005 to 2008

	2005	2007	2008
The risks of nanotechnology exceed the benefits	8	5	3
The risks of nanotechnology equal the benefits	35	28	18
The benefits of nanotechnology exceed the benefits	39	52	53
Unsure	18	15	26

6.10 Dr Cormick said that the survey shows that there is a high level of belief within the Australian community that nanotechnology will provide long-term benefits to the quality of life in Australia and ensure economic and employment benefits. Few risks or concerns about nanotechnology are foreseen, although most people recognise that risks could arise and should be addressed. Dr Cormick said that the current level of knowledge among the public has implications for increasing public knowledge via awareness campaigns:

> If I summarise that situation, we have very high expectations for nanotechnology, a moderate level of concern and a very low level of knowledge. This creates an environment where information campaigns are very hard to push but emotive campaigns run very easily.[394]

[394] Dr Cormick, Evidence, 4 August 2008, p 7

Increasing public awareness and knowledge

6.11 The fact that nanotechnology refers to a broad range of current and future applications raises a number of issues that need to be considered when developing strategies to increase public awareness and to provide information

6.12 As part of the National Nanotechnology Strategy (NNS), the public awareness campaign being coordinated by the Australian Office of Nanotechnology is currently funded until 30 June 2009.

6.13 Mr Craig Pennifold, Head, Innovation Division, Department of Innovation, Industry, Science and Research referred to the Australian Government Approach to the Responsible Management of Nanotechnology, which has as its second high-level objective to foster informed community debate. He said that this entailed using a variety of mechanisms to engage the public on the benefits and risks of nanotechnology:

> …what we are talking to people about through a variety of mechanisms is about the benefits and risks. It is about providing information to school kids, to the community in general…This is through a number of media, written media and direct engagement. We are looking at pod casts and those sort of things as we suspect that different age groups will get their information in different ways.[395]

6.14 Professor Sue Dodds from the University of Wollongong said that when seeking to raise public understanding of nanotechnology, the most important thing was to increase the engagement of young people in science issues:

> Directly getting into schools, engaging the imagination 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 year, I think there will be lots of other technological issues.

6.15 The previous chapter highlighted the importance of increasing student participation in science and science issues. That chapter noted that there was a demand for student resources on nanotechnology because of student interest in the area. The Committee also notes that the survey of community attitudes on nanotechnology reflected the knowledge of the general community over 18 years of age.

6.16 Professor John Weckert from the Centre of Applied Philosophy and Public Ethics, suggested that when seeking to engage people on nanotechnology applications, different applications will have different resonance with groups. He said that issues such as energy and the environment would likely be of more interest to the young:

> 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

[395] Mr Craig Pennifold, Head, Innovation Division, Department of Innovation, Industry, Science and Research (DIISR), Evidence, 4 August 2008, p 8

> to people like me and to older people, whereas the energy and environment issues are much more a focus of young people.[396]

6.17 Dr Cormick said that in providing information to the public it was important to achieve public trust in the first instance, and that comes from providing information on both the risks and benefits when discussing any particular nanotechnology application.[397]

6.18 Dr Cormick said that as part of its strategy it will endeavour to provide public information in response to information that is alarmist, false or misleading. He stressed that the ambit of the awareness campaign was the provision of factual and balanced information:

> …it is based on an issue of public trust where we say the public do have the democratic right to make up their own mind. So it is not about over-promoting the technology to the public, it is about providing more information so that they can make sensible decisions based on balanced and factual information.[398]

6.19 Professor John Weckert noted that any information provided must be balanced. He noted that neither the advocates or critics of nanotechnology do themselves any favours by not conceding the other side of the argument:

> 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 the 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.[399]

6.20 Dr Cormick said that the results of the latest community attitude survey indicated that community support for nanotechnology increases when they are engaged in dialogue about the subject:

> What we did through the study, we asked people at the start of the survey, "Are you excited or hopeful about nanotechnology or concerned about it?" Then we asked them again at the end of the study, and we actually found an increase. So 86 per cent were initially very positive or excited , and it rose to 92 per cent, which is interesting when you look at the data coming out of Europe and America that says the more people understand nanotechnology the more concerned they become – maybe so – but when they are engaged on nanotechnology through any form of dialogue it seems their support goes up.[400]

6.21 As part of the public awareness campaign the AON held a nanotechnology public forum in each capital city. Dr Cormick advised the success of the forums was being reviewed to inform whether to continue the format for the remaining twelve months of the awareness campaign.[401]

---

396 Professor John Weckert, Centre for Applied Philosophy and Public Ethics, Charles Sturt University, Evidence, 28 April 2008, p 42

397 Dr Cormick, Evidence, 4 August 2008, p 8

398 Dr Cormick, Evidence, 4 August 2008, p 9

399 Professor Weckert, Evidence, 28 April 2008, p 42

400 Dr Cormick, Evidence, 4 August 2008, p 3

401 Dr Cormick, Evidence, 4 August 2008, p 11

6.22 Professor John Weckert from the Centre for Applied Philosophy and Public Ethics, Charles Sturt University was involved in a number of the Australian Office of Nanotechnology public forums. Professor Weckert said that his experience led him to believe that there was not an enormous interest or concern by people in general about nanotechnology:

> It seems to be the case that there are concerns among two groups – a lot of the scientists on 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 them.[402]

6.23 Dr Catherine Foley, Research Program Leader, CSIRO said that NSW has a particular issue in trying to engage the general public in science, and that this applies to nanotechnology. She said experience had shown that when running a public lecture on nanotechnology the attendance in Sydney is very poor when compared to Melbourne or Canberra:

> It is really interesting that New South Wales, Sydney in particular, has a different culture or mentality about how they want to engage and learn things. It is going to be a real challenge for the New South Wales Government to work out how best to engage with the general public in a way that they are receptive and understand the things that are important. I am thrilled to hear that you have discovered as the week has gone on that nanotechnology is a very broad area. It is also a level of potential misunderstanding, where non-experience has meant that people have a particular concept which might be damaging to the wider community and can sometimes pick up the headlines – which sell newspapers because they are exciting to hear, and create a level of misunderstanding.[403]

6.24 Dr Foley said that meeting this challenge is also the responsibility of scientists and that the CSIRO was keen to do whatever is necessary to help the public achieve an understanding of nanotechnology.

6.25 Dr Cormick said that the Committee Attitude survey showed that the public placed most trust in scientists to inform them of any risks related to nanotechnology.[404]

6.26 Professor Susan Dodds that it was important to make available useful and reliable resources of information:

> The European Union…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.[405]

---

402 Professor Weckert, Evidence, 28 April 2008, p 39

403 Dr Catherine Foley, Research Program Leader, Materials Science and Engineering, CSIRO, Evidence, 1 May 2008, p 36

404 Dr Cormick, Evidence, 4 August 2008, p 6

405 Professor Susan Dodds, Head, School of Arts, University of Wollongong, Evidence, 28 April 2008, p 40

6.27 Currently the Australian Office of Nanotechnology website provides one public information fact sheet on nanotechnology.[406] The fact sheet entitled: *Nanotechnology: working on the smallest things* serves as an introduction to the topic of nanotechnology. Dr Cormick advised that three further fact sheets were close to finalisation, which would provide information on:

- occupational health and safety
- food
- ethics.

6.28 Dr Cormick said that the topics for the fact sheets were derived from feedback they had received through the AON public forums on nanotechnology. He said it was important to respond to the public need for information. The AON plans to develop further fact sheets based around specific nanotechnology applications. Dr Cormick said that the focus was on ensuring the advice was accurate and accessible;

> We are working with national and Australia-wide agencies and that is why sometimes we are a little bit slower to arrive than we would like because we want to make sure they are right. They go through a very rigorous process. They have been commented on by everybody who needs to comment on them, and then they still have to be in plain English at the end of that process. It is going to take a little bit of fine tuning but we want to make sure what is given to the public is the best possible thing to give to the public. We have looked at some overseas models in terms of fact sheets and we have found some that we think work extremely well and we have found some we think do not work very well at all. I think the difference is often they come from too science-a-point-of –view or rather, getting into great detail on the science, without getting into much detail of what the public is really looking for – again we use the public as our sounding board for those.[407]

6.29 Professor Sue Dodds said that when attempting to raise public awareness a certain level of explanation of the science is necessary:

> 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 some type of technologies.
>
> ….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.[408]

6.30 With respect to the fact sheet on food, Dr Cormick indicated the current issues in peoples' minds that the fact sheet needs to address:

---

406 As at 3 October 2008.

407 Dr Cormick, Evidence, 4 August 2008, p 9

408 Professor Dodds, Evidence, 28 April 2008, p 39

> Nanotechnology in food is very high in people's minds. That is an issue. They want to know what might be done to the food. They want to know what safety techniques are in place. For their minds we talk about that risk benefit analysis they have. Is this a benefit, putting nanotechnology in food? Are the regulators making sure it is safe? They are the things they want to see when making their evaluation, whether they approve of it or not.[409]

6.31 Dr Cormick advised that as well as being available on the internet the current fact sheets are handed out at public science forums and events. The AON is also working on an initiative with Melbourne University to provide a gene and nanotechnology information service on a free call number or fax, hot line or email.

6.32 Dr Cormick said that ideally the AON website would have a feedback mechanism so that it could gauge how beneficial the public found information provided.

Where the public are getting their information

6.33 At present the public's primary source of information on nanotechnology derives from the mass media (television, radio, print), rather than the internet. Dr Cormick said that this was a surprising feature, as in the past with biotechnology and other applications the internet was the dominant form of information.[410]

6.34 Given the low underlying awareness of nanotechnology it is possible that the public would only search for information on nanotechnology on the internet once their interest in the subject has first been prompted.

Nanotechnology State and Territory Committee

6.35 The Nanotechnology State and Territory Committee (NSTC) was established to provide a coordination and communication role between the Commonwealth and States. Public engagement and education being one of the specific areas of the NSTC. Mr Pennifold said the NSTC provided a useful forum for the States to share information:

> …the other thing we want to do is draw the different States and Territories together so rather than it be the Federal Government driving it all so the States can learn off each other which is why we have set up that regular committee to bring the officials together to so that they can talk about what they are doing in each State.

6.36 Dr Cormick said there was a lot of interest from various State agencies in nanotechnology communications. He said that the different States were using different methods, and that he could not say that one State was necessarily doing better than the rest:

> It is a hard question to say leader because some engage in different areas. For instance, Queensland is doing a lot in terms of nano dialogues. They are doing discussions and dialogues on nanotechnology with different community groups and seeing what comes out of those. They are doing different things. It is actually very hard to say which one is leading in terms of the other one. If we pool all the data across all the

409 Dr Cormick, Evidence, 4 August 2008, p 20

410 Dr Cormick, Evidence, 4 August 2008, p 8

> States together we are going to know an awful lot about how to engage with the community.[411]

Another GM debate?

