

# **‘Nanoscience and Nanotechnologies: Opportunities and Uncertainties’ Two-Year Review of Progress on Government Actions**

## **Government Response to Call for Evidence by Council for Science & Technology**

### **INTRODUCTION**

1. This paper is the Government’s response to the request by the Council for Science & Technology for evidence to inform their two year review of progress on the Government’s progress in addressing the uncertainties and challenges posed by nanotechnologies.
2. It describes the actions taken by Government Departments, Agencies and Research Councils in delivering the Government’s commitments.
3. The Government’s response to the Royal Society (RS) and Royal Academy of Engineering (RAEng) report on nanotechnologies was published in February 2005 and since then we have made considerable progress in delivering the agenda that we set out to ensure the responsible development of nanotechnologies.

### ***Ensuring responsible development***

4. The RS/RAEng report identified that the potential health and environmental risks of free engineered nano scale materials should be an early topic for consideration. Little is currently understood about these risks and so a central strand of our work on nanotechnologies is to gather the necessary evidence to enable appropriate controls to be determined.
5. The evidence gathering comprises, in the main, a comprehensive programme of research (described in Chapter 1), a programme of stakeholder and public engagement, and a Voluntary Reporting Scheme for industry and research organisations to provide Government with information on potential risks (described in Chapters 2 and 3).
6. Another important component of our work involves assessing whether the existing regulatory framework is adequate to deal with potential hazards from engineered nanoscale materials (see Chapter 4). Reviews have concluded that the current legislative approach is capable of regulating current and emerging risks posed by engineered nanoscale materials, although this is contingent on Government gaining a better understanding of the potential risks and thus of the adequacy of the risk assessment models that sit within existing regulatory frameworks. The situation will be kept under review as research results and other evidence become available. Government advisory committees have played a role in the reviews of existing legislation and their expert advice will continue to be sought as new developments occur and in the light of horizon scanning activities (Chapter 5).

## ***International engagement***

7. In the Government's response to the RS/RAEng report we set out our intention to shape global developments in nanotechnologies. We consider that it is essential for any control regimes to be internationally agreed and harmonised, as far as possible. In this way, the benefits of nanotechnologies should be realised more quickly and cost effectively.

8. The UK has a wide network of international contacts and has played a prominent role in discussions in the EU and in international fora such as the OECD. The UK's proactive stance means that we have been influential in steering the direction in which standards and controls are being developed. The UK is hosting a meeting of the OECD Extended Steering Group on Manufactured Nanomaterials in October 2006 to take this agenda forward. The main objective of this meeting is to agree a draft Programme of Work on the safety of manufactured nanomaterials, 2006-2008, to be forwarded to the OECD Chemicals Committee. The meeting is not restricted to OECD member countries; non member countries, observer countries and NGOs have also been invited.

9. The Department of Trade and Industry (DTI) is supporting the British Standards Institute (BSI) and the National Physical Laboratory (NPL) to place the UK in a leading position for the development of international standards for nanotechnologies. Building on our well established national activities, the UK now holds the Chair and the Secretariat for the newly created Technical Committees for Nanotechnology Standards both in the EU and the International Standards Organisation (ISO). DTI is also supporting BSI work on draft Good Practice Guides on handling nanomaterials and essential terminology documents to be submitted to ISO as base documents for standards development.

10. The FCO's overseas Science & Innovation Network (SIN) has been very active in promoting UK nanotechnology and identifying opportunities for collaboration. For example, a 'Health Impacts of Nanotechnology' workshop was held between the Royal Society and the Science Council of Japan in July 2005. The workshop identified future research needs and collaborations, and further collaborative work has been taking the initiative forward. In addition, the SIN has undertaken much work elsewhere to promote UK strengths in nanotechnologies and opportunities for collaboration, notably in Russia, Germany, Taiwan, Malaysia and Singapore.

11. The Research councils also have international schemes such as BBSRC's International Scientific Interchange Scheme (ISIS) scheme and its Japan Partnering Awards.

## ***Coordination***

12. The Nanotechnology Issues Dialogue Group (NIDG), chaired by the Office of Science and Innovation (OSI), is co-ordinating the activities

described in the Government's response to the RS/RAEng report on nanotechnologies. The Group meets quarterly and brings together representatives from across departments, agencies and Research Councils. Summaries of the meetings are made publicly available<sup>1</sup>.

13. The Nanotechnology Research Co-ordination Group (NRCG), which is chaired by the Department for Environment, Food and Rural Affairs (Defra), is responsible for developing a cross-Government research programme into the potential human health and environmental risks posed by the products of nanotechnologies and overseeing the programme of public dialogue and social research. Further details are at Chapter 1. NIDG ensures that the work of the NRCG is integrated with other parts of the programme of work set out in the Government's response. The NRCG also meets quarterly and notes of the meetings are made publicly available<sup>2</sup>.

14. The Research Councils also coordinate their activities and facilitate joint working on research and capability building through a committee which reports to the Research Directors Group of the Research Councils UK (RCUK). RCUK is a strategic partnership through which the UK's eight Research Councils work together to champion the research, training and innovation they support.

15. A nano network, NanoSafeNet<sup>3</sup> is funded by the EPSRC and aims to bring together people from academia, industry and policy making to explore concerns about the health, safety and environmental impacts of nanotechnologies and options for addressing them in a collaborative, holistic manner.

### **Benefits**

16. Although this paper focuses only on the Government's agenda to ensure the responsible development of nanotechnologies (as in our response to the RS/RAEng report), the actions it describes should be seen in the context of the wider benefits from nanotechnologies. Nanotechnologies have the potential to deliver enormous benefits to society both in terms of wealth creation and more direct benefits. The Government is committed to ensuring that the UK remains at the forefront of the development of these new technologies. The Research Councils are funding on-going fundamental research. For example, EPSRC invests about £40 million per annum in responsive mode research grants in the area of nanotechnology and supports 40 new PhD studentships per annum. The BBSRC spent nearly £6 million in total on grants, studentships and interdisciplinary research collaborations in bionanotechnology in 2004/05.

