

## INQUIRY INTO NANOTECHNOLOGY IN NEW SOUTH WALES

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Dear Sir/Madam

Thank you for the letter dated 18 December 2007 inviting the Australian Office of Nanotechnology (AON) to make a submission to the New South Legislative Council's Standing Committee on State Development inquiry into nanotechnology. I am pleased to enclose the submission prepared by the AON which contains input from across the Australian Government. I understand the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Australian Nuclear Science and Technology Organisation (ANSTO) are providing separate submissions to the Inquiry.

The Australian Government supports nanotechnology through existing research, innovation and industry policies that promote the development of enabling technologies and through initiatives implemented under the National Nanotechnology Strategy (NNS):

- to address the health, safety and environmental impacts of nanotechnology on regulations and standards;
- to undertake a public awareness and engagement program to provide balanced advice on nanotechnology;
- to establish a nano particle metrology capability at the National Measurement Institute; and
- to facilitate a whole of government approach to nanotechnology through establishing the Australian Office of Nanotechnology.

The NNS commenced in July 2007 and is currently funded to 30 June 2009. It is being assessed as part of the Australian Government's Review of Australia's National Innovation System that is to report by 31 July 2008. The NIS review is looking at the issues of frontier science and enabling technologies to determine how these can be integrated into the national innovation system. The review will help us to assess whether the current approach to a NNS is the best way to achieve the Government's objectives in this area.

If you require further information in relation to the submission please direct your enquiry to the Australian Office of Nanotechnology at [nanotechnology@innovation.gov.au](mailto:nanotechnology@innovation.gov.au) or 02 6213 6000.

Yours sincerely

Craig Pennifold  
Head  
Innovation Division

2 April 2008



**Australian Government**

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**Department of Innovation  
Industry, Science and Research**

## **AUSTRALIAN OFFICE OF NANOTECHNOLOGY**

### **SUBMISSION TO THE NEW SOUTH WALES GOVERNMENT INQUIRY INTO NANOTECHNOLOGY**

The purpose of this submission is to provide the New South Wales Legislative Council's Standing Committee on State Development with factual background information relevant to their inquiry into Nanotechnology in New South Wales.

Appendix 1 contains a list of documents relevant to nanotechnology which the Committee may wish to review in the context of their inquiry. Documents contained in Appendix 1 are referred to under each term of reference.

The Australian Office of Nanotechnology is responsible for the implementation of the National Nanotechnology Strategy (NNS). The NNS aims to establish the environment that allows Australia to capture benefits of nanotechnology while addressing the issues impacting on successful and responsible development of nanotechnology. Health, safety and environmental concerns associated with nanotechnology are being addressed as part of the NNS.

Appendix 2 contains the National Measurement Institute's submission to the Inquiry.

## **A. Current and future applications of nanotechnology for NSW industry and community**

Nanotechnology is a set of enabling technologies that has the potential to fundamentally alter the way people live, to grow new industries and to transform manufacturing, healthcare, electronics, agribusiness, energy and communications. This was highlighted in the June 2006 *Options for a National Nanotechnology Strategy* taskforce report.

In 2005 global research and development investments in nanotechnology were approximately US\$9.6 billion (OECD). Forecasts indicate that by 2015 the global value of products incorporating nanotechnology is estimated to be between US\$1 trillion and US\$2.6 trillion (OECD; National Science Foundation, 2001; Lux Research 2006).

Nanotechnology can play a role in addressing some of Australia's key economic and social challenges. Nanotechnology can address problems and provide benefits to a number of industry sectors including manufacturing, mining, agricultural, health, energy, environmental, electronics, information and communication sectors. Due to the applicability of nanotechnology to numerous industry sectors across the economy, nanotechnology is often referred to as an enabling or platform technology.

### **Australian Government support for nanotechnology**

The Australian Government supports the development of nanotechnology through existing research, innovation and industry policies that promote the development of enabling technologies. Complementing these initiatives and recognising the importance of nanotechnology the Australian Government is implementing a National Nanotechnology Strategy (NNS) which addresses the issues impacting on successful and responsible development of nanotechnology. Additional information on the NNS is provided under term of reference E.

The Australian Government consulted with all states and territories, including NSW, on the development of and implementation of the NNS.

The Australian Government has actively promoted Australia's nanotechnology capability through the Australian Nanotechnology Capability Report and the support of international delegations. The Australian Government supported delegations to attend the NSTI Nanotech USA Conferences and Tradeshows from 2004 to 2007 and nano tech Japan Tradeshows in 2007 and 2008. The NSW Government, companies and research organisations were invited to participate in these events. NSW companies and research organisations had good representation at all NSTI Nanotech Conferences and Tradeshows from 2004 to 2007. Two NSW companies joined the nano tech Japan delegation in 2007. No NSW companies attended in 2008.

The table below summarises some of the key areas of Australian Government support for nanotechnology. Where possible the support relevant to New South Wales has been identified. The table below is not intended to be exhaustive due to the broad application of nanotechnology across a variety of industry sectors and the difficulty associated with disaggregating educational support and research expenditure across universities. In addition, the Australian Research Council (ARC), National Health and Medical Research Council (NHMRC) and National Collaborative Research Infrastructure Strategy (NCRIS) projects contain elements that are not solely related to nanotechnology. Taking into account these limitations and the information provided in the table, the AON estimates that Australian Government expenditure on nanotechnology is in the order of \$180 million per annum. This is likely to underestimate the total expenditure.

<b>Australian Government support program or Agency</b>	<b>Nanotechnology related project</b>	<b>NSW nanotechnology related projects</b>
<b>NCRIS – Fabrication project</b>	Total project value \$137 million over 5 years. Australian Government support \$41 million. CSIRO support \$15 million	This facility includes nodes at Macquarie University, University of Newcastle, University of New South Wales, University of Sydney and University of Wollongong. The NSW Government has provided \$5 million in support to this NCRIS project.
<b>NCRIS – Characterisation project</b>	Total project value \$238 million over 5 years. Australian Government support \$48 million. ANSTO support \$4 million	This facility includes nodes at University of New South Wales, University of Sydney and University of Western Sydney. The NSW Government has provided \$5.5 million in support to this NCRIS project.
<b>AusIndustry – various grant programs</b>	Between 1997/98 and 2005/06 \$67.5 million has been provided to nanotechnology related projects. \$6.7 Million in 2006/07.	Since 1997/98 \$28.7 million has been provide to nanotechnology companies based in NSW.
<b>Australian Research Council (ARC)</b>	Between 1997 and 2006 \$315 million has been provided to nanotechnology related projects. The 2006 expenditure on nanotechnology projects is estimated at \$67 million.	
<b>National Nanotechnology Strategy (NNS)</b>	Funding of \$9.5 million in 2007/08 and 2008/09. Allocated to: policy coordination, reviewing existing regulatory frameworks, enhancing metrology capacity, and public awareness.	
<b>National Health and Medical Research Council (NHMRC)</b>	23 nanotechnology related projects worth \$7.6 million (2000-2010)	One project based in NSW worth \$0.2 million (2000-2010). NSW may also benefit from research based in other states.
<b>CSIRO</b>	Estimated 2006 expenditure of \$70 million and CSIRO Niche Manufacturing flagship of \$36 million over 4 years. Please refer to CSIRO submission for additional information.	
<b>ANSTO</b>	Please refer to ANSTO submission for additional information.	

## Additional information

The following documents provide additional information on the current and future applications of nanotechnology.