6.37 With respect to the need to increase public awareness and engage them on nanotechnology, commentators often draw a comparison between nanotechnology and genetically modified (GM) food. The argument is that the public backlash experienced with GM foods, would also emerge with respect to nanotechnology if the public were not engaged early on.

6.38 Dr Cormick argued that countries planning on applying the engagement model they developed with respect to GM to nanotechnology were 'in for a surprise'. Apart from the obvious fact that the GM debate virtually commenced after it had been developed, there was also the fact that nanotechnology is so broad an area:

> …because nanotechnology is so broad and across so many different applications we cannot talk about nanotechnology: we have to talk about nanoenvironment, nanohealth, nanofood, nanomanufacturing and some very different things.[412]

6.39 Professor John Weckert from the Centre for Applied Philosophy and Public Ethics, Charles Sturt University noted that people are naturally more concerned about what they eat than they are about other things, and that is why people are less concerned about nanotechnology:

> GM foods have created a lot more interest, but I think that is partly because people are more concerned about what they eat in a way that we are not perhaps concerned about some of the things we use, and…there is such an enormous array of products that…there is not really a nanotechnology that people can see, there is a whole vast array [413]

6.40 It is worth reiterating that the Australian Community Attitudes survey indicated that nanotechnology applications in food was the area of greatest concern for the Australian public.

Wider social implications

6.41 Nanotechnology is often cited as having the potential to fundamentally alter the way society lives. The submission from the Friends of the Earth Australia noted its disappointment that the Committee's terms of reference did not specifically include a reference to the social implications of nanotechnology.[414] It strongly urged the Committee to recommend that nanotechnology's wider social, economic, ethical and democratic implications be assessed alongside its implications for human health and environmental safety.[415]

---

411 Dr Cormick, Evidence, 4 August 2008, p 11

412 Dr Cormick, Evidence, 4 August 2008, p 12

413 Professor Weckert, Evidence 28 April, p 39

414 Submission 9, Friends of the Earth Australia, p 10

415 Submission 9, p 4

6.42 Dr Craig Cormick said that he did not think that these wider implications of nanotechnology were not yet on the public's 'radar'.[416] Mr Craig Pennifold said that at the federal level the issue of the potential workplace changes that may arise from nanotechnologies had not been examined or reviewed at this stage:

> We have not looked at the specific changes that the introduction of these new technologies would make in particular workplaces so there is not any specific planning in place to address what those changes might be.[417]

Committee comment

6.43 The Committee notes the concerns about the potential social, economic, ethical and democratic implications of nanotechnology and notes that this will require analysis and consideration by governments in the future.

New South Wales nanotechnology website

6.44 At the public hearing on 28 April, the Committee was interested to explore if there was a need for a New South Wales website to provide information on nanotechnology. The Executive Director of the Office of Science and Medical Research advised that the need had not been examined at that point in time. Ms Doyle did note that information was available from a number of sources:

> 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.[418]

6.45 Ms Doyle said that if a decision was made to establish a website, the question of which agency or department would have responsibility would depend on the type of information the website contained.

6.46 Mr Kaustuv Mukherjee, from the Department of State and Regional Development noted the role of the Australian Office of Nanotechnology in raising public awareness:

> 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.[419]

---

416 Dr Cormick, Evidence, 4 August 2008, p 7

417 Mr Pennifold, Evidence, 4 August 2008, p 9

418 Ms Kerry Doyle, Executive Director, Office of Science and Medical Research, Department of State and Regional Development, Evidence 28 April 2008, p 16

419 Mr Kaustuv Mukherjee, Senior Manager, Innovation Statement, Industry Division, Department of State and Regional Development, Evidence, 28 April 2008, p 19

6.47 The Committee further explored this question with the then Minister for Science and Medical Research, the Hon Verity Firth MP, at the public hearing on 6 June 2008. Minister Firth said that she was always in favour of providing more information, and that some steps had been taken in that respect:

> I am always in favour of more information rather than less information. In new areas like this, we really need to ensure that the public is well informed. Then they can make up their own minds and determine their opinion, but with all the facts available to them. It is very important that the public, as well as politicians, are informed about the potential benefits and risks involved in new technologies such as nanotechnology. This in turn will promote an informed and rational debate. As such I strongly believe that the provision of high quality information is one of the key instruments that we have at our disposal.
>
> The Office of Science and Medical Research's website includes links to relevant nanotechnology information reports and bodies. However, it is also being significantly redesigned. In its new form it will provide an information resource for science and medical research-related nanotechnology issues. I totally agree, in any debate about new technologies and science, we should have more information rather than less and we should let the public have an informed and rational debate.[420]

Committee comment

6.48 Throughout the Inquiry the Committee has heard that nanotechnologies, across a very broad range of disciplines and applications, are poised to have a significant impact on people's lives. Because of the breadth of areas to which nanotechnology can be applied, and because of the complexity of the science involved, there is a danger that people will react negatively to threats, real or imagined, of nanotechnology applications.

6.49 The Committee notes the comments of Professor Weckert that the level of interest amongst the general public in nanotechnology is not overwhelmingly high. It may not be appropriate to attempt to raise awareness and understanding of nanotechnology to a very high level – but what is important is to ensure that information is available when needed.

6.50 The NSW Government and the scientific community have an obligation to ensure that information is readily available to the public, so that as interest and awareness in nanotechnology grows there is a source of authoritative, reputable and balanced information to access.

6.51 Accordingly, the Committee believes that the NSW Government, through the relevant government agency, should create and maintain a website that provides information, or links to information, on nanotechnology. The website would provide up to date, factual and balanced information on nanotechnologies, including the NSW Government's public statement on nanotechnology recommended by the Committee in Chapter 5. The creation of a NSW Nanotechnology Unit, also recommended in Chapter 5, would provide an appropriate body to coordinate and maintain the website.

---

420 Hon Verity Firth MP, Minister for Science and Medical Research, Evidence, 6 June 2008, p 11

Recommendation 18

That the NSW Government, or the new NSW Nanotechnology Unit as recommended by the Committee, create and maintain a website that provides information, or links to information, on nanotechnology.

6.52 Noting the findings of the Community Attitude survey that the public trust scientists to inform them of any risks associated with nanotechnologies, the Committee believes the website should be introduced not just by the Minister but also the Chief Scientist. The Committee also acknowledges the significant education and information role played by the university sector in New South Wales, which provides an opportunity for collaboration with the NSW Government in the production of authoritative and reliable information.

6.53 The NSW Government, specifically the Office of Science and Medical Research, should continue to take the opportunity to work with the Australian Office of Nanotechnology in their ongoing activities to raise awareness and understanding of nanotechnologies.

Appendix 1 Submissions

No	Author
1	Dr Diana Bowman, Professor Graeme Hodge and Dr Karinne Ludlow (Monash University)
2	Mr Bill Scales (Australian Safety and Compensation Council)
3	Mr Nick Koerbin (Materials Australia)
4	Mr David Henry (Australian Manufacturing Workers' Union)
5	Mrs Leslie McCawley
6	Mr Craig Linn
7	Mr Paul Pearce MP (Member of the NSW Legislative Assembly)
8	Ms Tina Rankovic (Australian Nano Business Forum)
9	Ms Georgia Miller (Friends of the Earth Australia)
10	Professor Les Field (University of New South Wales)
11	Professor Andrew Cheetham (University of Western Sydney)
12	Dr Lee Astheimer (University of Wollongong)
13	Professor Barney Glover (University of Newcastle)
14	Dr Chennupati Jagadish (Australian National University)
15	Ms Claire Gunning (Standards Australia)
16	Ms Rosie Hicks (Australian National Fabrication Facility Ltd)
17	Dr George Collins (Australian Nuclear Science and Technology Organisation)
18	Dr Simon Ringer (Australian Microscopy and Microanalysis Research Facility)
19	Dr Stephen Morton (CSIRO)
20	Ms Renata Musolino (Victorian Trades Hall Council)
21	Professor Michael Cortie (Institute for Nanoscale Technology, University of Technology Sydney)
22	Dr Jennifer MacDiarmid and Dr Himanshu Brahmbhatt (EnGeneIC Pty Ltd)
23	Mr Craig Pennifold (Australian Government – Department of Innovation, Industry, Science and Research)
24	Dr Michael Patane (Protech Research Pty Ltd)
25	NSW Government
26	Mr David Vaile (University of Western Sydney)

Appendix 2 Witnesses

Date	Name	Position and Organisation
28 April 2008 **Jubilee Room, Parliament House**	**Ms Kerry Doyle**	Executive Director, Office of Science and Medical Research, Department of State and Regional Development.
	Dr Derek Van Dyk	Director, Science, Officer of Science and Medical Research, Department of State and Regional Development.
	Mr Kaustuv Mukherjee	Senior Manager, Innovation Statement, Industry Division, Department of State and Regional Development.
	Mr Peter Dunphy	Director, Hazard Management Group, WorkCover,
	Prof Graeme Hodge	Centre for Regulatory Studies, Faculty of Law, Monash University
	Dr Diana Bowman	Centre for Regulatory Studies, Faculty of Law, Monash University
	Prof Andrew Cheetham	Pro, Vice-Chancellor Research, University of Western Sydney
	Prof Susan Dodds	Head, School of Arts, University of Wollongong
	Prof John Weckert	Centre for Applied Philosophy and Public Ethics, Charles Sturt University
	Prof Brian Priestly	Australian Centre for Human Health Risk Assessment, Monash University
	Associate Professor Paul Wright	Toxicology Key Centre, RMIT University
	Prof Will Price	Head, School of Chemistry, University of Wollongong
	Dr George Collins	Chief of Research, Australian Nuclear Science and Technology Organisation
	Dr Miriam Goodwin	Senior Advisor Research Management and Policy, Australian Nuclear Science and Technology Organisation
1 May 2008 **Jubilee Room, Parliament House**	**Dr Peter Binks**	Chief Executive Officer, Nanotechnology Victoria