17. In addition, the DTI is spending £90 million over six years on research and infrastructure that promotes the commercialisation of nanotechnologies,

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<sup>1</sup> [http://www.dti.gov.uk/science/science-in-govt/st\\_policy\\_issues/nanotechnology/nano\\_issues/page20563.html](http://www.dti.gov.uk/science/science-in-govt/st_policy_issues/nanotechnology/nano_issues/page20563.html)

<sup>2</sup> <http://www.defra.gov.uk/environment/nanotech/research/meetings/index.htm#nrcgmeetings>

<sup>3</sup> <http://www.nanosafenet.co.uk/index.html>

with a focus on collaborative research and technology transfer. Much of this is “pump priming” funding to enable the nanotechnology industry to develop sufficiently over the next few years such that it will be in a position itself to generate the income to fund and co-ordinate the activities. Key components of DTI’s investment are -

- funding of £40 million for applied research projects that are relevant to industry;
- funding of over £50 million to establish and maintain for five years a network of 23 facilities developing nanometrology, nanomaterials, nanomedicine and nanodevices (the Micro and Nano Technology Network (MNT<sup>4</sup>)). These facilities provide information and services to encourage the development of the nanotechnology industry in the UK; and
- support for the Nanotechnology Industry Association. The Association coordinates the views of the major industrial groupings which are actively commercialising nanotechnology and provides a cross-industry input to policy makers, nationally and internationally, the media and other interested parties.

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<sup>4</sup> <http://www.dti.gov.uk/innovation/micro-and-nanotechnology/index.html>

### RESEARCH

#### ***Nanotechnology Research Coordination Group (NRCG)***

1. The Nanotechnology Research Coordination Group (NRCG) was set up early in 2005 to develop and oversee the implementation of a cross-Government research programme into the potential human health and environmental risks posed by free engineered nanoscale materials. The research programme is designed to inform policy discussions on the nature of appropriate controls for the management of any risks that may arise.

2. The Group is comprised of members of Government Departments, Agencies and the Research Councils with an interest in nanotechnologies. One of its first tasks was to commission two scoping studies to identify gaps in our knowledge of the hazard and exposure data needed for addressing the potential risks presented by free engineered nanomaterials. The resulting reports formed the basis for the first Government research report 'Characterising the potential risks posed by engineered nanoparticles'<sup>5</sup>, published in November 2005.

#### ***Priorities for research and risk assessment***

3. This report identified 19 research objectives that have been taken forward by five Task Forces set up under the NRCG. Their objectives are grouped under the following inter-related work areas -

- metrology, characterisation and standardisation;
- exposure, sources, pathways and technologies;
- human health hazard and risk assessment;
- environmental hazard and risk assessment; and
- social and ethical dimensions of nanotechnologies.

4. The Task Forces have developed action plans to progress the 19 objectives and an overarching plan will be published on the Defra website early in Autumn 2006. The plans consider ongoing research projects and research requirements including some project specifications to meet immediate research needs. The plans recognise that certain projects are of a higher priority than others and set out a structured, tiered approach to delivery of the research objectives. It is important to ensure that work is carried out using well characterised materials that can be accurately measured in the environment or in laboratory studies undertaken to understand their hazardous properties.

5. This chapter describes the considerable amount of work that has already been put in hand. But not everything can be done at once. It takes time to build a consensus about the specific research that is needed and to

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<sup>5</sup> <http://www.defra.gov.uk/environment/nanotech/research/reports/index.htm>

establish a scientific community, especially one with the strength of interdisciplinary collaboration that nanoscience requires. Much initial work is therefore focusing on establishing the scientific community, building capacity and addressing fundamental underpinning issues, in particular the ability to measure, detect and characterise nanoscale materials. Such techniques must be developed before research in many other areas, for instance meaningful toxicology studies, can proceed. International consensus about the techniques is also important if a common approach to the regulation of nanotechnologies is to emerge, and considerable resource is being invested to achieve such agreement.

6. At present, exposure to engineered free nanoscale materials is most likely to occur in industrial and university laboratories where research on new materials and applications is being undertaken. A priority for research has therefore been to assess exposure through such routes, and considerable work is being undertaken in this area. Exposure from manufacture, use and disposal is less well understood and the subject for important research in its own right. Research needs on the human health and environmental impact of nanomaterials have been identified and funding opportunities provided, within both the UK and the EU. We hope that researchers will take full advantage of these opportunities to take forward work in this area.

7. Members of the Task Forces are a mix of government officials, scientists and experts in the various fields of interest. The Task Forces have sought and will continue to seek wider consultation in the development of the research action plans through a series of workshops and by discussion at meetings of the Defra's Nanotechnologies Stakeholder Forum (described in Chapter 2). Furthermore, and where appropriate, research project specifications are peer reviewed by appropriate Government scientific advisory committees and in particular the Advisory Committee on Hazardous Substances.

8. In drawing up the action plans, the Task Forces have taken into account on-going work in the EU and other international fora and have established links to promote dialogue and facilitate exchange of relevant information. Particular links are being forged with the OECD which is seen to have a key role in identifying and coordinating research into the human health and environmental implications of nanotechnology, thereby avoiding unnecessary duplication of work.

9. The following descriptions of work follow the broad areas covered by the five Task Forces, with the exception of the work on social and economic dimensions described in Chapter 2.

### *Metrology, characterisation and standardisation*

#### *Measurement*

10. The availability of reference materials was identified as the most critical gap by both metrology and toxicology members of the NRCG task forces.

Well characterised reference materials are crucial in order to be able to interpret studies and to compare results with other experiments carried out in laboratories across the world. From the toxicological point of view, well characterised materials (in terms of composition, mass, dimensions, surface area, etc.) are essential if we are to know exactly the exposure of the cell, tissue or animal, identify the most appropriate dose metric for a given type of nanomaterial, and thus interpret the results in a meaningful way. In addition, such materials will be crucial if we are to make progress regarding structural activity relationships within given types of nanomaterials. Defra recently issued a call for proposals to prioritise the development of reference materials, in line with a research specification drawn up by the Metrology and Standardisation Task Force. The EPSRC has made awards of £9.9 million in the area of nanometrology, to develop new tools and applications in the fields of medical science, medicine and manufacture.