- *Nanotechnology -Australian Capability Report* (May 2007), Department of Innovation, Industry, Science and Research.  
This capability report is the 3<sup>rd</sup> edition and lists nanotechnology companies and research centres in Australia. It is divided into sectors and indicates the breadth of nanotechnology development in Australia. The report was used by Invest Australia's international offices to promote Australia's nanotechnology and attract inward investment.
- *Emerging Industries occasional paper 16 - Smaller, Cleaner, Cheaper, Faster, Smarter -Nanotechnology Applications and Opportunities for Australian Industry* (June 2002) prepared by Ernst & Young for the Department of Innovation, Industry, Science and Research.  
This 2002 report was written to raise awareness in the wider business and investor community about:

  - what nanotechnology is;
  - what it is not;
  - which Australian companies are already engaged in developing or using nanotechnology; and
  - how other Australian companies could benefit by applying these technologies.
- *Nanotechnology: National Business Survey 1* (2005) prepared by Dandolo Partners for the Department of Innovation, Industry, Science and Research and Nanotechnology Victoria.
- *Nanotechnology business survey wave 2* (2006) prepared by Dandolo Partners for the Department of Innovation, Industry, Science and Research and Nanotechnology Victoria.  
An industry survey was conducted to gauge the level of awareness and understanding of nanotechnology issues among targeted firms with a potential interest in nanotechnology. This 2006 Nanotechnology business survey report presents the detailed outcomes of 134 interviews with appropriate representatives of a variety of companies identified as having a potential interest in the area and who personally are aware of nanotechnology.
- *Nanotechnology: National Business Interviews* (July 2005), Report by Dandolo Partners for Nanotechnology Victoria.  
This report contains findings from a component of that research base - in-depth interviews with 15 representatives from the business community. Businesses interviewed ranged from small businesses to multinational companies, industry associations and local government.

Details of how to obtain copies of these documents are provided in Appendix 1.

## **B. The health, safety and environmental risks and benefits of nanotechnology**

Health, safety and environmental (HSE) issues in nanotechnology were closely examined by the National Nanotechnology Strategy Taskforce report of June 2006. The *Options for a Nanotechnology Strategy* taskforce report made three key recommendations to the Government to address HSE issues. These included:

- a Health, Safety and Environment forum composed of policy makers, regulators and funding agencies be established to coordinate the management of and research into HSE issues.
- that the appropriateness of HSE regulatory frameworks be assessed in light of evidence based risks posed by nanotechnology; and
- that specific funds be made available to support HSE research in Australia and to support Australian involvement in international HSE studies.
- See <http://www.innovation.gov.au/Section/Innovation/Documents/NNSFeb08.pdf>

### **HSE and the National Nanotechnology Strategy**

HSE is a key component of the National Nanotechnology Strategy (NNS). The key HSE activities of the NNS are explained below.

#### **Analysis of regulatory frameworks**

An analysis of existing regulatory frameworks to ensure they appropriately address the impact of nanotechnology is a key priority of the NNS. Funding has been provided to the relevant agencies to undertake this work. Further details of the analysis of existing regulatory frameworks relevant to nanotechnology are provided under term of reference C.

#### **Nanotechnology HSE Working Group**

Under the NNS a HSE Working Group was established consisting of policy, regulatory and research funding agencies across the Australian Government. Membership of the HSE Working Group is at Appendix 3. The Working Group coordinates the assessment of existing regulations with all relevant agencies, including non government bodies such as Standards Australia. Where appropriate it liaises with research bodies on areas of potential scientific and policy research. The HSE Working Group works closely with the Public Awareness and Engagement Program of the NNS on the provision of balanced and factual information.

#### **State and Territory regulation regimes**

The NNS recognises that HSE issues associated with nanotechnology will also likely impact State and Territory regulatory frameworks. In this context there are well established mechanisms for interaction between the Australian Government and States/Territories on HSE issues. Existing mechanisms will be used to consult the State and Territories on HSE issues. Some examples include occupational health and safety through the Australian Safety and Compensation Council, and Ministerial Councils related to the environment, transport and health.

### International Engagement

A key HSE activity of the NNS is the coordination by the HSE Working Group of international engagement activities. This enables Australia to leverage off technical and policy developments in other countries and to influence the development of international regulatory guidelines and standards. A number of Australian Government agencies have active links to international projects and overseas regulatory and research bodies. Current examples include:

- National Industrial Chemicals Notification and Assessment Scheme (NICNAS) is an active member on the Organisation of Economic, Co-operation and Development's Working Party on Manufactured Nanomaterials. It leads the development of an OECD database on HSE research, and is coordinating Australian interest in an OECD project on the testing of a representative set of nanomaterials – see [http://www.oecd.org/department/0,3355,en\\_2649\\_37015404\\_1\\_1\\_1\\_1\\_1,00.html](http://www.oecd.org/department/0,3355,en_2649_37015404_1_1_1_1_1,00.html);
- Food Standards Australia and New Zealand (FSANZ) participates in food related nanotechnology events organised by the World Health Organisation/Food and Agriculture Organization of the United Nations; and
- The National Measurement Institute (NMI) and the Department of Employment, Education and Workplace Relations (DEEWR) are actively involved with the International Standards Organisation Nanotechnology Committee (TC 229), which is working to develop standards in the field of nanotechnologies.

### Additional information

The following documents provide additional information on HSE risks and benefits of nanotechnology.

- *Options for a National Nanotechnology Strategy* (June 2006), National Nanotechnology Strategy Taskforce.  
The report examined options for a national nanotechnology strategy. Pages 25-33 provide a summary of HSE issues.
- *The Senate - Community Affairs References Committee - Workplace exposure to toxic dust* (May 2006, Senate Community Affairs References Committee Secretariat, chapter 7).  
The Senate report contains a chapter on nanotechnology. It discusses implications of the significant gaps in knowledge about how nanoparticles act, their toxicity and how to measure and monitor nanoparticle exposure. It makes several recommendations. The formal Australian Government response to the report is being finalised.
- *Environmental, Social, Legal and Ethical Aspects of The Development of Nanotechnologies in Australia* (April 2006, prepared by the National Academies Forum for The Department of Innovation, Industry, Science and Research).  
A report on the environmental, social, legal and ethical aspects of nanotechnology conducted by the National Academies Forum for the National Nanotechnology Strategy Taskforce



- *Nanotechnology Enabling technologies for Australian innovative industries* (March 2005), prepared by an independent working group for the Prime Minister's Science, Engineering and Innovation Council ((PMSEIC). PMSEIC received a presentation and report from a Working Group on the industrial opportunities that nanotechnology provides Australian industry and the impediments to its uptake. Pages 14, 17, 20, 29 and 35-36 deal with HSE issues.
- ASCC nanotechnology OHS webpages  
<http://www.ascc.gov.au/ascc/HealthSafety/EmergingIssues/Nanotechnology/NanotechnologyandOccupationalHealthandSafety.htm>
- A Review of the Potential Occupational Health and Safety Implications of Nanotechnology  
<http://www.ascc.gov.au/NR/rdonlyres/AC17BA49-8BA1-43B8-BC08-219DE53781E6/0/ASCCReviewOHSImplicationsNanotechnology2006.pdf>
- DEEWR Nanotechnology OHS R&D Program  
<http://www.ascc.gov.au/ascc/HealthSafety/EmergingIssues/Nanotechnology/NanotechnologyOHSResearchandDevelopmentProgramtoSupporttheNationalNanotechnologyStrategy.htm>
- Nanotechnology -Australian Capability Report (May 2007) Department of Innovation, Industry, Science and Research.  
This capability report is the 3<sup>rd</sup> edition and lists nanotechnology companies and research centres in Australia. It is divided into sectors and indicates the breadth of nanotechnology development in Australia. The report was used by Invest Australia's international offices to promote Australia's nanotechnology and attract inward investment.
- NanoSafe Australia's position paper *Current OHS best practices for the Australian Nanotechnology Industry*  
<http://mams.rmit.edu.au/72nuxiavskpg.pdf>
- NICNAS Information Sheet 2006 – Nanomaterials  
Reviews NICNAS activities on the regulation of nanomaterials, including international engagement  
[http://www.nicnas.gov.au/Publications/Information\\_Sheets/General\\_Information\\_Sheets/NIS\\_Nanomaterials\\_PDF.pdf](http://www.nicnas.gov.au/Publications/Information_Sheets/General_Information_Sheets/NIS_Nanomaterials_PDF.pdf)

Details of how to obtain copies of these documents are provided in Appendix 1.

