

Nanotechnology – here and now

Proceedings from the conversations of the workshop

23 – 24 April 2009

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1. Introduction

This report summarises the outcomes of a workshop to discuss Nanotechnologies in a New Zealand context. The workshop was sponsored and hosted by the MacDiarmid Institute of Advanced Materials and Nanotechnology, the Ministry of Research, Science and Technology, the Ministry for the Environment, Toi te Taiao: the Bioethics Council, and the Royal Society of New Zealand.

Background

Nanotechnologies are a suite of rapidly developing technologies that seek to manipulate matter at the atomic scale in order to develop new materials and devices with novel properties. Current and projected applications cover a very broad range of fields – including health care, manufacturing, electronics, energy generation and storage, food production and processing and environmental management. Many reports, both local¹ and international^{2,3}, have previously discussed the scope and potentially revolutionary nature of nanotechnologies. Internationally, there are at least 800 nanoproducts on the market⁴, with revenues in 2007 of US\$150billion⁵. Projections for growth in nano-related markets suggest revenues in 2015 in the range US\$1-4 trillion⁵. There are significant opportunities for New Zealand researchers and firms to develop businesses and products focussed around nanoscience or nanotechnologies.

There are, at present, a very limited number of commercial nanotechnology developers in New Zealand, but there is extensive research activity and we are encountering nanotechnologies through a range of imported products, processes or services. Internationally, increasing attention is being paid to the potential for adverse impacts of nanotechnologies, how to encourage and support broad social discussions about nanotechnologies, and how to effectively assess risks associated with manufactured nanomaterials.

This Report

This report is intended to represent the outcomes of the workshop in a relatively “raw” form. While it has been edited to clarify the comments recorded by the participants, no attempt has been made to bring those comments together into a cohesive whole. While there was - perhaps surprisingly - quite general agreement on many of the issues and actions listed in the report, the report necessarily reflects the diverse views of the participants.

An evaluation of the workshop, based on a survey of the participants and 5 interviews, was prepared by Dr Bruce Small (AgResearch) – see Appendix 4. His full report is available at the workshop website:

<http://www.morst.govt.nz/current-work/roadmaps/nanotech/workshop-2009/>.

¹ “Nanoscience and nanotechnologies: A NZ Nanotechnology Roadmap” (2006); <http://www.morst.govt.nz/current-work/roadmaps/nanotech/>

² Royal Society and Royal Academy of Engineering: “Nanoscience and nanotechnologies: opportunities and uncertainties” (2004); <http://www.nanotec.org.uk/finalReport.htm>

³ Royal Commission on Environmental Pollution: “Novel Materials in the Environment: The case of nanotechnology” (2008), www.rcep.org.uk.

⁴ Woodrow Wilson Centre Project on Emerging Nanotechnologies. <http://www.nanotechproject.org/inventories/consumer/browse/products/>

⁵ Lux Research Inc.

Workshop Purpose and Process

There are many competing views on the possible benefits, opportunities, costs and risks associated with the development of this suite of new technologies. The purpose of the workshop was to:

- discuss current and future opportunities and challenges for New Zealand associated with nanotechnologies
- identify the key issues that require attention, and
- agree on ways to address these

The objective was not just to hear about nanotechnologies but to identify what New Zealand needs to do to properly address the opportunities and challenges that they bring.

The workshop programme can be viewed in Appendix 1. The workshop was anchored by a set of presentations from invited international speakers. The New Zealand context was explored with a round of presentations from a range of New Zealand perspectives. The second day of the workshop was a series of facilitated discussions.

