Environment Agency

using science to create a better place

A people's inquiry on nanotechnology and the environment

Science Report

SCHO0607BMUJ-E-P

The Environment Agency is the leading public body protecting and improving the environment in England and Wales.

It's our job to make sure that air, land and water are looked after by everyone in today's society, so that tomorrow's generations inherit a cleaner, healthier world.

Our work includes tackling flooding and pollution incidents, reducing industry's impacts on the environment, cleaning up rivers, coastal waters and contaminated land, and improving wildlife habitats.

This report is the result of research commissioned and funded by the Environment Agency's Science Programme.

Published by:
Environment Agency, Rio House, Waterside Drive, Aztec West, Almondsbury, Bristol, BS32 4UD
Tel: 01454 624400 Fax: 01454 624409
www.environment-agency.gov.uk

ISBN: 978-1-84432-782-9

Further copies of this report are available from:
The Environment Agency's National Customer Contact Centre by emailing:
enquiries@environment-agency.gov.uk
or by telephoning 08708 506506.

Author(s):
Phil Irving
Brian Bone
Emma Hayes
John Colvin
Jimi Irwin
Jack Stilgoe (Demos)
Kevin Jones (University of Liverpool)

Dissemination Status:
Publicly available / released to all regions

Keywords:
Nanotechnology, people's inquiry, upstream engagement, environment, remediation

Environment Agency's Project Manager:
Phil Irving
Environmental Policy, Environment Agency, Kings Meadow House, Kings Meadow Road, Reading, Berks, RG1 8DQ

Collaborators:
Demos
University of Liverpool

Product Code:
SCHO0607BMUJ-E-P

Science at the Environment Agency

Science underpins the work of the Environment Agency. It provides an up-to-date understanding of the world about us and helps us to develop monitoring tools and techniques to manage our environment as efficiently and effectively as possible.

The work of the Environment Agency's Science Group is a key ingredient in the partnership between research, policy and operations that enables the Environment Agency to protect and restore our environment.

The science programme focuses on five main areas of activity:

- **Setting the agenda**, by identifying where strategic science can inform our evidence-based policies, advisory and regulatory roles;
- **Funding science**, by supporting programmes, projects and people in response to long-term strategic needs, medium-term policy priorities and shorter-term operational requirements;
- **Managing science**, by ensuring that our programmes and projects are fit for purpose and executed according to international scientific standards;
- **Carrying out science**, by undertaking research – either by contracting it out to research organisations and consultancies or by doing it ourselves;
- **Delivering information, advice, tools and techniques**, by making appropriate products available to our policy and operations staff.

Steve Killeen

Head of Science

Executive summary

Technological innovation is vital to the economy and it can help organisations such as the Environment Agency protect and improve the environment. But with new technologies come new unknowns and the potential for new risks. Technology developers, regulators and, indeed, all of us hope to benefit from technological advancements, but we could also suffer if things go wrong. Technology has brought us many benefits but also unanticipated effects, including adverse consequences. The independent think tank Demos and other groups argue that open debate can guide the development of new technology and that, for maximum benefit, dialogue should begin early – this is known as 'upstream engagement'.

In 2005, the government's Office of Science and Innovation funded a project called the *NanoDialogues* to test the usefulness of upstream engagement. The project ran four exercises, each with a different partner and each focusing on an aspect of nanotechnology. This report describes one of these exercises, involving the Environment Agency. The other exercises were:

- *Bio-nanotechnology and the implications of convergence*, with the Biotechnology and Biological Sciences Research Council (BBSRC) and the Engineering and Physical Sciences Research Council (EPSRC). Key questions of the exercise were: What might be at stake in convergence between bio- and nanotechnologies? How can research priorities anticipate and reflect these concerns?
- *Globalisation and nanodiffusion*, with the campaign group Practical Action. The main questions addressed were: How can debates about nanotechnologies be extended to include the public in developing countries? What are the potential impacts and concerns from the perspective of communities in southern Africa?
- *Public engagement in the corporate innovation cycle*, with Unilever. This exercise asked: What assumptions are made about public attitudes throughout the research and development process? At what stage can social intelligence be brought into the mix?

The Environment Agency carried out *A people's inquiry on nanotechnology and the environment*, focusing on the use of nanoparticles to treat chemical contamination released into the natural environment. Our inquiry took place over three days at the beginning of 2006 and involved a group of 13 people from East London who knew very little about nanotechnology. The group was asked to discuss new technology in general before moving on to nanotechnology and its application to cleaning up the environment. Demos organised and ran the event and a number of experts shared their knowledge and answered questions. The participants were actively involved and heeded encouragement to question the material presented to them.

A number of themes emerged during the inquiry, the first of which was uncertainty. Participants acknowledged the scientific uncertainties surrounding the fate and transport of nanoparticles once released into the natural environment. They recognised that, at the time of the inquiry, information simply did not exist to allow anyone to say, with any certainty, what would happen if substances such as nanoscale iron were released to tackle chemical contamination. Unsurprisingly, the group's recommendations included calls for more research, for information sharing and for a cautionary approach to regulation.

The second theme was openness. The participants called for honesty and clarity about what was known and what wasn't, and about how decisions were made. A few sceptical comments revealed suspicions that exercises such as the one carried out here were undertaken only so that 'boxes could be ticked'.

The third theme to emerge was the importance of context for discussions about science, technology and risk. Several people observed that technological developments might

benefit them individually, but expressed fears and concerns about the motivations of industry and, mindful of the uncertainties, the likelihood that regulators would be able to do their jobs effectively. Participants also wanted to know whether other technologies that were better developed and understood might not be used instead. Regeneration of industrial land entered the conversation – all of the panel lived in East London and wondered if nanotechnology might feature in the development of the 2012 Olympics site.

Our inquiry produced 12 recommendations, endorsed by all of the participants. These called for caution until more is known about the consequences of releasing nanoparticles into the natural environment, and for more research, in particular long-term research undertaken in real-life situations with all findings published. A further recommendation was for more forums to enable wider groups of people to find out what was happening, to engage in debate and to contribute to both the monitoring and regulation of nanotechnology.

Many of the recommendations were about consultation, communication and engagement. The participants valued their opportunity to be involved in the inquiry and called for more opportunities for this type of initiative. Whilst the complexity surrounding the regulation of new technologies – from manufacture to ultimate disposal – surprised the participants, they were clear about wanting to see an open and flexible approach to regulation. Demos concluded that, at the end of the process, the mood of the participants was one of informed scepticism but, interestingly, their conversation closely matched that taking place at the time between scientists in the UK.

To summarise, this inquiry established a meaningful dialogue where issues important to the general public clearly emerged, including openness and honesty, especially where scientific uncertainty is concerned, and context. Participants highlighted the need to be cautious in the face of uncertainty and to resist pressure from those who stand to gain financially at the possible expense of others.

We conclude that early engagement can add value to the work of the Environment Agency, and is likely to add most value where we are either:

- in a position to act on any recommendations made in the short to medium term;
- where we believe that socially-framed evidence is lacking and that this may threaten our ability to effectively carry out our functions in the future.

We plan to undertake further work to help us understand how we might use the social intelligence from this experiment. This work will seek to ensure that we are well placed to decide when and how to gather social data to inform our decisions and our advice to others.

Regarding nanoremediation, we will inform our operational staff (technical specialists based in our Area offices) of the issues around the deliberate release of engineered nanoparticles. We will also engage with local authorities as they lead on planning issues and most remediation is carried out through the planning system. To help achieve effective communication we will work with Defra to inform the Department for Communities and Local Government (CLG) of the issues and encourage the development of a reporting system to minimise the chance of a nanoremediation proposal being approved without due consideration of both the benefits and the associated risks.

Acknowledgements

This report is the result of work jointly funded by the Environment Agency and by the Office of Science and Innovation under its Sciencewise programme. We would like to thank the NanoDialogues steering group for its comments during the planning phase and Demos who designed and facilitated the experiment with support from Gillian Thomas. Demos wrote Chapter 2 and Appendix B of this report. The University of Liverpool Management School undertook an independent evaluation of the experiment and its report is included in Appendix C.

We would like to thank the residents of East London who came together to form our people's panel and whose interest, energy, insights and questions helped to shape a meaningful dialogue. That dialogue, however, could not have taken place without the participation of a number of experts who gave up their time to share their knowledge and perspectives with our panel and who did their best to answer the questions put to them.

The members of our people's panel were:

- Jackie Delventhal
- Dayvid Lott
- Eliza Mellen-Ikose
- Sam Phillips
- Denise Bingham
- Catherine Freeman
- David Donoghue
- Steve Butcher
- Nadia Milligan
- Terrence Nairne
- Santosh Chadda
- Davinia Hammond
- Debbie Perry

The experts were:

- Nicole Grobert (Oxford University)
- Olaf Bayer (Corporate Watch)
- Kristen Kulinowski (Rice University)
- Graham Norris (formerly of Golder Associates)
- Steven Banwart (University of Sheffield)
- Brian Bone (Environment Agency)
- Mike Raco (King's College London)
- Nick Christofi (Napier University)
- Julia Black (London School of Economics)
- Andy Stirling (University of Sussex)
- Doug Parr (Greenpeace)

The NanoDialogues steering group comprised:

- Rachel Bishop (Engineering and Physical Sciences Research Council)
- Sue Bolton (Nanotechnology Issues Dialogue Group)

- Adrian Butt (Department of Trade and Industry)
- Joanna Coleman (Biotechnology and Biological Sciences Research Council)
- Charles-Francois Gaudefroy (Unilever)
- David Grimshaw (Practical Action)
- Phil Irving (Environment Agency)
- Jimi Irwin (Environment Agency)
- Elaine Kearney (Sciencewise)
- Maggie Leggett (Biotechnology and Biological Sciences Research Council)
- Phil Macnaghten (University of Lancaster)
- Elizabeth Mitchell (Medical Research Council)
- Chris Snary (Department for Environment, Food and Rural Affairs)
- Jack Stilgoe (Demos)
- Gillian Thomas (Telling Research)
- James Wilsdon (Demos)
- Richard Wilson (Involve)
- Monica Winstanley (Biotechnology and Biological Sciences Research Council)
- Brian Wynne (University of Lancaster)

And finally, the Environment Agency's project steering group, that oversaw the people's inquiry, were:

- Brian Bone
- John Colvin
- Emma Hayes
- Phil Irving
- Jimi Irwin
- Richard Owen
- David Pugh
- Chris Snary (Defra)

Contents

1. Introduction

1.1 Background

> "Technological innovation is vital both to the economy and to the environment. Innovation drives much of our economic growth. And new technologies can deliver solutions to environmental problems."

Barbara Young
Chief Executive of the Environment Agency
Foreword to *See-through Science* (Wilsdon and Willis, 2004)

There you have it. The development of new technologies is not only important for the economy but it can also help us protect and enhance environmental quality. But it can, of course, damage the environment unless appropriate controls are in place.

One of the biggest challenges facing mankind is our changing climate[1]. As the debate on climate change gathers pace, it is becoming increasingly clear that technology is both implicated as one of the causes (IPCC, 2001) and may need to play a major role in helping us mitigate harmful emissions and adapt to new climatic conditions. Regulation will be important, as will responsible technological development along with the choices that we all make every day – notably those relating to energy use – and our attitudes to the environment. Existing regulatory approaches are suitable for regulating the development of some technologies, but others will require organisations such as the Environment Agency to develop new approaches. In her foreword to *See-through Science*, Barbara Young adds that "broader societal acceptance of new technologies, especially where they are novel and raise concerns, requires open dialogue…[where] engagement and dialogue must take place at the right time and involve the right people".

See-through Science puts a strong case for 'upstream' public engagement. The independent think tank Demos believes that public involvement can be constructive if it takes place at a point in the development lifecycle of a new technology when its final characteristics and the applications to which it will be put have not been set in stone. The problem comes in generating sufficient interest, where people are prepared to engage in meaningful dialogue about future possibilities.

Discussions about public engagement in policy-making usually recall the difficulties encountered in addressing issues such as genetically modified (GM) food. Information provision and dialogue and the implications for public trust in government have been widely discussed (see for example, Horlick-Jones *et al.*, 2004) and with the benefit of hindsight, it is clear that earlier dialogue could have been beneficial in the case of GM. But the question remains, would it have been possible at a sufficiently early stage to foresee how the science of genetic modification would develop, and establish a meaningful debate that could have influenced the development and acceptance of its applications? We cannot know.

1.2 The nano angle

Exploitation of materials at the nanoscale (from 100 nm down to the size of atoms, at approximately 0.2 nm) is a fast-growing area that has the potential to yield significant

[1] Tony Blair (2004) – see http://www.number-10.gov.uk/output/page6333.asp

benefits to society (see for example, Owen and Depledge, 2005). Research and development is already well underway to exploit new and beneficial properties that emerge at the nanoscale. Early applications include thin coatings used in electronics and active surfaces such as self-cleaning windows; cosmetics; sunscreens and wound dressings. In July 2004, the Royal Society and the Royal Academy of Engineering published a report, *Nanoscience and nanotechnologies: opportunities and uncertainties*. Amongst the recommendations made was a call for more research into public attitudes and for government to initiate public dialogue on the development of nanotechnologies.

The government's Office of Science and Innovation (OSI) decided, in 2005, to fund a project called the *NanoDialogues* to evaluate the role and possible benefits of 'upstream engagement'[2]. The project set out to address issues such as what 'upstream' dialogue entails; when it is realistic to raise issues of social concern; how and on whose terms such issues should be debated; how engagement can be reconciled with the need to maintain the independence of science; and the economic dynamism of its applications. The project's aims were to:

- experiment with new methods of 'upstream' public dialogue on nanotechnologies;
- ensure that these dialogue experiments were framed in a way to inform institutional decision-making and priority-setting;
- generate intellectual and practical resources for public, policy and scientific debate about the social implications of nanotechnologies;
- identify wider lessons and insights to inform the policy and practice of public engagement in science and technology.

Demos led the project which comprised four separate experiments, each with a different partner (more information is available from http://www.demos.co.uk). The Environment Agency was one such partner and this report describes our experiment and the lessons learned. The findings of this report will be considered alongside those from the other three experiments when they are completed, and a report outlining the *NanoDialogues* project will be issued in 2007.

1.3 The Environment Agency's exercise: a people's inquiry on nanotechnology and the environment

1.3.1 Our aspirations

In 2004, the Environment Agency sponsored the publication of *See-through Science* by Demos (Wilsdon and Willis, 2004). We welcomed the OSI's decision to initiate the *NanoDialogues* project in 2005, along with the opportunity to become a partner. The project offered a means of testing the utility of 'upstream' engagement and gaining valuable evidence to help us and colleagues in the Department for Environment, Food and Rural Affairs (Defra) with ongoing work on nanotechnology policy and, in particular, environmental clean-up. Appendix A lays out our thinking in August 2005, early in the planning phase of this experiment.

Our reasons for becoming involved in this project included the chance to establish a meaningful dialogue with members of the public, to explore how trust is developed and to generate 'social intelligence' to guide our policy discussions in two areas, namely

[2] These dialogues are not fully 'upstream' in the sense of *See-through Science*. However, nanotechnology is at a relatively early stage of development, notwithstanding the fact that some products have already been brought to the market.

environmental remediation (clean-up) policy and nanotechnology policy. In particular we wanted to:

- understand the issues that are important to the public as regulatory frameworks are put into place;
- explore attitudes to risk-based decision-making and the role of precaution in regulating new technologies;
- avoid (if possible) the development of new technologies being held back by misplaced public concerns and equally, to ensure (where possible) that well-placed public concerns and public views contribute to the debate.

The project also offered an opportunity to learn more about the role of 'socially framed' evidence in policy-making, and the usefulness of the approach adopted here (based on a citizens' jury) to provide such 'social intelligence'.

1.3.2 Background

The Royal Society and Royal Academy of Engineering report (2004) states that many nanotechnologies pose no new health and safety risks. But concerns remain over risks to human health and the environment from the deliberate and unintentional release of engineered nanoparticles in a free form. There is a significant knowledge gap regarding the fate, behaviour and toxicity of nanoparticles following environmental release, and one area of concern is the use of nanoparticles for treating contaminated soil and groundwater. The Royal Society and Royal Academy of Engineering report states that:

- "Until more is known about environmental impacts of nanoparticles and nanotubes, we recommend that the release of manufactured nanoparticles and nanotubes into the environment be avoided as far as possible" (Recommendation 4);
- "… that the use of free (that is, not fixed in a matrix) manufactured nanoparticles in environmental applications such as remediation be prohibited until appropriate research has been undertaken and it can be demonstrated that the potential benefits outweigh the potential risks" (Recommendation 5).