11. The Micro and Nano Technology Network (MNT) Measurement Club<sup>6</sup> has been established to promote awareness and take up of micro and nano technology. It focuses on metrology and related issues such as national and international standards and regulations. NPL (which has strong capability in both the characterisation of engineered nanoparticles and air monitoring of "ultrafines") held a seminar in September 2005 to bring together the engineered and environmental nanoparticle measurement communities to benefit from shared skills. As indicated in the introduction, the UK is also playing a prominent role in the development of international standards for the measurement and characterisation of nanoscale materials.

#### *Detection*

12. It has become clear that for life cycle modelling the key issue is the detection and measurement of engineered nanoscale materials, particularly nanotubes, released into the environment during the product life cycle. The environment is full of carbonaceous material derived from natural causes such as fires or volcanoes or from combustion of diesel fuel and there are very few methods that can distinguish engineered nanomaterials from the surrounding carbonaceous material. The NRCG Metrology and Standardisation Task Force is writing, with expert advice, a research specification for the development of measurement protocols to detect and measure the most important class of particles for which good measurement techniques do not currently exist.

#### *Exposure, sources, pathways and technologies:*

13. The Health and Safety Executive's (HSE) current research focuses on issues relating to exposure and control; and fire and explosion. It also contributes to the work on human health issues.

14. A key area is investigation of current exposure levels and control measures in university laboratories where much of the work in the UK

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<sup>6</sup> <http://www.npl.co.uk/mnt>

involving nanomaterials is undertaken. HSE is committed to spending approximately £1.1 million on research in this area over the next 3 years. As results are generated and conclusions drawn HSE, advised by the Health and Safety Commission's (HSC) advisory committees, will work with stakeholders to prepare advice on good practice to control exposure for use by employers, employees and the public.

15. HSE is also investigating the fire and explosion risks of nanoparticles. One project aims to understand the fire and explosion hazards of selected nanopowders. Areas for investigation include explosion properties; ignition properties; accumulation of electrostatic charge; fire properties; the ease with which selected nanopowders can be made to form a cloud; and the suitability of standard test methods. The total cost will be over £300,000 and the funding for the first year has been committed.

16. Exposure, sources and pathways are key to understanding human and environmental effects. NERC is currently supporting fundamental research in this area through studentships and responsive mode grants (awards totalling £750,000). The Environmental Nanoscience Initiative (described in paragraph 18 below) will also promote the development of research capacity and generate high quality preliminary data on the environmental risk of internationally produced nanomaterials.

#### Human health hazard and risk assessment

17. As part of the work on the development of a tiered and strategic approach to investigating the potential health hazards of novel nanoparticles, HSE funded the Health and Safety Laboratory (HSL) to conduct a literature-based review of *in vitro* methods for assessing the toxicology of nanomaterials. This was discussed and modified by an ad-hoc group and the final report edited by the Chairman of the Group. The report sets priorities for the work and will be published shortly as an annex to the overarching action plan of the NRCG Task Forces. Together they will provide a guide for regulators, applicants for funding and assessors of funding bodies, and their recommendations will be considered carefully.

18. In addition, the EPSRC is providing £100,000 for a project on the toxicology of manufactured nanoparticles and the DTI is working with the Institute of Occupational Medicine to examine and investigate the likely industrial demand for an advisory service on nanotoxicology and for a toxicological testing service. To address the fact that researchers have not been submitting proposals for research into toxicology, the MRC will issue in Autumn 2006 a notice highlighting nanotoxicology and encouraging researchers to submit proposals for work in this area.

#### Environmental hazard and risk assessment

19. The Environmental Nanoscience Initiative (ENI) has recently been established. It is funded by Defra, NERC and the Environment Agency and will provide exploratory grants into the fundamental science underpinning the

environmental effects of engineered nanoparticles and act as a bridge between fundamental science into the benefits and risks of nanotechnologies and policy development. Key questions include –

- are dose response relationships (at all levels of biological organisation) influenced by particle size, number or shape?
- do nanoparticles influence the fate, behaviour or ecotoxicology of other substances present in the environment (e.g. in the rhizosphere, groundwaters, sediments)?
- are substances in their nanoform within environmental matrices more persistent, bioaccumulative or toxic when compared to the substance in bulk or dissolved form?
- is agglomeration an important factor mitigating hazard of nanoparticles once in the environment? and
- are the fate, behaviour, interaction and toxicological/ecological effects of nanoparticles governed by specific properties exhibited at the nanoscale (e.g. specific surface properties), properties that are both measurable and general to certain or all classes of particles?

20. The ENI will bring together scientists from across the UK and beyond, build research capacity, encourage knowledge transfer and forge links with international researchers and policy makers. A funding round for grants was announced in September 2006, with £500,000 available for small grants. Details of existing and future research opportunities can be found at the ENI website<sup>7</sup> as can details of workshops and other activities. Other grants funded through NERC's blue skies schemes will also have the opportunity to become part of the Initiative.

21. In addition, the NERC has recently funded about £750,000 of research into environmental fate, behaviour and ecotoxicology. Defra has commissioned a project to evaluate current ecotoxicological methods for hazard assessment of nanomaterials, a priority work area. The aim is to identify specific aspects of current regulatory tests and methods that are not suitable for nanomaterials. Defra has also commissioned a project on environmental exposure. An EU working group under the Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR) is also looking at test methods in respect of the impact of nanomaterials on the environment and human health.

22. Although not specifically targeting nanomaterials, the NERC-led Environment and Human Health Programme may also contribute to our understanding in this area through small proof of concept studies that link researchers across disciplines under its theme of "Transport and dynamics of

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<sup>7</sup> <http://www.nerc.ac.uk/funding/thematics/eni>

both chemicals and particles of different sizes and compositions in the natural environment that are of human health importance”.