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

### Analysis of existing regulatory frameworks

As part of the National Nanotechnology Strategy, the Government is actively reviewing the existing regulatory frameworks to ensure they appropriately address the impacts of nanotechnology. Funding of \$3.3 million over 2 years has been provided to the relevant agencies to undertake this work. Funding has been provided to the Department of Health and Ageing (DHA), Department of Education, Employment and Workplace Relations (DEEWR); and the Department of Environment, Water, Heritage and the Arts (DEWHA).

Regulators are continuing to review their regulatory frameworks to ensure they appropriately address the health, safety and environment (HSE) impacts of nanotechnology.

After undertaking these reviews the relevant agencies will decide, if necessary, whether regulations and administrative practices need to be addressed to ensure HSE issues associated with nanotechnology are adequately addressed. The intended outcomes of these work programs include:

- improved knowledge about environmental risks and benefits arising from nanotechnology materials and products;
- improved approaches to nanotechnology risk assessment;
- reviewed and adjusted Australian regulatory framework for nanotechnology; and
- support provided for businesses to allow safe application of nanoparticles and nanotechnology in the workplace.

### Additional information

The following documents provide additional information on the regulatory frameworks in operation for the management of nanomaterials.

- DEEWR Nanotechnology OHS R&D Program  
<http://www.ascc.gov.au/ascc/HealthSafety/EmergingIssues/Nanotechnology/NanotechnologyOHSResearchandDevelopmentProgramtoSupporttheNationalNanotechnologyStrategy.htm>
- *DEEWR Nanotechnology OHS Research and Development Program and Nanotechnology OHS Regulation*. Presentation at the International Conference on Nanoscience and Nanotechnology, ICONN 2008, (February 2008).
- NICNAS Information Sheet 2006 – Nanomaterials  
Reviews NICNAS activities on the regulation of nanomaterials, including international engagement  
[http://www.nicnas.gov.au/Publications/Information\\_Sheets/General\\_Information\\_Sheets/NIS\\_Nanomaterials\\_PDF.pdf](http://www.nicnas.gov.au/Publications/Information_Sheets/General_Information_Sheets/NIS_Nanomaterials_PDF.pdf)

- In 2006 NICNAS undertook a voluntary call for information on the industrial uptake of nanomaterials used as industrial chemicals in Australia. The results of this work are in the NICNAS information Sheet - Summary of call for information on the use of Nanomaterials ([http://www.nicnas.gov.au/Publications/Information\\_Sheets/General\\_Information\\_Sheets/NIS\\_Call\\_for\\_info\\_Nanomaterials.pdf](http://www.nicnas.gov.au/Publications/Information_Sheets/General_Information_Sheets/NIS_Call_for_info_Nanomaterials.pdf))
- NICNAS has established a Nanotechnology Advisory Group to:
  - (a) consider the implications of the potential impact of nanomaterials on public health, workers and the environment;
  - (b) consider the implications of nanomaterials for the regulation of industrial chemicals in Australia; and
  - (c) advise the Director on measures that NICNAS can take to address these implications.

Two papers which provide an overview of policy and technical challenges relating to the risk assessment and management of nanomaterials are:

- Safe Handling of Nanotechnology, Andrew Maynard et al, Nature vol 444, 267-269, 2006;
- A prudent approach to nanotechnology environmental, health, and safety risks, Matthew Nordan and Michael Holman, Industrial Biotechnology, Fall 2005, 146-149.

Details of how to obtain copies of these documents are provided in Appendix 1.

## **D. The adequacy of existing education and skills development opportunities related to nanotechnology**

Education and skills were addressed as part of the report on the Options for a National Nanotechnology Strategy (NNS). The taskforce concluded that education and skills development is a critical factor in the take-up of nanotechnology. The taskforce also concluded that several initiatives are currently underway that impact on the skills and educational base of the community in relation to nanotechnology. It was therefore recommended by the taskforce that the strategy be cognisant of these reviews and integrate their outcomes into the strategy as appropriate.

### **National Nanotechnology Strategy**

Education and skills development is not a specific priority under the NNS. Under the public awareness element of the NNS support is provided to the development of educational curriculum material and teacher training, and the development of educational resources including:

- worksheets for use in classroom curriculum;
- published booklets containing DVDs of the profiles on nanotechnology experts, together with worksheets and other information for use in schools;
- distribution of promotional resources to schools which could link in with an outreach program by Questacon or CSIRO. The material could be web-based or in hardcopy format;
- development of online forums for school children to interact with nanotechnology experts; and
- podcasting of seminars with nanotechnology experts.

### **Educational activity in NSW**

The Australian Office of Nanotechnology is aware of several activities aimed at addressing the education and skills development opportunities related to nanotechnology. There are several tertiary courses developed specifically relating to nanotechnology including at the University of Western Sydney and University of Wollongong. Victoria has developed nanotechnology educational material particularly through the St Helena Innovation in Nanotechnology Education (SHINE) program.

### **Additional information**

The following documents provide additional information on the adequacy of existing education and skills development relevant to nanotechnology.

- *Options for a National Nanotechnology Strategy* (June 2006), National Nanotechnology Strategy Taskforce.  
The report examined options for a national nanotechnology strategy. Pages 39 and 40 provide a summary of nanotechnology related education and skills issues.

- SHINE Program (2007), NanoVic  
The St Helena Innovation in Nanotechnology Education (SHINE) program includes a number of initiatives such as nanotechnology curricula, a web-enabled e-learning package, and the NanoVic Nanotechnology Laboratory.
- ASCC nanotechnology OHS webpages  
<http://www.ascc.gov.au/ascc/HealthSafety/EmergingIssues/Nanotechnology/NanotechnologyandOccupationalHealthandSafety.htm>
- DEEWR Nanotechnology OHS R&D Program  
<http://www.ascc.gov.au/ascc/HealthSafety/EmergingIssues/Nanotechnology/NanotechnologyOHSResearchandDevelopmentProgramtoSupporttheNationalNanotechnologyStrategy.htm>

Details of how to obtain copies of these documents are provided in Appendix 1.

## **E. The adequacy of the National Nanotechnology Strategy in the NSW context**

### **National Nanotechnology Strategy**

The National Nanotechnology Strategy (NNS) aims to establish the environment that allows Australia to capture benefits of nanotechnology while addressing the issues impacting on successful and responsible development of nanotechnology.