Globally, there is growing interest in using engineered nanoparticles to treat contaminated land and the first workshop of its kind, the *US Environmental Protection Agency Workshop on Nanotechnology for Site Remediation*[3], was held in Washington on 20-21 October 2005. In the US alone, 14 trials involving the injection of zero valent iron nanoparticles (mainly to treat chlorinated hydrocarbons) are known. Information from this workshop and other meetings also points to trials or commercial use in Germany, the Czech Republic, Italy and Canada (B. Bone, personal communication). Whilst nanoscale iron or bimetallic compounds have been used for the treatment of chlorinated hydrocarbons, a wide range of materials are currently being evaluated for remediation, such as biopolymers for the treatment of mercury (Kostal *et al*., 2003) and polycyclic aromatic hydrocarbons (Tungittiplakorn *et al*., 2005). The potential remediation market for engineered nanoparticles is significant as research on both materials and behaviour becomes more widely available, but only if the benefits of nanotechnology will be greater than the risks to the environment and human health.

1.3.3 Our experiment

Section 2 of this report, written by Demos, describes our experiment and presents the conclusions reached by our people's panel. Here we provide an overview of the scope of the experiment and some general details.

[3] See http://www.frtr.gov/nano/

Our focus is environmental remediation, by which we mean work carried out to deal with chemical contamination that has affected soil and groundwater quality. Many industrial activities have given rise to such contamination and some continue to do so (see for example, Environment Agency, 2005). The Environment Agency has a clearly defined role in dealing with soil and groundwater contamination[4]. Research and development is well underway to exploit the properties of nanoscale materials for this application (for example, Tratnyek and Johnson, 2006). Indeed, some trials have already taken place (Zhang, 2003).

For this experiment, our project steering group (comprising the Environment Agency, Defra and Demos representatives) decided to begin with the concept of new technologies, to follow this with sessions on nanotechnology and, finally, to introduce the topic of environmental remediation and the possible role of nanotechnological applications.

We labelled our experiment 'a people's inquiry', where we brought 13 members of the public together to talk with a range of experts, undertake research (such as searching on the internet), reflect together on what they learned and draw some conclusions. Our approach was similar to that used for a citizens' jury (Coote and Lenhaglan, 1997), with the main difference being the lack of a specific charge and no requirement for a verdict. The panel sessions took place in January and February 2006 on three separate Saturdays, with a free weekend between each of them. Panel members had all signed up to be involved in exercises such as this, without expressing any particular interest in issues such as nanotechnology or environmental remediation. Experts were drawn from a range of organisations: details are provided in Section 2 and Appendix B.

1.4 Report structure

This report is organised as follows:

- Section 2 – A people's inquiry on nanotechnology and the environment
- Section 3 – Responding to the panel's recommendations
- Section 4 – Discussion
- Section 5 – Conclusions

References and a glossary can be found at the end of the report. A number of supporting appendices provide further information.

[4] See http://www.environment-agency.gov.uk/subjects/landquality/113813/?version=1&lang=_e

2. A people's inquiry on nanotechnology and the environment

The conclusions of the people's panel

For three Saturdays, we have deliberated on the issue of nanotechnology and the environment. We have heard from leading experts with a range of perspectives. We have made these conclusions and recommendations:

1. Given what we have heard, nanoparticles should not be used to clean up contaminated land until we know more about their long-term effects.

2. This problem is more complicated than yes or no. Nanotechnologies should not all be treated as nanotechnology.
    a. Definitions of different areas of nanotechnology need to be made clearer.
    b. Distinctions need to be drawn between manufactured and existing nanoparticles.

3. Companies using nanotechnology in the environment should be obliged to conduct long-term research, in real-life situations. They should constantly monitor for unpredictable effects and be flexible in the face of changing circumstances.
    a. New types of testing and modelling should be used to increase our understanding of the effects of nanoparticles.

4. Tests of nanoparticles in the environment should take into account their location, particularly nearby human populations.

5. It should be mandatory to publicly declare the results of tests, good or bad. Research findings should be freely available.

6. We need a register of all organisations involved in nanotechnology to make monitoring easier. There is disagreement among the panel as to whether this should be voluntary, which would facilitate dialogue, or compulsory, which would be more robust and encourage public confidence. However, we support the efforts of Defra to put in place a notification scheme in the absence of legislation in this area.

7. We recommend the formation of a new group containing specialists and lay people to oversee research, monitoring, regulation and communication of issues around nanotechnology. This group would feed into all relevant government departments and agencies. It should have the power to recommend new areas of research.

8. In managing nanotechnology, as well as thinking about the UK situation, we need to think both more globally and more locally.
    a. The UK needs to be part of a global effort to realise the benefits of nanotechnology, and to research the health and environmental effects of nanoparticles. We need to know more about worldwide testing and monitoring.
    b. Different areas of the UK will have different contexts. Local communities should be involved in decisions about nanoparticles and the environment.

9. We should consider the place of nanotechnology in education. We need to hear the voices of young people in decisions about new technologies and the environment.

10. The monitoring and regulation of nanotechnology needs to be done by a broad group of people, including Defra, the Environment Agency, Environmental NGOs and lay people.

11. We need to increase the provision of information, debates, forums and literature about nanotechnologies.

12. We need to engage the public in nanotechnology issues as early as possible, in plain English and as economically as possible.

Written and agreed by the participants, March 2006

"2006, mark my words, is going to be a very, very important year for regulation in nanotechnologies. Extremely important." - Kristen Kulinowski, to the people's inquiry

21st January 2006 – "I feel like a nano-person"

Within an hour of arriving at the first day of the first Environment Agency **people's inquiry**, our participants were in the thick of a nanotechnology discussion. It didn't start well. The conversation moved through Mork and Mindy ("nanoo, nanoo",) and the Teletubbies' vacuum-cleaning pet (NooNoo) before David admitted, "We don't know. We don't do science." Finding out about the promise others held for nanotechnology, Debbie shrugged: "I feel like a nano-person."

A month later, after 15 hours' deliberation involving 11 expert visitors, the **people's panel** of 13 Londoners had produced a set of recommendations to address a policy question that at first glance seemed rather esoteric – How should we regulate the release of nanoparticles for land remediation? This three-day experiment in public engagement produced a wealth of insight into the public context of new technology.

Background

In 2004, a report from the Royal Society/Royal Academy of Engineering played a large part in setting the agenda for all things nano. The government response to this report heeded the warnings to manage the new uncertainties of nanotechnologies. For the purposes of our experiment in public engagement, two of the RS/RAE's recommendations are particularly pertinent:

Recommendation 4
Until more is known about the environmental impacts of nanoparticles and nanotubes, we recommend that the release of manufactured nanoparticles and nanotubes into the environment be avoided as far as possible.

Recommendation 5
We recommend… that the use of free (that is, not fixed in a matrix) manufactured nanoparticles in environmental applications such as remediation be prohibited until appropriate research has been undertaken and it can be demonstrated that the potential benefits outweigh the potential risks.

http://www.nanotec.org.uk/finalReport.htm

The RS/RAE report was produced by a group of experts from a range of areas – science, social science and engineering. As such it identified a range of uncertainties that were both technical and social – just as we don't yet know the implications or applications of some nanotechnologies, so we don't yet know what people will think of them.

The uncertainties around new nanoparticles in uncontrolled environments are given new meaning by research that has demonstrated an application in land remediation. Nanoparticles of iron have been tested and used in a number of countries to clean up pollution (particularly chlorinated hydrocarbons).[5] For a given mass, nanoparticles are more reactive than their bigger equivalents, and their size allows them to reach the parts of contaminated land that bigger particles cannot. In the USA, but also in Europe, what testing has taken place has focussed on the extent to which the nanoparticles are doing their job rather than possible unintended effects they may have.

Nano-remediation is a promising set of possibilities, but it also brings new concerns. Scientists and governments maintain that we don't know much about the effects of nanoparticles on the environment or the human body. For agencies whose responsibility is protecting the environment, there are no easy answers. And it is not even clear what questions should be asked.

Our public discussion had an interesting setting – a technology on the horizon, with suggested environmental benefits; expert advice that suggested we should prevent release

[5] See Zhang, 2003. Nanoscale iron particles for environmental remediation: an overview. *Journal of Nanoparticle Research,* 5, 323-332.

until we knew more; a small group of experts around the world, most of whom openly acknowledged the inherent uncertainties; and virtually non-existent public knowledge about the technology or its potential hazard.

The experiment was also set in a context of a recent wave of similar activities in the UK and abroad. At the highest levels of government, it has now become accepted that **public engagement** needs to "move from being an optional add-on to science-based policy making and should become a normal and integral part of the process."[6] And for this public engagement to be constructive, it should take place at a time when people can still influence the future of technologies. Demos and others have called this 'upstream' public engagement.[7]

On the recommendation of the RS/RAE report, nanotechnologies have been a test case for this new style of engagement. In the UK, the first such process was the **Nanojury** (www.nanojury.org), initiated by Greenpeace, the Guardian newspaper and researchers at the University of Newcastle. This Citizens' Jury produced a set of recommendations that encompassed the spending of public money on research, openness about scientific results, economic growth, ethics and more. Also in the UK, a Demos-Lancaster study on nanotechnology, risk and sustainability brought together 12 nanoscientists and 12 members of the public to share their hopes and fears for technology in the future.[8] This project revealed a deep public ambivalence, laden with hope of enormous benefits and fear that the myriad technologies would be unmanageable.

Elsewhere, experiments with nano-engagement have taken place in different ways. In Wisconsin, a panel of 13 people emerged from their three-day 'consensus conference' with experts recommending, among other things, that the burden of proof of nanotechnology safety should rest with the producer. In New Zealand, a project aiming to feed public views into nano-policy revealed particular concerns about nanoparticles in the environment.[9]

These projects had demonstrated that not only could public discussion of nanotechnology futures flow freely (with the right encouragement), but it could also generate well-thought out, well-informed **'social intelligence'**,

Our experiment had a more specific aim. Rather than looking for public deliberation on nanotechnology in general, our aim was to ask, in particular, about nanoparticles, their environmental applications and the role of regulation. We recruited 13 people from East London, an area of the country which has received more industrialisation, remediation and regeneration than most. Our group contained two teachers, a recruitment consultant, two nurses, a web developer and a full-time mother. The thing that united them was some form of participation in the life of their local community. This local involvement had two benefits. Firstly, our participants were talkative and keen to be involved. Secondly, they thought that what they said was important, and that it would be listened to.

Over the three days, our people's panel talked, listened and got to know each other. We brought before them a collection of some of the world's leading experts in nanotechnology and remediation, covering specifics from nanotoxicology, ecotoxicology, land contamination, land remediation, urban regeneration to law and the politics of regulation. We called these people our **VIPs – very important perspectives**. New technologies, and the claims people make about them, are at first sight faceless and intimidating. Our VIPs allowed the participants, in the words of one, "to put a human face to nanotechnology".

---

[6] House of Lords, "Science and Society", 2000
[7] See Wilsdon, J. and Willis, R., 2004. *See-through Science*. London: Demos.
[8] See Kearnes, M., Macnaghten, P. and Wilsdon, J., 2006. *Governing at the nanoscale*. London, Demos http://www.demos.co.uk/publications/governingatthenanoscale
[9] Cook, A.J. and Fairweather, J.R., 2005. *Nanotechnology - ethical and social issues: results from New Zealand focus groups*. December 2005 (http://www.lincoln.ac.nz/story_images/1330_RR281_s4140.pdf)

The VIPs

Day One – Saturday Jan 21st 2006
Steve Killeen, Environment Agency
Nicole Grobert, Oxford University (member of the RS/RAE group)
Olaf Bayer, Corporate Watch
Kristen Kulinowski, Rice University

Day Two – Saturday Feb 4th 2006
Graham Norris, formerly of Golder Associates
Steven Banwart, University of Sheffield
Brian Bone, Environment Agency
Mike Raco, King's College London
Nick Christofi, Napier University
(…with apologies from Paul Nathanail, University of Nottingham, whose son was ill)

Day Three – Saturday Feb 18th 2006
Julia Black, London School of Economics
Andy Stirling, University of Sussex
Doug Parr, Greenpeace

Why 'people's inquiry'?

We were keen to move away from the antagonistic language of a citizens' jury, where typically a 'charge' is presented, 'witnesses' are called and a 'verdict' agreed. Our experiment was designed to be a collective exploration, by members of the public and scientists, of the content and context of a new scientific issue. The phrase '**people's inquiry'** is a metaphorical extension of the 'public inquiry,' which is conducted *in* public, but not *by* the public. A public inquiry usually takes place after something has gone wrong. The purpose of the people's inquiry is to explore an issue of emerging scientific and public concern before it has impacted on the public consciousness. At this stage, we would hope, the conversation can be constructive rather than antagonistic.

Over three Saturdays, we invited VIPs from around the world to bring their perspectives to bear on the issue of nano-remediation. But their job was not just to explain what the facts were. They were there as much to explain **what science didn't know** and to help the panel explore relevant issues.

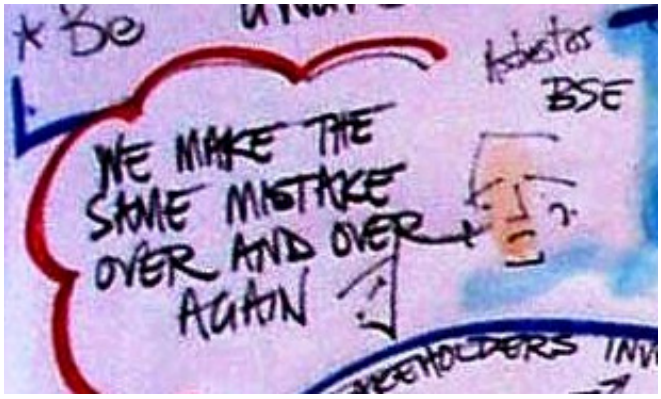
4th February 2006 – What's left unknown?

As on the first day, we began with an open discussion led by the participants. But this time our participants were able to draw on a fortnight of research, reflection and conversations with others. A tension was apparent between the novelty of nanotech in the public domain and the vast amount of unsifted information available on the internet. The perception was that big nanotechnology decisions had already been made and that policy and the public were struggling to keep up. Introducing the topic of land remediation into this sceptical environment prompted immediate questions about the benefits of nanoparticles and our understanding of their interaction with the environment. The panel realised that nothing is ever risk-free, but our uncertainties in this case seemed to be profound.

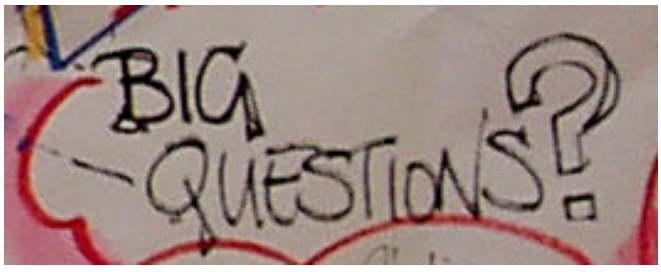
Discussion turned, unprompted, to nearby examples of contaminated sites – the Dagenham ford plant, the oil depot in Buncefield (scene of the recent fire) and the Olympic site. In this discussion, the broader context of regeneration was raised as an issue. The changes our participants saw happening around them were felt to be very fast, and they felt there was no time to question them, to object or to know enough about what's going on. Similarly, as we were reminded by one VIP, formal procedures for regulation and monitoring are very slow.

Open questions

When science and society are given the chance to engage in dialogue, the pattern of questions and answers reveals the dynamics of their relationship. Most of the time, science is constructed to answer the questions that it sets itself. Past studies of science-in-public have shown that, time and again, members of the public, NGOs and governments want to ask a very different set of questions.[10] And in public, as we saw with the cases of bovine spongiform encephalopathy and genetically modified foods, the credibility of science is tested by the questions that are asked of it.[11] Our participants mentioned both BSE and GM as important policy mistakes and reasons for low trust in government.



The people's inquiry provided a forum for members of the public to ask their questions, or at least have them noted. Our three days produced countless questions, addressed to individual witnesses, to government, to the Environment Agency and to the companies looking to take nano-remediation to market. Very few of these had answers, but they were all important.



Some questions were factual, asking how something works…

[10] Irwin, A. and Wynne, B., 1996. *Misunderstanding science? The public reconstruction of science and technology*. Cambridge: Cambridge University Press
[11] Stilgoe, J., 2005. Controlling mobile phone health risks in the UK: a fragile discourse of compliance. *Science and Public Policy*, Vol. 32(1).

"How do things actually stick to these nanoparticles? Is it that it's actually physically sticky or has it got little things like Velcro on it, or has it got sucky things that suck the contaminant out? Or is it a gluey thing?"

"Is the process of using nanoparticles for land remediation a quicker process than other methods?"

(all quotes, except where indicated, are from panel members)

Some questions echoed those of current scientific and regulatory concern…

"How far can the nanoparticles travel?"

"Presumably nobody's actually looked at whether the things could be made to break down in cells?"

But most were open questions which had no easy answers. They only pointed to the areas of concern that were likely to define the future public context of nanotechnologies and the environment…

"Will there be any unanticipated effects?"