The international speakers participated by videoconference:

- **Professor Richard Jones**, Professor of Physics at the University of Sheffield. He is currently Senior Strategic Advisor for Nanotechnology for the UK's Engineering and Physical Sciences Research Council, and is a well known commentator on nanotechnology. Richard provided an introductory overview to nanotechnologies and some of the issues associated with them.
- **Dr Chris Hartshorn**, Research Director at Lux Research. Lux Research provides strategic advice and on-going intelligence on emerging technologies for businesses. He spoke about the state of play of nanotechnologies from a business perspective.
- **Professor Ken Donaldson**, Scientific Director of the Edinburgh Lung and the Environment Group Initiative, Edinburgh University. He spoke about health and safety concerns associated with nanoparticles and research that is required to further investigate some of these concerns.
- **Professor Thomas Webler**, Department of Environmental Studies, Antioch University, New England and senior researcher at the Social and Environmental Research Institute in Greenfield, Massachusetts. He discussed new approaches to risk assessment.
- **Professor Dave Guston**, Arizona State University. He is Associate Director of the Consortium for Science, Policy & Outcomes at ASU and spoke about public participation and governing emerging technologies.
- **Professor Arie Rip**, University of Twente, the Netherlands. He is Professor of Philosophy of Science and Technology in the School of Management and Governance, and placed nanotechnology in a broader historical perspective of emerging technologies.

The international speakers' presentations are available at:

<http://www.morst.govt.nz/current-work/roadmaps/nanotech/workshop-2009/>

The New Zealand presenters covered a range of perspectives to Nanotechnologies the presenters and their focus were:

- **Prof Ashton Partridge – Nanotechnology Practitioner.** Ashton is Enterprise and Research Leader within the IFS MacDiarmid Centre at Massey University. He has a PhD in synthetic chemistry from La Trobe University (Melbourne, Australia).
- **Wendy McGuinness CA, BCom, MBA Sustainability.** Wendy McGuinness is the Chief Executive of Sustainable Future, an independent think tank specialising in research and policy analysis.
- **Dr Louis Tremblay - toxicology.** Louis is an environmental toxicologist with Landcare Research. His research interests are in the understanding of the mechanisms of toxicity of multiple stressors using bioassays based on different levels of biological organisation.
- **Gerry Te Papa Coates - Maori perspective.** Gerry Te Kapa Coates is a consulting professional engineer of Ngāi Tahu descent, and is currently the Managing Director of his own consultancy firm Wise Analysis Ltd. His expertise includes governance work, feasibility and policy work in the technical, energy and sustainability areas, strategic planning, ethical studies, forensic investigations, expert witness services, and writing on technical and policy issues.
- **Dr Joanna Govern - Learning from previous NZ experience.** Joanna is a Senior Lecturer in the School of Political Science and Communication, University of Canterbury. She is also Deputy Director and Social Science Leader, Centre for Integrated Research in Biosafety. Her research interests lie at the intersection of technoscience and democracy.
- **Regulation.** A team of representatives of various NZ government departments presented their perspectives on NZ's regulatory systems and government policy settings. The representatives were:

Kathryn Holdsworth (Senior Adviser, Hazardous Substances & New Organisms Team, Ministry for the Environment).

Peter Dawson (Principal Scientist, ERMA; on secondment to MfE).

Lynne Waterson (Applications Manager, Hazardous Substances, ERMA & NZ delegate to the OECD Working Party on Manufactured Nanomaterials).

Chad Tustin (Senior Policy Analyst, Policy Group, New Zealand Food Safety Authority).

John Reeve (Principal Advisor (Toxicology), Science Group, New Zealand Food Safety Authority).

Leigh Henderson (Section Manager (Product Safety Standards) Food Standards Australia New Zealand).

Colin du Plessis (Technical Leader, Department of Labour).

Martin Rushton (Ministry of Consumer Affairs).

Workshop methodology

The workshop was designed by Anne Pattillo in collaboration with representatives of the sponsoring organisation. The techniques used during the workshop included:

- Presentation
- Paired and small group conversation
- Sociometry
- World cafe
- Technology of Participation

The design of the workshop was configured to both maximise the use of speaker insights and opportunities for discussion, as well as the experience of participants drawn from diverse backgrounds. The first day was a full agenda of presentations, however the programme was interspersed with opportunities for people to meet and share expectations and reflections. These conversations were focussed on paired and small group conversations as it is clear that such dialogue is more effectively fostered in smaller groups. The paired and small group conversations allow for more exchange of personal information critical to building a stronger rapport. The other feature of the dialogue design in the initial phases was to focus participants on questions rather than the statement of solutions or positions. This design created more space for learning and building understanding, again critical to productive dialogue. Sociometry was used during the programme to assist with the process of building rapport through choosing people on the basis of commonality, judgment or interest. Technology of Participation techniques were used on day two to move the group through a series of conversations to synthesise issues and concerns, through to priorities for consideration, and then areas for action or development. The design frame for day two was the Focused Conversation technique. Small groups were again primarily used for conversation to increase the productivity and focus of the dialogue.