The NNS includes specific initiatives to:

- address the health safety and environmental (HSE) impacts of nanotechnology on regulations and standards;
- undertake a public awareness and engagement program to provide balanced advice on nanotechnology;
- establish a nano particle metrology capability at the National Measurement Institute (for more information see Appendix 2); and
- facilitate a whole of government approach to nanotechnology through establishing the Australian Office of Nanotechnology (AON).

The initiatives under the NNS aim to:

- encourage the uptake and use of nanotechnology based materials, products, and services by industry and to achieve increased competitiveness based on understanding of the potential and risks in nanotechnology;
- review existing regulatory frameworks to ensure they appropriately address the impacts of nanotechnology on public health, safety and the environment;
- establish a world-class nano metrology capability that supports regulation and industry use of nanotechnology; and
- build public confidence in nanotechnology products and services based on balanced and factual information about nanotechnology.

The NNS commenced on July 2007 and will cease in June 2009 and is currently being reviewed as part of the Australian Government's wide-ranging Review of Australia's National Innovation System. The review is specifically looking at the issues of frontier science and enabling technologies - such as nanotechnology - to determine how these technologies can be integrated into the national innovation system as a whole. The review will help to understand whether the NNS, as established under the previous Government is the best way to achieve the Government's objectives in this area. The Review of the National Innovation System will report to Government by 31 July 2008.

### **Interaction between the Australian Government and States/Territories**

The Department of Innovation, Industry, Science and Research consulted with all states and territories including NSW on the development of the NNS. A key priority of the AON is to coordinate nanotechnology policies with Federal agencies, State and Territory governments and external stakeholders. As part of this engagement process the AON has established a Nanotechnology State and Territory Committee (NSTC), which is made up of representatives from all States and Territories.

The purpose of the NSTC is to facilitate a regular dialogue and collaboration between the Australian Government and the States/Territories on innovation and industry development policy areas related to nanotechnology. The NSTC met on 25 February 2008 and agreed on the value of ongoing collaboration and the benefits of the Australian Government working with State and Territories in the implementation of the NNS. Areas of collaboration identified by the NSTC include:

- Information sharing;
- International promotion;
- Cooperation on industry development and awareness;
- Cooperation in public awareness and community engagement programs; and
- Maintenance of network of contacts to ensure ongoing dialogue.

#### **Additional information**

The following documents provide additional information on the NNS.

- *National Nanotechnology Strategy* (2008), AON, Department of Innovation, Industry, Science and Research  
This document outlines the initiative and objectives of the NNS.
- Nanotechnology OHS Reference Group Terms of Reference
- Nanotechnology OHS Measurement Reference Group Terms of Reference

Details of how to obtain copies of these documents are provided in Appendix 1.

## **F. The level of community understanding of nanotechnology and options to improve public awareness of nanotechnology issues**

A key part of the National Nanotechnology Strategy (NNS) is to undertake a public awareness and engagement program to provide balanced advice on nanotechnology. The aim of the program is to raise awareness and develop knowledge of the opportunities and potential of nanotechnology, and to encourage an informed debate based on balanced and factual information. The public awareness and engagement program has been provided \$1.3 million over 2 years under the NNS to undertake these activities.

The public awareness and engagement program consists of a combination of public forums, website, promotional material, conference events and road shows supported by targeted publicity in metropolitan, regional and rural media.

The objectives of the public awareness and engagement program are to:

- increase awareness and understanding among the general public about nanotechnology and its potentials;
- enable an informed public debate through improved awareness and understanding of social and ethical issues regarding the use of nanotechnology;
- understand the publics' knowledge, concerns and aspirations for nanotechnology;
- provide the Australian public with timely updates on the Government's response to emerging nanotechnology issues; and
- create public awareness and understanding of Australian regulatory bodies and practices concerning nanotechnology and related health and safety issues.

### **Community attitudes surveys**

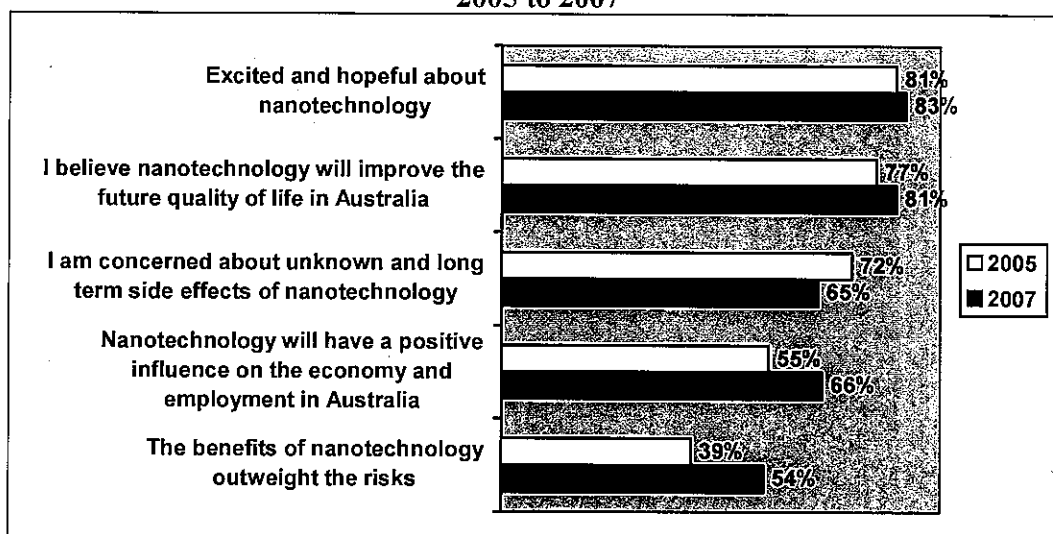
The Department of Innovation, Industry, Science and Research (DIISR) funded public awareness studies undertaken in 2005 and 2007. The studies surveyed the community on their understanding of nanotechnology related issues.

Some key findings of 2007 study *Australian Community Attitudes Held About Nanotechnology – Trends 2005 to 2007* are:

- Despite lacking detailed knowledge of exactly what nanotechnology is, 83% of respondents were "hopeful" or "excited" by the potential implications of nanotechnology. (See graph below);
- Medical health and environmental applications of nanotechnology were most strongly supported, ahead of security, food and consumer products;
- Australians are becoming more positive about nanotechnology. In 2005, 39% of respondents believed that the benefits of nanotechnology outweigh the risks; in 2007 this rose to 54%;
- 60% of people expressed no concerns about nanotechnology. 11% of people expressed concern about unethical applications of nanotechnology;



### TRENDS IN PUBLIC OPINION TOWARDS NANOTECHNOLOGY: 2005 to 2007



#### Media coverage of nanotechnology

A survey of the Australian media coverage of nanotechnology over the period 1 July 2005 to 30 April 2006 was commissioned by the Taskforce for the Prime Minister's Science, Engineering and Innovation Council (PMSEIC). The survey showed that:

- 666 print and 266 broadcast articles were published. The coverage equates to approximately three articles per day in Australian national, metropolitan, suburban, trade, regional and electronic media;
- The leading message in most of these articles was that "Australia has good opportunities in nanotechnology";
- Health was the most covered nanotechnology issue in the media accounting for 28% of coverage, and was predominantly favourable, focussing on the benefits of nanotechnology, which related mainly to the diagnostic 'point-of-care' benefits for health delivery;
- Environmental and safety issues, while attracting only around 3% coverage each, had mostly unfavourable coverage, focussing on possible risks, toxicology, water, and nano lifecycle impacts.