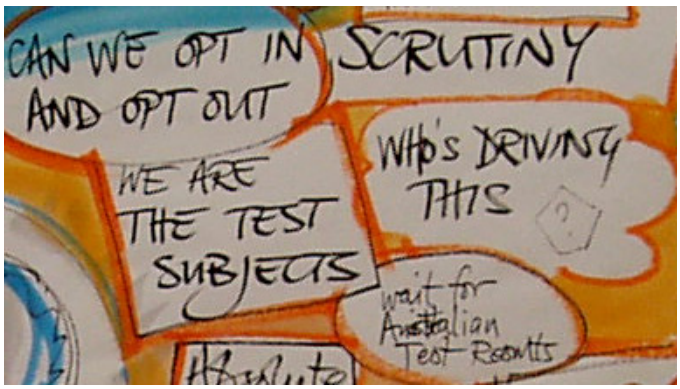
"Who has a say?"

"Would the fact that it's a quicker process mean that the safety issues may be overlooked?"

"What's the rush?"

"What about irresponsible companies?"

"Is information sharing too informal?"

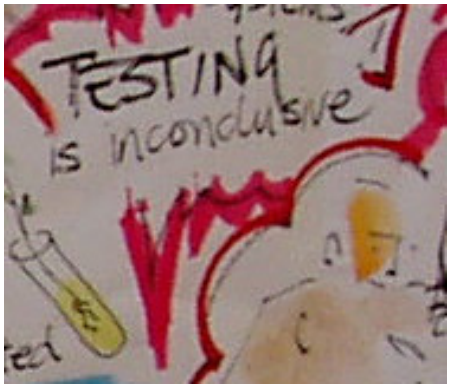


18th February 2006 – Recollecting and recommending

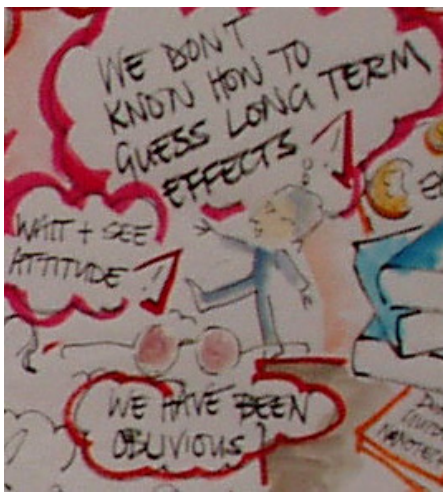
The final day's discussion turned to the question of what needed to be done. The morning provided an opportunity for the participants to impart their new-found expertise to our visiting regulatory experts and hear some new perspectives. Each new discussion revealed new difficulties, new uncertainties and new groups who might be interested. The multiple lines of debate continued down the stairs, out of the door and into the local Thai restaurant for lunch.

The realisation of the complexity of the issue tempered the recommendations that emerged from the afternoon. Well after the scheduled end of the session, the people's panel were still agreeing what they would say. Their product, which begins this report, represents some areas of agreement. But it by no means represents the quality or diversity of the discussion over the three days.

The panel's recommendations are not, on the whole, about what needs to be done and what regulations need to be put in place.



They are not about allowing or preventing certain things. They are about the sorts of relationships that would contribute to a sensible, credible regulatory roadmap. Three days of discussion, over which 13 members of the public felt increasingly able to contribute to decision-making, produced a paradoxical awareness that most of the important decisions were not the public's to make. The public does not want to be given control of new technologies. In this case, the public wanted to be able to trust that, when important decisions were taken, they would take into account the views, values and knowledge of stakeholders and potential stakeholders. Similarly, they wanted to know that, if ordinary people wanted to find out more and get involved, they would have access to information and receptive institutions. The recommendations tell a story of their own. But behind them lies some themes that characterised the rest of the conversation.



Big themes

Uncertainty

Our experiment was prompted by uncertainty – about effects and about ways forward. In past discussions of regulation, it has been observed that uncertainty is a challenge for risk assessment and for involving non-experts in decisions.[12] However, uncertainty is also at the heart of public discussions about risk issues. It is a feature that cannot be avoided if decisions are to be well-informed and publicly credible. It must be acknowledged and discussed as part of a regulatory move to openness.

> "But in fact the big question I think, that Olaf raised, or maybe alluded to was, when do we have enough information to allow government regulators to make decisions? I can't answer that question." – Kristen Kulinowski

Unlike other public engagement initiatives, our experiment began with an admission of uncertainty from all sides. This allowed for a constructive conversation to begin, exploring how different people define and describe the uncertainties they see as particularly relevant. It was clear that scientists currently know very little about the environmental fate of nanoparticles (what happens to them). Similarly, they are unsure about the transport of nanoparticles (where they end up). Both of these uncertainties were seen as important by the panel, whose discussions reinforced the need to keep uncertainty at the forefront of regulatory discussions, and to conduct more research before releasing nanoparticles.

> "Rumsfeld said, talking about weapons of mass destruction, there are things we know that we know, there are things we know we don't know, there are things we don't know that we don't know and I think this is one of those."

The panel were critical of claims that these uncertainties would be easy to resolve through more research. They agreed that testing would need to take place in real environments, but emphasised that these environments should be controlled – that is, there should not be full environmental release of nanoparticles.

There is clearly still much to find out about nanoparticles, but this should be done in a sensible, credible way. It should look at and monitor effects, intended and unintended. But, at the same time, our panel felt that research was not enough. There is room for precautionary policy designed to prevent release, as recommended by the RS/RAE report. Concern that regulatory research was struggling to keep up was reflected in a number of comments:

[12] Homan, J., Petts, J., Pollard, S.J.T. and Twigger-Ross, C., 2001. Participatory risk assessment for environmental decision-making. In: Andersson, K. (ed.) *VALDOR - VALues in Decisions On Risk*, pp. 398-406. Stockholm, Sweden, 10-14 June, 2001.

"Nobody seems to know enough. Everybody's holding their hands up straightaway to say, 'we do not know enough'… But still nobody seems to be saying 'well, why don't we wait until we have enough.'"

"But we can't do that because we're still not aware of what the risks are and there still haven't been safeguards put in. So we're the guinea pigs for this at the moment."

"What's happening to them, because we don't know how it breaks down, if it breaks down, whatever. So it's a little bit scary there, everybody knows that testing's inconclusive, but they've still gone ahead."

"When you give us an example of something like a nano-iron particle to do something to remove a contaminant from the soil, that's fine, right, cos you've probably done some work on a nano-iron particle to see what, the way it works and things. What's probably frightening is if you don't use an iron, a nano-iron particle but you use something else, will the same research and studies have been done on that particle, if that's being used to remove a contaminant? Does that make sense?"

It is clear that the uncertainty within this emerging issue needs to be seen in context. There are still few standards with which to understand nanotechnology. The resolution of uncertainty is complicated, as is deciding which uncertainties are most relevant. Certainly, we need to know more about the fate and transport of nanoparticles. But scientists must also ask another set of questions such as, how transferable is knowledge of one nanoparticle to others? How can we apply knowledge across different environments? How should we take account of unintended consequences? Scientists and regulators should be humble in the face of these questions, reflecting on their uncertainties and the public context of their knowledge. Knowledge of nanotechnology should grow without assumptions of simple benefits or simple risks. And it should grow in public, as openly as possible.

Openness

"So the number of case studies is very limited."

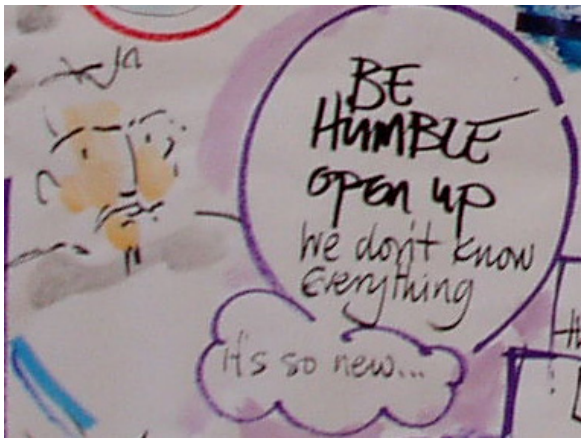
(Brian Bone) "Yes."

"Which places even more importance on the validity of having maybe a better, well it may be imperfect, but a better way of swapping information and tests and, so that maybe the tests are standardised so that somebody trying to ..."

(Brian Bone) "You've hit the nail on the head."

"Is that right?"

(Brian Bone) "Absolutely"



In such an uncertain environment, where information is hard to come by and policy hard to build, the panel were insistent that discussions between regulators, companies, local communities and members of the public should be as open as possible. Our participants were unsurprised that, as the issue had not yet attracted much public interest, information was not easily available in one place. They recommended that regulators should be proactive in making information available and accessible, rather than responding to public demands later in the day.

The openness which was evident as our experiment progressed could provide a model for future policy discussions. Throughout the process, VIPs were honest about the limits of their knowledge, eager to hear new perspectives and happy to have their take on the issue challenged. Similarly, the Environment Agency staff were enthusiastic and open-minded throughout, for which they received praise from the participants. Openness cannot just be about the availability of information. It also means viewing the problem as a collective one rather than just a scientific one.

Science, technology and risk in context

The chosen topic of our people's inquiry is not a 'risk issue', and it may never become one. But by prompting a public discussion, we can explore the boundaries of possible controversy and remind ourselves that risk issues are never just about risk.

Talk about risk always drags in other things. These things provide the context in which members of the public can make sense of science and technology. In the case of nano-remediation, our panel drew unavoidable connections with **the wider issue of regeneration**. The desire by the government to rebuild on brownfield land, requiring clean-up, was seen as having direct implications for remediation technologies. Surely the pressure to do things quickly would mean that regulation would always struggle to keep up?

What's the rush?

A: There was just one remark… it wasn't thrown away, but it was something to do with the lack of time, when you're looking at a site, it's the commercial drive and we need to do it now, we can't wait… because we're short on time we need to make a decision, therefore you haven't got the time to do this research, go ahead and do it anyway…. that's the thing that concerns me more than anything.

B: The Olympic thing, that's what might happen, yeah.

C: And we've already seen that in the Millennium Dome.

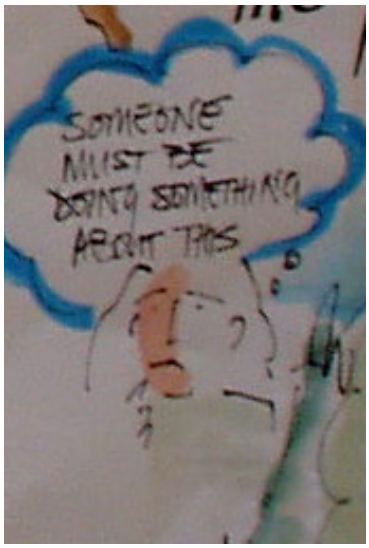
A: Exactly. It's done so fast. I first moved to London, 17 years ago.

C: It's different, a different world now.

The participants predicted that this rush, in which developers would ride roughshod over regulation and public concern, would be a particular problem when it came time to clean up the Olympic site, which currently cuts a grimy swathe through industrial East London.

The other important context for nano-remediation is that of **alternative technologies**.

"OK, nanoparticles can be used to clean up pollution, but is that the last resort? Is there nothing else that can do it?"



Presented with claims that nanoparticles would be a more effective way to clean up certain pollutants, people were as sceptical about benefits as they were about risks. People needed more convincing that nanoparticles presented a significantly increased benefit. Would they do new things or would they just do the same things better? More importantly, would they just do the same things more cheaply?

Questions of safety are tied up with questions of real-life application, alternatives and benefit. The difficulty is that in understanding and regulating new technologies, an organisation will necessarily have to strip away some of the meaning that members of the public might attach to issues.

Implications for regulation

> **A:** "With stringent controls, yeah. But if it's not controlled and if it's not over a long period of time, I think not, because I know that mankind has to advance… and you're supposed to get wiser as you go along, and we look back at things that have happened, decisions that people have made and we think now in all our wisdom, oh my God, what were we thinking about? And look, we're reaping the consequences now… we should take our time, and look into exactly what the consequences could be."
>
> **B:** "Do a bit more testing."
>
> **A:** "Over a long period of time, and then, after some measured testing and it's there and everybody looks at it and sees what the consequences are then we're saying, all right, well that was a good idea, let's do it."

When presented with the possibilities of nanotechnology, our participants assumed that someone would be in control. They were surprised to find out that responsibility for this issue, insofar as it existed, emerged from a complicated network of interactions.[13]

The regulation of new technologies poses fundamental problems for regulators in that it must take place in a context of uncertainty. Some uncertainties might be relatively easy to solve, through further research, but there are likely to be some things on which science will not be able to produce easy answers. They are, to use the phrase echoed by one participant, the things we "don't know we don't know." These areas are likely to characterise continuing discussions between scientists and the public in years to come, especially as nanotechnologies become more ubiquitous.[14]

This is important in the light of the recent move, across a range of policy areas, towards 'risk-based regulation'. The risk-based model looks to apply regulation proportionately and so reduce its overall burden. With new technologies, it is not simply a matter of regulating the *thing*. Regulation means understanding and controlling the system in which a technology is being developed and deployed. One of the participants made this point elegantly:

> "… because it's not nanoparticles we need to govern, it's the people that are making them and using them… say to them, OK, we're going to govern you – until you can show us basically X amount of tests have gone on over X amount of time, and show us some conclusive report, result basically, only then can you continue."

[13] See Kearnes, M., Macnaghten, P. and Wilsdon, J., 2006. *Governing at the nanoscale*, London, Demos, for a longer description of this point.

[14] Some commentators have referred to this as a problem of ignorance rather than uncertainty. See Wynne, B., 1992. Uncertainty and environmental learning - Reconceiving science and policy in the preventive paradigm. *Global Environmental Change*, 2 (2), 111-127.

But risk-based regulation assumes two things, both of which are problematic. First, it assumes that risks can be adequately assessed, and will be assessed in a similar way by companies, government, agencies, and so on. And second, it assumes that the acceptability of risks is something that most people agree on. Public concern is more likely to reflect what remains unknown, and it is likely that members of the public will have a collection of diverse opinions on what sorts of risk are acceptable. So while being risk-based is a sensible approach to regulation, regulators must not ignore areas of knowledge or uncertainty that people regard as important.

As regulation crystallises around nanoparticles, regulators should be acutely aware, as members of the public are, how quickly things can change. Behind many of the recommendations of the people's inquiry lies a desire for an **open, flexible approach to regulation.** Regulation should be proactive, rather than reactive, but it should also be responsive to the changing context of technology, which will include concerns and uncertainties about that technology.

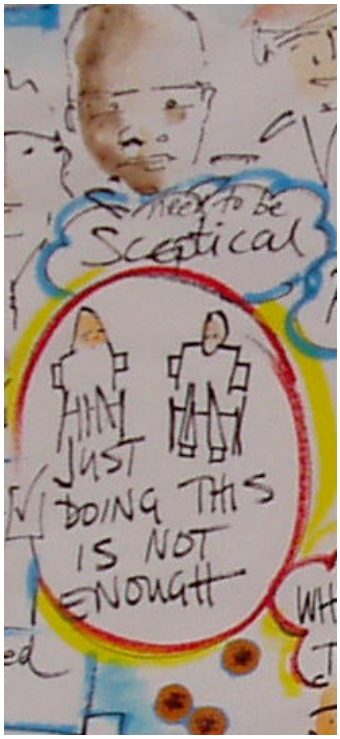
Lessons for upstream public engagement

Many of the panel's recommendations were about consultation, communication and engagement. Our participants valued their experience as part of the people's inquiry, but they thought that future public engagement needed to take place at different levels, and with different groups of people. In particular, as this issue impacted on communities, there needed to be more opportunities for local engagement in this issue, especially when new technologies are intended for use nearby.

Our experiment was designed to open up debate. The intention was never to come up with a firm idea about what the public think about new technologies. That said, the inescapable conclusion from this experiment was that it produced a public conversation that closely resembled the measured approach currently being taken by scientists in the UK. At the end of the process, the mood of the participants could perhaps be described as one of informed scepticism.

This informed scepticism extended to the power of the people's inquiry to make a difference. Participants worried that the process would be a way for organisations to tick a public engagement box and carry on. As organisers of the process, Demos and the Environment Agency have taken steps to ensure that the outcome of this experiment is both valuable and valued.

Compared with other 'upstream' public engagement, such as last year's Nanojury, our discussion had a more immediate focus. It was upstream in the sense that the technology had not (knowingly) been used in the UK. But it was also upstream in the sense that interests, risks, benefits and policies had not yet been defined. The people's inquiry was therefore well-placed to make sense of the diverse perspectives that currently define the issue. Our hope, and talking to the VIPs suggests this is reasonable, is that the visitors to the process left with a richer sense of the issue than they arrived with. In demanding open discussion of an emerging issue, perspectives and concerns were brought to the surface that might otherwise have remained hidden for years.



The people's inquiry model provides a useful way of opening up and exploring new areas, particularly for organisations beginning to shape their own perspectives on issues. All of the participants reported that they felt honoured to have been a part of this social experiment, and they praised the Environment Agency for supporting it and for their honesty throughout the process. It was clear however, and mentioned by the panel, that in the issue of nano-remediation, public engagement needed to continue in a different way, or rather in many different ways.

