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Community Participation in Australian Science and Technology Policy: The Case of Nanotechnology

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Abstract *Nanotechnology is widely considered to offer enormous competitive advantages to those countries that possess the knowledge and capacity to harness its potential. As in many other countries, Australia's nanotechnology policy is in its infancy and lags international research in the field. We examine the role of community engagement in the development of nanotechnology in Australia, and argue that if Australia is to establish a sustainable nanotechnology policy, then it must broaden its perspective and more carefully consider the social, ethical and environmental aspects of nanotechnology. We support the goal of shared economic growth through technological advancement; however, this seems unlikely as long as the Australian government persists with what is essentially a technical and socially exclusive approach to stimulating innovation in nanotechnology. While opposition to nanotechnology is still 'thin on the ground', it is starting to emerge and the Commonwealth and State governments would do well to treat it with respect.*

Keywords: community engagement; nanotechnology; science policy

The traditional, neoclassical economic belief that a comparative advantage in resources, agricultural produce and a cheap, relatively unskilled workforce is sufficient for national prosperity is no longer valid. Declining supplies of resources, falling resource prices and increasingly educated workforces, who are no longer prepared to work for low wages, have forced governments around the world to instead seek a 'competitive advantage'.[1] This has led them to promote so-called 'new technologies'—most notably biotechnology, information and communication technologies, and nanotechnology—to garner footholds in markets that they believe can ensure long-term economic sustainability and high standards of living for a broader cross-section of their workforces.

Nanotechnology is widely considered to offer enormous competitive advantages to those countries that possess the knowledge and capacity to harness its potential. Put simply, it involves 'the design, characterisation, production and application of

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structures, devices and systems by controlling shape and size at the nanometre scale'.[2] At this scale, that is, from the atomic level up to 100 nanometres, materials can behave differently compared to the same materials of a larger size. First, quantum effects can affect the optical, electric and magnetic properties of materials and, second, relatively larger surface areas (per unit mass) produce greater chemical reactivity. Nanotechnologists already use these phenomena to create polymers, sunscreens and cutting tools, while working towards developing efficient fuel cells, high quality mirrors, catalysts and lubricants.

As in many other countries, Australia's nanotechnology policy is in its infancy and lags international research in the field. In a sense, policymakers are reacting to scientific developments and attempt to pre-empt community opposition to these developments and their applications. Some are also mindful of the failures of governments around the world to manage community concern and opposition to biotechnology. For example, Schibeci and Harwood[3] and Schibeci *et al.*[4] found that the Australian government agencies, Biotechnology Australia and the Office of the Gene Technology Regulator, have mistakenly sought to manage these relations by depoliticising issues and/or alleviating, with more 'facts', what they implicitly regard as a 'cognitive deficit' among those who oppose elements of gene technology and their application. Consequently, members of the community are either excluded or ignored on the grounds that they do not possess the expertise to contribute to policymaking in any meaningful sense.

This is problematic for the development and effective application of science and technology. Studies in Australia,[5] Europe[6] and the US[7] have shown that policy research that privileges scientific knowledge at the expense of local and contextual knowledge and does not take seriously community concerns, lacks legitimacy in the eyes of the community. They distrust regulatory agencies that seem more eager to promote special interests than engage in balanced analyses of the science and technology and community concerns, and question the motives of companies that support particular interpretations of conditions with analyses produced by their own 'experts'.

In this article, we consider the prospects for genuine community participation in nanotechnology policy and conclude that these are not altogether positive. This is unfortunate because, as we explain in the first part of the article, an increasing number of researchers recognise the contributions that members of the community can make to science and technology policy. The second part of the article explains that the community is effectively excluded from participating in Australia's nanotechnology policy. Finally, we conclude that as long as economic growth is given greater weight than democratic goals, genuine community participation is unlikely to be integral to Australia's nanotechnology policy. The disregard for community participation in nanotechnology policy indicates that Australia appears destined to repeat the mistakes that characterised the emergence of biotechnology policy.