### **Funding**

23. Within the UK, Government Departments and Agencies provide funding for the research needed to inform policy development. Applied research is funded by Government Departments and Agencies from their existing Departmental allocations.

24. The Research Councils fund more fundamental research in two ways. Under the responsive mode there is no fixed budget for such work but funding is provided in competition with proposals on other topics. For example, the Medical Research Council is to encourage responsive mode applications on toxicology and BBSRC has a responsive mode research priority in bionanotechnology. Under the directed mode, there are calls by the Research Councils for proposals targeted on particular areas. In addition, the EPSRC, BBSRC and MRC are providing £19.8 million for an Interdisciplinary Research Collaboration on Nanotechnology.

25. It is the responsibility of commercial companies to fund the research necessary to identify potential hazards of specific products that they intend to market. The Voluntary Reporting Scheme described in Chapter 3 will enable Government to access some of the information resulting from research funded for commercial purposes.

26. It would be unrealistic to expect the UK alone to fund all of the research and other evidence gathering required to ensure the responsible development of nanotechnologies. We need access to the results of research carried out elsewhere to avoid unnecessary duplication of work so cooperation at international level, over research as well as regulation, is a key component of our agenda.

27. We are working closely with the European Commission and other Member States to encourage cooperation on the responsible development, use and fate of the products and applications of nanotechnologies. EU Framework Programme 7 (FP7) will provide significant funding for necessary research and we will encourage UK researchers to take full advantage of the funding opportunities provided.

28. The majority of this funding will be directed through the Specific Programme on Cooperation, in particular Thematic Priority 4: *Nanosciences, nanotechnologies, materials and new production technologies*, which will have a budget of about €3,500 million, of which about one third is expected to fund work on nanosciences and nanotechnologies. The detailed work programme is currently being developed and the first calls for proposals are expected when FP7 is launched early in 2007. The work programme is expected to deliver many of the actions proposed by the Commission in their communication “Nanosciences and nanotechnologies: An action plan for Europe 2005-9”. The predecessor programme FP6 has also provided funds

for some of these actions. For example, three current projects on nano-toxicology have received EU funding of over €8 million.

29. We have also been working with the European Commission to explore the possibilities for cooperation with the USA. One of the outcomes is likely to be a coordinated call with the USA (through the National Science Foundation) and the EU (through FP7) on nano-toxicology and eco-toxicology to bring together international expertise in this area.

### ***Building a research community***

30. A major aim of the Government's first research report was to raise awareness of the research priorities and funding opportunities here and in Europe as a first step towards building a nanoscience research community. To encourage the submission of novel research proposals the Research Councils are supporting networks of researchers, policy makers and other stakeholders. By way of example, the Environmental Nanoscience Initiative will through workshops and a programme of communication and pump-priming research, raise awareness of research requirements in the area of nanomaterials and the environment. Similarly, through funding of workshops, networks and working groups, the NERC-led Environment and Human Health programme will build relevant research capacity across disciplines (environmental, physical, medical and social science) that can be brought to bear on understanding the environmental and human health hazard from nanomaterials.

### SOCIAL AND ECONOMIC DIMENSIONS/PUBLIC DIALOGUE

1. In its response to the RS/RAEng report, the Government committed to addressing the science and society agenda as it relates to nanotechnologies, and to elicit and understand people's aspirations and concerns around the development of these new technologies.
2. To co-ordinate this agenda, we have established a dedicated Government Task Force with responsibility for monitoring and reviewing the implications of past and ongoing work on the social and economic implications of nanotechnologies and identifying new priority areas of research and public engagement. The Group reports to the NRCG and NIDG
3. In expanding on these responsibilities, we stress that while specific applications of nanotechnologies will unarguably pose new social issues, most likely in the longer term, many of the key questions in the immediate future are not peculiar to nanotechnologies. Common issues include, for example, the public confidence in scientific knowledge, and the nature of citizenship and expertise within contemporary society. All of our activities detailed below therefore need to be viewed against our broader commitment to the science and society agenda, including a recent £5.2 million ESRC research programme in this area. Its aims are to impact on national and international debates and practical interventions concerning the public understanding of science, science and technology policy, science studies and the nature of citizenship and expertise within contemporary society.

#### ***Public and stakeholder dialogue***

4. Government published its programme for public engagement on nanotechnologies<sup>8</sup> in August 2005 and then supplemented and consolidated this in its first research report in November 2005. The programme is centred on three Government funded projects: Nanodialogues; the Nanotechnology Engagement Group (NEG); and Small Talk.
5. Nanodialogues<sup>9</sup> is supported by a grant of £120,000 from the DTI's Sciencewise<sup>10</sup> programme, with matched funding from other partners. It is led by Demos, Lancaster University, the EA, the BBSRC, and the EPSRC. Practical Action, an international development group, is also involved. The project examines the practicalities of the concept of 'upstream' public engagement through a series of case studies looking at: the control of nanoparticles to remediate land contamination; the shaping of strategic research directions; the global diffusion of nanotechnologies; and public value and innovation in a corporate environment.

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<sup>8</sup> <http://www.dti.gov.uk/files/file27705.pdf>

<sup>9</sup> <http://www.demos.co.uk/projects/thenanodialogues/blog>

<sup>10</sup> <http://www.sciencewise.org.uk/>

6. While Nanodialogues is not due to report formally until September 2007, the people's inquiry on nanoremediation has produced an initial set of conclusions which Defra and the Environment Agency have discussed with its participants. We will be publishing our formal response before the end of 2006.

7. The NEG<sup>11</sup> is also funded through the DTI's Sciencewise scheme (with a grant of approximately £90,000) and aims to bring greater coherence to the increasing number of projects and activities that address the interface between technical and social understandings of the potential risks posed by nanotechnologies. The Group – which is made up of people with expertise and projects in this area – is charged with mapping out and analysing the current practices of public engagement on nanotechnologies. This exercise is intended to inform the Government and others about the conditions under which early public engagement can influence policy and decision-making. It also provides a forum for deliberation on the implications of ongoing public engagement activities around nanotechnologies for future research and public engagement priorities.