A short video giving a sense of the dynamics and success of the workshop is available at the workshop website:

<http://www.morst.govt.nz/current-work/roadmaps/nanotech/workshop-2009/>.

2. Workshop outcomes

The three major outputs from the workshop discussed in this report were:

- Identification of the key issues and opportunities in relation to nanotechnologies
- Preliminary agreement on the basis for moving forward in terms of nanotechnologies in New Zealand
- Identification of key areas for development and recommendations for initial actions that might be taken

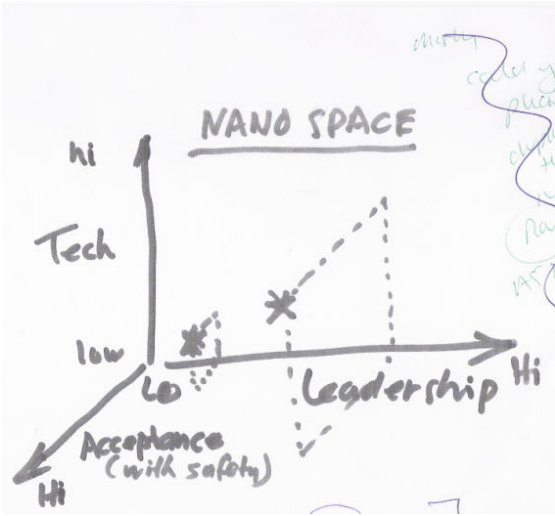
Key issues and opportunities to be explored

Participants were asked to identify the key issues and opportunities to explore in relation to nanotechnologies and sciences either from their own research experience or the presentations from day one. The key issues and questions raised are summarized below.

Issue summary	Key questions raised
What is nanotechnology?	<p>The answer to the fundamental question “what is nanotechnology” is still not generally agreed on.</p> <p>What are the boundaries of the science and is nanotechnology even a useful term?</p> <p>The understanding of the meaning of nanotechnology by the public will affect discussions and decision-making about the technology its uses, benefits and risks.</p>
How do we respond to or manage any risks associated with nanotechnology in the face of uncertainty as to benefits or risks?	<p>There is uncertainty in relation to both the benefits and risks associated with some nanotechnologies. How can decisions be made in the face of these uncertainties?</p> <p>In a New Zealand context the concerns included spiritual and cultural concerns in terms of the effects on whakapapa, taonga kai species, introducing Mauri into places it is not usually found, effects on Mana.</p>
Impact of international development on New Zealand as a “technology taker”.	<p>Are overseas standards applicable in New Zealand?</p> <p>Given its position as a technology taker should New Zealand simply follow overseas approaches?</p> <p>Does being a “technology taker” impact on the level of influence we can have via public consultation?</p>
Governance Approach	<p>What is the most appropriate governance approach?</p> <p>Can we use anticipatory governance approaches or adaptive</p>

	governance and management?
Are our regulatory regimes ready and appropriate to undertake the required risk assessment and monitoring?	<p>What is the readiness of New Zealand regulatory regimes to respond to developments in nanotechnologies?</p> <p>Is the level of readiness different with regard to locally internationally developed nanotechnology applications?</p>
Liability	<p>Who carries the liability for any risk of harm?</p> <p>Should government be expected to carry the risk?</p> <p>How do we balance “moral hazard”, social risk and commercial benefit?</p>
Funding	<p>What policy framework needs to be in place to guide funding decisions?</p> <p>What level of investment and research funding should be available?</p> <p>What level of social science funding is needed in order to contribute to science decision making and risk assessment activities?</p> <p>How can funding be structured to support collaboration across research disciplines?</p>
Institutional capacity to manage and use information from engagement	<p>Is there is an opportunity for NZ leadership in deliberative public participation, especially in relation to issues of indigenous participation.</p> <p>Does New Zealand have the capability to engage with diverse perspectives on issues like these?</p> <p>Are decision makers willing to take account of the information gathered through public engagement processes?</p>
Upstream engagement	<p>Upstream engagement is an opportunity for government, funders and researchers to engage the public and other stakeholders in decision making.</p> <p>What is the place of a New Zealand dialogue in informing national policy in an export dominated economy?</p> <p>How will we integrate and take into account different perspectives?</p>
Education	How do we prepare students for a world that may be dominated by nanotechnologies?