Date	Name	Position and Organisation
	Mr Clive Davenport	Chief Executive Officer, Australian Nano Business Forum
	Mr David Henry	Occupational Health and Safety Officer, Australian Manufacturing Workers' Union
	Prof Les Field	Deputy Vice Chancellor (Research), University of NSW
	Prof Bob Clark	Director, Centre for Quantum Computer Technology, University of NSW
	Prof Michelle Simmons	Director, Atomic Fabrication Facility, University of NSW
	Dr Maxine McCall	Theme Leader (Nanosafety), CSIRO Niche Manufacturing Flagship
	Dr Nicola Rogers	Stream Leader (Nanosafety), CSIRO Niche Manufacturing Flagship
	Dr Cathy Foley	Theme Leader, CSIRO Materials Science and Engineering
	Dr John Miles	Clayton Laboratory and Nanometrology Manager, National Measurement Institute
	Mr Max Maffucci	Program Manager – International, Standards Australia
	Ms Georgia Miller	Nanotechnology Project Coordinator, Friends of the Earth Australia
	Dr Jennifer MacDiarmid	Joint Managing Director, EnGeneIC Pty Ltd
	Mr Himanshu Brahmbhatt	Joint Managing Director, EnGeneIC Pty Ltd
6 June 2008 **Jubilee Room, Parliament House**	**Hon Verity Firth MP**	Minister for Science and Medical Research
	Dr Lisa Szabo	Chief Scientist, NSW Food Authority
	Mr Craig Lamberton	Director, Specialised Regulation, Department of Environment and Climate Change
	Ms Jane Mallen-Cooper	Manager Chemicals Policy Unit, Department of Environment and Climate Change
	Ms Theresa Manning	Ecological Risk Specialist, Department of Environment and

Date	Name	Position and Organisation
		Climate Change
10 June 2008 **Jubilee Room, Parliament House**	**Dr Simon Apte**	Research Director, Centre for Environmental Contaminants Research, CSIRO
	Dr Nicola Rogers	Research Scientist, Centre for Environmental Contaminants Research, CSIRO
	Ms Elaine Attwood	Consumer Representative, Consumers' Federation of Australia
	Mr David Vaile	Cyberspace and Law Reform, University of New South Wales
	Dr Howard Morris	Assistant Director Research, Office of the Australian Safety and Compensation Council
	Dr Phillip Reeves	Principal Scientist, Regulatory Strategy and Compliance, Australian Pesticides and Veterinary Medicines Authority (APVMA)
	Dr Jamie Nicholls	Regulatory Strategy Project Officer, APVMA
	Mr James Suter	Acting Chief Executive Officer, APVMA
	Prof Michael Roberts	Director, Therapeutics Research Unit, University of Queensland
	Dr Marion Healy	Director National Industrial Chemicals Notification and Assessment Scheme (NICNAS)
	Dr Matthew Gredley	A/g Reform Team Leader, NICNAS
	Ms Suzanne Smith	Research Programme Leader, Nuclear Solutions, Institute of Materials Engineering, Australian Nuclear Science and Technology Organisation (ANSTO)
4 August 2008 **Jubilee Room, Parliament House**	**Mr Craig Pennifold**	Head, Innovation Division, Department of Innovation, Industry, Science and Research
	Dr Craig Cormick	Manager, Public Awareness, Australian Office of Nanotechnology, Department of Innovation, Industry, Science and Research

Appendix 3 Site visits

Date	Location
17 March 2008	Intelligent Polymer Research Institute, University of Wollongong, Northfields Avenue, Gwyneville
	BlueScope Steel Ltd, Port Kembla Steelworks, Conniston
18 March 2008	ARC Centre of Excellence for Quantum Computer Technology, Newton Building, University of New South Wales, Kensington
	National Measurement Institute, Bradfield Road, Lindfield
	CAP-XX (Australia) Pty Ltd, Mars Road, Lane Cove
12 May 2008	Australian Nuclear Science and Technology Organisation (ANSTO), New Illawarra Road, Lucas Heights
	Centre for Environmental and Contaminants Research, CSIRO, Lucas Heights Science and Technology Centre, New Illawarra Road, Lucas Heights

Appendix 4 Tabled documents

Monday 1 May 2008

Public Hearing, Jubilee Room, Parliament House

1. Document titled 'Nanostructured Superconducting Magnetic Sensor' – tendered by Dr Maxine McCall, Theme Leader (Nanosafety), CSIRO Niche Manufacturing Flagship

2. Document titled 'Written Statement for Inquiry into Nanotechnology in NSW' containing responses to questions provided to the National Measurement Institute prior to the 28 April 2008 hearing – tendered by Dr John Miles, NMI

Friday 6 June 2008

Public Hearing, Jubilee Room, Parliament House

1. Diagram depicting the elements of the nationally coordinated framework for food regulation – tendered by Dr Lisa Szarbo, Chief Scientist, NSW Food Authority

Tuesday 10 June 2008

Public Hearing, Jubilee Room, Parliament House

1. Document titled 'Nanotechnology and consumer privacy: some examples' – tendered by Mr David Vaile, Cyberspace Law and Policy Centre, UNSW

2. Document titled 'Nanotechnology and its Impact on Consumers' providing a summary of consumer attitudes and identified needs drawn from a Consumers Council of Canada's 2008 Report – tendered by Ms Elaine Attwood, Consumer Representative, Consumers' Federation of Australia

3. Document titled 'Nanotechnology OHS Research & Development Program to Support the National Nanotechnology Strategy, Department of Education, Employment and Workplace Relations (DEEWR), Office of the Australian Safety & Compensation Council – tendered by Dr Howard Morris, Assistant Director Research, Office of the Australian Safety and Compensation Council

Monday 4 August 2008

Public Hearing, Jubilee Room, Parliament House

1. Powerpoint presentation on Australian Community Attitudes Held About Nanotechnology – copy of presentation tendered by Dr Craig Cormick, Manager, Public Awareness, Australian Office of Nanotechnology, Department of Innovation, Industry, Science and Research

Appendix 5 Minutes

Minutes No. 10

Thursday, 6 December 2007
Members' Lounge, Parliament House, at 2.05pm

1. Members present
Mr Catanzariti (*Chair*)
Mrs Pavey (*Deputy Chair*)
Mr Mason-Cox
Revd Nile
Ms Robertson
Mr Veitch

2. Confirmation of previous Minutes
Resolved, on the motion of Ms Robertson: That minutes no. 9 be confirmed.

3. Consideration of terms of reference
The Chair tabled correspondence containing the following terms of reference received from the Hon Verity Firth MP, Minister for Science and Medical Research, on 5 December 2007:

1. That the Standing Committee on State Development inquire into and report on nanotechnology in New South Wales, in particular:
   a. current and future applications of nanotechnology for New South Wales industry and the New South Wales community
   b. the health, safety and environmental risks and benefits of nanotechnology
   c. the appropriateness of the current regulatory frameworks in operation for the management of nanomaterials over their life-cycle
   d. the adequacy of existing education and skills development opportunities related to nanotechnology
   e. the adequacy of the National Nanotechnology Strategy in the New South Wales context
   f. the level of community understanding of nanotechnology and options to improve public awareness of nanotechnology issues.

2. That the Committee report by 31 October 2008.

Resolved, on the motion of Ms Robertson: That the Committee consider the terms of reference provided by the Minister for Science and Medical Research.

Resolved, on the motion of Revd Nile: That the Committee under standing order 218(2) invite Mr David Boyd, Policy Adviser to the Minister for Science and Medical Research, to join the meeting to give a short briefing on the terms of reference, and that Mr Boyd be excluded when the Committee deliberates.

Mr Boyd was admitted and briefed the Committee on the terms of reference.

Mr Boyd withdrew and the Committee proceeded to deliberate.

Resolved, on the motion of Mr Veitch: That the Committee adopt the terms of reference received from the Minister for Science and Medical Research for an inquiry into nanotechnology in New South Wales.

Resolved, on the motion of Ms Robertson: That:
- the closing date for submissions be 28 March 2008
- the Chair issue a media release announcing the establishment of the inquiry as soon as practicable
- that advertisements calling for submissions be placed in the *Sydney Morning Herald* and the *Daily Telegraph* in the week beginning Monday 28 January
- that advertisements calling for submissions be placed in relevant scientific and industry publications in the most appropriate timeframe.

Resolved, on the motion of Revd Nile: That the terms of reference be placed on the Committee's website as soon as practicable, with a link to the Australian Office of Nanotechnology.

Resolved, on the motion of Revd Nile: That the Secretariat compile a list of stakeholders to be invited to make a submission to the Inquiry, with Committee members to provide suggestions by 5pm Wednesday 12 December 2007, and that the list be circulated to the Committee thereafter.

Resolved, on the motion of Revd Nile: That the Committee hold a two-hour briefing on Friday 29 February 2008 at 10am, and that the Committee invite:

- the Minister for Science and Medical Research, if available
- an acknowledged expert in nanotechnology, to be identified by the Chair in consultation with the Committee.

4. Adjournment

The Committee adjourned at 2.45pm until 10am on Friday 29 February 2008.

Madeleine Foley
Clerk to the Committee

Minutes No. 11

Friday, 29 February 2008
Room 1102, Parliament House, at 9:50am

1. Members present
Mr Catanzariti (*Chair*)
Mrs Pavey (*Deputy Chair*)
Mr Mason-Cox
Revd Nile
Ms Robertson
Mr Veitch

2. Mr Veitch Previous Minutes
Resolved, on the motion of Mr Veitch: That draft minutes no. 10 be confirmed.

3. Correspondence
The Committee noted the following items of correspondence:

Sent

- 16 January 2008 – Letter from Chair to the Hon Verity Firth MP, Minister for Science & Medical Research extending an invitation to attend the Committee briefing on nanotechnology on 29 February 2008.
- 5 February 2008 – Letter from Chair to Dr John Miles, Clayton Laboratory and Nanometrology Manager, National Measurement Institute, confirming the appearance of Dr Clayton Teague, Director, National Nanotechnology Coordination Office (USA) to provide a briefing to the Committee on 29 February 2008.

Received

- 9 January 2008 – Email from Ms Jane G Hall to Committee.

Resolved, on the motion of Revd Nile: That the Committee Secretariat provide a written response to Ms Hall advising that her e-mail will be treated as correspondence to the Committee.

4. Inquiry into Nanotechnology in NSW

4.1 Publication of submissions

Resolved, on the motion of Mr Mason-Cox: That, according to section 4 of the *Parliamentary Papers (Supplementary Provisions) Act 1975* and Standing Order 223(1), the Committee authorises the publication of Submissions Nos 1 and 2, and that they be placed on the inquiry website.

4.2 Site visits

Resolved, on the motion of Mrs Pavey: That the Committee conduct a site visit to the Intelligent Polymer Research Unit, University of Wollongong and to Bluescope Steel on Monday 17 March 2008.

Resolved, on the motion of Mrs Pavey: That the Committee conduct a site visit to the ARC Centre of Excellence in Quantum Computing, University of NSW; the National Measurement Institute, Lindfield; and to CAP-XX (Australia) Pty Ltd, Lane Cove on Tuesday 18 March 2008.