8. The NEG has to date produced an introductory report setting out its working rationale; published a first policy report providing an initial analysis of public engagement exercises on nanotechnologies; and organised a one-day event exploring the tensions and synergies between the needs and expectations of the different parties involved in public engagement on nanotechnologies. A third report, planned for publication in the autumn 2006, will elaborate on the findings of the workshop. There are plans for further workshops and the final NEG report will be published in Autumn 2007.

9. One of the projects being considered by the NEG is 'Nanojury', a citizen's jury organised by the Policy, Ethics and Life Sciences Research Centre at Newcastle (PEALS), with partners including the BBSRC, the Guardian newspaper, Greenpeace and the Interdisciplinary Research Collaboration in Nanotechnology. This jury brought together 15 randomly chosen people to discuss issues surrounding nanotechnology. They met 10 times and produced a series of recommendations that included greater openness in public funding of the development of nanotechnologies, lay membership of funding committees and more public consultation and dialogue about nanotechnology. In response to the latter recommendation, BBSRC held a dialogue event about nanotechnology at the Edinburgh Science Festival in April 2006 and developed a small exhibition to support that and future events. The exhibition includes information about the public engagement activities BBSRC is involved with as well as the science.

10. Government is also funding Small Talk, a project that pulls together the findings of a wide range of activities around the UK that are focussed on discussing nanotechnologies with the public and scientists. It is a £50,000 Copus project delivered by a collaboration of the British Association for the

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<http://www.involving.org/index.cfm?fuseaction=main.viewSection&intSectionID=213&intParentID=2>

Advancement of Science, Ecsite-UK, the Royal Institution, the Cheltenham Science Festival, and is managed by Think Lab. The project will report formally in October 2006.

11. Government needs to learn from the activities taking place under this programme, as well as those funded by other organisations, to maximise the benefits of any new public dialogue initiatives. To ensure that this learning takes place throughout the duration of the projects, the chair of the Government Task Force on the social and economic implications of nanotechnologies, sits on the steering board of the Nanodialogues project, is a member of the NEG, and is in regular contact with the contractor responsible for Small Talk.

12. Government is additionally working to ensure that a full range of (professional) stakeholder views inform its policy making activities on nanotechnologies. There are very few clear-cut rights and wrongs in this policy area and we need a constructive debate through which to address them. It will never be possible to reconcile different stakeholder views on key issues completely, nor is this necessarily desirable, but this interaction will lead to more informed and thus stronger policy outcomes. Defra has helped to catalyse and formalise this through its Nanotechnologies Stakeholder Forum, which enables key stakeholders from industry, academia and civil society organisations to learn about and discuss each other's views, as well as Government activities, on appropriate controls and research.

### ***Social and economic research***

13. In 2003, the ESRC funded the University of Sheffield to report on the social and economic aspects of nanotechnologies. In particular, the study identified two dimensions to the debate on the social implications of nanotechnologies<sup>12</sup>. The first focused on radical, long-term technological possibilities, including a future in which fabrication from a molecular level of virtually any material or structure is possible. The second concerned much more incremental, short-term outcomes, such as the enabling of sensing devices.

14. An updated version of this study, which provides a succinct literature review on the debate surrounding nanotechnologies since the publication of the first report, is now available as "The Social and Economic Challenges of Nanotechnology" on the ESRC website<sup>13</sup>.

15. The ESRC has also awarded the University of Lancaster £226,450 for a project entitled "Nanotechnology Risk and Sustainability: Moving Engagement Upstream"<sup>14</sup>. The project considered how dialogue between the public, scientists and regulators could shape the innovation and regulation of nanotechnologies, and more specifically, how public debate about new technologies could be moved closer to the heart of the R&D processes around

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<sup>12</sup> <http://www.shef.ac.uk/physics/people/rjones/PDFs/SECNanotechnology.pdf>

<sup>13</sup> <http://www.esrc.ac.uk>

<sup>14</sup> <http://www.sustainabletechnologies.ac.uk/Projects/nanotechnology.htm#i>

nanotechnologies. It demonstrated in particular that meaningful dialogue could be generated despite an initial low level of understanding.

16. More recently, the ESRC has started to progress a programme of research (with matched funding from others) on the adequacy of current risk governance frameworks for nanotechnologies. The specific research questions that the programme will seek to address include -

- the relationship between private, national, European Union and global resources and their responsibilities in terms of effective governance;
- the effective upstreaming of citizen influence in relation to global governance systems; and
- effective multi-level governance in relation to securing advantages for the range of different private sector stakeholders.

17. Also of note is an ESRC funded scenarios workshop, in the latter part of 2006, which will address the future social and economic drivers and implications of convergence between nanotechnologies and other technologies.

18. In addition to the ESRC's investments, Defra is funding two projects on the social and economic dimensions of nanotechnologies. The first addresses the popular debate around public value and innovation by seeking to identify potential barriers to the development and realisation of environmentally beneficial nanotechnologies, including how Government can help in this respect. The project is expected to report its conclusions early in 2007.

19. The second project is concerned with the handling of scientific advice by Government on nanotechnologies. Some academics and policy makers now see non-scientific expert advice as a means of emboldening public confidence and legitimacy in the way knowledge and expertise are applied in policy processes. This discussion is particularly important in deciding how we build and use expert advice on the potential risks posed by nanotechnologies. To this end, the study seeks to understand how we can best utilise non-scientific expertise on the ACHS, which has responsibility for nanotechnologies. Some of the key findings will be communicated in a Demos science and society pamphlet, which will be launched early in December 2006.