It is easy to assume that existing discussions among stakeholders will suffice. What is clear from our experiment is that there are many people with the potential and desire to become stakeholders, where previously they would have been uninterested. Local consultation of the sort that councils engage in should be extended to allow discussion of the scientific and technical aspects of what's going on in land remediation. The challenge ahead for this issue is to keep the discussion open – to make sure that, as this technology is tested, trialled and used, there is as much opportunity as possible for ordinary members of the public to find out where it's happening, find out what scientists and others think about it and offer their perspectives.

Postscript – A dialogue with Defra

A commonly-heard criticism of public engagement is that it fails to connect with policy-making. Members of the public and civil servants usually ask very different questions about an issue. But it is vital to try to extend dialogue into the places where decisions get made. With this in mind, and at the request of the participants, we took our people's inquiry to Whitehall. On a sunny afternoon in May 2006, four panel members met three members of the nanotechnology policy team at the Department for Environment, Food and Rural Affairs to reflect on their experiment and hear about the government's approach to nano and the environment.

The discussion reached beyond the panel's initial recommendations. David insisted that the issue was much broader than just land contamination. It was about trust, openness and learning the lessons from the GM controversy. Steve was glad to hear that the government were open about their uncertainties, and emphasised the importance of "looking for things you might not be looking for". Debbie felt honoured to have been a part of this experiment in public engagement and recommended more of the same. "We can help," she insisted, "and I feel like we can make some nanoscule contribution to society."

Representatives from the people's inquiry at the Department for Environment, Food and Rural Affairs, May 2006

3. Responding to the panel's recommendations

The Environment Agency and Defra prepared a response to the recommendations of the panel. This section presents the text of the response that was shared with the panel members in September 2006.

Recommendation 1

"Given what we have heard, nanoparticles should not be used to clean up contaminated land until we know more about their long-term effects."

We agree. We understand that nanotechnologies can potentially offer huge benefits in terms of cleaning up harmful pollutants and we have a real interest in ensuring that the best available technologies are used to improve and restore polluted environments. However, we need to be confident that the use of new technology will not introduce new risks to people's health or the broader environment, and that solving one problem does not cause others. We do not presently have enough information to assess risks confidently – we need to know more about how engineered nanoparticles behave in the environment, where they go, how they react, and their potential to cause harm. We have asked industry not to use nanoparticles in remediation until this understanding is there.

Some industry groups are interested in piloting nano-remediation in the UK. We have informed those that have contacted us of the government position and indicated that we would encourage them to undertake any field trials in controlled conditions, and undertake a detailed risk assessment prior to proceeding. We are working hard to ensure that there are good communication links between all parties involved in decisions about environmental clean-up. These include those responsible for the contamination, their remediation consultants and contractors, and Local Authorities, in addition to ourselves. It is important that everyone is aware of our position – that nanoparticles should not be used before we understand the risks involved – and that Defra and the Environment Agency are involved in decision-making where appropriate.

Recommendation 2

"This problem is more complicated than yes or no. Nanotechnologies should not all be treated as nanotechnology: (a) definitions of different areas of nanotechnology need to be made clearer; (b) distinctions need to be drawn between manufactured and existing nanoparticles."

We fully agree that there is nothing as straightforward as "nanotechnology". Some applications are simply employed to reduce the size of a particle, whereas others can result in complex combinations of chemicals and draw on the effects of quantum physics. The various applications can therefore present very different risks and benefits.

At present, the government is putting considerable work into better defining nanomaterials, working closely with organisations such as the British Standards Institute (BSI). The BSI has already come up with a book of terminology and is now working with the International Standards Organisation (ISO) to achieve a more widely agreed set of definitions and standards. Those involved are aware of the urgent nature of their work.

Government is looking at both manufactured and existing nanoparticles, but through different approaches. Existing nanoparticles, which come mainly from combustion, are being considered largely for their impact on our air quality. The quantity of these nanoparticles is much higher than that which is currently being made deliberately. Deliberately manufactured nanoparticles, including those that could be used in nano-remediation, are being addressed under a separate, dedicated programme of government research and policy development, which involves a number of government departments and agencies.

Recommendation 3

"Companies using nanotechnology in the environment should be obliged to conduct long-term research, in real-life situations. They should constantly monitor for unpredictable effects and be flexible in the face of changing circumstances: (a) new types of testing and modeling should be used to increase our understanding of the effects of nanoparticles."

We agree that where the use of nanotechnologies results in environmental exposure to deliberately manufactured nanomaterials, companies should work to understand the impact of the releases. Companies need to be flexible in this respect, constantly updating their use of nanotechnologies in line with emerging findings. We are taking this position forward in discussions about good practice with relevant industries, industry associations, and the Health and Safety Executive.

This work needs to be informed by more basic research to understand, for example, the way nanoparticles move in the environment and suitable metrics and devices for their measurement. The government is taking forward a programme of research to address these and other priority issues. More details can be found at: http://www.defra.gov.uk/environment/nanotech/research/index.htm

Recommendation 4

"Tests of nanoparticles in the environment should take into account their location, particularly nearby human populations."

We assume that the panel is referring to field remediation trials to develop good scientific understanding of how nanoparticles behave in 'real' environments.

It is very important that sites are selected carefully for such field trials. Selection criteria should include proximity to all receptors and the likelihood that inadvertent exposure could take place. We feel strongly that trial areas should be 'contained', that is with natural or engineered features present or constructed to prevent releases beyond the study area. This will help prevent inadvertent exposure of nearby people and environmental receptors such as watercourses and sensitive ecosystems.

We noted earlier, in our response to the first recommendation, that good communication between all parties involved in environmental remediation decisions is essential. This will give us the best possible chance of finding out about any trial so that we can encourage appropriate public engagement and an active approach to reducing risks to people and the broader environment

Recommendation 5

"It should be mandatory to publicly declare the results of tests, good or bad. Research findings should be freely available."

Openness and transparency are important characteristics of an effective environmental risk management process. For this reason, we will subject the results of all government-funded research on the environmental risks posed by nanotechnologies, to independent peer review, and place them in the public domain. We cannot, however, force industry to publish the results of its research as some of the information might be commercially confidential. In other words, the company that has undertaken the research might be placed at a competitive disadvantage if its data were to be made freely available. Government and its agencies have duties regarding health and environmental protection but we must also be mindful of the economic consequences of our actions. We are engaging actively with companies involved in researching and developing nanotechnology as noted previously. We hope, in this way, to develop good working relationships with those undertaking research in this area. This will enable us to have access to commercially sensitive data so that we can discuss them with our expert advisory committees, which consist of leading independent experts in relevant fields.

Recommendation 6

"We need a register of all organisations involved in nanotechnology to make monitoring easier. There is disagreement among the panel as to whether this should be voluntary, which would facilitate dialogue, or compulsory, which would be more robust and encourage public confidence. However, we support the efforts of Defra to put in place a notification scheme in the absence of legislation in this area."

We agree that it is important to monitor the manufacture and use of nanotechnologies in the UK. Defra, the Environment Agency and the Health and Safety Executive commissioned a study last year in order to find out more about the current and short-term future scope of manufacture and use of nanoparticles and nanotubes in the UK, and the report from this study can be found on the Defra nanotechnology website[15].

We thank the panel for recognising Defra's efforts to implement a Voluntary Reporting Scheme for engineered nanoscale materials[16]. The scheme was launched at the end of September 2006, and will run to September 2008. It will provide government with important information on the properties and characteristics of the engineered nanoscale materials being manufactured, used, researched and disposed of in the UK. The effectiveness of the scheme will be reviewed on a regular basis.

The design of the scheme was informed by a full public consultation, as well as a partial Regulatory Impact Assessment (RIA). The RIA considered a number of different options, including that of mandatory reporting, and concluded that at this point in time, a voluntary approach is the best option. The benefit of the voluntary approach is that it will allow government to build the evidence on the risks of engineered nanoscale materials more rapidly than other options, allowing faster progress towards a more informed debate about appropriate controls for the products of nanotechnologies.

[15] http://www.defra.gov.uk/environment/nanotech/research/reports/index.htm
[16] http://www.defra.gov.uk/environment/nanotech/index.htm

Recommendation 7

"We recommend the formation of a new group containing specialists and lay people to oversee research, monitoring, regulation and communication of issues around nanotechnology. This group would feed into all relevant government departments and agencies. It should have the power to recommend new areas of research."

Defra has already established the Nanotechnologies Stakeholder Forum to facilitate critical discussion of policy activities around nanotechnologies, including issues of research, monitoring, regulation and communication. Its outputs inform Defra's work in these areas, and also, where appropriate, the work of wider government (coordinated through the government's two cross-departmental groups on nanotechnologies). Members are drawn from academia, civil society organisations and industry. All of the meetings are open to the public.

We are interested to know if the inquiry panel members think this is the sort of approach that they had wanted. What more or different might inquiry members want?

Recommendation 8

8a)

"In managing nanotechnology, as well as thinking about the UK situation, we need to think both more globally and more locally: the UK needs to be part of a global effort to realize the benefits of nanotechnology, and to research the health and environmental effects of nanoparticles. We need to know more about worldwide testing and monitoring;"

Our global economy demands that we work with other countries around the world as we develop nanotechnology policies, build our scientific understanding, and learn from our experiences. We are working through the European Commission and the Organisation for Economic Cooperation and Development (OECD) to achieve this coordination.

8b)

"Different areas of the UK will have different contexts. Local communities should be involved in decisions about nanoparticles and the environment."

We recognise that people want to be involved in decisions about nanotechnology, especially in relation to its use near where they live. Currently, a formal consultation process operates through the planning system and we expect this to remain as the most important communication route for local community responses to be taken into account. However, we will also encourage both contractors and consultants to talk to the local community at an early stage, preferably before a remediation solution is selected to allow their views to be considered during decision-making.

We believe it is important to debate the justification for selecting a particular type of remediation, particularly the added benefit gained by using nanoparticles and the measures that would be taken to reduce risks. But, where trials are conducted for research purposes by either government or the private sector, we can only estimate what the added value might be. We want to promote openness and transparency about uncertainties and encourage careful estimation and management of risk by anyone involved in this work.

Recommendation 9

"We should consider the place of nanotechnology in education. We need to hear the voices of young people in decisions about new technologies and the environment."

We agree that it is important to include young people in discussions about new technologies and the environment, but believe they are one of many groups within society who should be involved in these discussions.

There are a number of existing programmes of work in this area, and a number of government departments, including the Department for Education and Skills, have important roles.

The Office of Science and Innovation's Sciencewise programme aims to help policy makers commission and make effective use of public dialogue to inform decisions related to emerging areas of science and technology. There are a number of projects funded through this programme (including the NanoDialogues, which you have been involved with). Another project is RiskyBusiness which aims to help 14-19 year olds explore risk and technology.

Defra has a number of pieces of work to engage with young people on environmental issues. More information about this work can be found on Defra's website (www.defra.gov.uk) under 'Education'.

There have already been some events where young people have been involved in discussions about nanotechnologies. For example, there have been a number of Small Talk (www.smalltalk.org.uk) events on nanotechnology which have involved young people. These include the Young People's Parliament in Birmingham in March 2006, and a schools' debate on nanotechnology for the Brighton Science Festival in February 2006.

Recommendation 10

"The monitoring and regulation of nanotechnology needs to be done by a broad group of people, including Defra, the Environment Agency, environmental NGOs and lay people."

The way in which industry is monitored and regulated involves a number of government departments and agencies, all of which have particular responsibilities. Additionally, companies involved in manufacturing and using the products of nanotechnologies may need to undertake their own monitoring. As the panel notes, nanotechnologies encompass a wide range of applications. This means that different applications fall under the responsibility of different regulators. Examples of relevant regulatory agencies include the Environment Agency, the Health and Safety Executive (HSE), the Food Standards Agency (FSA) and the Medicines and Healthcare products Regulatory Agency (MHRA). There is an important role for environmental NGOs and lay people in the regulatory process, but we accept that this is not always well-defined. We are prepared to work with all parties with a legitimate interest in these issues, as we work with other regulators to enforce the law.

Recommendation 11

"We need to increase the provision of information, debates, forums and literature about nanotechnologies."

Defra has, from the outset, sought to provide as much web-based information as possible on its policy-making and research activities on nanotechnologies (see: http://www.defra.gov.uk/environment/nanotech/index.htm). We are also aware that there is a considerable amount of information on the web provided by organisations such as the Institute of Nanotechnology, the European Commission, the BBC, and many others. Notably, the DTI has also sponsored an exhibition on nanotechnologies at the Science Museum. It would be helpful if the panel could expand on the types of information and discussion forums that they feel are currently lacking, including any views on how any new initiatives could be promoted to the wider public.

Recommendation 12

"We need to engage the public in nanotechnology issues as early as possible, in plain English and as economically as possible."

We agree. The Office of Science and Innovation has a programme of public engagement on nanotechnologies. This is designed to access the public's views on nanotechnologies and how their potential risks can be managed most effectively. The Nanotechnology Engagement Group, one of the projects funded under the programme, is charged with reflecting on this intelligence, including the effectiveness of the approaches used to access it, and making recommendations to government on how to address key outcomes. Indeed, the conclusions of our people's inquiry will feed into this process as well as being taken on board directly by government.

4. Discussion

4.1 Introduction

We have evaluated the success of our people's inquiry with reference to our reasons for getting involved: namely, to develop trust and build a meaningful dialogue, and to help us form a view on the usefulness of the method. This section discusses what we have learned. We focus on the value of the results from the inquiry in Section 4.2 and on various elements of our approach in Section 4.3. An independent view from the University of Liverpool is presented in Appendix C and summarised in Section 4.4.

4.2 Developing trust and a meaningful dialogue

Our panel met for the first time in London on 21 January 2006. Following an introduction by Steve Killeen, the Environment Agency's Head of Science, the facilitators led a discussion about new technology. Information boards stimulated questions and discussion and it became clear that the panel comprised individuals who were both interested in the information presented and were able and willing to articulate well-conceived and challenging questions. These included admissions of confusion, where some of the participants clearly felt out of their depth, but this was only the first morning and was to be expected. As the Demos report (Section 2) notes, there were references to Mork and Mindy and the Teletubbies as our panel struggled to understand why we had recruited them to be part of our inquiry.

During the course of the first day and over the ensuing month, the panel listened to perspectives from eleven experts drawn from academia, industry, NGOs and the Environment Agency. Numerous questions were asked and group discussions allowed further exploration of many issues. Some of the participants undertook independent research (such as using the internet) and spoke to colleagues and friends between the formal Saturday sessions. A range of perspectives was brought out, resulting in a lively debate that concluded with the agreement of twelve considered conclusions. Four members of the panel visited Defra's offices in May to discuss their conclusions with both Environment Agency and Defra staff. They mentioned how much they had enjoyed the experience – a point that had already been made by some – but were keen to understand what would happen next. That meeting closed with a promise from us to write down a response to the conclusions (see Section 3). This was welcomed by the panellists, which was an indication that they remained engaged and were prepared to continue to talk to us.

So was the dialogue meaningful? Our thoughts follow.

4.2.1 Nanotechnology policy

The inquiry began by considering new technologies before focusing on nanotechnology and its application to environmental remediation. This approach and the specific focus of the inquiry generated a wide-ranging discussion encompassing several aspects of nanotechnology. Many of the observations made by the panel were relevant to non-environmental applications, notably those pertaining to the planning, undertaking and publication of research, regulation and oversight and the role of the public. But these are not new issues and, as our response (Section 3) demonstrates, they are already being addressed.

4.2.2 Environmental remediation

The panel clearly understood the potential benefits of using nanotechnology to clean up chemically-contaminated soil and groundwater. They also grasped the uncertainties and risks involved, where the data needed to understand how nanoparticles behave in the environment and where they end up are sparse at best (Royal Society and Royal Academy of Engineering, 2004). But participants voiced some scepticism, too; they were worried that companies investing in research and development were motivated by profits and that these firms might be able to circumvent regulatory controls. The group articulated the issue in a local context – the planned regeneration of parts of East London in connection with the 2012 Olympic Games. They wondered if nanotechnology might be used in their area.

Our experiment showed that it is possible to develop a dialogue about a complex environmental issue with a group of people who initially know very little about it. The nature of the questions asked by the panel and their focus on uncertainties and risks, the need for contextual research, openness, accountability and education shows that their input has been not only meaningful, but valuable. This 'socially framed' evidence adds weight to the existing government position on the use of nanoparticles in environmental clean-up, where issues brought up by the panel accord well with issues already under discussion between policy makers and technical experts. Our experience was similar to that of others who have been engaged in public dialogues about nanotechnology (for example, Cook and Fairweather, 2005).

4.2.3 Understanding the issues that are important to the public

Issues of concern to the participants in our inquiry can be summarised as: uncertainty, openness and context. Scientific uncertainty was discussed at length and the participants called for more research and for data to be made publicly available so that the basis for decisions could be scrutinised. Our inquiry clearly called for evidence-based decisions and, where uncertainties were significant, for action to be taken to prevent the possibility of harm occurring. The importance of context has been discussed elsewhere and we have noted that the possibility that nanotechnology might be used in East London – where our participants all live – caused some concern.