1. The Case for Community Participation

An increasing number of researchers have found that community participation in science and technology policy facilitates a mutual understanding of the issues between themselves and policymakers. In this first part of the paper, we explain how community participation, especially that which utilises deliberative inclusionary processes (DIPs), can contribute to more effective and legitimate science and

technology policies. While there are costs associated with the use of DIPs, we contend that these can be addressed and that the benefits outweigh the costs.

Ordinary citizens can make a positive contribution to public policy if they are given opportunities to participate in what they consider a receptive and sympathetic environment. This is premised upon the belief that ordinary citizens can possess what has variously been termed contextual or local knowledge. Studies indicate that people are often more aware of what is happening in their local surroundings than the scientists who are sent to study the particular phenomenon. While the scientists are generally more adept at measuring the different aspects of the phenomenon, the locals sometimes possess much more knowledge about the vagaries of local conditions. Just as importantly, they are, at least, as equally well equipped to consider the ethical, personal and regional implications of policy decisions.

Deliberative inclusionary processes (DIPs), such as citizens' juries and consensus conferences, can constitute the bases to an alternative and more effective approach to the management of science and innovation policy.[8] These require organisers, policymakers and experts to adopt a more respectful and reflective attitude towards members of the community and their potential contributions. For example, in a citizens' jury, a randomly selected group of usually 12–20 lay members of the community deliberate upon a public issue for 30–50 hours. Before coming to their decision(s), they can question invited expert witnesses on aspects of the issue. DIPs have received positive evaluations from participants and organisers overseas; however, little research work has been undertaken in Australia into the applicability of DIPs across a range of policy sectors. Insufficient interest in the community may not warrant the time and cost of a DIP. Alternatively, it may be the case that opposition from policymakers and other experts to the use of DIPs will be too great.

While the case for community participation in science and technology policy is strong and premised upon considerable empirical evidence, it is contested by opponents who privilege expert advice and/or question the cost and practicality of genuine public participation in public policy. One common misgiving about public participation is that it is unlikely to generate significant interest among the participants. King *et al.* draw attention to the 'realities of everyday life'[9] and Irwin and Stansbury, too, contend that ordinary members of the public may find it difficult to participate because of insufficient free time.[10] Moreover, they may decide that their participation will not have any real effect upon the decision-making process. Some policymakers may find the idea of engaging the public a costly and pointless exercise, which is fraught with political risks.[11]

In response to the claim that people will not participate because of insufficient free time, it is not expected that *all* members of the community will be interested in all issues or can make themselves available on a regular basis. Instead, it is assumed that some people will have an occasional, but strong, interest in particular issues and, given an opportunity and encouragement, will participate in a public forum. As Carson and Martin found in their efforts to encourage participation, persistent telephoning of a random selection of potential participants and some words of encouragement can coax people out of their comfort zones and into the public arena.[12] This initial stage of the process would likely be advanced, if a decision-making framework was already established into which the outputs of the forum could be introduced.

While it is not possible to claim with certainty that the benefits can offset the costs associated with deliberative inclusionary processes, it is possible to identify

how some costs may be reduced over the long term. Elitism and cultural resistance among policymakers may be addressed, first, by restructuring the education of graduate students in public administration and policy programmes.[13] Typically, these programmes teach technical skills that are supposed to help practitioners identify problems in the community, determine the nature of the problem and how best to the resolve the problem. There is no disputing that they have their place in certain circumstances, however, they privilege the role of experts and democratic elitism, rather than community-centred democracy. Instead, greater emphasis needs to be placed upon the teaching of qualitative research methods that situate practitioners and the community at similar levels.

