



Report

DMR-2673

Citizens' Panel on Nanotechnology Report to Participants

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April 2005

CSIRO Minerals

Citizens Panel on Nanotechnology: Report to Participants

Melbourne Australia December 2004

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Abstract

Nanotechnology, the development of materials and capabilities at the nanometre scale, is thought to hold enormous potential for current and future human lifestyles and activities. CSIRO, an active participant and promoter of nanotechnology research, is also engaged in researching the social aspects and implications of this emerging technology. In addressing the challenge of integrating social and nanotechnology research, CSIRO recognises the importance of identifying and exploring the societal changes that this technology could bring about.

This report outlines and describes the community forum (called the Citizens' Panel) conducted by CSIRO as a component of the SEI Nanotechnology Scoping Project. The aim of the Nanotechnology Scoping Project was to explore perspectives on the implications of nanotechnology research and development in five areas - commercialisation, ethics, regulation, environmental and social impacts. In addition to the community forum (Citizens' Panel), data for this project was also gathered from interviews, and a literature review.

The findings of this community forum were summarised and expressed as statements by three stakeholder categories – industry, government and community. The following list represents a snapshot of these perspectives:

- Democratic accountability and transparency is important in science and technology research and development.
- Australians have shown themselves to be interested in understanding the impacts of nanotechnology and other emerging technologies, and CSIRO and similar organisations have nothing to fear from a genuine proactive science-community dialogue.
- The potential for growth of industrial applications of nanotechnology R&D is exciting, and its development should be used to decouple resource consumption from economic growth through initiatives in the recovery, recycling and reuse of material products as well as ensuring the cleanness of natural resources used like water, soil and air.
- The development of a nanotechnology industry should allow local industry and smaller players to survive and develop.

In general, the participants in the Citizens' Panel were concerned about:

- Monitoring the health and safety of both humans and the natural environment, and those working with nanoparticles
- Nanotechnologies developed for the purposes of war
- Ownership and control of emerging technologies
- The adequacy of current international regulation for nanomaterials
- The social divides that nanotechnology might generate or exacerbate internationally as well as intra-nationally
- The ramifications of intellectual property laws both for Australia and for developing countries in light of what are likely nanotechnology impacts and paths of development.

This report contains information which is commercial-in-confidence. Accordingly, it must not be used or disclosed in whole or in part except in accordance with the terms of the agreement covering this work.

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1. INTRODUCTION

Decisions about the ways in which technology is developed entail values and beliefs about how we want to live, and the kind of world we would like our children to inherit. Nanoscale technology research and development is currently an area of high hopes and considerable investment. In 2003 the US Government spent more than \$700 million on nanotechnology R&D and other countries are also investing heavily in order to be a player in a future global market (Wertheim, 2003). Alongside claims of great scientific and technological advances and advantages attributed to nanoscale technologies, are concerns about the pace of such development, (for example, Joy 2000), and questions on how we are to evaluate their impacts (Grove-White et al, 2000).

In December 2004 CSIRO invited citizens interested in contributing to a discussion on nanotechnology to a public forum held in Melbourne. The Citizens' Panel built on the work of an earlier regional public forum (see report by Mee et al, 2004)¹ by broadening the scope of the social research to five key areas/contexts most likely to affect and/or be affected by nanotechnology R&D.

Underlying our project is the assumption that in addition to learning about the potential impacts of nanotechnology development, science-community interaction can contribute to shaping the path of such development, and lead to a better informed public discussion of nanotechnology by members of both e communities.

2. BACKGROUND

CSIRO's first public participatory workshop was held in Bendigo in March 2004. The Bendigo workshop brought together CSIRO staff, nanotechnology specialists, government representatives, and people living in a regional community to learn about and discuss some of the applications and possible implications resulting from nanotechnology research and development. Its purpose was to listen to and analyse public input in order to begin the process of shaping an ethical and ecological framework with which to evaluate research decisions within CSIRO around this emerging technology.

In general, the Bendigo workshop participants highlighted issues related to regional economic development; and to public health and safety. They wanted CSIRO to:

- Demonstrate that it takes the issue of public participatory processes seriously, by being more proactive in conducting and funding effective public communication and participatory research activities,
- Foster an understanding of and commitment to the needs and priorities of rural and regional Australians, and
- Address issues arising from the potential conflict between matters of public interest and those of commercial confidentiality.