4.2.4 Attitudes to risk-based decision-making

Demos note (Section 2) that risk-based regulation assumes two things: firstly, that risks can be adequately assessed and in the same way when there is more than one interested party (such as manufacturers and regulators); and secondly, that there is agreement on the acceptability of risks. They also note that, for new technologies, regulatory approaches need to be developed in full understanding of the system within which the technology is being developed and deployed. Although this inquiry did not explicitly cover the merits of risk-based decision-making, much of the discussion centred on where nanoparticles might go if released into the environment and what might happen to them and, indeed, anything that they contact. Additional research called for in the recommendations would provide the data needed to assess such risks. Participants would therefore appear to be supportive of risk-based decisions, providing that their basis was clearly explained and understandable.

4.2.5 Summary

We developed a good working relationship with the panel, due in part to the good work that Demos undertook up front and their role in facilitating the inquiry sessions and subsequent dialogue and meetings. We believe that we successfully developed trust, although we acknowledge the concerns voiced by some panel members that their recommendations

may not be considered seriously. Our challenge is to ensure that the dialogue continues and to make sure that our stated purpose in undertaking this work (Appendix A) is not forgotten as time passes.

The inquiry showed that well-founded views and concerns can be expressed by a group of people who know very little about a subject at the outset. With access to information and encouragement to ask questions and explore issues, people can articulate their concerns with respect to their own values.

4.3 Our approach

The inquiry was, essentially, a citizens' jury although it differed from the normal approach (see, for example, Coote & Lenhaglan, 1997) in that there was no specific charge and no requirement for a verdict. Our evaluation focuses on a number of aspects of planning and implementation that should be considered if a similar exercise is run in the future. These are discussed below.

4.3.1 Selection of method

The project steering group recognised the complexity of the issues to be discussed and agreed that a citizens' jury would be an appropriate model upon which to base our approach. It was clear that participants would need time to get to grips with the wealth of information from which they should be able to draw considered conclusions. The method chosen allowed for information to be acquired, discussed and rationalised, but this came at an estimated cost of £75,000. This cost included staff time required to plan and organise the inquiry, to manage the three days, and all associated expenses.

4.3.2 Focus and structure

One of the objectives of the *NanoDialogues* project was to "inform institutional decision-making and priority-setting" (see Section 1.2). We considered several policy areas and concluded that two had attractive environmental dimensions and were worth exploring further: consumer products and environmental remediation. The first is relevant because raw materials and energy are used in manufacture and entail waste disposal issues. The latter had a direct link to the recommendations made by the Royal Society and Royal Academy of Engineering, and is an area where the Environment Agency has a clearly defined role.

We settled on the latter and had a number of discussions with Demos about how we might best structure the inquiry. Meeting our objectives was our main criterion, but we knew that we would need to take care to avoid stifling the social process that we anticipated taking place in the inquiry sessions. We wanted to allow the panel members to get to know each other and the issues at hand and we felt it was important to avoid directing them more than necessary. However, practical considerations meant that we had to develop a general discussion plan, identify experts and put dates in their diaries, and book venues and equipment. The final structure of the inquiry reflects competing pressures and pragmatic decisions made by the project steering group.

Whilst we were pleased with what came out of the inquiry, we recognise that a degree of flexibility was lost; for example, we were not able to satisfy some requests from the panel to speak to particular experts. There was, however, scope for conversations to range beyond environmental remediation and the conclusions (Section 2) reflect this. Should we embark upon a similar exercise in the future, we will need to think about how we structure it. A sensible approach might be to plan the first day and finish with an agreement between

participants on the timing and scope of further sessions. Busy diaries and availability of venues could mean delays between subsequent sessions, but this approach would allow for more input from the participants. Careful facilitation is a prerequisite to ensure that the focus does not stray from what is intended.

4.3.3 Duration and timing

Our inquiry was conducted over three Saturdays, with a free weekend between each of them. Each session ran roughly between 10 am and 4 pm, with breaks. The panel was therefore active for approximately 15 hours in total, with some additional research being undertaken outside the formal sessions. Judging by the nature of discussions, the questions asked of experts and the relevance of the conclusions, the timing seems about right. It might have been possible to get something of value out of a slightly shorter inquiry, perhaps two days rather than three, but we knew that the panel would be starting from a low base (the Royal Society report noted that only 19 per cent of people surveyed in 2004 could offer a definition of nanotechnology) and we decided that three days, with breaks, was necessary to both listen to and question experts as well as hold discussions. The panel started to develop recommendations on the second day, but it wasn't until late on the third day that these were finalised.

4.3.4 Selection of panel members

All of the panel members had signed up to be involved with exercises similar to this one. They were not told exactly what they would be doing until the morning of the first day. During the recruitment process, they were told simply that they would be discussing technology and the environment. They were paid a modest amount for their time. We do not claim that the panel is representative of society or, indeed, any particular community. We wanted a meaningful dialogue based on an exploratory exercise with a group of interested people, which is what we achieved.

4.3.5 Selection of experts

Nanotechnology encompasses a wide range of individual technologies and applications. It raises many issues including questions of ownership, responsibility, financial reward, risks and benefits. We assembled a group of experts from a range of organisations to ensure that different perspectives were presented to the participants, but always with a focus on environmental remediation.

4.3.6 Facilitation

Demos designed and facilitated our inquiry, as already noted. They adopted an open and friendly style throughout and engaged well with the participants. Their role was germane to the success reported here.

4.4 Independent evaluation

The University of Liverpool undertook an independent evaluation of our exercise (see Appendix C). Their report states that everyone they spoke to felt that the event was worthwhile, even if some of the benefits seemed rather intangible. It also highlights the relative novelty of events such as this one and congratulates the Environment Agency for 'exposing itself to the public', concluding that our inquiry marks an important contribution to knowledge in this area.

The evaluation team defined three criteria for the evaluation:

- the ability of the organisers and sponsors to encourage active engagement with the subject of nanotechnology, the environment and regulation of the technology;
- the ability of the organisers and sponsors to create a context in which the results of the engagement could contribute to ongoing work on nanotechnology policies;
- the ability of the event to advance the understanding of the application, benefits and limitations of public engagement, particularly 'upstream' engagement.

Their observations are summarised below.

Encouraging participation and active engagement

- The purpose of the inquiry and the roles of the participants were explained well at the outset.
- The organisers created an environment that fostered involvement and meaningful dialogue. Their open style encouraged the participants to explore issues from several angles. This helped to contextualise discussions on environmental clean-up and contributed to the relevance of the conclusions.
- Participants engaged well with the invited speakers.
- The invited speakers were of variable quality and were, for the most part, scientists. Consequently, the discussion was science-heavy. Whilst acknowledging the need to book speakers in advance, the report highlights the inability of the organisers to respond to requests to hear from a Defra representative and from an MP.
- Several participants stated that they felt privileged to be involved and to have an opportunity to learn about the issues at hand and discuss them.
- The openness shown by the Environment Agency should be extended beyond the inquiry itself.

Creating a context for the outputs to be used

- Participants got to grips with a complex subject and were able to appreciate the importance of issues such as scientific uncertainty. This is reflected in their calls for more research and for regulators to take a cautious approach to regulating the use of nanotechnologies in environmental clean-up until more is known.
- Knowledgeable perspectives and a series of relevant recommendations came out of the inquiry. The report concludes that "an impressive range of social knowledge about a difficult and unfamiliar subject" was generated.
- Some of the panel members voiced scepticism. One suggested that governments got involved in exercises like this because they had to or because they wanted to look good. Others wondered if this was a "paper exercise" and questions were asked about the completeness of the information provided. The report notes that the inquiry "was a learning exercise intended to fill in some of the uncertainties about how engagement could contribute to the work of the Environment Agency and Defra". It challenged us to continue an open and honest dialogue and to communicate the value of the exercise back to the panel members.

Advancing the understanding of public engagement

- Trials have already been carried out on the use of nanotechnology to clean up environmental pollution and so it is not correct to claim that either the technology itself, or the engagement exercise, is 'upstream' in the sense of *See-through Science* (Wilsdon and Willis, 2004). However, the event itself did allow the participants to take a broad look at a new technology, as called for by *See-through Science*.

- The success of this engagement should not be judged on where it stands – upstream or downstream – but on the value gained by participants, the Environment Agency and Defra.
- The willingness and ability of the public to be involved in discussions about the governance of science and technology has been demonstrated.

5. Conclusions

Early engagement can add value to the work of the Environment Agency in specific circumstances. It is likely to add the most value when technologies are sufficiently well developed that their potential applications are already understood, at least in broad terms.

Careful consideration needs to be given before the Environment Agency invests in an exercise such as that reported here, to ensure that the ends justify the means. We estimate that the total cost of our people's inquiry is in the order of £75,000. Prime candidates include issues where:

- the subject in question relates strongly to the Environment Agency's policy or operational role (or will in the future) and/or we are involved with government policy-making;
- there is limited information on public perceptions and preferences to guide the development of policy.

In other words, engagement is likely to add value where the Environment Agency is either:

- in a position to act on any recommendations in the short to medium term;
- where we believe that socially framed evidence is lacking and that this may threaten our ability to effectively carry out our functions in the future.

General points

- Members of the public are capable of engaging in meaningful dialogue about complex and unfamiliar issues. Sufficient time, a supportive environment and good facilitation are needed for the process to work well. We should never assume that an issue is too complex or that the public will not be sufficiently interested to give up their time to learn about it and contribute to decision-making.
- Our approach (the people's inquiry) has proven to be an appropriate model for producing socially framed evidence about a complex set of issues, namely nanotechnology and the environment. Careful thought needs to be given to both the novelty of the issue at hand and its complexity when planning exercises such as this in the future.
- When discussing a complex issue with a group of people who know very little about it, time is needed for the group to feel their way, to learn terminology and to become comfortable discussing something new to them.
- Early and open engagement with the public can create conditions in which a trusting relationship can be developed. It is critically important that the purpose of any engagement (including the limits of influence) is communicated clearly at the outset and again as necessary to avoid misunderstanding.

A meaningful dialogue?

- Our (Defra and Environment Agency) understanding of public views on nanotechnology appears to be good, based on the evidence from this inquiry. The issues covered by the recommendations are not new to us and are already being addressed.
- We are not yet able to fully characterise the value of the results from the people's inquiry. However, we note that the recommendations presented in Section 2 mirror those in the Royal Society/Royal Academy of Engineering report. This is important, as it suggests that both the inquiry presented here and the work of the independent expert group have homed in on the salient issues. Our participants started from a very different place to the experts who worked on the RS/RAE report, yet they came up with

similar recommendations that are, for the most part, already being addressed. This is reassuring, and adds weight to our conviction that we do indeed understand public views and are acting to address them.

- It is important that public engagement exercises such as this one are commissioned, that the outputs are used by those responsible for decision-making and that there is a forum for the outputs to feed into. In this case, it is Defra that develops nanotechnology policy relevant to our work. Defra has been represented on our project steering group throughout, has been involved in meetings with some of the participants and, importantly, has responded to their recommendations. Both Defra and the Environment Agency are members of the cross-government policy group on nanotechnologies, known as the Nanotechnology Issues Dialogue Group (NIDG). This policy group will be made aware of the outputs of our people's inquiry.

Process design

- It is important to try to build flexibility into public engagement exercises. Our experience suggests that there would be merit in allowing the participants to have some say in whom they hear from, but it is also important that they receive a balanced set of perspectives. Open dialogue, facilitated by an independent party (such as Demos who fulfilled this role in our case), should be employed and decisions taken consensually.
- Careful thought needs to be given to the duration of engagement exercises dealing with complex and unfamiliar issues. Time is needed for information to be acquired and assimilated and it is important that participants are not pressured to come up with firm views too quickly.
- There is no right or wrong way to recruit participants. We used a specialist recruitment organisation and were rewarded with a group of interested and articulate individuals who ensured that a meaningful dialogue took place. We cannot comment on how the outcome would have differed had we recruited a disinterested random group or, indeed, a group with a vested interest.
- Careful thought is needed when selecting experts. An important balance needs to be struck between allowing participants to have a say on who they hear from, and ensuring that balanced information is provided. There is some scepticism regarding the purpose of inquiries such as ours, and so there are good reasons to involve participants in the planning phase. However, it is unlikely that members of the public will be very knowledgeable about issues that are the subject of 'upstream engagement' exercises and, consequently, they will need help to understand the breadth of an issue and the range of experts from whom they might want to hear. An important reason, again, for having independent facilitators.

Next steps

It is becoming increasingly clear that the most effective regulatory approaches don't just draw on a single instrument but rather on a mix or portfolio of instruments. The Government's Sustainable Development Strategy (Defra, 2005) describes a number of alternatives to traditional command and control regulation and focuses on the need to engage (e.g., deliberative fora), enable (e.g., give information), exemplify (e.g., lead by example) and encourage (e.g., reward schemes). Our response to the panel's recommendations (Section 3) demonstrates that the use of alternatives is already underway. Examples include:

- Engaging
  "Defra has already established the Nanotechnologies Stakeholder Forum to facilitate critical discussion of policy activities around nanotechnologies, including issues of research, monitoring, regulation and communication. Its outputs inform Defra's work in these areas, and also, where appropriate, the work of wider government" (response to recommendation 7)

- Enabling
  "Some industry groups are interested in piloting nano-remediation in the UK. We have informed those that have contacted us of the government position and indicated that we would encourage them to undertake any field trials in controlled conditions, and undertake a detailed risk assessment prior to proceeding. We are working hard to ensure that there are good communication links between all parties involved in decisions about environmental clean-up" (response to recommendation 1)

- Exemplifying
  "… we will subject the results of all government-funded research on the environmental risks posed by nanotechnologies, to independent peer review, and place them in the public domain" (response to recommendation 5)

- Encouraging
  "We thank the panel for recognising Defra's efforts to implement a Voluntary Reporting Scheme for engineered nanoscale materials. The scheme was launched at the end of September 2006, and will run to September 2008. It will provide government with important information on the properties and characteristics of the engineered nanoscale materials being manufactured, used, researched and disposed of in the UK" (response to recommendation 6)

We plan to undertake further work to help us understand how we might use the social intelligence from this experiment. This work will seek to ensure that we are well placed to decide when and how to gather social data to inform our decisions and our advice to others.

Regarding nanoremediation, we will inform our operational staff (technical specialists based in our Area offices) of the issues around the deliberate release of engineered nanoparticles. We will also engage with local authorities as they lead on planning issues and most remediation is carried out through the planning system. To help achieve effective communication we will work with Defra to inform the Department for Communities and Local Government (CLG) of the issues and encourage the development of a reporting system to minimise the chance of a nanoremediation proposal being approved without due consideration of both the benefits and the associated risks.

6. References

Cook, A.J., and Fairweather, J.R., 2005. *Nanotechnology – ethical and social issues: results from New Zealand focus groups*. December 2005 (http://www.lincoln.ac.nz/story_images/1330_RR281_s4140.pdf).

Coote, A. and Lenhaglan, J., 1997. *Citizens' Juries: From Theory to Practice*. London: IPPR.

Defra (2005). Securing the Future - UK Government sustainable development strategy. London: The Stationary Office.

Environment Agency, 2005. *Indicators for land contamination*. Environment Agency, Bristol.

Homan, J., Petts, J., Pollard, S.J.T. and Twigger-Ross, C., 2001. Participatory risk assessment for environmental decision-making. In: Andersson, K. (ed.) *VALDOR - VALues in Decisions On Risk*, pp. 398-406. Stockholm, Sweden, 10-14 June, 2001.

Horlick-Jones, T., Walls, T., Rowe, G., Pidgeon, N., Poortinga, W. and O'Riordan, T., 2004. A deliberative future? An independent evaluation of the GM nation? Public debate about the possible commercialisation of transgenic crops in Britain 2003. Understanding Risk, Working Paper 04-02, Norwich (http://www.uea.ac.uk/env/pur).

IPCC, 2001. *Climate change 2001: synthesis report. Summary for policy makers*. Intergovernmental Panel on Climate Change: Third Assessment Report. See http://www.ipcc.ch/pub/un/syreng/spm.pdf.

Irwin, A. and Wynne, B., 1996. *Misunderstanding science? The public reconstruction of science and technology*. Cambridge: Cambridge University Press

Kearnes, M., Macnaghten, P. and Wilsdon, J., 2006. *Governing at the nanoscale*. London, Demos. See

http://www.demos.co.uk/publications/governingatthenanoscale

Kostal, J., Mulchandani, A., Gropp, K.E. and Chen, W., 2003. A temperature responsive biopolymer for mercury remediation. *Environmental Science and Technology*, 37(19), 4457-4462.

Owen, R. and Depledge, M., 2005. Nanotechnology and the environment: risks and rewards. *Marine Pollution Bulletin*, 50, 609-612.

Royal Society and Royal Academy of Engineering, 2004. *Nanoscience and nanotechnologies: opportunities and uncertainties*. London: The Royal Society.

Stilgoe, J., 2005. Controlling mobile phone health risks in the UK: a fragile discourse of compliance. *Science and Public Policy*, Vol. 32(1).