This twenty-first century approach to science and innovation policy is not unique in Western countries. In its report, *Policy through Dialogue: Informing Policies on Science and Technology*, the UK Council for Science and Technology identified 'public dialogue' as essential to the effective introduction of new technologies.[14] The report recommended that the government establish 'an explicit framework for the use of public dialogue to inform science and technology related policies'[15] and 'clear criteria for identifying and prioritising areas that could usefully be explored through dialogue processes'.[16] It also highlighted the crucial distinction between determining policy and informing policy: the contributions of the community and stakeholders having equal standing with those of scientists and policymakers, however, 'government must retain responsibility for decision-making'. If Australia is to develop new technologies that will likely play an ever-increasing role in our lives and economies, then it, too, must look to these new mechanisms of political engagement.

2. Public Participation in Australian Nanotechnology Policy

In this second part, we present a general overview of public participation in nanotechnology policy and show that genuine public participation has not been integral to Australian nanotechnology policy. We observe that deliberative inclusionary processes (DIPs), which foster dialogue and develop mutual understanding, are rarely used by policymakers. The concerns raised by individuals and groups are reported and politely dismissed as ill informed and the promotion of 'community awareness' focuses upon the perceived need to persuade people of the benefits of nanotechnology and alleviate the cognitive deficit that exists in the community. Survey research is utilised to ascertain levels of public understanding and approval, in the hope that the sector will avoid the mistakes associated with the emergence of gene technology. While we find pockets of support for genuine public participation, policymakers generally favour token public *consultation* processes that prevent the community from seriously participating in Australian nanotechnology policy.

For the most part, policymakers appear excited about the ways that nanotechnology might transform society and improve peoples' standards of living. This idea is nearly always underpinned by the claim that Australian industry must establish a foothold in these emerging industries or risk being left behind. It is a perspective that pervades Australia's innovation policy and is evident throughout the innovation reports of the *Backing Australia's Ability* package (http://backingaus.innovation.gov.au/). Hence, a priority has been to build public support for nanotechnology by presenting the 'facts' in a positive light and emphasising the economic potential of nanotechnologies.

The Department of Industry, Technology and Resources (DITR) has demonstrated much interest in promoting nanotechnology, but much less interest in

encouraging community involvement in policy formulation. For example, in the discussion paper that it released seeking submissions as to what a National Nanotechnology Strategy should contain, the DITR actively promoted the benefits nanotechnology could offer, but was somewhat more circumspect about the 'implications' (that is, the harm or damage).[17] Of particular note is an image generated by the European Commission that presents 'possible future applications in our everyday lives'.[18] Set in cosmopolitan Paris and with the Eiffel Tower in the background, it identifies applications such as 'organic light-emitting diodes', non-corrosive 'nano-particle paint', clothing that can measure cardiopulmonary performance and cars powered by 'fuel cells'. The discussion paper acknowledges that there exist differences of opinion about the risks associated with nanotechnology, but does not elaborate upon these in any detail.

In calling for public submissions, the taskforce assigned to the role of promoting consultation on a National Nanotechnology Strategy stated that 'Public engagement is critical to achieving the responsible development of nanotechnology and measures such as providing balanced information and a commitment to promoting constructive dialogue and providing opportunities for comment will assist this'.[19] While the taskforce had, in its words, 'consulted extensively with Federal and State government organisations, met with industry, science and community interested parties and commissioned research, conducted surveys and spoken at conferences'[20] it did not promote a dialogue within the broader community. Instead, it met people—mostly officials, experts and stakeholders—in arenas in which it felt comfortable and was least likely to meet 'ordinary' citizens. Therefore, it is not surprising that the taskforce decided that the best way to engage with the community was by calling for public submissions, rather than, for example, conducting a series of citizens' panels around the country.