Subsequent research was conducted in the form of background interviews in five key areas/contexts identified as likely to affect and/or be affected by nanotechnology R&D, and by holding a second public workshop, this time in a metropolitan area (Melbourne). The five identified areas - commercialisation, ethics, environmental impact, social

¹ The Nanotechnology OLP Bendigo Workshop Report can be found at <http://www.minerals.csiro.au/sd/index.html>

impact, and regulation - were chosen on the basis of issues emerging out of the Bendigo workshop as well as international discussions and debates.

3. THE MELBOURNE CITIZENS' PANEL

The interviews described above, the Bendigo community engagement workshop, and the literature review provided the background and preparatory information for a Citizens' Panel – i.e. a public engagement workshop, held in Melbourne in December 2004.

Participants at the Melbourne Citizens' Panel were self-selected, made up of people who responded to advertisements placed on online science forums, in an inner urban local newspaper, and on departmental noticeboards of universities (RMIT, Melbourne and Swinburne), and the Centre for Adult Education. The participants represented members of the broader community and included a number of people associated with civil society groups such as environmental and/or ethically oriented NGOs.

4. CITIZENS' PANEL PRESENTATIONS

In the morning session, six invited speakers gave short presentations (summarised below and contained in the appendices) and answered questions and comments from participants. The exchange of views between the speakers and audience was lively, and conducted with good will and respect despite often differing positions and ideas in some areas.

4.1. Small Wonders: Nanotechnology in Perspective

Dr. Terry Turney, Director of CSIRO Nanotechnology Centre and Science Director, CSIRO Division of Manufacturing and Infrastructure Technology

Terry gave an overview of the current activity and applications of nanotechnology R&D, and its possible future impacts. He made the point that nanotechnology occurs in Nature, for example, the water-capturing surface of the fused overwings (elytra) of the desert beetle, and presented an overview of the environmental, social and commercial factors that drive nanotechnology R&D.

Other key points were:

- Nanotechnology is not one particular technology, but a tool kit for manufacturing structures on the nanometre scale.
- This tool-kit gives us novel properties, phenomena and processes. It involves many areas of knowledge and is a bridge between the living and non-living worlds.
- Nanotechnology is at the convergence of traditional science disciplines.

4.2. Nanotechnology: Business and Investment Perspectives²

Dr. Peter Binks, CEO of NanoVic

Peter began by looking at the interaction between business, community and science. In his view scientific revolutions typically promise to change human existence, alleviating poverty, conflict, disease, and injustice, but in reality they mostly address one dimension, and have little economic impact. The real revolutions, he said, are those that change consumer behaviour, like the railroad, the car, television, and mobile phones. Industry gets to 'vote' by choosing where to invest, what to develop, bring to market: only then can people vote as 'consumers'.

Addressing the implications and issues, Peter said that one of the difficulties lies in the poor definition of nanotechnology; defined as it is only by scale makes it a weak value proposition i.e. it is hard to sell something at 10^{-9} . The scale and timing of investment may be important in nanotechnology, with only the very large corporations and the fastest to grasp the opportunities being able to invest. This presents investment challenges for Australian industry. A clear drawback for the Australian industry and for investors is the lack of national effort around nanotechnology in Australia.

Peter concluded that from a business perspective nanotechnology is incremental; like most technologies it faces major challenges to become an attractive investment proposition; and positioning of the technology, i.e. generating or ensuring a marketable image and acceptance of the value of nanotechnology, is critical to enable a commercial future.

4.3. Coming to Grips with Nanomaterials³

Dr. Ian Rae, Professor Fellow in the Department of History and Philosophy of Science, Melbourne University

Based on his experience as Chair of the Scheduled Waste Management Group and National Advisory body on Scheduled Wastes on behalf of the Australian and New Zealand Environment and Conservation Council, Ian made the following points.

- There is no such thing as nanotechnology but there are nano materials, which form particles with sizes between those of molecules and living cells, having high surface: volume ratios.
- The great diversity of nano materials militates against a single approach, so they are best dealt with case by case. Some are prepared by building up, some by breaking down. Organic and inorganic materials may be involved.
- When looking at the 'people side' of nanotechnology, we need to ask who 'the public' are. Ian presented a population model of 1: 10: 1000 – a ratio that depicts the degree of interest in technology R&D. The 1 represents the one passionate person, 10 people he classified as 'interested', and the 1000 represents those who are indifferent. A dilemma in social impact assessments

² See Appendix C

³ See Appendix D

is the natural inclination to limit participation and representation to make such assessments manageable. This is a mistake because different groups have different power and resources. Some groups are resource poor but not intellectually poor.