Resolved, on the motion of Ms Robertson: That the Committee authorise the expenditure for the hire of bus transport for the purpose of conducting site visits on Monday 17 and Tuesday 18 March 2008.

4.3 Public hearings

Resolved, on the motion of Mrs Pavey: That the Committee hold public hearings for the Inquiry into Nanotechnology in NSW at Parliament House on Monday 28 April and Thursday 1 May 2008.

4.4 Attendance by Chair and Director at the ICONN Conference

The Director briefed the Committee on the ICONN Conference in Melbourne, which the Director and Chair attended on 27 and 28 February 2008.

Resolved, on the motion of Mrs Pavey: That the Committee Director prepare a report for the information of the Committee on the attendance by the Chair and the Director at the ICONN Conference in Melbourne on 27-28 February 2008.

5. Briefing on nanotechnology
Resolved, on the motion of Mr Veitch: That the Committee, under Standing Order 218(2), invite the following individuals to join the private meeting of the Committee to provide a briefing on nanotechnology, and that they be excluded when the Committee deliberates:

- Dr Clayton Teague, Director, National Nanotechnology Coordination Office (USA)
- Dr John Miles, Clayton Laboratory and Nanometrology Manager, National Measurement Institute
- Mr Derek Van Dyk, Director, Science, Office of Science and Medical Research.

Dr Teague, Dr Miles, Mr Van Dyk and the Minister for Science and Medical Research, Hon Verity Firth MP, were admitted.

The Chair welcomed the invited guests to the meeting of the Committee.

The Minister for Science and Medical Research, as per the written invitation of the Committee dated 16 January 2008, gave a brief address on nanotechnology in NSW.

The Minister for Science and Medical Research withdrew.

Dr Teague provided a presentation to the Committee entitled: *An introduction to Nanotechnology and the US National Nanotechnology Initiative*.

The Chair, on behalf of the Committee, thanked Dr Teague, Dr Miles and Mr Van Dyk for attending and providing the briefing to the Committee.

Dr Teague, Dr Miles and Mr Van Dyk withdrew.

6. Adjournment

The Committee adjourned at 12.45pm until 9:00am on Monday 17 March 2008.

Simon Johnston
Clerk to the Committee

Minutes No. 12

Monday, 17 March 2008
Parliament House, at 9:00am

1. Members present
Mr Catanzariti (*Chair*)
Mr Mason-Cox
Revd Nile
Ms Robertson
Mr Veitch

2. Apologies
Mrs Pavey

3. Inquiry into Nanotechnology in NSW – site visit

Intelligent Polymer Research Institute
The Committee arrived at the Intelligent Polymer Research Institute, University of Wollongong, Northfields Avenue, Gwyneville at 10:45am.

The Committee received a briefing on the ARC Centre of Excellence for Electromaterials Science (ACES) and the Intelligent Polymer Research Institute (IPRI) from the following:

- Professor Gordon Wallace
- Professor Sue Dodds
- Professor Will Price

The Committee, accompanied by Professor Chee Too, conducted a tour of inspection of the following laboratories:

- Carbon nanotubes and grapheme – Dr Dan Li, Dr Jun Chen
- Wet spinning – Dr Joe Razal
- Ink-jet printing – Dr Rod Shepherd
- Nanobionics – Dr Simon Moulton, Dr Michael Higgins
- Energy – Dr Attila Mozer.

The Committee concluded its visit of inspection at 12:45pm

Bluescope Steel
The Committee arrived at the North Gate Steelworks Visitor's Centre, Port Kembla Steelworks, Conniston at 1:15pm, and was met by:

- Mr Mike Archer, Manager, External Affairs, Bluescope Steel
- Mr Jim Williams, Manager, Metallurgical Technology and Industrial Markets, Bluescope Steel.

Mr Archer provided a presentation on the Port Kembla plant and its layout.

Mr Archer and Mr Williams guided the Committee on a tour of the steel slab casting process and plant.

The Committee attended the Central laboratory and was met by:

- Mr Alan Thomas, General Manager, Engineering, Technology & Environment
- Mr Jim Graham, Manager, Slabmaking
- Mr Chris Killmore, Product Design Manager
- Mr Rama Mahapatral, Process Metallurgy Development Manager
- Professor Simon Ringer, University of Sydney.

Mr Williams provided a briefing on the castrip slabmaking process and nanotechnology. A general discussion ensued.

The Committee concluded its visit of inspection at 3:45pm.

4. Adjournment

The Committee adjourned at 5:30pm until 9:300am on Tuesday 18 March 2008.

Simon Johnston
Clerk to the Committee

Minutes No. 13

Tuesday, 18 March 2008
Parliament House, at 9:30am

1. **Members present**
   Mr Catanzariti (*Chair*)
   Mrs Pavey *(Deputy Chair)*
   Mr Mason-Cox
   Revd Nile
   Mr Veitch

2. **Apologies**
   Ms Robertson

3. **Inquiry into Nanotechnology in NSW – site visit**

Centre for Quantum Computer Technology
The Committee arrived at the ARC Centre of Excellence for Quantum Computer Technology, Newton Building, University of New South Wales, Kensington at 10:00am and was met by:

- Professor Bob Clark, Director, Centre for Quantum Computer Technology
- Professor Michelle Simmons, Director, Atomic Fabrication Facility

Professor Clark provided a brief introductory presentation on the Centre for Quantum Computer Technology and nanotechnology.

Professors Clark and Williams guided the Committee on a tour of the Centre's facilities.

The Committee returned to the Level 2 Boardroom and was met by Professor Les Field, Deputy Vice Chancellor (Research), University of New South Wales. A general discussion on nanotechnology ensued.

The Committee concluded its visit of inspection at 11:50am.

National Measurement Institute
The Committee arrived at the National Measurement Institute, Bradfield Road, Lindfield at 12:45pm, and was met by:

- Dr Peter Fisk, General Manager, Physical Metrology
- Dr John Miles, Clayton Laboratory and Nanometrology Manager.

Dr Fisk provided a brief presentation on the National Measurement Institute (NMI).

Dr Miles provided a brief presentation on nanometrology at the NMI.

Drs Fisk and Miles guided the Committee on a tour of the facilities at the Lindfield site.

The Committee concluded its visit of inspection at 2:00pm.

CAP-XX (Australia) Pty Ltd
The Committee arrived at the premises of CAP-XX (Australia) Pty Ltd, Mars Road, Lane Cove at 2:30pm and was met by:

- Dr Phillip Aitchison, Vice President Research
- Mr Warren King, Technical Advisor to the Board.

Dr Aitchison and Mr King provided a brief presentation on CAP-XX and how nanotechnology is incorporated into its production process.

Dr Aitchison and Mr King guided the Committee on a tour of the production facilities.

The Committee returned to the Boardroom where a general discussion on nanotechnology ensued.

The Committee concluded its visit of inspection at 3:45pm

4. Adjournment

The Committee adjourned at 4:15pm *sine die*.

Simon Johnston
Clerk to the Committee

Minutes No. 14

Wednesday, 9 April 2008
Member's Lounge, Parliament House, at 1:07 pm

1. Members present
Mr Catanzariti (*Chair*)
Mrs Pavey (*Deputy Chair*)
Mr Mason-Cox
Revd Nile
Ms Robertson
Mr Veitch

2. Previous Minutes
Resolved, on the motion of Revd Nile: That draft minutes nos. 11, 12, and 13 be confirmed.

3. Inquiry into Nanotechnology in NSW

3.1 Publication of submissions
Resolved, on the motion of Ms Robertson: That, according to section 4 of the *Parliamentary Papers (Supplementary Provisions) Act 1975* and Standing Order 223(1), the Committee authorises the publication of Submissions Nos 3 to 25, and that they be placed on the inquiry website.

3.2 Additional hearing dates
Resolved, on the motion of Mrs Pavey: That the Committee conduct public hearings for the Inquiry into Nanotechnology in New South Wales on 6 and 10 June 2008.

3.3 Proposed witnesses for public hearings on 28 April and 1 May 2008
The Committee noted the following witnesses proposed for the hearings on 28 April and 1 May 2008:

Universities

- University of New South Wales – Vice Chancellor Field, Professor Bob Clark, Professor Michelle Simmonds (Submission 10)
- University of Wollongong – Professor Gordon Wallace, Dr Lee Astheimer, Professor Sue Dodd (Submission 12)
- Charles Sturt University – Professor John Weckert
- Monash University – Dr Diana Bowman, Professor Graeme Hodge, Dr Karinne Ludlow (Submission 1)
- University of Western Sydney – Dr Christina Martinez, Mr Kim Leevers (Submission 11)
- Australian National Fabrication Facility – Ms Rosie Hicks (Submission 16)
- Australian Microscopy Microanalysis Research Facility – Dr Simon Ringer (Submission 18)
- University of Queensland - Professor Michael Roberts

Government departments and agencies etc

- NSW Government – Office of Science and Medical Research and/ or Department of State and Regional Development
- Australian Office of Nanotechnology (AoN)
- National Measurement Institute (Submission coming under AoN umbrella)
- National Health and Medical Research Council (Submission coming under AoN umbrella)
- CSIRO - Dr Steven Morton, Dr Maxine McCall (Submission 19)
- NanoVic
- Australian Nuclear Science and Technology Organisation – Dr George Collins, Dr Miriram Goodwin (Submission 17)
- Therapeutic Goods Administration; Food Standards Australia New Zealand; National Industrial Chemicals Notification & Assessment Scheme (input possibly to be included in AoN submission)
- Australian Safety and Compensation Council (Submission 2)
- Standards Australia (Submission 15)
- NanoSafe Australia

Non government organisations

- Friends of the Earth (Submission 9)
- Australian Manufacturing Workers Union (Submission 4)
- Victorian Trades Hall Council (Submission 20)

Businesses and Business associations etc

- Protech Research Pty Ltd – a start up company using nanotechnology for applications in food products
- Australian Nano Business Forum (Submission 8)
- EnGeneIC (Submission 22)

The Committee noted that the 6 and 10 June 2008 hearings would include additional witnesses, including representatives of consumer organisations (e.g. Australian Consumers' Association), and scientific communications experts.

4. Adjournment

The Committee adjourned at 1:22 pm until 9:45am Monday 28 April 2008, in the Jubilee Room, Parliament House.

Simon Johnston
Clerk to the Committee

Minutes No 15

Monday, 28 April 2008
Jubilee Room, Parliament House, Sydney at 9:45am

1. Members present

Mr Catanzariti (*Chair*)
Mrs Pavey (*Deputy Chair*)
Mr Mason-Cox
Revd Nile
Ms Robertson
Mr Veitch

2. Confirmation of previous minutes

Resolved, on the motion of Mr Veitch: That draft Minutes No.14 be confirmed.