There is some evidence, however, that suggests growing support for public participation in nanotechnology policy. When the Prime Minister's Science, Engineering and Innovation Council (PMSEIC) first advocated a National Nanotechnology Strategy to evaluate nanotechnology and its implications, it *did not* consider the matter of public participation in nanotechnology policy.[21] By 2005, however, the PMSEIC[22] was comparing favourably a DITR commissioned survey and its findings that almost half of the respondents displayed an awareness of nanotechnology, with similar findings emanating from a workshop organised by CSIRO Minerals. The significance of this is that the CSIRO workshop, as is explained below, took the form of a citizens' panel and the subsequent analysis was qualitative. That the PMSEIC was prepared to accept such research suggests the possibility of a changing attitude towards public participation in nanotechnology policy.

Like the DITR, CSIRO has promoted the benefits of nanotechnology, but most divisions have shown little interest in seriously engaging the community in a mutual dialogue over the future of Australian nanotechnology policy. Instead, the caricature of the apolitical scientist is reinforced by most of the websites produced under the umbrella of the Information, Manufacturing and Minerals sector. The websites are used to promote CSIRO's nanotechnology research and explain how it will benefit Australia. They provide profiles of key staff, contact details, news items, research of the respective divisions, list of achievements and links. Instead of treating members of the community as equals, they implicitly dismiss them as possessing a cognitive deficit that the CSIRO must rectify.

There are positive signs, however, that CSIRO is opening up to the possibilities of public participation in policymaking. Over the past few years, the Sustainable

Development section of CSIRO Minerals has worked with industry stakeholders and interested publics to stimulate public participation and incorporate the results into their analyses. More recently, some of this work has focussed on the economic, social and ethical dimensions of nanotechnologies. This is in keeping with CSIRO's Social and Economic Integration initiative (2002–2006) designed to make its research more relevant to the broader community.[23]

Notably, the Sustainable Development section of CSIRO Minerals organised two one-day workshops to further public participation in nanotechnology policy. The first was held in Bendigo, about 200 km north of Melbourne, in March 2004. A 'key informant approach' was utilised, which involved contacting by telephone 'likely participants' from the community, government, industry, the nanotechnology sector and academia.[24] In turn, these people were asked to recommend others who may be interested and could contribute to the workshop. Finally, a group was selected that would provide the most diverse range of inputs. The second workshop was held in Melbourne in December 2004. This time the participants were 'self-selected' interested publics, who had responded to postings in on-line forums, on university noticeboards and the Centre for Adult Education.[25]

The responses highlighted similarities, but also differences between the participants who attended the two workshops. The Bendigo workshop evidenced 'little in the way of nanotechnology-specific concerns'.[26] Instead, the participants used regional issues, such as economic development, employment, public health, and social and environmental sustainability, to analyse the nanotechnology scenarios. Moreover, they felt that CSIRO tended to adopt a public relations approach to public awareness and recommended that the CSIRO learn from the GMO debate and incorporate public consultation and public participation into planning and development, and ensure that it makes clear how the community's contributions will be considered in policy deliberations. The participants in Melbourne also evidenced concern for public health, the environment and workers, and sought greater democratic accountability from the CSIRO and researchers in general.[27] The concerns about regional issues expressed by the Bendigo participants were not raised in Melbourne and this was thought to be due to the participation of representatives from NGOs based in urban centres. Overall, it was concluded that policymakers had nothing to fear from public participation in nanotechnology policy.

This general overview of public participation in Australian nanotechnology policy shows that policymakers are anxious to promote nanotechnology and, generally, avoid engaging with the community. The workshops on nanotechnology held in Bendigo and Melbourne indicate that the Sustainable Development section within CSIRO Minerals constitutes, at the very least, a pocket of support within the CSIRO for genuine public participation. The conclusion of the Social and Economic Integration initiative in June 2006 does not necessarily mean that this expertise will be lost to the CSIRO; however, it suggests that the concepts of public dialogue and engagement may no longer be a priority. With the DITR continuing to emphasise survey research, the community appears effectively excluded from contributing in any meaningful sense to Australian nanotechnology policy.[28]

3. Explaining the Exclusion of the Community

Science and technology policies do not emerge in a policy vacuum; rather, they are consistent with certain modes of governance and complement styles of policymaking that can vary across policy sectors. In this final part, we explain how widespread

support within Australian political circles for a liberal-minimal state and 'new public management' underpins not just particular economic objectives, but also privileges the role of particular experts and policymakers over the citizenry. We contend this reveals a pervasive policy rationality that permits public consultation, but excludes authentic community participation in the policy process. Hence, the difference between *community participation* and *public consultation* is not a matter of semantics, but of governance.