	How does the current education system respond to new sciences and technologies which require scientists and engineers with a range of skills from different traditional disciplines?
Scaling up	Is sufficient support available to take research results and scale them up for the market place?



The Nano Space, as viewed by some of the participants.

Key agreements on the current state of play in the New Zealand context

During the conversations there were a number of issues on which the participants were able to reach agreement:

- There is no single nanotechnology but rather a broad range of nanotechnologies and sciences. It is clear that there are a range of nanotechnologies with diverse benefit and risk profiles.
- For each nanotechnology there is a need to identify and analyse benefits, costs and risks.
- Given the fast moving and uncertain nature of the development of nanotechnologies, it is important to work out how best to communicate the level of uncertainty that exists.
- Optimally, research should include both physical and social perspectives.

Key areas for Action

An attempt was made to identify key thematic areas and then the participants worked in small groups to collate ideas and expand on required actions. The groups worked semi-independently and so there is necessarily some overlap between the key action areas, especially in the areas of governance, risk management and regulation. The overlap between the actions in different areas nicely demonstrates the inter-relationships between the issues.

Key Action Area: Definition	
Scope:	A definition of nanotechnology will underpin an understanding of risk/benefit priorities, risk management and investment decisions. Issue: Definitions are value-laden and reflect issues of who is privileged.
Actions:	<ol style="list-style-type: none"> 1. Develop a working definition of nanotechnology that characterizes the issues and is a basis of risk governance: <ul style="list-style-type: none"> • Need to be able to distinguish different types of nanotechnology with different risk / benefit profiles. • Need to account for natural, manmade, and manufactured nanomaterials. 2. Determine whether definition used by the Royal Society (essentially accepted internationally) is really the best one, and / or whether functionality or size provides a better definition. 3. Definition should be regularly revisited. 4. Develop a definition that embodies precaution and allows for uncertainty.
Priorities for first steps:	All.

Key Action Area: Benefits	
Scope:	How best to extend, expand, and maximise economic, social and health benefits for New Zealand using nanotechnologies.
Actions:	<ol style="list-style-type: none"> 5. Understand the commercial opportunities and especially niche market opportunities. 6. Identify and understand and focus on the best and most accessible niche markets.

	<p>7. Maximise cooperation within NZ.</p> <p>8. Take maximal advantage of linkages world wide.</p> <p>9. Make the most of New Zealand’s advantages: creativity, innovation, small size and speed of response.</p> <p>10. Maximise beneficial environmental impact, which may be much smaller \$ for \$ than existing industries.</p>
Priorities for first steps:	Unclear.

Key Action Area: Reporting and Traceability

Scope:	Identify appropriate agencies and framework for regulation in order to ensure protections are in place and to give confidence to the public, workers, funders and other countries on the rigor of the New Zealand approach.
Actions:	<p>11. Identify the responsible lead agency (possibly MoRST?).</p> <p>12. Update nano road map.⁶</p> <p>13. Maintain good contact internationally (OECD working party and others).</p> <p>14. Pro active engagement with industry to:</p> <ul style="list-style-type: none"> • Inform of obligations. • Gather intelligence of market developments. <p>15. Maintain active monitoring of potential future developments to gain foresight.</p> <p>16. Ensure appropriate reporting systems are in place to record presence of nanomaterials:</p> <ul style="list-style-type: none"> • Imported into NZ. • Made in NZ. • Used in NZ (See Workplace Health and Safety Section).