#### Community forums

The public awareness and engagement program acknowledges the importance of community consultation. Public and community forums have been held in Darwin, Brisbane and Melbourne. A community forum is scheduled for Sydney on 3 April at the State Library.

#### Website development

An Australian Office of Nanotechnology (AON) website homepage is being developed. The website will outline the Australian Government's role in progressing nanotechnology in Australia and provide factual, balanced information on nanotechnology issues for public use.

### **Science teacher educational activities**

A series of forums with science teachers are being held throughout 2007-08 to encourage uptake of teaching nanotechnology in secondary schools. In September 2007 a forum was held with ACT science teachers at CSIRO Discovery Centre with assistance from CSIRO.

In December 2007, science teachers from all states and territories met in Melbourne at St Helena Secondary College to discuss the St Helena Innovation in Nanotechnology Education (SHINE) project and the development of teaching nano-science in secondary schools. This forum was arranged by AON with assistance from the Australian Science Teachers Association (ASTA).

DIISR is currently contracting the development of a national nanotechnology school's resource for all secondary schools. It is planned that in 2009 that teacher training days will be conducted to train science teachers in using the nanotechnology secondary schools resource.

### **Fact Sheets**

A range of fact sheets on nano-related issues are being developed for the public and it is planned that the documents will be available in hardcopy and online on the AON website.

### **Professional and Industry events**

In 2007 the AON consulted with relevant Australian nanotechnology bodies and industry associations inviting them to collaborate on awareness and uptake of nanotechnology by the Australian industry. The AON has supported the following projects and conferences:

Support for the Australian Nanotechnology Business Forum (ANBF) leading the Australian delegation to nano tech Japan 2008;

- Major sponsorship of the International Conference on Nanoscience and Nanotechnology (ICONN 2008) held in Melbourne 25-29 February 2008.
- Industry workshop CAP-XX Commercialising Nanotechnology Opportunities and Challenges - 6 Dec 2007, Sydney – ANBF;
- Responsible Nano Code workshop – Sep 2007, Melbourne– Australian Nanotechnology Business Forum;
- Industry workshop Nanotechnology Medical Advances – 27 Nov 2007, Melbourne - Australian Nanotechnology Alliance (ANA);
- National Nano Road Show proposal - ANA;
- Sustainable Nano manufacturing workshop – 23-24 Feb 2008, Melbourne - Australian Research Council Nanotechnology Network (ARCNN);
- SA Nano Awareness Road Show – May 2008 - Materials Australia;

### Additional information

The following documents provide additional information on the level of community understanding and options to improve public awareness of nanotechnology.

- *Australian Community Attitudes Held About Nanotechnology – Trends 2005 To 2007* (June 2007), Market Attitude Research Services (MARS).  
In March and April 2007, Sydney based company MARS undertook a telephone survey of 1,000 randomly selected households from metropolitan, regional, and rural Australia to gauge community understanding of nanotechnology
- *Nanotechnology: A National Survey of Consumers Detailed Report* (July 2005), Dandolo Partners.  
This survey investigates consumer awareness of and attitudes towards nanotechnology. Detailed findings were compiled from a quantitative consumer phone survey with more than 1,000 people (conducted from 4 to 19 June 2005).
- ASCC nanotechnology OHS webpages  
<http://www.ascc.gov.au/ascc/HealthSafety/EmergingIssues/Nanotechnology/NanotechnologyandOccupationalHealthandSafety.htm>
- National Industrial Chemicals Notification and Assessment Scheme (NICNAS) Community Engagement Forum (CEF) was established to assist NICNAS address aspects of the community's right to know in relation to the control and use of industrial chemicals. It meets twice yearly. Information on the CEF is at [http://www.nicnas.gov.au/Community/CEF\\_Brochure\\_PDF.pdf](http://www.nicnas.gov.au/Community/CEF_Brochure_PDF.pdf).
- In addition, the Community Engagement Charter outlines the principles and protocols to be followed by NICNAS in the conduct of its work delivering services to its stakeholders and clients and ensuring that it maximises opportunities for effective engagement about industrial chemicals.  
[http://www.nicnas.gov.au/Community/CEF\\_Charter\\_PDF.pdf](http://www.nicnas.gov.au/Community/CEF_Charter_PDF.pdf)

Details of how to obtain copies of these documents are provided in Appendix 1.

## Appendix 1 – Nanotechnology related documents

Attach No.	Activity/Report	Description	Supporting documentation for NIS Review Panel	Terms of Reference
1	<i>National Nanotechnology Strategy (2008), Australian Office of Nanotechnology, Department of Innovation, Industry, Science and Research</i>	This document outlines the initiative and objectives of the National Nanotechnology Strategy.	<a href="http://www.innovation.gov.au/Section/Innovation/Documents/NNSFeb08.pdf">http://www.innovation.gov.au/Section/Innovation/Documents/NNSFeb08.pdf</a>	A,B,C,D,E,F
2	<i>Nanotechnology -Australian Capability Report (May 2007, Invest Australia)</i>	This capability report is the 3 <sup>rd</sup> edition and lists nanotechnology companies and research centres in Australia. It is divided into sectors and indicates the breadth of nanotechnology development in Australia.	<a href="http://www.investaustralia.gov.au/NR/rdonlyres/38A6751A-1CEA-4502-84CE-BF80AFA9D9E9/0/NANOREPORT07Final.pdf">http://www.investaustralia.gov.au/NR/rdonlyres/38A6751A-1CEA-4502-84CE-BF80AFA9D9E9/0/NANOREPORT07Final.pdf</a>	A
3	<i>Options for a National Nanotechnology Strategy (June 2006, National Nanotechnology Strategy Taskforce)</i>	The report examined options for a national nanotechnology strategy. It provides a comprehensive summary of nanotechnology issues relevant to Australia.	<a href="http://www.innovation.gov.au/Documents/taskforcereport20070215100254.pdf">http://www.innovation.gov.au/Documents/taskforcereport20070215100254.pdf</a>	B,C,D,F
4	<i>The Senate - Community Affairs References Committee - Workplace exposure to toxic dust (May 2006, Senate Community Affairs References Committee Secretariat)</i>	The Senate report contains a chapter on nanotechnology. It discusses implications of the significant gaps in knowledge about how nanoparticles act, their toxicity and how to measure and monitor nanoparticle exposure. It makes several recommendations.	<a href="http://www.aph.gov.au/SENATE/COMMITTEE/CLACCTTE/toxic_dust/report/report.pdf">http://www.aph.gov.au/SENATE/COMMITTEE/CLACCTTE/toxic_dust/report/report.pdf</a>	B, F
5	<i>Environmental, Social, Legal and Ethical Aspects of The Development of Nanotechnologies in Australia (April 2006, prepared by the National Academies Forum for The Department of Industry, Tourism and Resources)</i>	A report on the environmental, social, legal and ethical aspects of nanotechnology conducted by the National Academies Forum for the National Nanotechnology Strategy Taskforce.	<a href="http://www.innovation.gov.au/Documents/NanoreportNANAF27June20060829114520.pdf">http://www.innovation.gov.au/Documents/NanoreportNANAF27June20060829114520.pdf</a>	B, C
6	<i>Summary of recent surveys on nanotechnology undertaken to support the work of the National Nanotechnology Strategy Taskforce (March 2006)</i>	Since October 2004, the Department of Industry, Tourism and Resources has supported, commissioned or undertaken a number of nanotechnology surveys relating to science capacity, industry uptake and community awareness. The surveys are described below and summarised in this report.	<a href="http://www.innovation.gov.au/Documents/Summary_of_Surveys_030620060824155521.pdf">http://www.innovation.gov.au/Documents/Summary_of_Surveys_030620060824155521.pdf</a>	F