Since the second half of the 1980s, Australian governments across the political spectrum have placed their faith in markets to stimulate economic growth and exports.[29] It is widely held that tariffs and other forms of subsidies, along with an insular and inward-looking manufacturing sector, have undermined Australia's long-term economic development and made it dependent on the resource sector. The response by the previous Labor government was to reassess its support for industry plans in favour of lowering tariffs, encouraging export-oriented manufacturing and actively supporting free trade in international forums, such as those for the General Agreement on Tariffs and Trade and the Asia Pacific Economic Cooperation. It was argued that competition and fewer impediments to market entry would foster competition, entrepreneurialism and expansion into global markets. The Liberal government that followed has continued this generally neo-classical economic policy, notably through the privatisation of government business enterprises.[30]

Corollaries of this were moves towards the 'new public management' of smaller and more efficient departments and agencies in keeping with the push for a smaller, liberal-minimal state. This has resulted in: the political appointment of departmental heads by ministers, rather than by public service boards or the like; departmental heads being held responsible, while ministers rarely resign; departmental heads and managers being granted greater autonomy, while being held accountable by performance contracts; the increased used of markets for the provision of public services; and a greater interest in public *consultation*. This mode of governance, while not essentially anti-democratic, neither facilitates nor promotes public participation in science and technology policy. Instead, the market mindset that accompanies the liberal-minimal state and new public management regards citizens as consumers of policy information, rather than as equal participants in the policy process. Certainly, this is consistent with the practice of the DITR in nanotechnology policy, and Biotechnology Australia (http://www.biotechnology.gov.au/) and the Office of the Gene Technology Regulator (http://www.ogtr.gov.au/) in biotechnology policy. All have mistakenly sought to manage these relations by depoliticising issues and/or alleviating with more facts what they implicitly regard as a 'cognitive deficit' among those who oppose elements of gene technology and their application.[31]

A further explanation for the privileging of experts and policymakers over the citizenry is the pervasiveness of a policy rationality that is consistent with a variant of the 'rational-comprehensive' model of policymaking. As an ideal type, this model requires policymakers to identify policy problems, determine and rank all the policy objectives and goals associated with the resolution of the problem, collect all the facts about the problem, identify, consider and rank all of the policy options, and choose that option that maximises the objectives and goals.[32] While the idea that policymakers can consider all possibilities has long been rebuked, the belief that policymaking is a job for policy specialists—people who are specifically trained in quantitative data collection and policy analysis—rather than 'ordinary'

citizens, appears entrenched in the DITR. Hence, innovation in science and technology is regarded as an essentially technical exercise. It is believed that science can discern truths about social reality, which can be used to formulate answers to policy problems. Moreover, the idea that policymakers engage in serious and meaningful dialogue with public values and emotions is dismissed as subjective and an irrational basis for policy.

Policymakers often meet calls for public involvement in the policy process with scepticism and this has led Tyler to make the crucial conceptual distinction between 'public consultation' and 'public participation'.[33] Tyler notes that, typically, policymakers respond by establishing a framework of public consultation, which involves their conducting public hearings and calling for written submissions on proposals that have more-or-less already been decided on.[34] The policymakers retain responsibility for policy outputs. Using Arnstein's ladder of citizen participation,[35] Tyler situates 'this approach between "informing" and "placation" within the broader description of "tokenism"'.[36] While there is space for interested publics to provide inputs into the policy process, there is no space for on-going discussion nor is there a requirement for policymakers to reply formally after they have consulted.