### OTHER EVIDENCE GATHERING

#### *Voluntary Reporting Scheme*

1. Following consultation, Defra has introduced a Voluntary Reporting Scheme for engineered nanoscale materials. The scheme will be run by Defra, working with other Government Departments and Agencies, the Scottish Executive, the National Assembly for Wales and Northern Ireland Administration and will operate for the period September 2006 to September 2008. The scheme is voluntary and does not require legislation.
2. The scheme is targeted at any company or organisation involved in manufacturing, using, importing or managing wastes consisting of engineered nanoscale materials.
3. Information submitted will include risk management practices currently employed by industry in order to reduce or remove emissions of engineered nanoscale materials to the environment or to waste streams.
4. The purpose of the scheme is to develop a better understanding of the properties and characteristics of different engineered nanoscale materials, so enabling potential hazard, exposure and risk to be considered. The building of an evidence base in this way will allow for a more informed debate about the nature of appropriate controls and in the shortest time frame. Additionally, it will allow the UK Government to work towards creating a level playing field in the global community.
5. A similar scheme is intended to operate at EU level. The European Commission will invite industry to provide a number of dossiers on different representative engineered nanoscale materials, to show what kind of data is available, how risk assessment is being performed and how the risks are controlled.

#### ***Landscaping the products and applications of nanotechnologies in the UK***

6. Defra, the Environment Agency and the HSE commissioned a study to review the manufacture and uses of the products of nanotechnologies in the UK. This study, which built on an earlier review of industry capability carried out by DTI, has been essential in identifying companies to contact with a view to participating in Defra's Voluntary Reporting Scheme. The resulting database will be updated on a regular basis. The results of the study have been published in *Occupational Medicine* Vol 56#5 p 300-306 (Aitken et al)<sup>15</sup>.

#### ***Other monitoring***

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<sup>15</sup> <http://occmed.oxfordjournals.org/cgi/content/abstract/56/5/300>

7. HSE monitors the manufacture and use of engineered nanoscale materials, using a wide range of national and international sources and provides a regular quarterly report to the NRCG and NIDG. This is made publicly available on the HSE website<sup>16</sup>.

### ***Sustainable technologies***

8. Sustainable consumption and production is a strategic priority for the Government, which is committed to moving towards manufacturing processes that are increasingly sustainable. The use of nanotechnologies may enable significant reductions in the level of resources, including energy consumed in manufacturing cycles and product supply chains.

9. Defra, DTI and EA are examining the potential in this area and Defra has commissioned a project to examine the nature and magnitude of the potential environmental benefits, including the implications for government policy. The analysis will include an assessment of the benefits from nanotechnologies in comparison to other technologies capable of addressing the same environmental challenges.

10. The project will be overseen by a multi-stakeholder steering group. An open workshop will be held in early 2007 to discuss the project's findings. The CST sub-group on nanotechnologies will be invited to that workshop. The final report and key conclusions will be used by Government Departments and Agencies to inform policy decisions.

11. The ESRC is currently commissioning a Targeted Initiative on Innovation which provides an opportunity for research proposals focusing on nanotechnology in the context of global development of sustainable technologies. Awards are expected to start from spring 2007.

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<sup>16</sup> [http://sro.hse.gov.uk/View\\_Article.aspx?id=54](http://sro.hse.gov.uk/View_Article.aspx?id=54)

### REGULATION

1. Although there is no legislation specifically relating to nanotechnologies at present, individual departments and agencies have generic legislation that applies to engineered nanoscale materials and enables the relevant agency or local authority to take prompt action if products pose a risk to health, safety or the environment.
2. This Chapter describes the existing legislation and procedures for responding to emergencies. It also describes the results of reviews of the legislation. Evidence from the work outlined in Chapters 1 and 3 will inform the development of any specific measures that are considered necessary, whether by changes to EU or national legislation. The legislation will also be kept under review in the light of future developments.
3. In addition to the legislative controls, Defra, the Environment Agency and HSE have had a constructive dialogue with industry over the responsible development of nanotechnologies. These discussions have included the issue of good practice guidance for the manufacture, use and disposal of nanomaterials and the industry has indicated a willingness to take this forward. Work will commence shortly to develop this approach.

#### ***Food safety***

##### *Prevention of harm*

4. Many of the manufactured nanoparticles that might be added to food are subject to pre-market approval under Regulation (EC) No 258/97 on novel foods and novel food ingredients, which reduces the possibility of potentially harmful products being marketed without a proper risk assessment. Separate legislation is in place covering food additives, and particle size has been identified as a potential risk factor during the evaluation of certain additives. More generally, the Food Safety Act makes it an offence to sell food which is injurious to health or which is unfit for human consumption. This provides a regulatory "safety net" for any materials that are not specifically regulated, and the obligation that this places on the food industry results in operators exercising a cautious approach to the introduction of such materials.

##### *Emergency measures*

5. The Food Standards Agency has well-established incident procedures which apply equally to foods containing nanomaterials as to other foods. This includes an EU-wide system for alerting other member States to potential health risks.

### Regulatory review

6. The Food Standards Agency issued a draft regulatory review of the potential uses of nanotechnologies in food manufacturing<sup>17</sup> for public comment in summer 2006 and several sets of comments were received. These are being evaluated and a final report will be published shortly.

7. As noted above, many potential uses of nanotechnologies that could affect the food area would come under some form of pre-market approval process. Where this does not apply, there are frameworks that allow for emerging risks to be investigated and addressed (for example in food packaging). Foods and ingredients that are produced using new processes are regulated under the Regulation on novel foods (EC) No 258/97, which establishes procedures for pre-market evaluation of new products. This legislation is currently under review, providing an opportunity to highlight and confirm the status of nanomaterials as novel food ingredients

### **Environment**

#### Prevention of harm

8. Defra, EA and HSE have spent time working with the European Commission and other Member States to reach agreement on the interpretation of nanomaterials in the context of the current Notification of New Substances Regulations (which implement Directive 67/754/EEC), the Existing Substances Regulation (EC) No 793/93 and the forthcoming REACH Regulation. The following has been agreed -

- whether a nanomaterial is a new or existing substance is related to the substance identification: what determines that one substance is the same as another. So far substance identification is done on the basis of the information on chemical structure, purity, the chemical name and the supporting spectral and analytical data. When a nanomaterial is derived from an existing substance, the Existing Substances Regulation (EC) No 793/93 applies. There are certain caveats to this and also data reporting requirements. To date, one nanomaterial has been agreed as a new substance and is subject to notification of new substances once the tonnage threshold is reached;
- nanomaterials having specific properties may require a different classification and labelling compared to the bulk material, also when the nanoform is derived from a bulk substance; and
- the European Commission will invite industry to provide a number of dossiers on different representative nanomaterials, to show what kind of data is available, how risk assessment is being performed

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<sup>17</sup> <http://www.food.gov.uk/news/newsarchive/2006/may/nanoreview>

and how the risks are controlled. (This activity is not dissimilar from the UK Voluntary Reporting Scheme).