7	<p><i>Report on Survey of Nanoscience Groups Issues Affecting Nanoscience in Australia</i></p>	<p>To assess the issues that are of significance to the Australian nanoscience community leading to the development of a national nanotechnology strategy, some 70 nanoscience research groups were surveyed during October-November 2005.</p>	<p>For a copy please contact the Australian Office of Nanotechnology  <a href="mailto:nanotechnology@innovation.gov.au">nanotechnology@innovation.gov.au</a> or 6213 600.</p>	
8	<p><i>Nanotechnology Enabling technologies for Australian innovative industries</i> (March 2005, prepared by an independent working group for the Prime Minister's Science, Engineering and Innovation Council (PMSEIC))</p>	<p>The Prime Minister's Science, Engineering and Innovation Council (PMSEIC) received a presentation and report from a Working Group on the industrial opportunities that nanotechnology provides Australian industry and the impediments to its uptake.</p>	<p><a href="http://www.dest.gov.au/NR/rdonlyres/1E1B501A-727A-4153-85EF-134B2DAF0925/4112/nanotechnology_pmseic110305.pdf">http://www.dest.gov.au/NR/rdonlyres/1E1B501A-727A-4153-85EF-134B2DAF0925/4112/nanotechnology_pmseic110305.pdf</a></p>	B, C, D, F
9	<p><i>Emerging Industries occasional paper 16 - Smaller, Cleaner, Cheaper, Faster, Smarter - Nanotechnology Applications and Opportunities for Australian Industry</i> (June 2002, prepared by Ernst &amp; Young for the Department of Industry, Tourism &amp; Resources)</p>	<p>This 2002 report was written to raise awareness in the wider business and investor community about:</p> <ul style="list-style-type: none"> <li>• what nanotechnology is;</li> <li>• what it is not;</li> <li>• which Australian companies are already engaged in developing or using nanotechnology; and</li> <li>• how other Australian companies could benefit by applying these technologies.</li> </ul>	<p><a href="http://www.innovation.gov.au/Documents/OccasionalpaperSmallerCleanerCheaperFasterSmarter20051111120225.pdf">http://www.innovation.gov.au/Documents/OccasionalpaperSmallerCleanerCheaperFasterSmarter20051111120225.pdf</a></p>	A
10	<p><i>Australian Community Attitudes Held About Nanotechnology - Trends 2005 To 2007</i> (June 2007, Market Attitude Research Services (MARS))</p>	<p>In March and April 2007, Sydney based company MARS undertook a telephone survey of 1,000 randomly selected households from metropolitan, regional, and rural Australia, to gauge community understanding of nanotechnology.</p>	<p><a href="http://www.innovation.gov.au/Documents/MARSreport20070801094555.pdf">http://www.innovation.gov.au/Documents/MARSreport20070801094555.pdf</a></p>	F
11	<p><i>Nanotechnology: A National Survey of Consumers Detailed Report</i> (July 2005, Dandolo Partners)</p>	<p>Investigates consumer awareness of and attitudes towards nanotechnology. Detailed findings were compiled from a quantitative consumer phone survey with more than 1,000 people (conducted from 4 to 19 June 2005). It should be noted that data has been weighted by ABS statistics to ensure that the results are representative of the Australian population.</p>	<p><a href="http://www.nanovic.com.au/downloads/Nanotechnology_Consumer_Research_Final_July_2005.pdf">http://www.nanovic.com.au/downloads/Nanotechnology_Consumer_Research_Final_July_2005.pdf</a></p>	F

12	<p><i>Nanotechnology business survey -November 2006</i>, A report by Dandolo Partners for Department of Industry, Tourism and Resources, Australian Government, and Nanotechnology Victoria Ltd</p>	<p>An industry survey was carried out in 2006 to gauge the level of awareness and understanding of nanotechnology issues among targeted firms with a potential interest in nanotechnology. This 2006 Nanotechnology business survey report presents the detailed outcomes of 134 interviews with appropriate representatives of a variety of companies identified as having a potential interest in the area and who personally are aware of nanotechnology.</p>	<p><a href="http://www.innovation.gov.au/Documents/NanotechnologyWave2Aug200720070810101822.pdf">http://www.innovation.gov.au/Documents/NanotechnologyWave2Aug200720070810101822.pdf</a></p>	A
13	<p><i>Nanotechnology: National Business Interviews</i> (July 2005, Report by Dandolo Partners for Nanotechnology Victoria)</p>	<p>This report (11 July 2005) contains findings from a component of that research base - in-depth interviews with 15 representatives from the business community. Businesses interviewed ranged from small businesses to multinational companies, industry associations and local government.</p>	<p><a href="http://www.innovation.gov.au/Documents/FinalBusReportJuly20051021103038.pdf">http://www.innovation.gov.au/Documents/FinalBusReportJuly20051021103038.pdf</a></p>	A
14	<p><i>Shine Program (2007), NanoVic</i></p>	<p>The St Helena Innovation in Nanotechnology Education ( SHINE) program includes a number of initiatives such as nanotechnology curricula, a web-enabled e-learning package, and the NanoVic Nanotechnology Laboratory</p>	<p><a href="http://www.nanovic.com.au/index.php?a=education.resources%20for%20schools.shine&amp;p=361">http://www.nanovic.com.au/index.php?a=education.resources%20for%20schools.shine&amp;p=361</a></p>	D, F
15	<p><i>A review of the scientific literature on the safety of nanoparticulate titanium dioxide or zinc oxide in sunscreens</i></p>	<p>This document contains summaries and comments on studies related to the safety on nanoparticulate sunscreen formulations up until 2006.</p>	<p><a href="http://www.tga.gov.au/npmeds/sunscreen-zotd.pdf">http://www.tga.gov.au/npmeds/sunscreen-zotd.pdf</a></p>	B, C
16	<p>ASCC nanotechnology OHS webpages (March 2008, DEEWR)</p>	<p>The webpages cover:</p> <ul style="list-style-type: none"> <li>• DEEWR Nanotechnology OHS Research and Development Program</li> <li>• Nanotechnology Links</li> <li>• Nanotechnology Resource Library</li> </ul>	<p><a href="http://www.ascc.gov.au/ascc/HealthSafety/EmergingIssues/Nanotechnology/NanotechnologyandOccupationalHealthandSafety.htm">http://www.ascc.gov.au/ascc/HealthSafety/EmergingIssues/Nanotechnology/NanotechnologyandOccupationalHealthandSafety.htm</a></p>	B, D, F
17	<p><i>A Review of the Potential Occupational Health and Safety Implications of Nanotechnology</i> (July 2006, DEEWR)</p>	<p>A review commissioned by the Office of the ASCC in 2006 of the potential OHS implications of nanotechnology. The review report, which includes a detailed examination of the potential toxicology of nanoparticles, is derived from a detailed review and analysis of worldwide literature, and consultation with nanotechnology stakeholders.</p>	<p><a href="http://www.ascc.gov.au/NR/rdonlyres/AC17BA49-8BA1-43B8-BC08-219DE53781E6/0/ASCCReviewOHSImplicationsNanotechnology2006.pdf">http://www.ascc.gov.au/NR/rdonlyres/AC17BA49-8BA1-43B8-BC08-219DE53781E6/0/ASCCReviewOHSImplicationsNanotechnology2006.pdf</a></p>	B