Whereas public consultation constitutes a specific stage in the policy process, Tyler conceptualises public participation as on going.[37] Interested publics provide inputs into the process *before* options are decided on. The policymakers then use these inputs to establish policy options for the interested publics to consider. Although policymakers retain ultimate responsibility for policy design and implementation, responsibility is shared between policymakers and interested publics in analysing the problem, deciding on policy options and evaluating the agreed policy.

It is this distinction between 'participation' and 'consultation' that is crucial to the debate over whether the wider community should be involved in science and technology policy. On the one hand, there are those policymakers who recognise consultation as part of the policy process, but are much less comfortable with the idea of an on-going process of public participation. These people realise that public policy is affected by politics, that is, peoples' values and interests, however, they believe that politics undermines rational decision-making and notions of smaller, limited government. Thus, 'consultation' is undertaken with the intention of drawing support for the preferred position of the policymakers and to present a veneer of democratic accountability to those whose values and interests will be undermined by the policy output. On the other hand, there are those who advocate public participation throughout the policy process. Many of these people not only value the knowledge that can be tapped from the broader community, but also the potential for personal transformation.

4. A Successful Nanotechnology Policy?

The prospect for a successful nanotechnology policy—one that presents a long-term upward growth trajectory with benefits spread widely throughout the community—is unlikely under the current policy regime. The current policy over-emphasises the business elements of innovation at the expense of the social and political dimensions that affect the long-term sustainability of innovative technologies. Science and innovation policies that policymakers in Australia regard as crucial to the national interest are already meeting considerable opposition from stakeholders and community members. For example, opposition to biotechnology has forced the

Australian government agency, Biotechnology Australia, to ascertain the degree and nature of support/opposition in regular surveys and to devise strategies that promote public acceptance of biotechnology. Public scepticism has also been directed towards the government's policies on the enhanced greenhouse effect, salinity and information and communication technologies. Rightly or wrongly, many members of the community do not trust the analyses provided by the Commonwealth government and its departments.[38]

It is crucial to the introduction and application of innovative technologies—in particular, nanotechnology, biotechnology, photonics, and information and communications technology—that governments effectively manage the interaction between researchers, stakeholders and the wider community. The Australian government agencies, Biotechnology Australia and the Office of the Gene Technology Regulator, have mistakenly sought to manage these relations by depoliticising issues and/or alleviating with more facts what they implicitly regard as a 'cognitive deficit' among those who oppose elements of gene technology and their application.[39] The moratorium by State governments on the general release of genetically modified canola and the continued opposition within the community indicate that this strategy is not entirely successful in managing the political, social and economic issues associated with gene technology policy.

Deliberative inclusionary processes (DIPs), such as the citizens' juries conducted by the Sustainable Development section of CSIRO Minerals, can constitute the bases of an alternative and more effective approach to the management of science and innovation policy. DIPs have received positive evaluations from participants and organisers overseas; however, little research work has been undertaken into the applicability of DIPs across a range of policy sectors. Insufficient interest in the community may not warrant the time and cost of a DIP. Alternatively, it may be the case that opposition from policymakers and other experts to the use of DIPs will be too great. Nevertheless, opposition to innovation needs to be heard and in a legitimate forum and considered in a transparent process, if it is to be addressed to the mutual satisfaction of all parties. 'Rational' discussion, in the form of information supplied through official channels, will not suffice.

In conclusion, if Australia is to establish a sustainable nanotechnology policy, then it must broaden its perspective and more carefully consider the social, ethical and environmental aspects of nanotechnology. We support the goal of shared economic growth through technological advancement; however, this seems unlikely as long as the Australian government persists with what is essentially a technical and socially exclusive approach to stimulating innovation in nanotechnology. While opposition to nanotechnology is still 'thin on the ground', it is starting to emerge and the Commonwealth and State governments would do well to treat it with respect. To do otherwise will risk alienating sufficient people to put at risk hopes of achieving long-term economic development and prosperity.