⁶ “Nanoscience and nanotechnologies: A NZ Nanotechnology Roadmap” (2006); <http://www.morst.govt.nz/current-work/roadmaps/nanotech/>

	<ul style="list-style-type: none"> • In each case need to identify those already present in NZ. <p>17. Develop a register of products containing nano materials:</p> <ul style="list-style-type: none"> • Publically accessible. • Consider categorizing into: consumer products, industrial inputs. <p>18. Develop analytical and detection capabilities to verify accuracy of register and detect non compliance and / or missing information, and secure funding for this.</p> <p>19. Ensure appropriate actions are taken to achieve compliance with controls.</p> <p>20. Ensure penalties for non compliance are commensurate risk.</p>
Priorities for first steps:	<ul style="list-style-type: none"> • Identify responsible agency . • Ensure reporting system and register are undertaken quickly.

Key Action Area: Regulation

Scope:	The existing framework for regulation is seen by some as piecemeal and ineffectual, while many regulators see it as adequate for the challenges presented by nanotechnology. The divergence between these two perspectives needs to be reduced so that all parties have confidence in the regulatory system.
Actions:	<p>21. Establish a lead agency:</p> <ul style="list-style-type: none"> • Existing (ERMA?) or new? <p>22. Find ways of imposing regulations that are commensurate with risk.</p> <p>23. Decide on how nano priorities fit with other priorities for regulators.</p> <p>24. Specific assessment of each application /type of technology.</p> <p>25. Clear identification of benefits versus risks.</p> <p>26. Provide a centralised source of information on upcoming</p>

	<p>regulations and products.</p> <p>27. Clearly identify who has responsibility for inter-agency coordination.</p> <p>28. Analyse the adequacy of the present regulatory framework as it pertains to nanotechnology , including issues of:</p> <ul style="list-style-type: none"> • Liability and redress. • Traceability and attribution. <p>29. Require producers / importers to notify regulators if products have nano-content.</p> <p>30. Analyse current status of regulatory framework in order to identify gaps.</p> <p>31. How do we work within the current regulatory framework to meet current and future needs?</p>
Priorities for first steps:	<p>Analyse current status of regulatory framework in order to identify gaps.</p> <p>Clearly identify who has responsibility for inter-agency coordination.</p>

Key Action Area: Building on existing strengths and expertise

Scope:	<p>New Zealand has some unique advantages and social and environmental conditions e.g. small population, good networks, Maori methods of engaging, which are successful and respected.</p> <p>How do we make best use of existing resources and knowledge?</p>
Actions:	<p>32. Identify lessons from earlier NZ science controversies.</p> <p>33. Identify existing science and technical expertise that is able to help address some of the concerns about nanomaterials:</p> <ul style="list-style-type: none"> • e.g. measuring and detecting <p>34. Extend our expertise in tracing technologies, impacts research, mitigation, Health and Safety.</p> <p>35. Promote good examples of corporate social responsibility.</p> <p>36. Develop more assurance about including cultural, spiritual, issues</p>

	<p>into discussions and decision making.</p> <p>37. Leverage existing international linkages.</p> <p>38. Publicise models that lead to good social outcomes.</p> <p>39. Improve networks to connect different groups more effectively e.g.</p> <ul style="list-style-type: none"> • more events like this. • use internet , websites. <p>40. Make available information more widely accessible.</p>
Priorities for first steps:	<p>Publicise models that lead to good social outcomes.</p> <p>Improve networks to connect different groups more effectively.</p> <p>Make available information more widely accessible.</p>

Key Action Area: Governance	
Scope:	<p>Decisions on nanotechnology governance are not just technical decisions, but socio-political decisions with important social (as well as economic) implications and are properly subject to democratic deliberation (see Engagement Section).</p>
Actions:	<p>41. Interim policy /governance needs to be developed for products currently on the market.</p> <p>42. Initiate public process of discussion of how we should prioritise our public investment in technology development.</p> <p>43. Initiate public process to determine shape of public investment in nano technologies.</p> <p>44. Review Government approach to funding – transparency, accountability, were public good outcomes achieved, risk prioritized, benefits published.</p> <p>45. We need an overarching strategy:</p> <ul style="list-style-type: none"> • Do we need a Royal Commission? • Does the strategy fit within NZ strategy? • Clean and Green?