3. Correspondence

The Committee noted the following items of correspondence received:

- 15 April 2008 – Document, sent by the Director, US National Nanotechnology Coordination Office to Committee Chair, entitled 'National Nanotechnology Initiative FY 2009 Budget & Highlights'

The Committee noted the following items of correspondence sent:

- 9 April 2008 – Letters from the Chair to Professor Gordon Wallace, University of Wollongong; Mr Jim Williams, BlueScope Steel Limited; Professor Bob Clark, University of NSW; Dr John Miles, National Measurement Institute; Dr Phillip Aitchison, CAP-XX (Australia) Pty Ltd, thanking them respectively for their efforts in arranging site visits by the Committee to their organisations on the 17 and 18 March 2008.

4. Inquiry into Nanotechnology in NSW

4.1 Return of answers to questions taken on notice

Resolved, on the motion of Rvd Nile: That the Committee request witnesses to return answers to questions taken on notice at the public hearing of 28 April 2008 by Monday 19 May 2008.

5. Inquiry into Nanotechnology in NSW – public hearing

Witnesses, the public and media were admitted.

The Chair made an opening statement regarding the broadcasting of proceedings and other matters.

The following witnesses were sworn and examined:

- Ms Kerry Doyle, Executive Director, Office of Science and Medical Research, Department of State and Regional Development.
- Dr Derek Van Dyk, Director, Science, Officer of Science and Medical Research, Department of State and Regional Development.
- Mr Kaustuv Mukherjee, Senior Manager, Innovation Statement, Industry Division, Department of State and Regional Development.
- Mr Peter Dunphy, Director, Hazard Management Group, WorkCover,

The evidence concluded and the witnesses withdrew.

The following witnesses were sworn and examined:

- Prof Graeme Hodge, Centre for Regulatory Studies, Faculty of Law, Monash University.
- Dr Diana Bowman, Centre for Regulatory Studies, Faculty of Law, Monash University.

The evidence concluded and the witnesses withdrew.

The following witness was sworn and examined:

- Prof Andrew Cheetham, Pro Vice-Chancellor Research, University of Western Sydney.

The evidence concluded and the witnesses withdrew.

The following witnesses were sworn and examined:

- Prof Susan Dodds, Head, School of Arts, University of Wollongong.
- Prof John Weckert, Centre for Applied Philosophy and Public Ethics, Charles Sturt University.

The evidence concluded and the witnesses withdrew.

The following witnesses were sworn and examined:

- Prof Brian Priestly, Australian Centre for Human Health Risk Assessment, Monash University.
- Associate Professor, Paul Wright, Toxicology Key Centre, RMIT University.

The evidence concluded and the witnesses withdrew.

The following witness was sworn and examined:

- Prof Will Price, Head, School of Chemistry, University of Wollongong.

The evidence concluded and the witness withdrew.

The following witnesses were sworn and examined:

- Dr George Collins, Chief of Research, Australian Nuclear Science and Technology Organisation.
- Dr Miriam Goodwin, Senior Advisor Research Management and Policy, Australian Nuclear Science and Technology Organisation.

The evidence concluded and the witnesses withdrew.

The public hearing concluded at 5.10pm. The public and the media withdrew.

6. Adjournment

The Committee adjourned at 5:10pm Thursday 1 May 2008 at 9:15am in the Jubilee Room, Parliament House (public hearing).

Simon Johnston
Clerk to the Committee

Minutes No 16

Thursday, 1 May 2008
Jubilee Room, Parliament House, Sydney at 9:15am

1. Members present
Mr Catanzariti (*Chair*)
Mrs Pavey (*Deputy Chair*)
Revd Nile
Ms Robertson
Mr Veitch

2. Apologies
Mr Mason-Cox

3. Confirmation of previous minutes
Resolved, on the motion of Ms Pavey: That draft Minutes No.15 be confirmed.

4. Inquiry into Nanotechnology in NSW

4.1 Return of answers to questions taken on notice
Resolved, on the motion of Mr Veitch: That the Committee request witnesses to return answers to questions taken on notice at the public hearing of 1 May 2008 by Thursday 22 May 2008.

4.2 Inquiry into Nanotechnology in NSW – public hearing
Witnesses, the public and media were admitted.

The Chair made an opening statement regarding the broadcasting of proceedings and other matters.

The following witnesses were sworn and examined:
- Dr Peter Binks, Chief Executive Officer, Nanotechnology Victoria.
- Mr Clive Davenport, Chief Executive Officer, Australian Nano Business Forum.

The evidence concluded and the witnesses withdrew.

The following witness was sworn and examined:
- Mr David Henry, Occupational Health and Safety Officer, Australian Manufacturing Workers' Union.

The evidence concluded and the witness withdrew.

The following witnesses were sworn and examined:
- Prof Les Field, Deputy Vice Chancellor (Research), University of NSW.
- Prof Bob Clark, Director, Centre for Quantum Computer Technology, University of NSW.
- Prof Michelle Simmons, Director, Atomic Fabrication Facility, University of NSW.

The evidence concluded and the witnesses withdrew.

The following witnesses were sworn and examined:
- Dr Maxine McCall, Theme Leader (Nanosafety), CSIRO Niche Manufacturing Flagship.
- Dr Nicola Rogers, Stream Leader (Nanosafety), CSIRO Niche Manufacturing Flagship.
- Dr Cathy Foley, Theme Leader, CSIRO Materials Science and Engineering.

Dr Maxine McCall tendered a document to the Committee.

The evidence concluded and the witnesses withdrew.

The following witnesses were sworn and examined:

- Dr John Miles, Clayton Laboratory and Nanometrology Manager, National Measurement Institute.
- Mr Max Maffucci, Program Manager – International, Standards Australia.

Dr John Miles tendered a document to the Committee.

The evidence concluded and the witnesses withdrew.

The following witness was sworn and examined:

- Ms Georgia Miller, Nanotechnology Project Coordinator, Friends of the Earth Australia.

The evidence concluded and the witness withdrew.

The following witnesses were sworn and examined:

- Dr Jennifer MacDiarmid, Joint Managing Director, EnGeneIC Pty Ltd.
- Mr Himanshu Brahmbhatt, Joint Managing Director, EnGeneIC Pty Ltd.

The evidence concluded and the witnesses withdrew.

The public hearing concluded at 5.10pm. The public and the media withdrew.

5. Publication of tendered documents

Resolved, on the motion of Ms Pavey: That the Committee accept and publish, according to section 4 of the *Parliamentary Papers (Supplementary Provisions) Act 1975* and Standing Order 223(1) the following document(s) tendered during the public hearing:

- Document titled 'Nanostructured Superconducting Magnetic Sensor', tabled by Dr Maxine McCall, Theme Leader (Nanosafety), CSIRO Niche Manufacturing Flagship.
- Document titled 'Written Statement for Inquiry into Nanotechnology in NSW', containing responses to questions provided to the National Measurement Institute prior to the 28 April 2008 hearing, tabled by Dr John Miles, NMI.

6. Discussion of potential site visit

The Committee agreed that a site visit to the Australian Nuclear Science and Technology Organisation's (ANSTO) facilities at Lucas Heights would be held on either 12 May 2008, 11 June 2008 or 27 June 2008, with the Secretariat to confirm the final date after consultation with Committee members.

7. Letter to Department of Premier and Cabinet

Resolved, on the motion of Rvd Nile: That the Committee secretariat write to the NSW Department of Premier and Cabinet requesting details of those NSW Government departments and agencies that are currently engaged in, or associated with, scientific research involving nanotechnology.

8. Adjournment

The Committee adjourned at 4:20pm *sine die*.

Simon Johnston
Clerk to the Committee

Minutes No. 17

Monday, 12 May 2008
Parliament House, at 10:30am

1. Members present
Mr Catanzariti (*Chair*)
Mrs Pavey (*Deputy Chair*)
Mr Mason-Cox
Ms Robertson

2. Apologies
Revd Nile
Mr Veitch

3. Inquiry into Nanotechnology in NSW – site visit

Australian Nuclear Science and Technology Organisation (ANSTO)
The Committee arrived at the ANSTO site, New Illawarra Road, Lucas Heights at 11:20am and was met by Mr Andrew Humpherson, General Manager, Public Affairs, ANSTO.

The Committee attended the lecture theatre where Mr Humpherson provided a brief presentation and overview of the ANSTO facilities. Mr Humpherson then escorted the Committee on a tour of the site facilities.

The Committee inspected the OPAL facilities, and was met by Mr Tony Irwin, Reactor Manager, OPAL, who provided an overview of the facilities.

The Committee returned to the lecture theatre and were met by Professor Mike James, Principal Research Scientist, Bragg Institute. Professor James provided a presentation on nanotechnology. Professor James then guided the Committee on a tour of the Neutron Guide Hall. The Committee were joined by Dr George Collins, Chief of Research, ANSTO.

The Committee returned to the lecture theatre and were met by Mr Chris Barbe, Chief Technical Officer, CeramiSphere Pty Ltd, who provided a presentation on CeramiSphere.

The Committee concluded its visit of inspection at 2:00pm.

Centre for Environmental and Contaminants Research, CSIRO
The Committee was escorted by Dr Suzanne Smith, Research Programme Leader, Nuclear Solutions, ANSTO, to the Lucas Heights Science and Technology Centre, New Illawarra Road, Lucas Heights. The Committee arrived at the Centre for Environmental and Contaminants Research (CECR) at 2:15pm and was met by:

- Dr Simon Apte, Research Director, CECR
- Dr Graeme Batley, Director, CECR.

Dr Apte and Dr Batley, provided an overview of the CECR and nano-material environmental toxicity research, and answered questions from the Committee.

The Committee concluded its visit of inspection at 3:15pm.

4. Adjournment
The Committee adjourned at 4:15pm, until Friday 6 June 2008.

Simon Johnston
Clerk to the Committee

Minutes No. 18

Friday, 6 June 2008
Parliament House, at 9:15am

1. Members present

Mr Catanzariti (*Chair*)
Mrs Pavey (*Deputy Chair*)
Mr Mason-Cox
Revd Nile
Mr Veitch

2. Apologies

Ms Robertson

3. Previous minutes

Resolved, on the motion of Mr Veitch: That draft Minutes Nos 16 and 17 be confirmed.

4. Correspondence

The Committee noted the following items of correspondence relating to the Inquiry into Nanotechnology:

Sent:

- 8 May 2008 – letter from Chair to the Director General, Department of Premier and Cabinet requesting a list of scientific research projects involving nanotechnology that are either commissioned or partnered by NSW Government departments or agencies; and indicating the Committees' desire to have representatives from the Department of Environment and Climate Change and the Office of Fair Trading appear as witnesses before the Committee.
- 22 May 2008 – letter from Chair to the Minister for Science and Medical Research regarding the establishment of a NSW Chief Scientist position.
- 28 May 2008 – letter from the Chair to the Minister for Science and Medical Research inviting the Minister to appear as a witness before the Committee on Friday 6 June.