Tratnyek, P.G. and Johnson, R.L., 2006. Nanotechnologies for environmental clean up. *Nanotoday*, 1(2), 44-48.

Tungittiplakorn, W., Cohen, C. and Lion, L.W., 2005. Engineered polymeric nanoparticles for bioremediation of hydrophobic contaminants. *Environmental Science and Technology*, 39(5), 1354-1358.

Wilsdon, J. and Willis, R., 2004. *See-through Science. Why public engagement needs to move upstream*. London: Demos.

Wynne, B., 1992. Uncertainty and environmental learning - Reconceiving science and policy in the preventive paradigm. *Global Environmental Change*, 2 (2), 111-127.

Zhang, W., 2003. Nanoscale iron particles for environmental remediation: an overview. *Journal of Nanoparticle Research*, 5, 323-332.

7. Glossary

BSE	Bovine spongiform encephalopathy
Chlorinated hydrocarbon	A generic term for compounds containing chlorine, carbon and hydrogen. It can describe pesticides such as lindane and DDT, industrial chemicals such as polychorinated biphenyls, and chlorine waste products such as dioxins and furans. These compounds are persistent in the environment and may bioaccumulate in the food chain.
Defra	Department for Environment, Food and Rural Affairs
DTI	Department of Trade and Industry
Environmental remediation	Action taken to prevent or minimise the effects of unacceptable risks to the environment or peoples' health.
GM	Genetically modified or genetic modification.
Nanoparticles	Very small particles only slightly larger than atoms. In scientific terms, particles less than 100 nm in diameter that exhibit new or enhanced size-dependent properties compared with larger particles of the same material.[1]
Nanotechnologies	The design, characterisation, production and application of structures, devices and systems by controlling shape and size at nanometre scale.[1]
Nano-remediation	The use of engineered nanoparticles to accomplish environmental remediation
Nanoscale	From 100 nanometres (nm) down to the size of atoms (approximately 0.2 nm).[1]
NGO	Non-governmental organisation
OSI	Office of Science and Innovation
RIA	Regulatory Impact Assessment
RS/RAE	Royal Society/Royal Academy of Engineering
Social intelligence	The process of incorporating more socially sensitive antennae into technological innovation, for example by bringing together a greater range of publics' views, and a better understanding of publics' values, into the framing of initial questions and the decisions framing the process of innovation.
Upstream dialogue or engagement	Public dialogue that takes place early in the development lifecycle of a new technology
VIP	Very important perspective

[1] Definition taken from the RS/RAE report *Nanoscience and nanotechnologies: opportunities and uncertainties* (2004)

Appendix A. Our purpose

This note was written in August 2005 to articulate the Environment Agency's purpose in becoming a partner in the NanoDialogues project.

NanoDialogues and the Environment Agency

The main purpose of this note is to summarise, primarily for the benefit of the wider project team, why the Environment Agency decided to be a partner in the Sciencewise NanoDialogues project and what we hope to get out of our participation. This will inform the detailed planning of our experiment. It also states what we believe can, and can not, be influenced by our experiment. It is important that this is communicated clearly to the jurors from the outset.

Relevant background information is annexed to this note.

Why are we involved?

We regulate activities that have the potential to impact adversely upon the natural environment. One such activity is the clean-up (remediation) of chemically contaminated soil and groundwater. Recent scientific and technological developments mean that nanoscale engineering[17] now seems to offer new solutions that might prove to be more effective than existing technologies. Field trials of nanoscale environmental remediation technologies have already taken place in the USA. The Environment Agency has started to receive requests to do the same here. But data are sparse. We know relatively little about the fate, transport and toxicity of materials at the nanoscale (from100 nm down to the size of atoms, at approximately 0.2 nm[18]) and we are not yet able to assess accurately the risks that might arise from their use.

Work is underway in government to scope out a programme of research to start to fill the gaps in our technical and socio-political understanding and, in parallel, to determine the need for, and scope of, new regulations. In the meantime, the government has decided to take a precautionary approach and has called for the Environment Agency and others to work with industry to prevent free nanoparticles or nanotubes being used for environmental clean-up until we have a fuller understanding of the risks.

Our dialogue experiment will help the Environment Agency and Defra to understand better the issues that are important to the public as the regulatory framework is put into place. We want to explore attitudes to risk-based decision-making and the role of precaution in regulating new technologies. This will help us ensure that the development of new technologies is not held back by misplaced public concerns – and equally, that well-placed public concerns contribute to the debate – and will increase public confidence that appropriate levels of protection are afforded to the environment. In addition, we hope to gain valuable insights into the usefulness of citizens' juries in providing information that helps us to make wiser ethical judgements as we develop proportionate approaches to regulating the use of new technologies.

[17] Including, for example, the use of gold-coated titanium nanoparticles or iron nanoparticles for groundwater clean-up. These can be used either in a fixed piece of apparatus or by injecting free nanoparticles into the environment.

[18] *Nanoscience and nanotechnologies: opportunities and uncertainties*. London: The Royal Society and The Royal Academy of Engineering, 2004.

What can our jurors influence?

Defra is responsible for developing the regulatory framework within which nanoscale environmental remediation technologies can be applied. The Environment Agency and Local Authorities will be responsible for its implementation. The jurors taking part in our experiment will not be able to influence decisions directly, as this is a research project designed to provide information that is useful to decision-makers. We are trying something relatively new here. And we hope that the findings of our experiment will contribute to policy and regulatory decisions in due course. Within the Environment Agency we intend to use the outputs from this exercise to inform our own regulatory activities once the legal framework is in place. We hope to gain insights that will help us understand the issues that matter to people as we move forward and, we hope, to make better judgements within the constraints that govern how we work.

Annex 1 – Background information

NanoDialogues: four experiments in upstream public engagement

A1. Background

Last year we sponsored the publication of the Demos pamphlet, *See-through Science*. Barbara Young wrote the foreword and chaired a high profile launch at the Royal Society of Arts.

See-through Science observes that debates over science and technology have often been dominated by questions of risk assessment. It suggests that this framework is too narrow as more fundamental questions regarding technology ownership, the ends to which it is directed, and who accrues benefit are often avoided. The publication goes on to consider why we might want to move engagement 'upstream' as new technologies are developed and what this might look like in practice. The argument is applied to private sector research followed by some practical suggestions on embedding upstream engagement in science, government and society.

A2. Nanotechnology

In the past two years, a policy and media debate about nanotechnologies has emerged, characterised by competing visions of promise and threat. The publication in July 2004 of the Royal Society/Royal Academy of Engineering report on nanotechnologies signals the start of a new phase in this debate. Discussions have started to focus on the need for public engagement to take place upstream in processes of innovation, at a stage when it can influence research decisions. Yet precisely what this move upstream entails remains ambiguous and open to multiple interpretations. At what stages in R&D processes is it realistic to raise issues of social concern? How and on whose terms should such issues be debated? Are dominant discourses of risk, ethics and social responsibility adequate? How can engagement be reconciled with the need to maintain the independence of science, and the economic dynamism of its applications?

A3. NanoDialogues

NanoDialogues is a Sciencewise project, supported by OSI and led by Demos, which seeks to answer these questions through a series of practical experiments, designed to inform decision-making in a variety of institutional settings. We are the regulatory partner. Two research councils (BBSRC/EPSRC), a company (tbc) and an NGO (Practical Action) are also involved. DTI and Defra are on the steering group.

This project has four core objectives:

- to experiment in new methods of ‘upstream’ public dialogue around nanotechnologies;
- to ensure that these dialogue experiments are framed in a way that can inform institutional decision-making and priority-setting;
- to generate intellectual and practical resources for enriched public, policy and scientific debate about the social implications of nanotechnologies;
- to identify wider lessons and insights that can inform the policy and practice of public engagement in science in technology.

We hope that our experiment, which will take the form of a citizens’ jury at the end of the year, will inform our approach to regulating the use of nanotechnologies in at least one area. We will explore the many issues surrounding the application of nanoscale science and technology to environmental remediation. The details will be worked out over the summer and detailed planning will follow in the early autumn. At this stage we expect to focus on the role of our preferred risk-based approach to regulation.

Appendix B – Supplementary information (Demos)

This appendix supplements Section 2. It presents Demos' reflections on the methodology, a list of questions asked by the panel and short summaries of the evidence provided by each of the experts.

B1. Methodological reflections

Our experiment was designed to draw on the best features of the citizens' jury model, in which citizens are given the opportunity to hear from and question expert witnesses. In contrast with the citizens' jury model, however, our experiment was framed as being exploratory rather than antagonistic. We were more concerned with exploring areas of uncertainty than with presenting both sides of an already polarised debate.

Upstream public engagement is necessarily exploratory. It is therefore better at opening up areas of public and institutional concern than it is at closing them down to a set of recommendations that make sense to organisations. The recommendations that the panel came up with represented the end-point of their discussion, and the areas of consensus that emerged. They were, as might be expected, different from the individual recommendations that were suggested at the end of the second day to spark ideas. The final recommendations were suggested by individuals, discussed by the group and amended as necessary. Opinions differed within the group about what exactly we should do about the specifics of new nanotechnologies, but everyone agreed that the final recommendations represented their views. The final recommendations were, in effect, a statement that everyone felt they could sign up to. They therefore do not represent the diversity of opinion that filled the discussions, but emerged from a diverse and wide-ranging discussion.

It is important with public engagement to maintain a balance between top-down relevance (how can the end result be useful to existing policy questions?) and bottom-up definition (how can the end result reflect what the participants wanted to talk about?) The organisers and partners of our experiment began with a discussion map, imagining the shape that the conversation might take. Rather than starting with the problem of land contamination and subsequently introducing nanotechnology, we decided to start with nano. This had the effect of putting the problem of land contamination in the context of a new technology, rather than vice versa. As such, it produced a rich set of insights about the politics of technology. However, it could be said that by framing the discussion in terms of nanotechnology, we constructed a false impression of its importance for land remediation. In the final reckoning, we can be happy with the quality of discussion and the starting point.

One clear limitation of our experiment, that would perhaps have been resolved had the discussion been spread out more, was the lack of opportunity for the participants to change the direction of the discussion. Given the logistics of organising VIPs for the people's inquiry, it would take longer than the two weeks between each session.

Previous citizens' jury-type exercises have found their participants through the electoral roll. Ours were recruited directly by a recruitment company to provide a diverse, interesting group. They all came from East London – Walthamstow, Hackney, Stratford and West Ham. They were selected to be in some way involved in their local communities, which greatly aided the quality of discussion. But it perhaps gave us a false picture of citizen engagement. The differences between this sort of group and a truly disinterested random group of publics need to be further explored, as do their differences from an *interested*

public, who might have been recruited through advertising that this experiment was about nanotechnology or the environment.

We also chose to pay our participants for their time. We wanted them to feel valued for their time, and we also wanted to attract some people who considered their time particularly valuable. The danger with this technique is that some people will be there for the incentive more than for the experience. Having been a part of the discussion, we can conclude that most of the participants were fully engaged, making the incentive less of an issue. We were also pleased that some participants have been keen to give up more of their time, unpaid, to stay involved.

B2. A list of questions asked by the people's panel

Why are we finding out about this now?
Is nanotechnology being used to alter or manipulate DNA?
Do you get to touch them?
What are carbon nanotubes used for?
What does your lab look like?
When was this first discovered?
How far have we already come with nanotechnology?
How much further can this go?
Is there anything smaller?
Can we see it?
Have we been informed?
Was nanotechnology discovered by accident or were they trying to develop it?
How many scientists are there?
How can we make people more aware?
Could we ask companies if they use nano?
Who decides what the public should know?
Who will regulate nano research?
Who is regulating nanotechnology research?
Could we use GM regulation for nano?
Won't different people use things in different ways?
Are there guidelines for living and working with nanoparticles?
How do we contain nanoparticles?
What is nanotechnology tested on?
Who will control it?
Who's overseeing it?
Is it a pandora's box?
Is it about nanoproducts or nanoprocesses?
Will there be unanticipated effects?
Who has a say?
Are we passive?
Are we letting a genie out of a bottle?
Have any of the elements you've been working with been unstable?
Are there any waste materials produced? And are they hazardous?
When we do an experiment, and get no effect, should we not just go to the next stage?
What can we learn from animal studies?
Do nanoparticles break down? What happens to them?
Do benefits outweigh risks?
How do we establish risks?
How do we measure the toxicity of nanoparticles?
What is an acceptable risk?
How do we model the implications?
Can we predict effects?
When cells/particles are manipulated to make them smaller, has the larger cell/particle been manipulated?
Will we become redundant in future years?
Can we become clones?
What are the moral issues? Life, death and humanity
What are the medical benefits?
What are the cosmetic benefits?
Why are people funding nanotechnology?
How much financial (and other) pressure are scientists under?
Who polices the scientists?
Is there a rush to market?
Can we reduce the monopoly effect of nanotechnology?

How do scientists work with the materials?
What instruments are involved?
How much does equipment cost?
What's so different about being nano?
"Nanoparticles can be used to clean up …" Who's saying this? How do they know?
Where do waste products go?
What about the Hemel Hempstead fire?
Is nanotech being used in human trials?
What else is there that people don't know enough about?
Are people required to label it?
How does the cleaning process work? Is it sticky?
What if irresponsible companies hire consultants who aren't regulated?
What about irresponsible companies?
Can a company discover a spill and deal with it themselves, without telling others?
How far can the nanoparticles travel?
Do we need to live half a km away to avoid ill effects?
Is the process of using nanoparticles for land remediation a quicker process than other methods?
Testing is still not conclusive that the particles themselves will have no long-term effects.
Would the fact that it's a quicker process mean that the safety issues may be overlooked?
What's the rush?
Are we part of the decision-making process?
Is this people's inquiry just an exercise that's going to be ignored? Will they use it for the Olympics anyway?
Is information sharing too informal?
Can we prevent soil erosion?
What safeguards are being put in place to limit pollution from using nano?
What's in place to prevent emissions?
Are the Environment Agency government-funded?
Are the Environment Agency working to protect society?
Is nanotechnology going to be used to decontaminate land which is being cleared for the Olympics?
What would happen if they wanted to use nano?
Is that why these workshops are being held for people in East London?
Will testing catch-up?
Is this a big problem?
How do the particles work?
Who should know?
How often is the technology used?
What unknown effects might it have?
Is there a register of what is going on?
Is there a register of contaminated land?

B3. Summaries of evidence

Nicole Grobert from Oxford University introduced the idea of nanotechnology to the panel. She explained why people were more and more interested in very small things and told the panel about her time on the Royal Society working group. She highlighted areas of benefit and areas of concern. Questions to Nicole focussed on risk, uncertainty, acceptable risk, the pressures of being a scientist and the self-policing of scientific research.

Olaf Bayer from Corporate Watch told the panel about his involvement as a campaigner on the GM issue, and his subsequent interest in nanotechnology. Olaf was asked about the marketing of nanoproducts, the possibility of regulation and public awareness of the issue.

Kristen Kulinowski from Rice University gave the panel a fascinating guide to the debate around nano in the US: how the initial hype has now been tempered with concern for environmental and health effects. Kristen was asked about what happens to nanoparticles in the environment, how we can control how people use nanoparticles if it's not as intended and how we get information about toxicity from animal experiments.

Graham Norris, formerly of Golder Associates, explained how and why nanoparticles might be used to clean up land contamination. He explored the new possibilities offered by nanoparticles and pointed to some things we need to know more about.

Steven Banwart from the University of Sheffield offered a personal perspective as an environmental scientist and a nanotechnology researcher. Growing up on a farm in the American Mid-West, Steve became aware of the long-term problems of intensive agriculture. He explained how this direct interest in the environment has driven his career as a scientist.

Brian Bone from the Environment Agency described the Environment Agency's approach to new environmental technologies. He explained how the organisation is dealing with the suggested use of nanoparticles in cleaning up land contamination.

Mike Raco from King's College London put the issue in a wider context. He discussed the problems of regeneration involving local people in discussions about what would be best for communities.

Nick Christofi from Napier University is an ecotoxicologist. He discussed the hidden effects that new materials might have on microbes and other living organisms in the environment.

Julia Black from the London School of Economics talked about the difficulties of regulating new technologies when we don't know enough about their effects. She explained how regulation was changing in the UK and talked through some different approaches.

Andy Stirling from the University of Sussex discussed some alternative types of regulation, involving the precautionary principle. He emphasised the need for institutions to be open and humble in their dealings with non-experts.

Doug Parr talked about how **Greenpeace** were developing their approach to nano. He said that, although there were some clear environmental benefits of nanotechnologies, they would need to be handled and regulated in a robust way to avoid the mistakes of GM.