	<p>46. All Ministries with relevant portfolios should be briefed on the outcomes of this meeting and desired next steps.</p> <p>47. Need regulation based on risk, not production method.</p> <p>48. Governance – any potential legislation needs:</p> <ul style="list-style-type: none"> • Flexibility to be practical for each new nano area. • Avoid unintentional consequences from too broad a definition. <p>49. MORST should initiate upstream engagement with regards to its priority–setting.</p> <p>50. FRST should significantly broaden the categories of participants in their Domain reviews.</p> <p>51. FRST should introduce upstream engagement into research priorities and funding decisions.</p> <p>52. Revisit MORST nanotech roadmap to bring up to date with current landscape.</p> <p>53. Can we agree on minimum standards, e.g.</p> <ul style="list-style-type: none"> • No self-reproducing nanotechnology? • No synthetic nano-biology?
Priorities for first steps:	<p>Interim policy /governance needs to be developed for products currently on the market.</p> <p>MORST should initiate upstream engagement with regards to its priority –setting.</p>

Key Action Area: Engagement	
Scope:	“Upstream engagement” with all stakeholders is believed to be essential for good governance (see previous section), which in its widest sense goes far beyond regulation.
Actions:	54. Ensure all sectors understand that decisions on publically funded nanotechnology are not just technical decisions, but socio-political

	<p>decisions with important social (as well as economic) implications and are properly subject to democratic deliberation.⁷</p> <p>55. Interim policy / governance needs to be developed for products currently on the market.</p> <p>56. Identify who would fund / do governance and regulation.</p> <p>57. Develop NZ capacity for RS and T-prioritisation/innovation planning based on participatory and anticipatory technology assessment.</p> <p>58. Encourage self and co-regulation approaches (e.g. by industry).</p> <p>59. Review international best practice.</p>
Priorities for first steps:	<p>Publicise good models –consider who is the audience and the decision makers, to show how you can get better outcomes.</p> <p>Improving networks-connecting different groups more effectively e.g. more events like this and use internet, websites.</p> <p>Making information more widely available.</p>

Key Action Area: Consumer issues

Scope:	<p>Consumers are not able to choose to avoid nanotech products if they should wish to, because products are not labelled and there is no public discussion of risks. There is confusion and lack of knowledge about hazards associated with nanotechnologies.</p> <p>There is a significant absence of knowledge about waste products, decommissioning, interactions of different nanoparticles/ products in e.g. landfills.</p>
Actions:	<p>60. Get a definition clear.</p> <p>61. Develop measurement techniques for analysis of consumer products.</p> <p>62. Develop register of nano-products.</p> <p>63. Institute system of labelling.</p> <ul style="list-style-type: none"> • Determine what a label means to consumers, don't want to

⁷ Unfortunately no FoRST staff were present at the workshop: engagement with FoRST on the issues identified in this report is clearly an important priority.

	<p>mislead one way or the other.</p> <p>64. Establish mix of education and labeling for informed choice.</p> <p>65. Develop life-cycle analysis of nanotechnology products</p> <ul style="list-style-type: none"> • need more data about potential adverse effects. <p>66. Develop regulatory capacity.</p>
Priorities for first steps:	<p>Develop measurement techniques for analysis of consumer products.</p> <p>Institute system of labelling .</p> <p>Develop regulatory capacity.</p>

Key Action Area: Risk Assessment

Scope:	<p>If available information is insufficient to allow standard risk assessment procedures, or monitoring potential adverse effects of nanomaterials is difficult, how should products currently on market or awaiting commercialization be treated?</p> <p>If, for most nano materials, there is insufficient information to make a science based risk assessment, does this mean that we should not permit release of these products into the social and physical environment?</p>
Actions:	<p>67. Clearly establish, as soon as possible, whether current risk assessment regimes will work for nano products.</p> <ul style="list-style-type: none"> • It is important to begin with some do-able examples. • Is workplace health and safety a possible starting point? • What can we learn from other countries? <p>68. Life-cycle analysis techniques need to be developed for nano products.</p> <p>69. Establish clear statement/agreement on objectives e.g. what is it about the environment we want to protect?</p> <p>70. Do SWOT analysis so risks can be weighed against opportunities.</p>
Priorities for first steps:	All.