Received:

- 1 May 2008 – document from Professor Les Field, Deputy Vice Chancellor, Research, University of New South Wales containing responses to written questions on notice.
- 1 May 2008 – document from Dr John Miles, Chief Research Scientist, National Measurement Institute containing Dr Miles' opening statement from his appearance before the Committee on that date and responses to written questions on notice.
- 5 May 2008 – document from Mr David Henry, Occupational Health and Safety Officer, Australian Manufacturing Workers' Union containing responses to questions taken on notice at the public hearing of 1 May 2008 and responses to written questions on notice.
- 19 May 2008 – letter from Professor Andrew Cheetham, Pro Vice Chancellor, Research, University of Western Sydney enclosing answers to questions taken on notice at the public hearing on 28 April 2008 and additional information.
- 20 May 2008 – document from Professor Sue Dodds, Head, School of English Literatures, Philosophy and Languages, University of Wollongong enclosing answers to written questions on notice.
- 20 May 2008 – document from Professor Brian Priestly, Head, Australian Centre for Human Health Risk Assessment and Professor Paul Wright, Key Toxicology Centre, RMIT enclosing answers to written questions on notice.
- 21 May 2008 – document from Dr Peter Binks, CEO, Nanotechnology Victoria Ltd enclosing answers to written questions on notice.
- 22 May 2008 – letter from Dr Rohan Hammett, National Manager, Therapeutic Goods Administration to Committee Secretariat declining invitation to have representatives appear as witnesses before the Committee.

- 23 May 2008 – document from Ms Georgia Miller and Mr Arius Tolstoshev, Friends of the Earth Nanotechnology Project enclosing supplementary information on public awareness and engagement.
- 28 May 2008 – letter from Mr JL Schmidt on behalf of the Director General, Department of Premier and Cabinet to Committee Chair enclosing a list of scientific research projects involving nanotechnology that are either commissioned or partnered by NSW Government departments or agencies.
- 5 June 2008 – letter from Ms Lyn Baker, Commissioner for Fair Trading, declining the Committee's invitation to give evidence and advising of the statutory responsibilities of the Office in relation to nanotechnology.
- 6 June 2008 – email from Mr Jonathan Chamarette, Australian Office of Nanotechnology, advising that Ms Tess McDonald, Department of Innovation, Industry, Research and Science, is unable to attend the public hearing of 6 June 2008.

Resolved on the motion of Ms Pavey: That representatives of the Department of Innovation, Industry, Research and Science and the Australian Office of Nanotechnology be invited to attend a public hearing to be held on the afternoon of Monday 23 June 2008.

Resolved on the motion of Mr Mason-Cox: That, according to section 4 of the Parliamentary Papers (Supplementary Provisions) Act 1975 and Standing Order 223(1), the Committee authorise the publication of answers to questions on notice, correspondence and additional information provided by the following:

- Professor Les Field, University of New South Wales
- Dr John Miles, National Measurement Institute
- Mr David Henry, Australian Manufacturing Workers' Union
- Professor Andrew Cheetham, University of Western Sydney
- Professor Sue Dodds, University of Wollongong
- Professor Brian Priestly and Professor Paul Wright, RMIT
- Dr Peter Binks, Nanotechnology Victoria
- Dr Rohan Hammett, Therapeutic Goods Administration
- Ms Georgia Miller and Mr Arius Tolstoshev, Friends of the Earth Australia
- Mr J L Schmidt, Department of Premier and Cabinet
- Ms Lyn Baker, Commissioner for Fair Trading
- Mr Jonathan Charmarette, Director, Australian Office of Nanotechnology.

5. Inquiry into Nanotechnology in NSW – Public Hearing

Resolved on the motion of Mr Mason-Cox: That the Committee request witnesses to return answers to questions taken on notice at the public hearing of 6 June 2008 by Friday 27 June 2008.

Witnesses, the public and media were admitted.

The Chair made an opening statement regarding the broadcasting of proceedings and other matters.

The Hon Verity Firth MP, Minister for Science and Medical Research, NSW Government was admitted and examined.

The evidence concluded and the Minister withdrew.

The following witness was sworn and examined:

- Dr Lisa Szabo, Chief Scientist, NSW Food Authority

Dr Szabo tendered a document depicting the elements of the nationally coordinated framework for food regulation.

The evidence concluded and the witness withdrew.

The following witnesses were sworn and examined:

- Mr Craig Lamberton, Director, Specialised Regulation, Department of Environment and Climate Change

- Ms Jane Mallen-Cooper, Manager, Chemicals Policy Unit, Department of Environment and Climate Change
- Ms Theresa Manning, Ecological Risk Specialist, Department of Environment and Climate Change

The evidence concluded and the witnesses withdrew.

The public hearing concluded at 12: 05pm. The public and the media withdrew.

Resolved on the motion of Mr Veitch: That the Committee accept and publish, according to section 4 of the Parliamentary Papers (Supplementary Provisions) Act 1975 and Standing Order 223(1) the following document(s) tendered during the public hearing:

- Diagram depicting the elements of the nationally coordinated framework for food regulation, tendered by Dr Lisa Szabo, Chief Scientist, NSW Food Authority.

6. Adjournment

The Committee adjourned at 12.07pm, until 10.15am, Tuesday 10 June 2008, in the Jubilee Room, Parliament House

Simon Johnston
Clerk to the Committee

Minutes No. 19

Tuesday, 10 June 2008
Parliament House, at 10.15am

1. Members present

Mr Catanzariti (*Chair*)
Mrs Pavey (*Deputy Chair*)
Mr Mason-Cox
Revd Nile
Ms Robertson
Mr Veitch

2. Correspondence

The Committee noted the following item of correspondence received:

Received:

- 10 June 2008 – Letter from Mr Craig Pennifold, Head, Innovation Division, Department of Innovation, Industry Science and Research to Committee Chair advising of the inability of a representative from the Australian Office of Nanotechnology to attend the public hearing on 6 June 2008 as had been previously arranged and enclosing the prepared opening statement and responses to the indicative questions that had been prepared in anticipation of the representative's appearance.

Resolved, on the motion of Mr Veitch: That, according to section 4 of the Parliamentary Papers (Supplementary Provisions) Act 1975 and Standing Order 223(1), the Committee authorise the publication of the correspondence from Mr Craig Pennifold dated 10 June 2008.

3. Inquiry into Nanotechnology in NSW – Public Hearing

Resolved on the motion of Mr Veitch: That the Committee request witnesses to return answers to questions taken on notice at the public hearing of 10 June 2008 by Tuesday 1 July 2008.

Witnesses, the public and media were admitted.

The Chair made an opening statement regarding the broadcasting of proceedings and other matters.

The following witnesses were sworn and examined:

- Dr Simon Apte, Research Director, Centre for Environmental Contaminants Research, CSIRO
- Dr Nicola Rogers, Research Scientist, Centre for Environmental Contaminants Research, CSIRO

The evidence concluded and the witnesses withdrew.

The following witnesses were sworn and examined:

- Ms Elaine Attwood, Consumer Representative, Consumers' Federation of Australia
- Mr David Vaile, Cyberspace and Law Reform, University of New South Wales

Ms Attwood tendered a document providing a summary of consumer attitudes and identified needs drawn from a Consumers Council of Canada's 2008 Report 'Nanotechnology and its Impact on Consumers'.

Mr Vaile tendered a document entitled: "Nanotechnology and consumer privacy: some examples".

The evidence concluded and the witnesses withdrew.

The following witness was sworn and examined:

- Dr Howard Morris, Assistant Director Research, Office of the Australian Safety and Compensation Council

Dr Morris tendered the following documents:

- Nanotechnology OHS Research & Development Program to Support the National Nanotechnology Strategy, Department of Education, Employment & Workplace Relations (DEEWR), Office of the Australian Safety & Compensation Council
- Draft terms of reference – Nanotechnology OHS Reference Group, which Dr Morris requested remain confidential to the Committee

- Draft terms of reference – Nanotechnology OHS Measurement Reference Group, which Dr Morris requested remain confidential to the Committee.

Dr Morris tendered copies of the following public documents:

- (US) National Institute for Occupational Safety and Health (NIOSH) Evaluation Report, October 2006
- Inhalation Toxicology: Monitoring Multiwalled Carbon Nanotube Exposure in Carbon Nanotube Research Facility, 1 June 2008
- Journal of Toxicology Science: Induction of mesothelioma in p53+/- mouse by intraperitoneal applicaton of multi-wall carbon nanotube, Vol 33, No 1. 2008
- Nature Publishing Group: Carbon nanotubes introduced into the abdominal cavity of mice show asbestone-like pathogenicity in a pilot study, May 2008

The evidence concluded and the witness withdrew.

The following witnesses were sworn and examined:

- Dr Phillip Reeves, Principal Scientist, Regulatory Strategy and Compliance, Australian Pesticides and Veterinary Medicines Authority (APVMA)
- Dr Jamie Nicholls, Regulatory Strategy Project Officer, APVMA
- Mr James Suter, Acting Chief Executive Officer, APVMA

The evidence concluded and the witnesses withdrew.

The following witness was sworn and examined:

- Prof Michael Roberts, Director, Therapeutics Research Unit, University of Queensland

Resolved on the motion of Ms Robertson: That the Committee proceed to take evidence from Professor Roberts *in camera*.

The public and the media withdrew.

The Committee proceeded to take *in camera* evidence.

Persons present other than the Committee: Mr Simon Johnston, A/Director; Mr John Young, Principal Council Officer; Ms Christine Nguyen, Committee Secretariat and Hansard Reporters.

Resolved on the motion of Mr Veitch: That the hearing resume in public.

The public and the media were readmitted.

The evidence concluded and the witness withdrew.

The following witnesses were sworn and examined:

- Dr Marion Healy, Director, National Industrial Chemicals Notification and Assessment Scheme (NICNAS)
- Dr Matthew Gredley, A/g Reform Team Leader, NICNAS

Dr Healy tendered a hard copy of a slide presentation depicting the role of NICNAS within the overall scheme for assessment and management of industrial chemicals, and package of public documents relating to the activities of NICNAS.

The evidence concluded and witnesses withdrew.

The following witness was sworn and examined:

- Ms Suzanne Smith, Research Programme Leader, Nuclear Solutions, Institute of Materials Engineering, Australian Nuclear Science and Technology Organisation (ANSTO)

The evidence concluded and the witness withdrew.