Appendix C - Independent evaluation report

THE UNIVERSITY of LIVERPOOL

Independent Evaluator's Report

A people's inquiry on nanotechnology and the environment

Dr. Kevin Edson Jones
University of Liverpool

Evaluation Team

Dr. Kevin E. Jones
Lecturer in Science and
Technology Policy Studies

Prof. Alan Irwin
Dean, Social and
Environmental Studies

Marion Schulte zu Berge
Doctoral Student

Contact:

University of Liverpool Management School
Chatham Street
University of Liverpool
Liverpool, L69 7ZH
Tel: 0151 795 3016
E-mail: k.e.jones@liverpool.ac.uk

http://www.liverpool.ac.uk/management

1. Introduction

1.1 The following is an independent evaluation of the "people's inquiry on nanotechnology and the environment" organised by the Environment Agency in collaboration with Demos during January and February of 2006. In this report we offer an evaluation of what was branded an "experiment in upstream engagement," looking first at what such an experiment might achieve and how this can be assessed, before offering our findings and conclusions.

A summary of the main points of this evaluation are included at the end of this document.

2. Why public engagement?

2.1 Engaging publics about science, technology and their potential risks is a necessary element of contending with the complex issues and dilemmas associated with development in today's society. Novel technologies, including nanotechnology, pose difficult questions about the way we live our lives and the world in which we live. Along with many potential benefits, such progress may also be accompanied by potential risks to personal, social and environmental well-being.

2.2 While engagement is not solely an issue for governments alone – scientists, corporations, and NGOs may all find merits in creating dialogues with members of the public – it is, nonetheless, a particularly salient point for policy makers. As residents of the United Kingdom, we rely upon our political leaders and political institutions to operate in ways which ensure our well-being and quality of life. Public trust in the political decisions and regulatory processes surrounding the development and application of novel technologies is an essential element in ensuring a healthy democracy[19].

2.3 In recent years, governments have been criticised for making decisions about novel technologies, and issues of environmental hazard, beyond the public gaze and with little consultation outside established networks of scientific expertise. These practices not only did little to encourage public confidence in decision making and regulation but, furthermore, undermined governments' ability to provide robust solutions to complex risk issues. BSE, a watershed in UK risk management, was not only a failure because politicians and scientists failed to fully disclose the risks associated with the disease to the public, but also because they got it wrong in determining these risks in the first instance (Jones, 2003). Uncertainties were poorly dealt with, risks ignored and the early actions of government to curb the spread of the disease largely futile (Phillips *et al*., 2000). Environmental governance done behind closed doors not only closes out the public, who hold important stakes in these practices, but tends to produce poor policy and regulation[20].

2.4 With this in mind, the evaluation presented here consciously seeks to stretch the boundaries on what might be considered a successful engagement. In other words, it takes a wider

[19] Despite its common usage, trust is a complex and difficult term to define and its relationship with democracy is complex and multifaceted. Most often 'trust' is used to describe public confidence in political leaders and government institutions (see Bromley *et al*., 2004). Yet what counts as public confidence, or distrust, is difficult to define and measure. For instance, trust is very much reliant on social expectations about the responsibilities of government (Warren, 1999). In the context of environmental regulation and risk management, trust is related to social expectations about the role of governments to protect the environment and citizens from harm (Beck, 1997). To complicate the issue further, governments increasingly rely on a range of outside experts to inform policy making and regulation (Jasanoff, 1990; Ezrahi, 1990). Trust in governments increasingly overlaps trust in science and expertise as well as the sources of these inputs (i.e. scientists, academics, industry). Shoring up democracy in Britain, by developing a trusting relationship between its citizens and governors is thus a far from straight-forward task. What most would agree, however, is that by bringing together publics, governments, scientists and other stakeholders *an opportunity* is created to strengthen democratic relations and legitimacy in governance.

[20] These concerns permeate the Royal Society's (2004) report on "Nanotechnology and nanoscience" and The Society's clear call for a comprehensive and meaningful engagement on the subject.

gaze than an evaluation of substantive contribution of the NanoDialogues process, or the ability of the event to meet the aims and objectives of the organisers. The intention is not to undermine the importance of these aspects of the engagement, indeed these aspects are covered at length by Demos and the Environment Agency in the main body of this report. Instead, drawing on perspectives from the social sciences, this evaluation seeks to understand the people's inquiry within the wider context of debates over public participation in governance. Indeed, this approach strongly correlates with the intentions of Demos and the Environment Agency to conduct an exercise which challenges the way in which environmental governance is undertaken, specifically by encouraging participation from the public.

2.5 Engaging publics potentially holds several benefits, both for concerned citizens, as well as for government bodies. Indeed the organisers and facilitators of the people's inquiry envision engagement as a means of encouraging democratic participation, and building confidence, in science and government. Moreover, engagement can be a means of improving the cognitive resources at the disposal of decision-makers. In other words, engagement isn't just about shoring up public confidence, but is also potentially a means of enlightening government and improving policy (Brown, 1992; Irwin & Wynne, 1996; Irwin *et al.*, 1999). For an engagement, therefore, to be successful it must hold the promise of making progress in each of these two overlapping aspects.

3. Evaluation criteria

3.1 Reflecting the overall aims of engagement, as described above, the evaluation will be based on two core criteria. The first focuses on the ability of the organisers to facilitate an open and fully engaged process. The second reflects the further challenge of recognizing and paying credence to the idea of citizens as enlightened participants with an active role to play in the policy process:

a. The ability of the organisers and sponsors to encourage participation and active engagement with the subject of nanotechnology, the environment and the regulation of the technology.
b. The ability of the organisers and sponsors to create a context in which the outputs of the engagement might meaningfully contribute to ongoing work on nanotechnology policies.

3.2 Finally, it is important to recognise that engagement, despite an increased profile in recent years, is still relatively undeveloped and exercises such as that in question here should be evaluated as part of an ongoing process of development. A third evaluation criterion should, therefore, also include:

c. The ability of the event to advance the understanding of the application, benefits and limitations of public engagement, and the upstreaming of engagement[21] in particular.

[21] This is an argument put forward by Demos in a pamphlet entitled *See-through Science* (Wilsdon and Willis, 2004) which states that engagement, although important as part of the regulatory process, should be moved forward in the innovation chain of a technology to allow the public to have input into how the technology may be applied and developed. While we will return to look at the notion of upstream engagement in more detail later, it is important to note that the people's inquiry was designed with this perspective in mind.

4. Methodology

4.1 The approach of this evaluation has been iterative as well as analytical. It was the feeling of the evaluation team and the organisers that more was to be gained through an ongoing and constructive process, as opposed to one which was wholly independent and observational in nature. As such, the evaluation team was routinely in touch with members of Demos and the Environment Agency throughout the process, including discussions about what might be achieved through the engagement, as well offering feedback about how well the process was managing to achieve these.

4.2 The primary materials used in drafting this evaluation included:

- research notes and materials relating to each of the three one-day events;
- informal discussions with public participants during the events, as well as a small number of formal interviews which took place after the engagement had finished;
- formal interviews with members of the Environment Agency involved in the development of the engagement exercise;
- informal discussions with members of Demos and the Environment Agency, as well as the invited speakers who participated in the process.

5. Encouraging an open and engaging exercise

5.1 In order to address the first evaluation criterion, concerning the ability of the exercise to encourage an active engagement, four further questions will be addressed. Developed by the research team through discussion with the organisers, each gives shape to what might be understood as an open and engaging exercise, further challenging how the process may, or may not, contribute to democratic participation. Specifically, they address communication issues, the extent to which public participants were allowed to be active participants in the process, and how their perspectives were valued in relation to other forms of expertise.

5.2 Communication and feedback

How well were the organisers able to communicate the aims and objectives of the engagement, the role of the participants, and how their input into the process would be utilized by Demos and by the Environment Agency?

5.21 For a successful engagement participants should be clearly versed as to why they have been asked to participate, what their roles will be and how their contributions will be viewed and applied by the organisers. Such clarity is important in that it is essential for developing an open and transparent context for debate, where participants are treated as equal members of the engagement and in doing so, acknowledged as relevant and valued contributors.

5.22 Demos and the Environment Agency were very aware of the need to clearly communicate the objectives of the project. During the first session, the Environment Agency's Head of Science gave participants information about the event, and why the Environment Agency valued their contribution. Importantly, participants were asked to challenge themselves and fully interrogate the material they received. Furthermore, Demos provided clear direction of the overall purpose of the engagement, and of the separate tasks which made up the process. When asked about their experience, one participant pointed to the level of organisation and clarity of the exercises as contributing to their enjoyment of the experience.

5.23 Interestingly, on the suggestion of the evaluation team, Demos agreed to allow part of the third day of engagement to involve a session on public engagement, its purpose and why Demos and the Environment Agency were pursuing it. This session was successful not only in

communicating the purpose of engagement, but through an engagement with the social science literature surrounding public participation and governance, added another layer of knowledge associated with discussion over the regulation of nanotechnology. In this way Demos was able to situate itself within the political context shaping regulation, and be exposed to questions and interrogation. Interestingly, this question spilled out of the formal setting of the engagement into lunch on the final day when the participants were taken out to a local restaurant. Aside from offering participants a meal as thanks for their contributions, the informal context of lunch out of the office allowed participants to reflect on the process they had been involved in and the role of Demos in policy-making.

5.24 While the people's inquiry has been exemplary in its communication of the purpose of the engagement, and the willingness of the organisers to expose their own role in the debate to scrutiny, it is important that this openness be extended beyond the end of the engagement itself. There is, in other words, an obligation on the part of Demos to communicate back to participants, to inform them of the outcomes of the process, what has been learned and how their recommendations are being dealt with. Importantly, if, as is likely the case, the Environment Agency and Defra are unable to take on some of the recommendations of the participants, the onus is on these bodies to explain why this is the case.

5.3 Flexibility

How were the organisers able to respond to participants' interests, questions and concerns in forming agendas and shaping the engagement?

5.31 In any engagement, organisers are required to walk a thin line between providing a framework with which to address the topic, while also being flexible enough to allow participants to shape the engagement themselves. In other words, having overly rigid boundaries imposed by organisers would only serve to narrow conversation and limit the contribution of members of the public.

5.32 Certainly this was not the case here, where organisers adopted an open style encouraging participants to explore the technology from a variety of angles. While the organisers did work to keep a focus on nanotechnology and its role in land remediation, participants also discussed issues of health and safety, the wider environment, and trust in government and industry. Moreover, participants were encouraged to actively consider their own roles in the process and the potential benefits of these sorts of public engagement exercises.

5.33 While such breaks from the topic may often seem like distractions, in this case they allowed participants to contextualise and inform their discussion and assessment of the technology. For example, the conclusions put forward by the panel offer much more than specific regulatory measures concerning the use of nanotechnology for environmental remediation. Instead, they situate these more specific measures alongside a series of wider recommendations which address the broad impact of the technology on society, including questions of how we know and relate to it. This level of contextual understanding has allowed the people's inquiry to offer a much more honest picture of the regulatory dilemmas facing government and society than a more limited discussion might have.

5.4 Participation

To what degree were participants able to feel actively part of the process?

5.41 As the main report from the people's inquiry notes (see Section 2), an effective engagement does not simply seek to uncover public opinion about an issue, in this case nano-remediation, but asks members of the public to involve themselves in a "collective exploration" of the issue. Members of the public should be participants in the process, not research subjects. It requires commitment on the part of participants to actively engage with the subject, as well as ownership and responsibility for the conclusions.

5.42 While it can sometimes be taken for granted, sustained and active engagement in events such as these is not easily achieved. Many factors can threaten to undermine the sense of purpose and commitment of participants. These include lack of interest in a subject, feeling overwhelmed at the task, an awareness of scrutiny, or beliefs that one's contributions are not being taken seriously.

5.43 For the most part, Demos negotiated these hazards very well. From speaking with participants, as well as observing the three sessions, it is clear that the engagement was on the whole an enjoyable experience for the majority of the participants, the organisers and the invited guests. The result was that participants stayed engaged and interested throughout each full day of discussion. Most of us would hesitate at the idea of giving up part of a weekend, despite the offer of limited financial compensation. To return on three separate occasions demonstrates a certain degree of commitment on the part of the members of the public. Moreover, participants in several instances continued to be actively engaged during the two week breaks between sessions, either by exploring the issues further through their own research, or through contact with the organisers by e-mail. More recently, two public participants were invited to attend Defra's Nanotechnologies Stakeholder Forum and update the forum on the outcomes of the inquiry.

5.44 Importantly, the participants we spoke with conveyed a sense of importance about what they were doing. This point was emphasised by the organisers throughout the engagement and further underlined in a useful discussion about the potential of these sorts of exercises, as well as what Demos and the Environment Agency hoped to achieve through the event. However, it is worth noting that some participants did express reservations, and harboured some distrust, that this was a "paper exercise," by its very nature, without much influence or clout. This topic will be given greater attention below.

5.5 Expertise

How was the knowledge and experience of the public participants able to be expressed, particularly in relation to the expertise of the organisers and invited speakers?

5.51 Nanotechnology, its benefits in terms of land remediation, and its hazards are complex subjects. Indeed, as the people's inquiry explored at some depth, considerable scientific uncertainty surrounds the technology. For most participants nanotechnology was a new and unfamiliar topic, of which they had little immediate knowledge. Asking members of the public to investigate this uncertainty and to make recommendations about how the technology should be regulated, is a daunting task. To be successful an engagement must, on the one hand, make complex scientific subjects accessible to participants. On the other hand, the purpose of this engagement has been to draw upon the "social knowledge", as the organisers termed it, of the participants. Again, this poses a difficult scenario for the organisers who have to inform the discussion without allowing expert scientific perspectives to bound and dominate the conversation.

5.52 The organisers sought to contend with this problem by adopting a conversational style to the use of expert advice. Instead of creating a context where the purpose of expert contributions was solely to educate, participants were asked to challenge expertise, explore issues of uncertainty and identify topics of particular relevance and importance to the debate.

5.53 Largely, the organisers were successful in this approach. Participants actively engaged in dialogue with invited speakers, asking for clarification on technical issues, but also engaging them on issues of uncertainty and potential hazard, as well as how these issues could be dealt with. For example, one issue which formed a recurring focus for discussion concerned the movement of nanoparticles when released into the soil. Participants picked up on the limited nature of scientific knowledge in this area, and the importance of the issue for environmental protection. Although an issue which both scientists and government regulators are familiar with, participants effectively acted

to bring this issue to the fore of the event. These discussions in no doubt gave shape to the group's final conclusions which suggest a cautious approach to regulation. This is a good example of the ways in which publics can learn from science, but also challenge it and contextualise knowledge, or in this case the lack of it.

5.54 While many other good examples took place during the engagement, not all expert-participant interactions were as successful as the above example. The quality of expert speakers was variable – some speakers were engaging, open to dialogue and willing to respond to participants whereas others seemed unprepared, or unsure of their roles, unable to relate material well to the participants and unable to effectively enter a dialogue with participants. Moreover, while the organisers provided members of the panel with a variety of expert opinion, this was at times repetitive and some lack of coordination showed through. While these situations did not represent the majority of cases, they do raise concern because of their potential for disengaging and isolating participants, as well as undervaluing their contribution as knowledgeable citizens.

5.55 A further issue of concern involves the selection of expertise. It is certainly understandable, given the pressures to find willing speakers and to cover a wide range of relevant material, for organisers to select experts in advance of consultation with the participants of the engagement. However, in doing so, organisers run the risk of creating a less *flexible* engagement and, therefore, pushing the dialogue in a direction which may counter the desires of the participating group. In this case, while a range of different experts presented material for consideration, participants themselves strongly expressed an interest to hear from speakers with whom they were familiar, or who they felt would add an important extra dimension. For example, this included requests for someone from the Department for Environment, Food and Rural Affairs to address participants, as well as the local Member of Parliament. Unfortunately, Demos and Defra were not able to find a way to fulfil these requests during the time period of the people's inquiry[22]. One consequence of this may have been that the engagement lacked the degree of expert input from government that participants felt was necessary in formulating their recommendations. Instead, one could argue that the use of expertise was somewhat science-heavy at the cost of including perspectives from those in decision-making roles within government.

6. Generating outcomes and influence

6.1 In Section 2 of the main report, the authors highlight the need for the engagement not to be seen as a simple addition to the development of policy, but as an integral part of its development. They rightly point out that engagement exercises are too often treated as add-ons to policy processes where decisions have already been made. Speaking sceptically about the outcomes of the evaluation, one participant suggested that governments get involved either because they have to, or because it makes them look good. To confront this kind of general scepticism means finding value not only in running the process itself, but in the knowledge and outcomes generated. For most readers this will seem like common sense, but it is a point which is often over looked in policy circles.

6.2 The production of social knowledge

6.21 It was always unlikely that the people's inquiry would generate a completely novel perspective on nanotechnology, or uncover policy implications that were not previously considered. This is understandable given that most participants had never heard of nanotechnology, or only had a

[22] In the case of the request for a member of Defra to address the evaluation, the situation was somewhat ameliorated by an invitation from the department to have representatives of the engagement exercise come to Defra to present their recommendations. However, for the majority of participants contact with the department was not possible. Moreover, while the Environment Agency and Defra were proactive in responding to the engagement (for example in inviting members of the inquiry to present their recommendations to Defra), some participants felt that it would have been helpful to have a governance perspective, and the opportunity to openly challenge this, incorporated into the development of the project's conclusions.

limited awareness. Alternatively, what was sought in this engagement was a less tangible form of social knowledge. Identifying these contributions will be an important task for the organisers as they reflect upon the dialogue and trawl through the transcripts produced. Without going into depth, in order to evaluate the event as a knowledge-generating process we will turn briefly to looking at the kind of perspectives produced.