Key Action Area: Education

Scope:	How can the workforce and society be prepared for the advent of new technologies?
Actions:	<p>71. Evaluate status quo including ethical training.</p> <p>72. Bench marking e.g.</p> <ul style="list-style-type: none"> • does Australia have more nanotech degrees? • Is the Bologna model helpful? <p>73. Build social science expertise in understanding implications of techno-sciences:</p> <ul style="list-style-type: none"> • Identify needs and appropriate funding. <p>74. Improve post graduate training, including:</p> <ul style="list-style-type: none"> • broader experience (e.g. MacDiarmid Institute student symposia). • international placements. <p>75. Public information and engagement.</p> <ul style="list-style-type: none"> • Need to do it in lots of ways with varied deliverables. <p>76. Identify needs for social dimensions and research and appropriate funding.</p>
Priorities for first steps:	Evaluate effectiveness of current education system in coping with new technologies like nanotechnology.

Key Action Area: Workplace Health and Safety

Scope:	Exposure of workers to nanomaterials is an important issue because they may be exposed to relatively high concentrations of materials with unknown toxicity. The meeting identified that Workplace Health and Safety was an important omission from the list of action areas.
Actions:	77. Involve Department of Labour in follow-up meetings.
Priorities for first steps:	Involve Department of Labour.

3. Summary

The following is based on closing comments made by Simon Brown (University of Canterbury).

The two day meeting was very intense and it was very gratifying that so many people were able to stay the distance and contribute to the development of the final outcomes of the workshop.

Given the enormous range of participants and diversity of opinions, it was not surprising that there was at times some rather heated debate, but it is a credit to all concerned that the workshop was conducted in a very positive atmosphere. It was amazing to see constructive discussions underway between such diverse people, and humbling to see the development of mutual understandings of the issues to be addressed (if perhaps not on the methods of addressing them!).

The participants brought a tremendous range of different perspectives and ideas to the meeting, and it was clear that sufficient expertise had been assembled to address the issues raised. One of the keys to moving forward is to now set up structures which harness the available talent, and in this respect it is critical that government is pro-active in establishing a lead organisation to take responsibility for the issues identified in this report.

In setting out the required actions listed above, this report provides a starting point for New Zealand in dealing with the challenges presented by Nanotechnology. The organisers are committed to monitoring the impact of the workshop and will provide updates on the progress made towards dealing with the issues identified.

The meeting focussed significantly on possible concerns about nanotechnology, and so it is important to recognise that the participants generally accepted that there is a very real potential for important benefits, and that it is vital that New Zealand puts systems in place to maximise them. The focus on negatives is perhaps recognition that, in the past, governance of new technologies has often been poor and that there is an opportunity to do things much better with nanotechnology.

It was refreshing that the attitude of the meeting was clear in regard to the need for more information on health and environmental impacts of nanotechnologies. Certainly more information is sorely needed, but there was no doubt that the sentiment of the workshop was that uncertainty should not be used as an excuse to delay attempts to govern or regulate. It is worth noting that many of the concepts discussed at the workshop are related to the idea of an adaptive governance regime⁸.

⁸ See for example, Royal Commission on Environmental Pollution: "Novel Materials in the Environment: The case of nanotechnology" (2008), www.rcep.org.uk.