9. For the longer term, a review of the applicability of testing methods and risk assessment methods should be carried out at international level (e.g. within the OECD chemicals programme) with active input from industry and contributions from the EU. (This is in line with existing UK activity and we support this proposal). It should also be noted that the Commission has requested an opinion from the Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR) on the appropriateness of risk assessment methods in the technical guidance documents for new and existing substances.

#### Emergency measures

10. The Environment Agency has procedures in place for dealing with environmental incidents that fall within its remit and may involve unknown toxins or materials. The Environment Agency works within the principles of Integrated Emergency Management and responds under a well-established incident management process. The Agency and the Health Protection Agency have a joint working group on incident management and, if required during an incident, the Agency would also liaise with DH to obtain any necessary advice. Defra's Advisory Committee on Hazardous Substances would be consulted when appropriate. Defra also has emergency powers which are available if needed.

#### Regulatory review

11. Defra, working with EA, has conducted a study on regulatory gaps as they affect the environment and human health via the environment<sup>18</sup>. Little evidence is available to determine either the level of hazard posed by nanoscale materials or the potential for exposure, and whether there are any potentially significant risks. Without such data it is not possible to fully assess the extent to which current controls and regulations for managing environmental risks cover nanoscale materials, or the type of additional measures that may be necessary to control risks.

12. The Government has stated that industry should not use engineered nanoscale materials to remediate land contamination (which would involve relatively large scale releases) until we have a better understanding of potential risks. The Environment Agency has also indicated that field trials of nanoremediation should only take place in controlled conditions, and they would consider it essential for the proponent to undertake a detailed risk assessment before proceeding. Government is working to ensure that there are good communication links between all parties involved in decisions about the remediation of land contamination, which include Local Authorities, the Environment Agency and remediation consultants and contractors.

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<sup>18</sup> [http://www2.defra.gov.uk/research/project\\_data/More.asp?I=CB01075&M=KWS&V=Na](http://www2.defra.gov.uk/research/project_data/More.asp?I=CB01075&M=KWS&V=Na)

## ***Health and safety***

### **Prevention of harm**

13. Under health and safety legislation, employers and the self-employed must protect employees and those that could be affected by work activities. They must assess the risk and put in place suitable controls to guard against the hazards. The main legal instruments are the general requirements of the Health and Safety at Work etc Act 1974, the Management of Health and Safety at Work Regulations 1999 and specific regulations such as Control of Substances Hazardous to Health Regulations 2002, Dangerous Substances and Explosive Atmospheres Regulations 2002.

14. This framework is based upon undertaking suitable risk assessment – which requires the ability to define hazard, determine risk and identify suitable means of control, including controlling the risks arising from foreseeable incidents. At this stage of development HSE considers that traditional risk control measures should be sufficient to control most foreseeable exposures, but more needs to be known about the hazards before we can be certain that the risks are being controlled. HSE therefore encourages researchers and businesses to adopt a precautionary approach.

15. Current interim information on health and safety issues for researchers and developers is contained in HSIN1<sup>19</sup> and this is scheduled to be updated in January 2007 in the light of developments in our understanding. The longer-term goal is to work with industry and academia to develop formal good practice guidance when research results give a clearer understanding of the risks.

16. The HSE/HSL NanoTeam disseminates information and interim guidance on controlling risks through their web page<sup>20</sup>, Infoline (HSE's public contact centre), a dedicated email address for internal use and through contacts in industry and academia. Their work is outlined in the HSC Annual report<sup>21</sup> and covered by an article in the May 2006 edition of the Royal Society for the Prevention of Accidents' Occupational Safety and Health Journal.

17. In addition, HSE is funding for 1 year a Helpdesk project to provide an information bulletin service reviewing studies on exposure and potential health effects of nanomaterials relevant to the occupational setting. The bulletins produced will be available on the web. Continued funding will depend on a review of the impact after the first year.

### **Emergency measures**

18. In the event of an incident, HSE's primary role is to investigate the causes and take the necessary regulatory actions. It has no formal role in responding to incidents but HSE experts would normally advise the

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<sup>19</sup> <http://www.hse.gov.uk/pubns/hsin1.pdf#search=%22HSIN1%22>

<sup>20</sup> <http://www.hse.gov.uk/horizons/nanotech/.htm>

<sup>21</sup> <http://www.hse.gov.uk/aboutus/reports/0506/ar0506.pdf>

emergency services on precautions to be taken by their personnel to control exposure.

### Regulatory review

19. HSE completed a regulatory review in February 2006 that is published on the HSE website<sup>22</sup>. In brief the review concludes that -

“... the principles of the existing regulations and the interconnections between them are appropriate and applicable to nanomaterials. We perceive no need to fundamentally change the regulations themselves, nor to introduce new regulations. However, there are important issues which require attention if, in reality, the current and foreseeable future general regulatory framework is to operate effectively in relation to nanomaterials.”

The most important of these issues is the lack of knowledge about aspects of nanoparticles.

### **Medicines and medical devices**

#### Prevention of harm

20. Medical products must go through an extensive series of quality, pre-clinical and clinical trials before they are granted a marketing authorisation. The risk/benefit must have been demonstrated to be acceptable for the particular patient population. Manufacturers of medical devices must also carry out an analysis of the risks associated with their products, with particular regard to their toxicity and compatibility with tissues, body fluids and other body systems as appropriate.