18	<p><i>DEEWR Nanotechnology OHS R&amp;D Program</i> (March 2008, DEEWR)</p>	<p>The program has four focus areas:</p> <ul style="list-style-type: none"> <li>• OHS support for Australian nanotechnology businesses and research organisations</li> <li>• Research Coordination - covering Australian research projects and international collaborations</li> <li>• Evaluation and Development of Workplace Controls</li> <li>• Considering the OHS Regulatory Framework in relation to Nanotechnology – includes identifying the specific information and knowledge requirements to ensure the framework operates effectively</li> </ul>	<p><a href="http://www.asec.gov.au/asec/HealthSafety/EmergingIssues/Nanotechnology/NanotechnologyOHSResearchandDevelopmentProgramtoSupporttheNationalNanotechnologyStrategy.htm">http://www.asec.gov.au/asec/HealthSafety/EmergingIssues/Nanotechnology/NanotechnologyOHSResearchandDevelopmentProgramtoSupporttheNationalNanotechnologyStrategy.htm</a></p>	B, C, D
19	<p><i>Current OHS best practices for the Australian Nanotechnology Industry</i> (November 2007, NanoSafe Australia)</p>	<p>A Position Paper by the NanoSafe Australia Network.</p> <p>This document discusses the OHS best practices using the current, although limited, knowledge. Specifically, it focuses on the health effects of exposure to nanomaterials and methods to reduce exposure.</p>	<p><a href="http://mams.rmit.edu.au/72nuxiavskpg.pdf">http://mams.rmit.edu.au/72nuxiavskpg.pdf</a></p>	B
20	<p><i>Nanotechnology OHS Reference Group Terms of Reference</i> (February 2008, DEEWR)</p>	<p>The role of the Nanotechnology OHS Reference Group is to provide support for a coordinated national approach to the management of nanotechnology OHS.</p>	<p>For a copy please contact the Australian Office of Nanotechnology <a href="mailto:nanotechnology@innovatiou.n.gov.au">nanotechnology@innovatiou.n.gov.au</a> or 6213 600.</p>	E

21	<p><i>Nanotechnology OHS Measurement Reference Group Terms of Reference</i> (March 2008, DEEWR)</p>	<p>The Nanotechnology OHS Measurement Reference Group will help ensure the safe development and use of nanotechnology in Australian workplaces by</p> <ul style="list-style-type: none"> <li>• helping establish credible grounds for its regulation and control based on sound measurement procedures</li> <li>• facilitating the development of suitable metrics for assessing workplace (and public) exposures to engineered nanoparticles</li> <li>• coordinating programs of work by experts to develop validated, replicable techniques to assess engineered nanoparticle exposures</li> <li>• helping develop criteria for the regulation of engineered nanoparticles</li> <li>• promoting the science of measuring nanoparticles within OHS and business communities in Australia.</li> </ul> <p>Summary of presentation:</p> <ul style="list-style-type: none"> <li>• From a legislative perspective, engineered nanomaterials are a subset of workplace chemicals</li> <li>• There are a number of nanotechnology OHS regulatory issues associated with the use of engineered nanomaterials</li> <li>• DEEWR is working to address those issues through the Nanotechnology OHS R&amp;D Program</li> </ul> <p>This public brochure reviews NICNAS activities on the regulation of nanomaterials, including international engagement</p>	<p>For a copy please contact the Australian Office of Nanotechnology <a href="mailto:nanotechnology@innovation.gov.au">nanotechnology@innovation.gov.au</a> or 6213 600.</p>	E
22	<p><i>DEEWR Nanotechnology OHS Research and Development Program and Nanotechnology OHS Regulation.</i></p> <p>Presentation at the International Conference on Nanoscience and Nanotechnology, ICONN 2008, (February 2008).</p>	<p>Summary of presentation:</p> <ul style="list-style-type: none"> <li>• From a legislative perspective, engineered nanomaterials are a subset of workplace chemicals</li> <li>• There are a number of nanotechnology OHS regulatory issues associated with the use of engineered nanomaterials</li> <li>• DEEWR is working to address those issues through the Nanotechnology OHS R&amp;D Program</li> </ul> <p>This public brochure reviews NICNAS activities on the regulation of nanomaterials, including international engagement</p>	<p>For a copy please contact the Australian Office of Nanotechnology <a href="mailto:nanotechnology@innovation.gov.au">nanotechnology@innovation.gov.au</a> or 6213 600.</p>	C
23	<p>NICNAS Information Sheet 2006 – <i>Nanomaterials</i></p>	<p>This public brochure reviews NICNAS activities on the regulation of nanomaterials, including international engagement</p>	<p><a href="http://www.nicnas.gov.au/Publications/Information_Sheets/General_Information_Sheets/NIS_Nanomaterials_PDF.pdf">http://www.nicnas.gov.au/Publications/Information_Sheets/General_Information_Sheets/NIS_Nanomaterials_PDF.pdf</a></p>	B



24	NICNAS Information Sheet - <i>Summary of call for information on the use of Nanomaterials</i>	In 2006 NICNAS undertook a voluntary call for information on the industrial uptake of nanomaterials used as industrial chemicals in Australia. The results of this work are described in the information sheet.	<a href="http://www.nicnas.gov.au/Publications/Information_Sheets/General_Information_Sheets/NIS_Call_for_info_Nanomaterials.pdf">http://www.nicnas.gov.au/Publications/Information_Sheets/General_Information_Sheets/NIS_Call_for_info_Nanomaterials.pdf</a>	A, B, C
25	Safe Handling of Nanotechnology, Andrew Maynard et al, Nature vol 444, 267-269, 2006;	Proposes major steps that need to be completed before nanotech can be adequately managed – methods to evaluate toxicity, models for predicting HSE impacts, programs of HSE research		
26	A prudent approach to nanotechnology environmental, health, and safety risks, Matthew Nordan and Michael Holman, Industrial Biotechnology, Fall 2005, 146-149.	Describes potential hazard, exposure and therefore risk of various kinds of nanomaterials in their different applications		
27	<i>A review of the scientific literature on the safety of nanoparticulate titanium dioxide or zinc oxide in sunscreens</i>	This document contains summaries and comments on studies related to the safety on nanoparticulate sunscreen formulations up until 2006.	<a href="http://www.tga.gov.au/npmids/sunscreen-zotd.pdf">http://www.tga.gov.au/npmids/sunscreen-zotd.pdf</a>	B, C

## Appendix 2 – National Measurement Institute (NMI) submission to the NSW Government inquiry into nanotechnology

### *National Measurement Institute*

The National Measurement Institute (NMI) is responsible for Australia's national infrastructure in physical, chemical, biological and legal measurements. Under the *National Measurement Act 1960*, NMI is responsible for coordinating Australia's national measurement system, and for establishing, maintaining and realising Australia's units and standards of measurement, thereby allowing Australian industry to operate competitively in a global environment.

NMI delivers essential services to the Australian economy by providing the legal and technical framework for disseminating measurement standards; working with clients in industry and government to provide measurement expertise, calibration services, chemical and biological analyses and pattern approval testing; and supporting Australia's standards and conformance infrastructure.