Appendices

Appendix 1 - Programme

Nanotechnology – here and now

23-24 April 2009

Day One

Time	Title	Speaker	Notes
8:00	Registration		
8:45	Welcome		Mihi Quick introductions
9:00	Nano-science and technology	Dr Richard Jones	
9:45	What brings you this is conversation?		Introductions, expectations and reflections
10:30	Morning Break		
11:00	The business of nano	Dr Chris Hartshorn	
11:45	Risk	Thomas Webler	
12:30	What did we hear?	Discussion	<ul style="list-style-type: none"> • Distilling insights from last presentations • Things we know/think more about • Questions that we have • Points for further discussion
12:45	Lunch		
1:30	ELSI and public engagement	Dr Dave Guston	
2:15	What did we hear?	Discussion	<ul style="list-style-type: none"> • Distilling insights from last presentations

			<ul style="list-style-type: none"> • Things we know/think more about • Questions that we have • Points for further discussion
3:00	Afternoon break		
3:30	New Zealand what's right here now? (health, environment, social, Maori, policy, risk)	Expo of local perspectives	Six perspectives from New Zealand – smaller presentations and discussions with participants “touring” to be in conversation with the New Zealand perspectives (everybody going to three insights)
5:00	Stretch drinks chit chat		<p>What did we hear?</p> <p>What did it tell us about our approaches to working with uncertainty, opportunity and risk?</p> <p>What is the position of New Zealand in the landscape of world developments?</p>
5:45	New Zealand what's right here now?		Summary conversation
6:00	Putting it in historical context	Arie Rip	
7:00	Environmental Health	Ken Donaldson	
7:45	Session close		

Day Two

Time	Title	Speaker	Notes
9:00	Introduction, process outline		
9:15	Shaping the discussion		Map and name the elements of those opportunities and problems and the relationships around nanotechnology
10:15	Morning Break		
10:35	Focusing the discussion		Defining the most pressing opportunities and challenges and possible scenarios for development and response
12:30	Lunch		
1:15	Exploring the approaches to moving forward in a landscape of uncertainty, opportunity and risk		Engagement, information sharing, regulation and policy making
2:45	Afternoon Break		
3:15	Next steps		Direction setting for the future conversations and developments in New Zealand Who else to engage and how?
4:15	Summary	Dr Simon Brown	
4:30	Workshop close		

Appendix 2 – Organising Committee

John Pennington (The Bioethics Council)

Simon Wright (The Bioethics Council)

Kathryn Holdsworth (Ministry for the Environment)

Robert Hickson (Ministry of Research Science and Technology)

Chad Tustin (New Zealand Food Safety Authority)

Simon Brown (University of Canterbury)

Audio/Visual: Danae Staples-Moon (Royal Society of New Zealand)

Facilitator: Anne Patillo (Patillo, www.patillo.co.nz)

Appendix 3 - Presentations

Available at

<http://www.morst.govt.nz/current-work/roadmaps/nanotech/workshop-2009/>

Appendix 4 – Evaluation of Workshop

Descriptive Statistics of Responses to Nanotechnology Workshop Evaluation Questions. Full evaluation report by Dr B. Small (AgResearch) is available on the workshop website: <http://www.morst.govt.nz/current-work/roadmaps/nanotech/workshop-2009/>.

No	Question	<i>n</i>	Median	Mean	SE Mean	St Dev.
1	Was video conferencing an acceptable medium for workshop presentations?	29	5	4.76	.08	0.44
2	Did the international speakers provide high quality useful information?	28	4	4.36	.14	0.73
3	Did the local speakers provide information relevant to the New Zealand context?	22	4	3.82	.20	0.96
4	How productive did you find the facilitated discussions?	29	4	4.10	.14	0.77
5	Did the workshop help you gain a greater understanding of nanotechnology?	29	4	3.48	.21	1.15
6	Have you increased your knowledge of the opportunities that nanotechnology opens up to New Zealand?	29	3	2.86	.21	1.13
7	Have you increased you knowledge of the challenges that nanotechnology creates for New Zealand?	29	4	3.66	.17	0.94
8	Did the workshop identify the key issues requiring attention in the New Zealand context?	29	4	3.69	.19	1.00
9	Are you satisfied that the workshop identified appropriate ways to address these issues?	29	3	3.24	.15	0.83
10	Was there an appropriate amount of diversity/representation amongst the workshop attendees?	29	4	4.17	.16	0.85
11	How well was the workshop organised?	29	5	4.69	.09	0.47
12	Overall, how satisfied were you with the workshop?	29	5	4.45	.14	0.74

Note: For all questions: 1 = a poor or negative response and 5 = a good or positive response.