Ian's experience with state-based environmental legislation persuaded him of the need to work through ministerial councils for a consistent national approach. In the public consultations on toxic waste management the debates were largely social, not technical. He noted that the often exhaustive public consultations did eventuate in a toxic waste management plan by the Federal Department of Environment.

4.4. Life Cycle Implications for Nanotechnology⁴

Dr. Tim Grant, Project Manager, Life cycle Assessment, Centre for Design, RMIT

Tim uses Life Cycle Assessment (LCA) methodology to model sustainability scenarios and possibilities. The LCA method has recognised international regulatory codes on review, quality and transparency criteria. However, there is a lack of information required to conduct LCA on nanotechnologies.

In addition, the methodology does not address longer-term risks although it is possible to build uncertainty data into the LCA process. In assessing the aggregate effect of a new industrial technology and economy, as distinct from a case by case basis, the concern has to be with the total amount of production and consumption.

Tim gave an overview of LCA principles and presented the following guidelines:

1. Follow the mass, i.e. account for all material entering or leaving a process
2. Ignore principle 1 when intensive processing is involved, e.g. electronics
3. With high value and impact materials there are economic and environmental benefits of recovery and reuse
4. Principle 1 holds where things are built once and used many times, i.e. things that consume many resources
5. Material properties do not guarantee lower environmental impacts, i.e. degradable, renewable, natural are properties, not performance indicators. Human behaviour is significant, for example, people who get energy efficient globes for their homes may be inclined to leave the lights on because they are energy efficient.
6. Be aware of positive and negative leverage of lifecycles on other lifecycles more substantial than the one investigated. The rebound effects also need to be considered, e.g. a cheaper service liberates income available for other consumption.

4.5. What is a responsible approach to nanotechnology R&D? - An ethics perspective⁵

⁴ See Appendix E

⁵ See Appendix F

Professor John Weckert, Professor of Information Technology and Professorial Fellow, Centre of Applied Philosophy and Public Ethics (CAPPE), Charles Sturt University, Wagga Wagga

John's presentation responded to the question, 'What is a responsible approach to nanotechnology research and development?' John spoke about the Precautionary Principle with regards to nanotechnology. This principle focuses attention on the possible harms of the technology, the nature and strength of the link between action and the possible harm, as well as on suitable remedies. If Action A has some possibility P of causing harmful effect E then apply remedy R. For example, if discharging the waste into the river has a reasonable chance of contaminating the water then stop the discharge. John identified three relevant issues - the strength of causal link between an action and its effect; the nature of the harm, i.e. catastrophic, irreversible; and the remedy. The hypothesis of a causal link must be more than logically possible and must be credible even if the current evidence is weak.

In the case of nanoparticles John believes that the hypothesis that their use may have harmful effects is credible, although currently there is little supporting evidence. Rather than halting development, a possible remedy is more research on the link.

In the case of nano-electronics John suggested that privacy is the main concern, particularly that the technology will be used in a way that reduces privacy. Here the possible remedy is to ensure that there is adequate legislation.

With regards to the fear that self-replicating robots or 'nano-bots' will be developed, with the possibility that they will escape, John said that the first hypothesis is not credible, but the second hypothesis would be credible were such a technology developed.

John acknowledged that the fear expressed by many researchers and governments is that applying this principle will effectively stop any research. However, he said that advocates for using the weaker version of the precautionary principle say it is a useful and responsible approach that will not stop R&D.

4.6. Nanotechnology and Society: a perspective⁶

Dr. Fiona Solomon, Group Leader, Social Values and Sustainability, CSIRO Minerals

A social perspective, said Fiona, looks at what *could* happen to people, communities, society and institutions. This is different from, but connected with ethics, which looks at what *should* happen. She addressed some of the dilemmas of technological solutions, such as, for example, the car. It provides mobility and access, personal freedom and expression, and is an employment and economic driver. At the same time, it is the cause of road trauma, dependency, individualisation, and the power of the car industry.