The public hearing concluded at 4:45pm. The public and the media withdrew.

Resolved on the motion of Ms Pavey: That the Committee accept and publish, according to section 4 of the Parliamentary Papers (Supplementary Provisions) Act 1975 and Standing Order 223(1) the documents tendered during the public hearing by the following:

- Mr David Vaile, Cyberspace and Law Reform, University of New South Wales.
- Ms Elaine Attwood, Consumers' Federation of Australia.

- Dr Howard Morris, Office of the ASCC.

Resolved on the motion of Ms Robertson: That the Committee accept the following documents tendered during the public hearing by Dr Howard Morris and that the documents be kept confidential:

- Draft terms of reference - OHS Nanotechnology Reference Group
- Draft terms of reference - OHS Nanotechnology Measurement Reference Group.

4. Adjournment

The Committee adjourned at 4.45pm until 23 June 2008.

Simon Johnston
Clerk to the Committee

Minutes No. 21

Monday 4 August 2008
Jubilee Room, Parliament House, at 1:00pm

1. Members present
Mr Catanzariti *(after item 3)* (*Chair)*
Mrs Pavey *(Deputy Chair)*
Mr Mason-Cox
Revd Nile
Ms Robertson
Mr Veitch

In accordance with Standing Order 211(2), in the absence of the Chair, the Deputy Chair took the Chair for the purposes of the meeting.

2. Previous Minutes
Resolved, on the motion of Mr Veitch: That draft Minutes No 20 be confirmed.

3. Correspondence
The Committee noted the following items of correspondence:

Sent:

- 24 June 2008 – Letter from Chair to Senator the Hon Kim Carr, Minister for Innovation, Industry, Science and Research requesting the attendance of representatives from the Australian Office of Nanotechnology to appear as witnesses before the Committee at the public hearing on 4 August 2008.

Received:

- 12 June 2008 – Email from Dr Simon Apte, Theme Leader, Centre for Environmental Contaminants Research, CSIRO Land and Water to Committee Secretariat enclosing the answer to the question taken on notice at the public hearing on 10 June 2008.
- 17 June 2008 – Email from Mr Jonathan Chamarette, Australian Office of Nanotechnology to Committee Secretariat enclosing answers to written questions relating to the activities of the Therapeutic Goods Administration.
- 25 June 2008 – Letter from Dr Lisa Szabo, Chief Scientist, NSW Food Authority to Committee Secretariat to Committee Secretariat enclosing the answer to the question taken on notice at the public hearing on 6 June 2008.
- 27 June 2008 – Letter from the Hon Verity Firth MP, Minister for Science and Medical Research to Chair enclosing answers to questions taken on notice at the public hearing on 6 June 2008.
- 27 June 2008 – Letter from Dr Suzanne Smith, Research Programme Leader, Institute of Materials Engineering, ANSTO to Chair enclosing copy of opening remarks made and answers to question taken on notice at the public hearing on 10 June 2008.
- 29 June 2008 – Letter from Dr Jamie Nicholls, Regulatory Strategy Project Officer, Australian Pesticides and Veterinary Medicines Authority to Committee Secretariat enclosing answers to questions taken on notice at the public hearing on 10 June 2008.
- 4 July 2008 – Letter from Dr Howard Morris, Nanotechnology OHS Program Manager, Department of Education, Employment & Workplace Relations to Committee Secretariat enclosing answers to questions taken on notice at the public hearing on 10 June 2008.
- 10 July 2008 – Email from Dr George Collins, Chief of Research, ANSTO and Dr Miriam Goodwin, Senior Advisor, Research Management and Policy, ANSTO to Committee Secretariat enclosing answers to questions taken on notice at the public hearing on 28 April 2008.
- 13 July 2008 – Email from Dr Maxine McCall, Nanosafety Theme Leader, Niche Manufacturing Flagship, CSIRO to Committee Secretariat enclosing answers to questions taken on notice at the public hearing on 1 May 2008.

- 17 July 2008 – Letter from Mr Craig Pennifold, Head, Innovation Division, Department of Innovation, Industry, Science and Research to Chair indicating that he and Dr Craig Cormick, Manager, Public Awareness Section would be appearing as witnesses at the public hearing on 4 August 2008.
- 28 July 2008 – Letter from the Hon Verity Firth MP, Minister for Science and Medical Research to Chair regarding the establishment of a NSW Chief Scientist and Scientific Engineer position.

Resolved, on the motion of Mr Veitch: That, according to section 4 of the *Parliamentary Papers (Supplementary Provisions) Act 1975* and Standing Order 223(1), the Committee authorise the publication of the answers to questions taken on notice, correspondence and additional information provided by the following:

- Dr Simon Apte
- Mr Jonathan Charmarette
- Dr Lisa Szabo
- Hon Verity Firth MP, Minister for Science and Medical Research
- Dr Suzanne Smith
- Dr Jamie Nicholls
- Dr Howard Morris
- Dr George Collins and Dr Miriam Goodwin
- Dr Maxine McCall.

4. Inquiry into Nanotechnology in NSW – Public hearing

Resolved, on the motion of Mr Veitch: That the Committee request witnesses to return answers to questions taken on notice at the public hearing of 4 August 2008 by Monday 25 August 2008.

Witnesses and the public were admitted.

The Chair made an opening statement regarding procedural matters.

The following witnesses were sworn and examined:

- Mr Craig Pennifold, Head, Innovation Division, Department of Innovation, Industry, Science and Research
- Dr Craig Cormick, Manager, Public Awareness, Australian Office of Nanotechnology, Department of Innovation, Industry, Science and Research.

Mr Pennifold made an opening statement.

Mr Cormick gave a presentation on Australian Community Attitudes Held About Nanotechnology – Trends 2005 to 2008.

Mr Catanzariti joined the meeting and assumed the Chair.

Examination of the witnesses continued.

Mr Cormick tendered a copy of his powerpoint presentation on Australian Community Attitudes Held About Nanotechnology.

The evidence concluded and the witnesses withdrew.

The public hearing concluded at 2:35pm. The public withdrew.

Resolved, on the motion of Ms Robertson: That the Committee accept and publish, according to section 4 of the *Parliamentary Papers (Supplementary Provisions) Act 1975* and Standing Order 223(1) the copy of the powerpoint presentation tendered by Mr Cormick.

Resolved, on the motion of Revd Nile: That the Committee meet on Monday 20 October for the purposes of considering the Chair's draft report on Nanotechnology in NSW.

5. ###

6. Adjournment

The Committee adjourned at 2:50pm until 10:00am, 20 October 2008.

Simon Johnston
Clerk to the Committee

Draft Minutes No. 22

Monday 20 October 2008
Room 1102, Parliament House, at 10.05am

1. Members present
Mr Catanzariti (*Chair)*
Mrs Pavey *(Deputy Chair)*
Mr Mason-Cox
Revd Nile
Ms Robertson
Mr Veitch

2. Previous minutes
Resolved, on the motion of Ms Robertson: That draft Minutes No 21 be confirmed.

3. Correspondence
The Committee noted the following items of correspondence:

Received

- 1 September 2008 – Letter from Ms Wendy Evans, Electorate Assistant, on behalf of the Hon Graeme Sturges MP, Minister for Infrastructure, Government of Tasmania, advising that the Committee's correspondence concerning the Inquiry into the New South Wales planning framework will be brought to the Minister's attention.
- 8 September 2008 - Letter from Mayor of Shoalhaven, Clr Greg Watson, advising that the Shoalhaven Council is considering making a submission to the Inquiry into the NSW planning framework.
- 8 September 2008 - Letter from Mr Michael Pahlow, General Manager, Local Government and Northern Australia, on behalf of the Hon Anthony Albanese MP, Minister for Infrastructure, Transport, Regional Development and Local Government, Australian Government, acknowledging the Committee's invitation to contribute to the Inquiry into the NSW planning framework.
- 10 September 2008 – Letter from Sophie Adlaf, Officer Manager, on behalf of the Hon Patrick Conlon MP, Minister for Transport, Infrastructure and Energy, Government of South Australia, advising that the terms of reference for the Inquiry into the New South Wales planning framework fall within the portfolio responsibility of the Minister for Urban Development and Planning, the Hon Paul Holloway MLC, and have been referred to that Minister for consideration.
- 12 September 2008 – Email from Mr Stephen Higham, Manager, Strategic Policy Unit, WorkCover NSW to Secretariat enclosing answers to additional written questions relating to the Inquiry into Nanotechnology in New South Wales.
- 6 October 2008 – Letter from Lord Mayor of Sydney advising that the Council of the City of Sydney will be making a submission to the Inquiry into the NSW planning framework.

Sent

- 25 August 2008, 28 August 2008 and 8 October 2008 - Letters inviting submissions to the Inquiry into the NSW planning framework (536 in total – *list of recipients attached*)
- 25 August 2008 – Letter from Chair to Hon Justin Madden MLC, Minister for Planning, Government of Victoria, requesting information on Victoria's planning framework.
- 25 August 2008 – Letter from Chair to Hon Allanah MacTiernan MLA, Minister for Planning and Infrastructure, Government of Western Australia, requesting information on Western Australia's planning framework.
- 25 August 2008 – Letter from Chair to Hon Paul Lucas, Minister for Planning and Infrastructure, Queensland Government, requesting information on Queensland's planning framework.
- 25 August 2008 – Letter from Chair to Hon Patrick Conlon MP, Minister for Infrastructure, Government of South Australia, requesting information on South Australia's planning framework.
- 25 August 2008 – Letter from Chair to Hon Graeme Sturges MP, Minister for Infrastructure, Government of Tasmania, requesting information on Tasmania's planning framework.

- 25 August 2008 – Letter from Chair to the Hon Andrew Barr MP, Minister for Planning, Government of the Australian Capital Territory, requesting information on the Australian Capital Territory's planning framework.
- 25 August 2008 – Letter from Chair to the Hon Delia Lawrie MLA, Minister for Planning and Lands, Government of the Northern Territory, requesting information on the Northern Territory's planning framework.
- 25 August 2008 – Letter from Chair to the Hon Anthony Albanese MP, Minister for Infrastructure, Transport, Regional Development and Local Government, Government of Australia, requesting information on Australia's planning framework.
- 25 August 2008 – Letter from Chair to the Rt Hon Hazel Blears MP, Secretary of State for Communities and Local Government, Government of the United Kingdom, requesting information on the UK's planning framework.
- 25 August 2008 – Letter from Chair to the Hon Lawrence Cannon, Minister of Transport, Infrastructure and Communities, Government of Canada, requesting information on Canada's planning framework.
- 25 August 2008 – Letter from Chair to the Hon Shane Jones, Minister for Building and Construction, Government of New Zealand**,** requesting information on New Zealand's planning framework.