6.22 Although not identifying any novel policy implications, participants were able to highlight issues of concern and emphasise the need for science and government to pay specific attention to these. As one member of the Environment Agency suggested following the event, participants spoke about risks in ways which have made these issues stand out in her mind.

6.23 Consider the example of the movement of nanoparticles beneath the ground surface. Assessing the limited knowledge about how nanoparticles behave in the environment, the lack of research in this area, and the pressure to use these technologies associated with the financial benefits of reclaiming land for development, participants produced recommendations urging caution and the need for more research. In other words, participants were able to contend with a range of complex technical information, assess this information in relationship to the social context and come up with rational and measured responses to this scenario.

6.24 A further example concerns the participants' emphasis on public education as part of the government's strategy in contending with nanotechnology. Such recommendations challenge and stretch government responsibilities and priorities. It was mentioned earlier that several participants expressed a feeling of pride and privilege in their involvement with this exercise. Partly this was expressed as a privilege to be part of the engagement, but it was also expressed as a privilege to learn about the issue and to be able to discuss it. Nanotechnology, as the panel's recommendations demonstrate, is something they believe everyone should have a chance to learn about, to think about how it will impact their lives and be given the opportunity to engage politically with. Again, these recommendations reflect an understanding of the importance of the potential benefits and risks of the technology and support the need for wider public engagement with the issue.

6.25 As these examples begin to illustrate, the commitment of participants through this engagement has translated into the production of knowledgeable perspectives and a series of meaningful recommendations for government. In other words, the engagement appears a considerable success in generating an impressive range of social knowledge about a difficult and unfamiliar subject.

6.3 Influencing policy-making

6.31 The organisers of the inquiry differentiate this exercise from others in its potential to break from past practice and provide meaningful input into governance. So soon after the end of the exercise, it is difficult to know precisely how the knowledge generated through this engagement will influence future policy decisions. However, it is hard to believe the people's inquiry process could be deemed a success, either in terms of its potential role in actively engaging the public in a dialogue about nanotechnology, or as a cognitive exercise in informing governance, if its outputs are not taken seriously.

6.32 Indeed, several participants we spoke with expressed varying degrees of scepticism about the impact of their recommendations, referring to the engagement as a "paper exercise." One participant worried that the engagement was conducted because the government was either obliged to as part of the process of developing a policy, or because it looked good for them to do so. A second felt that perhaps Demos and the Environment Agency were not giving participants all the information about the technology, particularly regarding how it was going to be applied in their neighbourhoods. They wondered, in other words, if the exercise was part of an eventual application to use the technology in East London and whether it was going to be applied in their neighbourhoods. Such views, in part, are likely to reflect overall levels of distrust and dissatisfaction

with government and the relationships it holds with its citizens. However, they also suggest considerable scepticism that the outcomes and recommendations produced during the inquiry would be fully acknowledged and impact upon the government's approach.

6.33 Such distrust poses difficult issues for the Environment Agency and Defra. It is worth reminding ourselves that the people's inquiry was an experiment in incorporating engagement in governance. In other words, it was a learning exercise intended to fill in some of the uncertainties about how engagement could contribute to the work of the Environment Agency and Defra. As such, the exercise, while informative, was never intended as part of a conclusive evaluation of the use of nanotechnology in land remediation. However, the limits of the engagement and the lack of clarity about how it will contribute to the actual governance of nanotechnology is a cause for concern for some participants. The challenge to the Environment Agency and Defra is to look beyond the limits of the engagement and to meet the commitment made by the participants of the process by continuing an open and honest dialogue with them. This should include an honest appraisal of the results of the engagement as well as a response to how the group's recommendations will be used, and in the case of rejected recommendations, a detailed account of why this was the case and how the issues identified might be dealt with. Simply, the task of the Environment Agency and Defra is to work at identifying what value they achieved in conducting this exercise, and to communicate this clearly to the participants.

6.34 Defra and the Environment Agency have already made some good progress in this regard. Firstly, reflecting a wish on the part of the participants, Demos effectively arranged a meeting in May 2006 between some of the participants and key policy makers, where they could submit their recommendations. During this meeting, some early feedback was provided about the value of their contribution and about how their recommendations might be dealt with. This provided a useful *first step* in engaging with the participants' recommendations and challenged government to actively think about how it could incorporate the knowledge produced through the engagement in policy-making.

6.35 Secondly, it is important to note that all of the members of the board responsible for the engagement at the Environment Agency found the event interesting and fruitful. While some expressed concern about how to identify exactly what made the event beneficial in a policy sense, each felt the engagement was still worthwhile. Although intangible, these sorts of benefits are important as they reinforce the value and validity of public engagement exercises and allow policy makers the opportunity to make best use of the outputs of engagement exercises. As one policy maker put it, the exercise challenged her in the way they she did her job, and reinforced the importance of fostering good relationships with the public.

6.36 These are important steps and begin to establish the context for an ongoing and fruitful relationship between government and the public as nanotechnology becomes more and more part of our everyday lives. It is crucial if this engagement is to be branded a success, that this relationship be permitted to evolve and the Environment Agency and Defra commit to the process started with the NanoDialogues engagement. It would be counter productive to view the engagement as a discrete one-off process.

7. Lessons learned?

7.1 At several points during this evaluation we have noted that public engagement, although becoming more prevalent in policy-making, is still a relatively new and untried part of the policy process. With the support of the Environment Agency, Demos has sought to develop engagement as a tool in contending with technology and environmental issues. Following the publication of *See-through Science* (Wilsdon and Willis, 2004), this exercise has been branded an experiment in upstream engagement, and presented as an attempt to embolden democracy in this area. It is,

therefore, worth asking how this event has helped evolve engagement, how it is practised and how it is applied.

7.2 The notion of upstream engagement involves allowing the public into the debate over a novel technology before the shape, purpose and structures of regulation surrounding a technology have been decided. It is a response to situations, such as that of the debate over genetically modified crops, where engagement did not occur until products were already on the market and companies were already applying to release GM materials into the environment. Thus, despite a series of public engagement exercises surrounding GM, the overall process by which the technology was developed and subsequently regulated was seen as profoundly undemocratic.

7.3 Yet given this overarching objective, choosing a regulatory case seems an odd first choice for an experiment in upstreaming democracy and engagement. Nanotechnology is indeed a novel and largely undeveloped technology, which will likely have a significant impact on development in the future. However, the use of nanoparticles in land remediation is already a well-developed technology, with trials having already taken place in the United States and with licensing requests already put forward in the UK. In other words, the technology, in this instance, is already pretty far downstream.

7.4 Is this important? On the one hand, this is important, as by framing a debate over nanotechnology in terms of environmental protection Demos and the Environment Agency have significantly bounded the terms of the dialogue. In particular, the dialogue was subsequently dominated by an overarching focus on ensuring that issues of uncertainty and risk were dealt with in regulating the technology and the means of how this could be accomplished. As one participant suggested, the choice of topic made her worry that the government was gearing up to allow the technology to be used in the remediation of brownfield sites associated with the development of the London Olympic Games in 2012. Her understanding of nanotechnology in the context of this engagement was framed by issues of protection and the need for public participation in this process. Certainly, these are crucially important issues, and the public should be involved in discussing them, but they are not particularly upstream.

7.5 Rather, there remains a strong need for a wider and more open dialogue about nanotechnology, about its potential and about how it fits with public perceptions of what our social futures will look like. These are the sorts of debates which did not take place during the GM debate (including, for example, debates over what type of farming system should be developed in Britain, about where we get our food and about who controls this industry). It would be tremendously unfair to Demos and the Environment Agency to suggest that these types of discussions did not take place. Significant time and effort, particularly in the first day, were spent on discussing the wider place of nanotechnology in society. However, if we look at the conclusions of the dialogue, only one of twelve recommendations does not concern the need to manage and regulate the potential hazards of the technology, or the need to generate awareness amongst the public of these risks.

7.6 On the other hand, it is not necessarily important that these more upstream discussions did not receive as much attention. More important is that public engagement becomes a routine and integral part of the evolution of the technology, including in terms of regulation and environmental protection. It can only become so if it can be made meaningful and found of value by publics and governments, as well as by the other actors involved in the development of nanotechnology. This engagement is not a success because of where it stands, upstream or downstream, but because of the values it offers to participants and to the Environment Agency and Defra. As outlined above, the people's inquiry has encouraged participation in the debate, produced insight into how the government might proceed with regulation, and made an important step forward in giving publics more influence in the governance of nanotechnology.

7.7 It is from this value that the important lessons of this exercise can be learned and several criticisms surrounding public engagement undermined. Firstly, following criticism of the GM-

Nation? debate[23] - that it only involved a small minority of politically active citizens - it has sometimes been suggested that this is a sign that the general public are ambivalent about these types of debates. The commitment of the participants in the people's inquiry and the sense of importance they ascribed to their roles suggests this is not the case here, and that members of the general public care about the governance of new technologies. A second common criticism of public engagement exercises concerns the inability of members of the general public to be able to understand and come to terms with complex scientific information. This engagement has shown that, given adequate resources and access to expertise, publics can not only take on difficult issues, but work with them in ways which provide meaningful contributions to governance. Finally, a third criticism of public engagement suggests that, while it may be a good idea in practice, when it boils down to decision-making it has very little influence. It is difficult to say how successful this engagement will be in this regard, but by working in cooperation with the Environment Agency and Defra, it is clear that the people's inquiry has created a context in which it may well be successful.

8. Summary

8.1 Overall, the people's inquiry has provided an interesting and useful engagement which potentially offers to make an important contribution to the regulation of nanotechnology as well as to the development of public engagement in governance. The following is a summary of the main conclusions of this evaluation, coinciding with the criteria identified above.

8.2 Engaging participants

The ability of the people's inquiry to encourage democratic participation in debates over nanotechnology and its regulation was evaluated according to four key themes:

8.21 *Flexibility* – the engagement was somewhat successful in allowing participants a certain degree of control over the process and to shape the terms of the engagement themselves. However, at times participants did struggle to assert themselves and their wider concerns against the focus on land remediation and regulation.

8.22 *Participation* – the engagement generated a strong commitment to the process from participants, who felt both interested in the topic and privileged to be part of the process. Some concern and scepticism was expressed about how their contribution would be valued in government.

8.23 *Expertise* – the engagement allowed most participants to effectively engage with complex technological and governmental issues, and provided the opportunity to challenge and assess this expertise. Unfortunately, the quality of experts and expertise provided to participants was somewhat uneven. Also of concern was the inability of the participants to determine the nature of the expertise they were provided with. This encouraged a discussion which was science-heavy and which was unresponsive to participants' requests for a more political perspective.

8.24 *Communication and feedback* – the purpose of the engagement and the role of the participants was clearly communicated to participants and well-defined. This involved the novel step of allowing participants to interrogate and discuss the benefits of public engagement, and the role of Demos in this process. Careful attention will need to be paid to following up on this good practice in providing feedback to participants about the uptake and application of the group's recommendations.

8.3 Generating outcomes and influence

[23] For a full discussion, please refer to the GM Nation Report (2003), as well as the report from the independent evaluators (Horlick-Jones *et al*., 2004).

Alongside the desire to encourage democratic participation in the development and regulation of nanotechnology, the people's inquiry hoped to provide government with access to social forms of knowledge. This aspect of the evaluation involved assessing the ability of the engagement to provide information of potential value to government, as well as the ability to influence policy-making.

8.31 The production of social knowledge

Although participants through this engagement exercise have identified few, if any, novel issues for policy makers to consider when developing UK nanotechnology policy, the engagement did provide insight in several areas. Examples included the identification of issues of particular public concern, the means of contending with scientific uncertainty and the identification of policy roles in informing and involving a wider public in the debate.

8.32 Influence in government

Concern has been expressed by participants about the ability and willingness of government to honestly consider and act upon the group's recommendations. These concerns most likely represent a more general distrust in government, but they also reflect an awareness of the difficulties faced by the government in doing so. However, Demos and the Environment Agency have made important steps in forming a constructive relationship between the public and government and a context in which engagement may be influential. It is crucial to the success of this engagement that these developments continue and for the government to make use of the value uncovered in this exercise.

8.4 Lessons learned

8.41 The people's inquiry was established as an experiment in developing public engagement in the governance of science and technology, and in upstreaming engagement specifically. Given the focus on a relatively developed technology – using nanoparticles in land remediation – it is difficult to suggest that this engagement has been fully successful in upstreaming engagement. While allowing some discussion of the potential of the technology and its relationship to the types of society we desire in the future, this type of upstream questioning was overshadowed by issues of risk, regulation and environmental protection.

8.42 However, the people's inquiry process has provided an engagement which has uncovered the willingness and ability of publics to be involved in these issues, and of their potential value to the development of a nanotechnology policy.

9. Conclusions

9.1 Demos, the Environment Agency and the members of the public who participated in the people's inquiry ventured onto some uncertain ground as they together sought to give shape to the role of engagement in environmental governance. Each individual we spoke with felt this was an event which was both engaging, and worthwhile in at least some capacity. These are sentiments which we, as part of the evaluation process, happily share. The organisers and facilitators worked hard to make an event which was engaging, forward looking and potentially meaningful. Governments have been asked to venture out from behind closed doors to practice governance in the open and with the cooperation of the public. Given the complex, difficult and potentially controversial policy scenarios surrounding the regulation of nanotechnology, the Environment Agency has taken a bold step in exposing itself to the public and should be congratulated for doing so. The public participants should also be praised for their commitment to the event and their contribution to conversations about the application and regulation of nanoparticles in land remediation.

9.2 Where we have made criticisms, or offered challenges to the organisers – for example regarding their responsibilities to carry forward and reflect seriously upon the outcomes of the debate – these have been made in the spirit of helping further develop engagement in government. We hope our comments here will contribute to the successful organisation and application of future events.

9.3 As an experiment in engagement with technology and its governance, this people's inquiry marks an important contribution to knowledge in this area. It has revealed both the potentials and difficulties of doing engagement, and provided a strong basis for evolving future practice in this area. We look forward to seeing how these lessons are developed and applied as government continues to develop its policy and regulatory strategy for nanotechnology.

References

Beck, U., 1997. *The reinvention of politics: rethinking modernity in the global social order.* Cambridge: CUP.

Bromley, C., Curtice, J. and Seyd, B., 2004. *Is Britain facing a crisis in democracy?* London: UCL Constitution Unit.

Brown, P., 1992. Popular epidemiology and toxic waste contamination: lay and professional ways of knowing. *Journal of Health and Social Behaviour*, 33(2), 267-281.

GM Nation, 2003. *GM nation? The findings of the public debate*. London: The Stationers Office.

Ezrahi, Y., 1990. *The descent of Icarus: science and the transformation of contemporary democracy*. Cambridge MA: Harvard University Press.

Horlick-Jones, T., Walls, T., Rowe, G., Pidgeon, N., Poortinga, W. and O'Riordan, T., 2004. A deliberative future? An independent evaluation of the GM nation? Public debate about the possible commercialisation of transgenic crops in Britain 2003. Understanding Risk, Working Paper 04-02, Norwich (http://www.uea.ac.uk/env/pur).

Irwin, A. and Wynne B. (eds), 1996. *Misunderstanding science? The public reconstruction of science and technology.* Cambridge: CUP.

Irwin, A., Simmons, P. and Walker, G., 1999. Faulty environments and risk reasoning: the local understanding of industrial hazards. *Environment and Planning A*., 31, 1311-1326.

Jasanoff, S., 1990. *The fifth branch: science advisers as policy makers*. Cambridge MA: Harvard University Press.

Jones, K.E., 2003. A cautionary tale about the uptake of 'risk': BSE and the Phillips report. In Stehr, N. (ed), *The governance of knowledge*. New Jersey: Transaction Books.

Phillips (Lord), Bridgeman, J. and Ferguson-Smith, M., 2000. *The BSE inquiry report*. London: The Stationary Office.

Royal Society, 2004. *Nanoscience and nanotechnologies: opportunities and uncertainties.* http://www.nanotec.org.uk/finalReport.htm

Stilgoe, J., Wilsdon, J. and Wynne, B., 2005. *The public value of science: or how to ensure that science really matters*. London: Demos.

Warren, M., 1999. *Democracy and trust.* Cambridge: CUP.

Wilsdon, J. and Willis, R., 2004. *See-through Science: New perspectives on science and innovation policy*. London: Demos.

We are The Environment Agency. It's our job to look after your environment and make it **a better place** – for you, and for future generations.

Your environment is the air you breathe, the water you drink and the ground you walk on. Working with business, Government and society as a whole, we are making your environment cleaner and healthier.

The Environment Agency. Out there, making your environment a better place.

Published by:

Environment Agency
Rio House
Waterside Drive, Aztec West
Almondsbury, Bristol BS32 4UD
Tel: 0870 8506506
Email: enquiries@environment-agency.gov.uk
www.environment-agency.gov.uk