Predicting the future of nanotechnology research and development is complex and unreliable. Such prediction tends to focus on the radical potential, such as no-cost manufacturing or 'grey goo', rather than on the mundane; yet the mundane may prove to be radical for society in the long-term. For example, computer technologies are now

⁶ See Appendix G

part of everyday life for many people, and their use raises issues such as employment, privacy, and a new societal/informational divide.

In her talk, Fiona highlighted a number of social issues that nanotechnology development might raise.

Health

If nanotechnology is successful in improving health by earlier diagnoses and treatment, as is claimed, then will the focus be on diseases of the rich or the poor? Will longer lives mean greater quality of life?

Education and employment

Will nanotechnology be labour-saving or create unemployment? Will more highly skilled labour be required? What are the implications for the nature and timing of education?

Social justice

Will the 'have-nots' gain access to new technologies? Will new technologies entrench or worsen social inequalities?

Consumption of resources

Will nanotechnology development address or perpetuate consumerism? What social impacts may arise from environmental impacts?

Local and national economies

How will new products, superseding old one, change economies? How would dematerialisation affect resource-dependent countries?

Control and ownership of matter and production

Can life and matter be patented and owned by corporations? Will intellectual property and capital-intensive manufacturing mean little competition and market dominance for a few big players?

Social relationships and culture

How might personal relationships change, and might cultures become more diverse or homogenous?

Privacy and security

How will we be able to control and monitor things that are invisible, can move themselves, or self-replicate? How could these technologies be abused?

Governance and the role of government

How can we evaluate risk under conditions of uncertainty? With nanotechnology touted as the new frontier we must ask, who will be the sheriffs? What power will governments have over industry?

The challenge for social scientists in exploring, analysing and responding to these issues is to work together with stakeholders in asking, 'Where are we going with this technology? Who gains and who loses by what mechanisms of power? And, is it desirable?'⁷

⁷ Adapted from Bent Flyvbjerg, (2001) *Making Social Science Matter*. Cambridge University Press.

Fiona concluded her presentation with the following points:

- Technology decisions are also social and political decisions for they represent choices about the kind of world we want and will create.
- There is a need for genuine dialogue about technology, and for wider public participation in science and technology development.
- We live in a democracy but much that influences us is decided in the private (i.e. unelected) sector. How, then, can we 'democratise' technology?
- Nanotechnology practitioners have the opportunity to consider the social consequences of their work.
- Forums like this one are opportunities for social scientists and stakeholders to come together. Creating a culture of transparency will create a well-informed public, and a well-informed public will be better equipped to evaluate the influences shaping and impacts resulting from nanotechnology research and development

5. CITIZENS' PANEL FINDINGS

In the afternoon participants attached themselves to one of the following three hypothetical groups - community, government, and industry – and were asked to devise questions they wished to put to the six presenters. Drawing on this discussion session, the final task for the three groups was to formulate a 'group' position in response to the hypothetical scenario: **'What statement will Australia make to the United Nations Forum on Nanotechnology in 2006?'**

5.1. Community group

Discussion within the group representing 'the community' revolved around several issues.

Concern was expressed about how to address the lack of transparency of business and private research, that is, the conflict between the public's right to know, particularly when R&D in emerging technologies involves risks to human or environmental health and safety, and a corporation's desire to protect its market share, profits and accountability to shareholders. There was agreement that where secrecy costs lives, governments should put greater penalties in place.

Discussion in the community group also questioned the assumption of public indifference. Reasons for public indifference to emerging technologies such as nanotechnology are varied and cannot be attributed only to apathy. Lack of knowledge and information about science and technology in general, and about nanotechnology in particular is one such reason. Another reason is that new technology is often presented in public as following an inevitable trajectory, development that is unstoppable. It is a powerful symbol of being up-to-date or 'cutting edge'. This sometimes has the effect of silencing people in that if they express any concerns they are seen as hindering progress. Furthermore, seeming indifference may mask an underlying belief that their voice does not count. Given that community consultation around technology development is a relatively new phenomenon, this is not surprising.

The issue of equity also arose. How can all sectors of the community be included in shaping the technology, especially when the technology is complex and its impacts

uncertain? Suggestions for how to help overcome the inequality of voices included education and information dissemination, forums such as this one, and establishing an Independent Technology Review Board with community representatives on all its science and technology committees. The Danish Board of Technology was held up as a model, and a parallel made with industries such as mining, using the Environmental and Social Impact Assessment (EIA/SIA) methods.