Resolved, on the motion of Revd Nile: That, according to section 4 of the *Parliamentary Papers (Supplementary Provisions) Act 1975* and Standing Order 223(1), the Committee authorise the publication of the answers to questions taken on notice, correspondence and additional information provided by Mr Stephen Higham, Manager, Strategic Policy Unit, WorkCover NSW.

4. Inquiry into the NSW Planning Framework

Resolved, on the motion of Ms Robertson: That the Committee hold a meeting in the first sitting week in November, on a date and at a time to be confirmed by the Secretariat in consultation with Members' offices, to consider the publication of a briefing note on the NSW planning framework prepared by the Parliamentary Library Research Service and the Secretariat.

5. Inquiry into Nanotechnology in NSW

Resolved, on the motion of Revd Nile: That, having received the author's permission, the following paragraphs, referring to previously unpublished evidence, be published as part of the Committee's Report on Nanotechnology in New South Wales:

"On 10 June 2008 the Committee heard evidence from Professor Michael Roberts from the University of Queensland. Professor Roberts had recently conducted research into the penetration of nanoparticles in sunscreen into the skin.

While Professor Roberts' research has not yet been cleared for publication, in general terms the research found that skin penetration by zinc oxide nanoparticles can occur in specific circumstances. Professor Roberts emphasised that the research does not indicate there is any hazard or toxicity associated with this – the research concentrated on the question of penetration. Rather, the findings challenged/refuted the current view that penetration to the viable epidermis did not occur."

The Chair submitted his draft report titled *Nanotechnology in New South Wales*, which, having been previously circulated, was taken as being read.

Chapter One read.

Resolved, on the motion of Ms Robertson: That Chapter One be adopted.

Chapter Two read.

Resolved, on the motion of Mr Veitch: That Chapter Two be adopted.

Chapter Three read.

Resolved, on the motion of Revd Nile: That paragraph 3.30 be amended by omitting the words ", even if it was of a mind to do so" from the end of the second sentence.

Resolved, on the motion of Ms Robertson: That the following part of paragraph 3.30 be inserted into the Executive Summary, after the first paragraph under the sub-heading 'Review of the current regulatory framework', and after the words 'Evidence to the inquiry showed': "there is limited scope for an individual State to implement an effective, comprehensive State-specific regulatory framework for nanomaterials. The more sensible and important approach for New South Wales is to ensure that it effectively contributes to, and influences, the national regulatory review".

Resolved, on the motion of Revd Nile: That the following recommendation be inserted after paragraph 3.164: "That the NSW Government recommend that nano-versions of existing chemicals are assessed as new chemicals during the review of the national regulatory frameworks." and adopted.

Resolved, on the motion of Mrs Pavey: That draft recommendation 1 be adopted.

Resolved, on the motion of Mr Mason-Cox: That draft recommendation 2 be deleted and replaced by the following:

That WorkCover NSW work with those companies, or premises of which it is aware, that manufacture or use engineered nanomaterials of 300 nanometres or less in size in one or more dimensions, to promote workplace safety in the use of nanotechnology.

That WorkCover NSW advertise its intention to undertake this endeavour and call for companies manufacturing or using engineered nanomaterials of 300 nanometres or less in size to contact it to participate in this workplace safety endeavour.

Resolved, on the motion of Mr Mason-Cox: That draft recommendation 2, as amended, be adopted.

Resolved, on the motion of Mr Mason-Cox: That, in order to reflect the amendment made to recommendation 2, paragraph 3.263 be amended by deleting all words after 'appropriate media' and inserting: "its intention to work with nanotechnology companies as it becomes aware of them. WorkCover should call for companies to contact them to arrange for WorkCover to visit them and provide assistance." and deleting paragraph 3.264.

Resolved, on the motion of Revd Nile: That draft recommendation 3 be amended to read: "That the NSW Government work in cooperation with federal agencies on the development of a national mandatory labelling scheme for engineered nanomaterials used in the workplace, and that in the absence of a national scheme, NSW should proceed with investigating the development of its own mandatory labelling scheme."

Resolved, on the motion of Revd Nile: That draft recommendation 3, as amended, be adopted.

Resolved, on the motion of Revd Nile: That, in order to reflect the amendment made to draft recommendation 2, the final sentence of paragraph 3.282 be deleted and the following new paragraph be inserted: "The Committee is of the view that a mandatory labelling scheme would be most effective at the national level. However, in the absence of a national scheme, NSW should proceed with investigating the development of its own mandatory labelling scheme for engineered nanomaterials used in the workplace."

Resolved, on the motion of Ms Robertson: That draft recommendation 4 be adopted.

Resolved, on the motion of Mr Veitch: That draft recommendation 5 be amended by omitting the words "in providing input to the review of the national regulatory framework" from the beginning of the sentence and inserting the words "during the review of the national regulatory framework" at the end of the sentence.

Resolved, on the motion of Ms Robertson: That draft recommendation 5, as amended, be adopted.

Resolved, on the motion of Mr Veitch: That in order to reflect the amendment to draft recommendation 5, paragraph 3.312 be amended to read: "The Committee recommends that, during the review of the national regulatory frameworks, the NSW Government recommend that ingredient labelling requirements for sunscreens and cosmetics include the identification of nanoscale materials."

Resolved, on the motion of Revd Nile: that paragraph 3.320 be amended by omitting the words "conduct inspections of" and inserting instead "assist".

Resolved, on the motion of Revd Nile: That paragraph 3.322 be amended by omitting the words "it is not aware of any such scheme being proposed" from the second sentence and inserting instead: "The Committee was not advised of the progress toward the implementation of a national mandatory reporting scheme." and adding the following sentence: "Until such time as the national scheme is implemented, NSW should examine the feasibility of, and requirements for, implementing its own interim mandatory reporting scheme."

Resolved, on the motion of Revd Nile: That paragraph 3.23 be deleted.

Resolved, on the motion of Revd Nile: That draft recommendation 6 be amended to read: "That the NSW Government work in cooperation with federal agencies on the development of a national mandatory reporting scheme for companies who use, manufacture, transport or dispose of nanomaterials, and that in the absence of a national scheme, NSW should proceed with investigating the development of its own interim mandatory reporting scheme."

Resolved, on the motion of Revd Nile: That draft recommendation 6, as amended, be adopted.

Resolved, on the motion of Mr Veitch: That Chapter Three, as amended, be adopted.

Chapter Four read.

Resolved, on the motion of Mr Veitch: That the following new recommendation be inserted immediately after paragraph 4.23: "That the New South Wales Government actively seek, through the use of leverage funding, the establishment of additional metrology infrastructure within the State to build on the current metrology strength and to provide additional benefit to industry, research and development.", and be adopted.

Resolved, on the motion of Ms Robertson: That draft recommendation 7 be adopted.

Resolved, on the motion of Ms Robertson: That draft recommendation 8 be adopted.

Resolved, on the motion of Revd Nile: That draft recommendation 9 be adopted.

Resolved, on the motion of Ms Robertson: That draft recommendation 10 be adopted.

Resolved, on the motion of Ms Robertson: That Chapter Four, as amended, be adopted.

Chapter Five read.

Resolved, on the motion of Revd Nile: That draft recommendation 11 be amended by amended by omitting the words "machine searchable" and inserting instead: "user-friendly, accessible".

Resolved, on the motion of Revd Nile: That draft recommendation 11, as amended, be adopted.

Resolved, on the motion of Mr Mason-Cox: That draft recommendation 12 be amended by omitting the words "and publish a statement on nanotechnology, referring, as a minimum" and inserting instead "publish and endorse a comprehensive statement on nanotechnology, referring, among other matters,".

Resolved, on the motion of Mr Mason-Cox: That draft recommendation 12, as amended, be adopted.

Resolved, on the motion of Mr Mason-Cox: That, in order to reflect the amendment to draft recommendation 12, paragraph 5.69 be amended by inserting the word "comprehensive" immediately before the word "statement" and by omitting the words "If nothing else" and inserting instead "Among other things".

Resolved, on the motion of Mrs Pavey: That draft recommendation 13 be amended by omitting all the words after the word "agency" and inserting "to act as a coordination point for all other NSW agencies dealing with issues relating to nanotechnology, provide a central point for whole of government information on or enquiries relating to nanotechnology, and proactively engage with industry in the promotion of nanotechnology."

Resolved, on the motion of Mrs Pavey: That draft recommendation 13, as amended, be adopted.

Resolved, on the motion of Mr Mason-Cox: That, in order to reflect the amendment to draft recommendation 13, paragraph 5.101 be amended by inserting the following words at the end of the paragraph: "it should also actively promote nanotechnology opportunities to industry."

Resolved, on the motion of Mr Mason Cox: That paragraph 5.103 be amended to read: "In setting up this body the NSW Government should have reference to the Victorian approach in establishing NanoVic. The success of the Victorian approach to commercialisation of nanotechnology through NanoVic has been evident throughout this Inquiry.", and that the paragraph be relocated to appear immediately prior to draft Recommendation 13.

Resolved, on the motion of Mr Veitch: That draft recommendation 14 be adopted.

Resolved, on the motion of Ms Robertson: That draft recommendation 15 be adopted.

Resolved, on the motion of Mr Veitch: That Chapter Five, as amended, be adopted.

Chapter Six read.

Resolved, on the motion of Revd Nile: That the following new paragraph under a heading of 'Committee comment' be inserted immediately after paragraph 6.42: " The Committee notes the concerns about the potential social,

economic, ethical and democratic implications of nanotechnology and notes that this will require analysis and consideration by governments in the future."

Resolved, on the motion of Mr Mason-Cox: That draft recommendation 16 be amended by omitting the words "through the relevant government agency, should" and inserting instead ", or the new NSW Nanotechnology Unit as recommended by the Committee,".

Resolved, on the motion of Mr Mason-Cox: That draft recommendation 16, as amended, be adopted.

Resolved, on the motion of Mr Mason-Cox: That Chapter Six, as amended, be adopted.

Resolved, on the motion of Revd Nile: That the Executive Summary be amended to reflect the amendments made to the body of the report.

Resolved, on the motion of Revd Nile: That the Executive Summary, as amended, be adopted.

Resolved, on the motion of Ms Robertson: That the report, as amended, be the report of the Committee and presented to the House in accordance with Standing Order 226(1).

Resolved, on the motion of Revd Nile: That the Committee express its appreciation to the secretariat staff, particularly, Mr John Young and Mr Simon Johnston, for their dedicated work during this inquiry.

6. Adjournment

The Committee adjourned at 11:50am until the first sitting week in November, on a date and at a time to be confirmed by the Secretariat in consultation with Members.

Rachel Callinan
Clerk to the Committee