Notes and References

1. Michael E. Porter, *The Competitive Advantage of Nations*, Macmillan, London, 1990.
2. The Royal Society and The Royal Academy of Engineering, *Nanoscience and Nanotechnologies: Opportunities and Uncertainties*, 2004, p. 5. Available at: http://www.nanotec.org.uk/finalReport.htm, accessed 25 August 2006.
3. R. Schibeci and J. Harwood, 'Stimulating authentic community involvement in biotechnology policy in Australia', *Public Understanding of Science*, 16, 2, 2007, pp. 244–55.

4. R. A. Schibeci, J. M. Harwood and H. Dietrich, 'Community involvement in biotechnology policy? The Australian experience', *Science Communication*, 27, 1, 2006, pp. 429–45.
5. For example, S. Benn, 'Managing toxic chemicals in Australia: a regional analysis of the risk society', *Journal of Risk Research*, 7, 4, 2004, pp. 399–412.
6. See, for examples, J. Bush, S. Moffatt and C. E. Dunn, 'Keeping the public informed? Public negotiation of air quality information', *Public Understanding of Science*, 10, 2, 2001, pp. 213–29; P. Taylor-Gooby, 'Social divisions of trust: scepticism and democracy in the GM Nation? debate', *Journal of Risk Research*, 9, 1, 2006, pp. 75–95.
7. See, for examples, Frank Fischer, *Citizens, Experts and the Environment: The Politics of Local Knowledge*, Duke University Press, Durham, 2002; William R. Freudenburg, 'Can we learn from failure? Examining US experiences with nuclear repository siting', *Journal of Risk Research*, 7, 2, 2004, pp. 153–69.
8. See, for examples, H. Catt and M. Murphy, 'What voice for the people? Categorising methods of public consultation', *Australian Journal of Political Science*, 38, 3, 2003, pp. 407–21; A. Davison and R. A. Schibeci, 'The consensus conference as a mechanism for community responsive technology policy', *Melbourne Studies in Education*, 41, 2000, pp. 47–59; D. M. Konisky and T. C. Beierle, 'Innovations in public participation and environmental decision making: examples from the Great Lakes region', *Society and Natural Resources*, 14, 2001, pp. 815–26; M. Nishizawa and O. Renn, 'Responding to public demand for assurance of genetically modified crops: case from Japan', *Journal of Risk Research*, 9, 1, 2006, pp. 41–56.
9. C. S. King, K. M. Feltey and B. O. Susel, 'The question of participation: toward authentic public participation in public administration', *Public Administration Review*, 58, 1998, p. 324.
10. R. A. Irwin and J. Stansbury, 'Citizen participation in decision-making: is it worth the effort?', *Public Administration Review*, 64, 2004, pp. 58–60.
11. L. Crase, B. Dollery and J. Wallis, 'Community consultation in public policy: the case of the Murray–Darling Basin of Australia', *Australian Journal of Political Science*, 40, 2, 2005, p. 226.
12. L. Carson and B. Martin, 'Random selection of citizens for technological decision making', *Science and Public Policy*, 29, 2002, pp. 105–13.
13. King *et al.*, *op. cit.*, p. 324.
14. Council for Science and Technology, *Policy through Dialogue: Informing Policies Based on Science and Technology*, 2005. Available at: http://www2.cst.gov.uk/cst/reports/files/policy-through-dialogue/report.pdf, accessed 23 August 2007.
15. *Ibid.*
16. *Ibid.*
17. Department of Industry, Technology and Resources, *A Discussion Paper on Issues to be Considered in a National Nanotechnology Strategy*, 2006, pp. 4–5. Available at: http://nano.foe.org.au/filestore2/download/92/Nanotechnology%20Taskforce%20discussion%20paper%2001.04.06.pdf, accessed 24 August 2006.
18. *Ibid*, p. 5.
19. *Ibid*, p. 3.
20. *Ibid*, p. 2.
21. Prime Minister's Science, Engineering and Innovation Council, *Nanotechnology—The Technology of the 21st Century: The Economic Impact of Emerging Nanometre Scale Technologies*, 1999. Available at: http://www.dest.gov.au/NR/rdonlyres/10B0670A-DE96-4BB7-A5CB-58B9687BC699/1982/Nanotech.pdf, accessed 24 August 2006.
22. Prime Minister's Science, Engineering and Innovation Council, *Nanotechnology: Enabling Technologies for Australian Innovative Industries*, 2005, p. 34. Available at: http://www.dest.gov.au/NR/rdonlyres/1E1B501A-727A-4153-85EF-134B2DAF0925/4112/nanotechnology_pmseic110305.pdf, accessed 24 August 2006.
23. CSIRO, *Social and Economic Integration Emerging Science Initiative*, no date. Available at: http://www.csiro.au/proprietaryDocuments/SEI_Flyer.pdf#search=%22Social%20and%20Economic%20Integration%20Emerging%20Science%20Initiative%22, accessed 24 August 2006.