In response to the hypothetical scenario - What should Australia say at the United Nations Forum on Nanotechnology in 2006? - the community group made this statement:

Community statement:

As members of the public we want to be informed, involved and ultimately in control of nanotechnology decisions. We would therefore want Australia and the UN Forum to respond to the following questions/concerns:

- How can all sectors of the community be included in shaping the technologies that will ultimately determine how we will live? Is it by labelling, mass media, consultation? All of these? Are there other means?
- How can we weaken the secrecy, power and control of corporations and bring them to a more democratic accountability to the people?

5.2. Government

In the group representing 'the government' discussion began by the observation that many of the issues involved with the development of nanotechnology need to be agreed to and regulated at an international level. Global agreements are necessary, firstly because the potential applications of nanotechnologies are so wide-ranging, and secondly, because transnational corporations are the agencies most likely to be actively involved in nanotechnology development and application. There are already a number of existing treaties and conventions which need to be examined for their adequacy in regulating the emerging technologies, particularly those developed for warfare, chemicals and waste, and cross-boundary movements of substances.

The government group expressed concern over the possible use of intellectual property provisions to suppress new technology research and development. Most countries are signatories to an international patent regime and this patent regime may be sufficient protection. But do IP rights inhibit the sharing of research findings, and affect research funding? Do they concentrate the control and ownership of the technologies in the hands of a few? Whose interests are served by intellectual property agreements? How amenable are such laws to change, such as, for instance, the development of emerging technologies?

Another concern raised was that as this technology is developed for therapeutic purposes in the developed countries, will it also be available to developing countries? How can we ensure poorer countries and people will benefit? It is possible perhaps to have something like the Free Technology Agreement with Africa, e.g. no IP charges on diagnostic tools, or instigate concessions on pharmaceuticals for overseas e.g. AIDS drugs?

Similarly, there is a need to look at whether current regulation and regulatory bodies are adequate at the national level when it comes to nanotechnology. This is urgent given the increasing convergence of nano- with bio-, info-, and cognitive technology.

One suggestion was the establishment of an office similar to the Office of Gene Technology Research. Some members of the group thought that nanotechnology would be too broad for such an Office to work, and pointed to the four national agencies, currently engaged in regulation and monitoring technologies. They are the APVMA – Australian Pest and Vet. Meds; FSANZ - Food and Science Australia and New Zealand - food additives; TPA – Therapeutic Good Administration - health and drugs, and NICNAS – industrial chemicals. However, they do not cover all aspects, such as the as yet unresolved question of whether nanoparticles should be treated as new chemicals. Also, the cosmetics industry falls outside the parameters of these four regulatory bodies.

Other items raised and discussed in the government group were:

- Whether research funding should have a percentage placed on environmental and social research and made a requisite from regulatory authorities?
- What controls could or should be placed on nanotechnology research developed for military purposes, such as that carried out by the US Department (DARPA) on human enhancement? We need international or intergovernmental conventions and/or treaties similar to those covering germ and chemical warfare/weapons.
- In an increasingly global market economy a national government has to develop policies or steps to resolve any tensions or conflicts between technology research for commercial purposes and open public dialogue on health, safety, social and environmental issues.

In response to the hypothetical scenario - What should Australia say at the United Nations Forum on Nanotechnology in 2006? - the government group made this statement:

Government statement

Many of the issues involved with the development of nanotechnology need to be regulated on an international level, as well as by national governments. Existing treaties and conventions should be examined for their adequacy in regulating nanotechnologies. Our specific concerns relate to (i) nanotechnologies developed for warfare; (ii) the management of nanoscale chemicals and wastes; (iii) cross-border movement of nanoscale materials; and (iv) use of IP provisions to suppress development, and the ramifications of IP provisions both for Australia and for developing countries.