NMI is Australia's representative under the international measurement treaties that establish the International Committee for Weights and Measures and the International Organization of Legal Metrology. In regional measurement forums, NMI also represents Australia at the Asia Pacific Metrology Programme and the Asia-Pacific Legal Metrology Forum. NMI's contributions in these activities are key factors in formally securing international mutual recognition of Australia's measurement standards which, in turn, underpins the international acceptance of testing and certification of Australian commodities and products.

In order to meet the measurement needs of government, the public, industry and scientific organisations, NMI undertakes cutting-edge research to anticipate the trends of new measurement technologies. NMI maintains a broad range of scientific and technical capabilities to fulfil its statutory responsibilities and to meet government and private sector requirements for traceability of measurements. With this expertise, NMI is well-placed to form strategic partnerships to solve measurement problems in industry and government.

### *Nanometrology*

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

NMI is establishing and coordinating a national nanometrology program covering physical measurement standards. NMI issued a technical paper on nanotechnology in 2006 (see [www.measurement.gov.au](http://www.measurement.gov.au) and follow links under 'Capabilities' and then

'Nanometrology'). NMI has received funding from the Australian Government under the National Nanotechnology Strategy (NNS) to establish a laboratory for nanoparticle studies, characterisation and measurement. The broad outcome will be increased confidence in nanoproduct quality and regulation, greater access to global markets, reduced technical barriers to trade and increased international competitiveness for Australian nanotechnology. Specific outcomes will include:

- an internationally recognised nanometrological infrastructure, with NMI providing traceable standards and measurement at the nanoscale for Australian industry, government and research organisations; and
- a world-class nanoparticle laboratory conducting high level research and development and providing calibration and characterisation services and technical advice and assistance to the Australian nanotechnology community.

The nanoparticle laboratory disseminates nanoparticle standards via a cost-recovery testing and calibration service. NMI staff will conduct proficiency testing, run training courses, publish standard operating procedures and participate in international comparisons.

NMI's development of physical standards and instruments for nanoscale measurements is being focussed initially on nanoparticle measurement. A recently acquired high-level dynamic light scattering instrument provides particle size measurement down to 1 nm. NMI offers a service for calibrating standard reference powders and nanoparticles from 6  $\mu\text{m}$  down to 1 nm at its Lindfield nanoparticle calibration laboratory.

Australia's primary length standards for nanoscale length measurements will be achieved with a metrological Atomic Force Microscope (AFM) to provide the reference measurement tool for nanoscale dimensional measurements. This has yet to be commissioned, but will be housed at NMI's Lindfield campus. The laboratory's principle objective by July 2009 will be the construction of the metrological AFM and significant progress towards the establishment of traceability to Australia's primary length standards for nanoscale dimensional measurements and hence to the International System of Units (SI). International recognition of these measurements will be achieved initially by participation in international comparisons and ultimately by peer assessment and accreditation. The advantage to Australia of this capability is that anyone wishing to determine dimensions of their nanoproduct will be able to compare it against a defined reference source, common across Australia and traceable to international definitions.

#### *NMI Progress and Activities under the NNS*

Since the commencement of the NNS in July 2007, NMI has actively been pursuing its plan to establish nanometrology in Australia. Highlights to date include:

- participation in three Asia-Pacific nanotechnology measurement comparisons involving nanopowders, nanoparticles and thin films. These activities bring the Australian nanotechnology measurement system into contact with those of Asia-Pacific metrology institutes;

- an Australian comparison of nanoparticles involving a number of Australian companies and research institutions. The results for this are still being collected and will be made generally available;
- a workshop on nanoparticle measurement last November with over 40 participants;
- a workshop on the role of measurement in nanotechnology held in March 2008 at NMI Lindfield, involving several internationally respected nanotechnologists;
- a dynamic light scattering instrument, used to measure the size distribution of nanoparticles suspended in solution, has been acquired. It is being used as the basis of a NMI calibration service for nanoparticles in Australia;
- the recruitment of two additional scientists, bringing the total to four. In addition, NMI has been active in promoting nanometrology and nanotechnology in general in Australia.

NMI has been appointed chair of the Standards Australia Technical Committee NT-001 on Nanotechnologies, representing Australia on the International Standards Organisation Technical committee TC229 Nanotechnologies. These committees are developing international standards on the terminology, measurement and health, safety and the environment aspects of nanotechnology;

*NMI's relevance to the Inquiry's Terms of Reference (ToRs)*

NMI provides the following comments in relation to the ToRs

- a) *current and future applications of nanotechnology for New South Wales industry and the New South Wales community*

Through the provision of its calibration and other services, NMI assists industry with current applications and will continue to do so, enabling them to better characterise and understand their nanotechnologies through the use of fit-for-purpose measurements, with benefits for further technical development, commercialisation and for meeting regulatory requirements for local and international trade and health, safety and environment (HSE) issues.

- b) *the health, safety and environmental risks and benefits of nanotechnology*

NMI's calibration and analysis services enable technology developers, industry and regulators to better understand and assess nanotechnology health, safety and environmental risks. Regulators can use NMI's measurement capabilities and technical advice when devising regulatory frameworks to help them set realistic tolerances and parameters, and allow for measurement uncertainties. NMI is a

member of the Australian Government's HSE committee. NMI will work with NSW Government regulatory bodies with regard to nanotechnology measurement issues.

Of relevance to regulators is work NMI is considering in collaboration with European Union and US researchers in relation to lifecycle tracking (behaviour and fate) of nanoparticles (proposed: gold, silver, titanium dioxide) in the environment and uptake mechanisms into biota. NMI is associated with similar Australian efforts.

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

NMI has organised two nanotechnology workshops that were attended by research, industry and government stakeholders. These occasions are very effective in disseminating information and establishing new networks in the nanotechnology community. NMI intends to develop standard operating protocols (SOPs) for nanotechnology measurement processes to help achieve standard methodologies and increase confidence in stakeholders' measurements.

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

Benefits from the National Nanotechnology Strategy's investment in nanometrology are directed to meeting national needs, however the location of NMI's services at its Lindfield campus provides for easier access for NSW firms. NMI's investment in staff and instrumentation in Lindfield will complement and be a significant addition to NSW's existing nanotechnology capabilities. NMI networks extensively with other research and higher education institutes, CSIRO and industry stakeholders including many located in the State.

NMI welcomes NSW Government participation in joint projects, which could include research and development, workshops, conferences, measurement comparisons, etc. Promoting the importance of measurement and traceability within the various State departments involved in nanotechnology would also be very useful.

## **Appendix 3 – HSE working group membership**

### **HSE Working Group Agencies**

#### **Department of Agriculture, Fisheries and Forestry (DAFF)**

Australian Pesticides and Veterinary Medicines Authority (APVMA)

Australian Quarantine and Inspection Service (AQIS)

#### **Department of Defence**

#### **Department of Education, Employment and Workplace Relations (DEEWR)**

Office of the Australian Safety and Compensation Council (ASCC)

#### **Department of the Environment, Water, Heritage and the Arts (DEWHA)**

#### **Department of Health and Aging (DHA)**

Food Standards Australia New Zealand (FSANZ)

National Health and Medical Research Council (NHMRC)

National Industrial Chemicals Notification and Assessment Scheme (NICNAS)

Office of Gene Technology Regulator (OGTR)

Therapeutic Goods Association (TGA)

#### **Department of Innovation, Industry, Science and Resources (DIISR)**

National Measurement Institute (NMI)

Australian Research Council

CSIRO Manufacturing and Materials Technology

Australian Competition and Consumer Commission (ACCC)

Australian Customs Service