24. W. Mee, R. Lovel, F. Solomon, A. Kearns, F. Cameron and T. Terry, *Nanotechnology: The Bendigo Workshop*, CSIRO Minerals Report DMR–2561, 2004, pp. 3–4. Available at: http://www.minerals.csiro.au/sd/pubs/Public%20report.pdf, accessed 24 August 2006.
25. E. Katz, R. Lovel, W. Mee and F. Solomon, *Citizens' Panel on Nanotechnology: Report to Participants*, CSIRO Minerals Report DMR–2673, 2005, p. 2. Available at: http://www.minerals.csiro.au/sd/pubs/Citizens_Panel_Report_to_Participants_April_2005_final_110.pdf, accessed 24 August 2006.
26. Mee *et al.*, *op. cit.*, p. 12.
27. Katz *et al.*, *op. cit.*, pp. 11–2.
28. This conclusion was also drawn by D. M. Bowman and G. A. Hodge, 'Nanotechnology and public interest dialogue: some international observations', *Bulletin of Science, Technology and Society*, 27, 2, 2007, pp. 118–32, who described the introduction of nanotechnology in Australia as 'conservative, corporate-oriented' and the approach to stimulating public dialogue as 'minimalist'.
29. Stephen Bell, *Australian Manufacturing and the State: The Politics of Industry Policy in the Post-War Era*, Cambridge University Press, Cambridge, 1993, pp. 146–56.
30. See, for examples, C. Aulich and J. O'Flynn, 'John Howard: the great privatiser?', *Australian Journal of Political Science*, 42, 2, 2007, pp. 365–81; S. Svensen and J. Teacher, 'Restructuring the Australian state: a bipartisan agenda?', *Public Management Review*, 1, 3, 1999, pp. 329–48.
31. Schibeci *et al.*, *op. cit.*
32. Peter Bridgman and Glyn Davis, *The Australian Policy Handbook*, 2nd edition, Allen and Unwin, St Leonards, 2000, p. 48.
33. N. Tyler, 'Practical experience of public participation: evidence from methodological experiments', *Innovation: The European Journal of Social Research*, 16, 3, 2003, pp. 253–70.
34. *Ibid*, pp. 255–6.
35. S. Arnstein, 'A ladder of citizen participation', *Journal of the American Institute of Planners*, 35, 1969, pp. 216–24.
36. Tyler, *op. cit.*, p. 256.
37. *Ibid*, pp. 257–8.
38. H. Dietrich and R. Schibeci, 'Beyond public perceptions of gene technology: community participation in public policy in Australia', *Public Understanding of Science*, 12, 4, 2003, pp. 381–401.
39. Schibeci *et al.*, *op. cit.*