5.3. Industry group

The industry group imagined itself as an industry association representing companies and investors – large and small – involved in the research, design and manufacture of nanotechnologies. The aims of the association were given as:

- To enable the Australian industry to grow and prosper
- To be proactive in heading off opposition to nanotechnology R&D

- To work together to a single aim

Underpinning the group's aims was a commitment to the long term sustainability of the industry's growth. The feeling amongst the group was that the long term economic growth of the industry will ultimately depend on developing technologies which advance Australia's environmental sustainability. This recognition was both pragmatic and strategic. The ability to favourably position nanotechnology as an important technology in addressing the challenge of balancing economic growth and environmental sustainability would not only enhance the industry's relevance and its potential benefits to Australia. It could also enhance the industry's international market profile as producers of nanotechnologies designed to have low environmental impacts and/or fill niche energy and environmental markets.

One area where nanotechnology was seen as having great environmental and economic potential to the benefit of all Australians was in the technologies capacity to decouple resource consumption from economic growth. The potential use of nanotechnology in energy-efficient power production, water and waste filtration technologies, and energy efficient products (e.g. new building materials) was seen as particularly relevant to industry in the Australian context and potentially an area of export growth.

The group was also keen to see Australian nanotechnology industry groups and government actively involved in national and international debates regarding nanotechnology-related standards and protocols. The association was concerned that the future of all its members could be jeopardized by the irresponsible actions of one or two players in the Australian context. For example, one serious health or environmental accident or corporate failure could turn public attitudes and government support against the industry. For this reason, the Association was also in support of robust and independent regulation not only in Australia but globally.

The group felt that such regulation was dependent on there being a level playing field with respect to international standards and protocols, particularly on environmental and public health testing, disclosure of health and safety research, and issues of access and equity. There was a concern that Australian companies might be penalized in the market place if other countries were allowed to invest in nanotechnology R&D without complying with internationally agreed to occupational, environmental and public health standards. The public disclosure of occupational, environmental and public health research was seen as particularly critical for smaller nanotechnology companies and countries – such as Australia – which lacked the financial and technical resources to undertake such research.

Finally, the group was aware of issues surrounding regulation and public acceptance of this technology. Commercialising new technology requires substantial financial investment, often in terms of million, if not billions, of dollars. This requires not only government support but secure investment and regulatory environments. The general feeling was that more regulation rather than less – as long as this did not impose unbearable costs on small start up companies – would lead to further investment in this technology and industry growth.

In response to the hypothetical scenario - What should Australia say at the United Nations Forum on Nanotechnology in 2006? - the industry group made this statement:

Industry statement:

We seek to enable Australian industry to grow and prosper through nanotechnological innovation but also by development that is environmentally friendly and socially responsible. We would like to use nanotechnology to decouple resource consumption from economic growth, through initiatives in water, air and soil reuse and purification, and material recovery.

We recognise that nanoscale materials and particles may have a potential for negative environmental, economic and social consequences, both nationally and globally. As a consequence, we are seeking a global set of standards and protocols.

We recognise that a level playing field around issues of disclosure, access and testing, must be put in place to the benefit of all. We would also like to see global scientific collaboration in order to resolve the toxicological and environmental impact of nanoscale materials.

6. SUMMARY OF CITIZENS PANEL FINDINGS

The three statements captured much of the feeling, intent and views of the three groups and showed how the workshop participants thought about and discussed issues from a range of perspectives.

Democratic accountability was seen to be important in the area of research and development in science and technology. The experience of the GMO debate and our two CSIRO workshops are preliminary evidence that Australians are not apathetic about the impacts of nanotechnology, and recognise that how we deal with them will both reflect and influence how we conduct ourselves as citizens of a democracy as well as inhabitants of the one planet. The workshop participants, in common with the UK Report (Royal Society of Engineers, 2004) and the American telephone survey (Cobb & Macoubrie 2004), were concerned for the health and safety of both humans and the natural environment, and for those working with nanoparticles. Both Bendigo and Melbourne workshop participants demanded a higher level of transparency and openness from researchers than they believe has been the case in the past. The outcomes of the regional (Bendigo) workshop differed from the urban (Melbourne) one. This may be because their scope and aims differed, but a tentative claim is that this is also due to differing concerns and priorities, and the fact that more civil society NGOs who actively engage in research and discussion around technology development are situated in major urban areas. To that end, the means of information exchange and communication need to be varied and made accessible to a range of persons.

In addition to human and environmental health and safety there is concern over nanotechnologies developed for the purposes of war, over the social divides that nanotechnology might generate internationally as well as intra-nationally, and the ramifications of intellectual property laws both for Australia and for developing countries. Thus what is needed is an audit and analysis of current international and national treaties, agreements and legislation, in light of what are likely nanotechnology impacts and paths of development.

Participants saw potential in the growth of industrial applications of nanotechnology R&D, but recommended that its development be used to decouple resource consumption from economic growth through initiatives in the recovery, recycling and reuse of material products as well as ensuring the cleanness of natural resources used like water, soil and air. Closely tied in with the regulatory aspects, the commercial development of a nanotechnology industry requires international equity (or 'level playing field') to allow local industry and smaller players to survive and develop.

7. OUTCOMES OF CITIZENS PANEL

The Melbourne Citizens' Panel contributed to:

- Raising public awareness of some of the issues associated with nanotechnology.
- Considering a range of perspectives around nanotechnology R&D
- Fostering information sharing and transfer of knowledge
- Learning about communicating science to a wider public
- Closing the gap between scientific and community understandings
- Awareness within international groups of CSIRO's work in the societal implications of nanotechnology R&D.

Participants have been able to draw on the experience of the Panel to:

- Publish an ABC Science online article on the Panel.⁸
- Publish an article in The Age newspaper (29 December 2004, p.13) on social and environmental aspects of nanotechnology.
- Inform a submission by Greenpeace to the Prime Minister's Science, Engineering and Innovation Council's Working Group on Nanotechnology, and to the Commonwealth Department of Science, Education and Technology (DEST), 21 Jan, 2005, on health, safety and environmental impacts of nanotechnology.
- Inform a submission by two workshop participants via GeneEthics Network to the PMSEIC Working Group on Nanotechnology, 20 January, 2005.

8. CONCLUSION

The Citizens' Panel highlighted a broad range of issues and perspectives towards nanotechnology research and development. Each one of the five contexts – commercialisation, environmental impacts, social impacts, regulation, and ethics – is a complex topic and deserves further exploration in its own right. Ongoing community engagement on these issues will be important to deepen the understanding of the non-technical implications and potential of nanotechnology development for scientists and non-scientists alike.

Both the regional community engagement workshop held in March 2004, and this one in December, provide support for the contention that science R&D organisations such as CSIRO should not 'fear' fallout from being proactive in public engagement of this type. While there were differences of opinion and robust debate, this did not appear to

⁸ Available at <http://www.abc.net.au/science/news/stories/s1257304.htm>

result in deepening polarisation or an unwillingness to engage with different perspectives.

CSIRO will draw on the insights from this workshop in developing recommendations for nanotechnology research and future social research around nanotechnology.

9. ACKNOWLEDGEMENTS

The authors would like to thank the presenters and participants in the Melbourne Citizens' Panel for their willingness to give of their time and effort. Their contribution to our collective understanding of nanotechnology is much appreciated.

We also thank Helen Cheney for her able facilitation of both of CSIRO's public workshops on nanotechnology.

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**APPENDIX A: CITIZENS PANEL PROGRAM
CSIRO NANOTECHNOLOGY SCOPING PROJECT
Melbourne, December 2004**

Workshop Facilitator

Helen Cheney, Senior Research Fellow, Institute of Sustainable Futures, UTS

8.30-9.00	<i>Coffee/tea</i>
9:00-9:10	Welcome and introductions
9:10-9:40	What is Nanotechnology? Dr Terry Turney CSIRO
9:40-10:10	Business and Investment Dr Peter Binks NanoVic
10:10-10:40	Environment and Regulation Professor Ian Rae University of Melbourne
10:40-11:00	<i>Coffee/tea break</i>
11:00-11:30	Assessing the Environment Dr Tim Grant RMIT
11:30-12:00	Ethics and technology R&D Dr John Weckert CAPPE, Charles Sturt U.
12:00-12:30	Considering the Social Dr Fiona Solomon CSIRO
12:30-1:20	<i>Lunch</i>
1:20-1:30	Introduction to afternoon activities Ms.Helen Cheney ISF
1:30-2:00	Small group work: scoping questions
2:00-2:30	Presenters respond
2:30-3.30	Small group discussion (including tea/coffee break)
3:30-4:00	Plenary: Reports from small groups and discussion of findings

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W.Mee	Project Leader	1
E.Katz	Project staff	2
R.Lovel	Project staff	3
A.Manzoori	Manager – PD&O	4
M.Fietz	R&D Manager / File	5
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