21. The existing regulations for medical devices require manufacturers to carry out an analysis of the risks associated with a medical device, to eliminate or reduce these where feasible, and to assess the balance of risks and benefits. Although the regulations for medical devices do not differentiate between medical devices that utilise nanotechnologies and those that do not, MHRA is of the view that the existing regulations for medical devices and medicines are sufficiently broad in scope to cover risks associated with nanotechnology.

#### Emergency measures

22. For both medicines and medical devices, there are systems in place that require the manufacturers and the physicians using medicinal products to report all adverse reactions to, or defects of, a given product to the competent authority. For medicines, the adverse reactions are entered into a database and monitored by the MHRA.

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<sup>22</sup> <http://www.hse.gov.uk/horizons/nanotech/regulatoryreview.pdf>.

23. Any medicinal product can be withdrawn from the market at the request of the MHRA.

### Regulatory review

24. The MHRA has reviewed the adequacy of the existing regulations as they pertain to medicines and devices. It has consulted with its advisory bodies (the Committee on Safety of Medicines<sup>23</sup>, Chemistry, Pharmaceutical and Standards sub-committee<sup>24</sup>, and Committee on the Safety of Devices (CSD)<sup>25</sup>). The conclusion of these consultations is that the legislation and the test methods employed are adequate to ensure the safe use of these products by the public and there are no significant regulatory gaps.

25. The MHRA will continue to consult its advisory committees as new products and our understanding of nanomaterials develop. For example, it intends to submit a further paper ('The Toxicology of Nanoparticles used in Healthcare) to the Commission on Human Medicines (CHM), the Commission on Toxicology (COT) and the CSD in September 2006. This paper will ask for the Committees' views on the adequacy of conventional toxicological assessment methods, as applied to healthcare products, for evaluating the toxicity of healthcare products which contain nanoparticles

26. However, relatively few medicines, devices or combination products currently on the market employ nanotechnologies. New products with potentially large benefits are expected to be developed in the near future and the MHRA will continue to monitor the adequacy of current regulations and risk assessment methodologies for nanocomponents, and to assess the need for new standards.

27. For medical devices, European standards are being developed on nomenclature for nanoparticles and, within the wider context of biological safety, on physicochemical characterisation.

### ***Cosmetics and consumer products***

#### Prevention of harm

28. The EU Cosmetic Products Directive bans the use of certain substances in cosmetics and others are subject to restrictions and conditions on their use. All cosmetic products sold in the UK must comply with the Cosmetic Products (Safety) Regulations 2004. The Regulations implement the Directive and require that all cosmetic products sold to the consumer must be safe under normal or reasonably foreseeable conditions of use. All cosmetic products are subject to a health and safety assessment by a suitably qualified person before they are placed on the market.

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<sup>23</sup> [http://www.mhra.gov.uk/home/idcplg?IdcService=SS\\_GET\\_PAGE&nodeId=301](http://www.mhra.gov.uk/home/idcplg?IdcService=SS_GET_PAGE&nodeId=301)

<sup>24</sup> [http://www.mhra.gov.uk/home/idcplg?IdcService=SS\\_GET\\_PAGE&nodeId=454](http://www.mhra.gov.uk/home/idcplg?IdcService=SS_GET_PAGE&nodeId=454)

<sup>25</sup> [http://www.mhra.gov.uk/home/idcplg?IdcService=SS\\_GET\\_PAGE&nodeId=308](http://www.mhra.gov.uk/home/idcplg?IdcService=SS_GET_PAGE&nodeId=308)

29. Similarly, the General Product Safety Regulations 2005 place an obligation on suppliers of other consumer products to supply only products that are safe for normal or reasonably foreseeable use. UK and EU standards must be taken into account in assessing the safety of a product.

### Emergency measures

30. In the event of a problem with cosmetics or other consumer products, the General Product Safety Regulations 2005 provide for Trading Standards Officers to order the withdrawal of the products from the market. To supplement the Regulations DTI has issued guidance to local authorities on the action to be taken depending on the nature of the problem. DTI would also notify the European Commission, who would alert other member States.

### Regulatory review

#### *Cosmetics*

31. The European Scientific Committee on Consumer and Cosmetics Products (SCCP) is the independent committee which advises on the suitability or otherwise of substances for use in cosmetics. It has been mandated by the European Commission to find ways of assessing ingredients in cosmetics in nanoparticulate form. This work is currently a priority for the SCCP. Their opinion has yet to be adopted but will contain a chapter listing the basic criteria for the *in vitro* assessment of dermal absorption of nanosubstances in cosmetics.

32. If any Member State has concerns about the use of particular substances in cosmetics they can approach the European Commission with relevant data. The Commission would then seek an opinion from the SCCP. The SCCP has been asked to consider the efficacy and health implications of using microfine zinc oxide as a UV filter. There is no evidence to show that this product is harmful (and normal scale zinc oxide is routinely used without evidence of harm) but the manufacturer has not supplied the additional dossier requested by the SCCP. As a result, the SCCP has not approved its use. But neither has it recommended a ban. The lack of approval means that microfine zinc oxide may only be used as a UV filter within the EU if Member States choose to temporarily allow its use (until December 2007 at the latest). Within the EU, only Germany has exercised that option.

#### *Other consumer products*

33. There has been no specific review of the legislation governing other consumer products. Discussions have not been held with interested parties about the possibility of manufacturers publishing their safety assessment methodologies or labelling consumer products which contain nanoparticles. The value of these actions can only be determined following the adoption and validation of safety assessment methodologies. The SCCP is currently considering such methodologies with a view to subsequent action being taken at EU level.

### ***End of life***

34. Extended producer responsibility measures include European Directives relating to End of Life Vehicles, Waste Electrical and Electronic Equipment, Packaging and Packaging Waste, Batteries and Accumulators, and the Restriction of Hazardous Substances. These restrict the use of certain hazardous substances.

35. Nanomaterials are not currently restricted by these Directives but, were restrictions on nanomaterials thought to be necessary in the light of developments, a suitable addition could be made to the list of hazardous substances restricted. This would require the agreement of the European Parliament and Council to a Commission proposal. We are not aware that any Member State has made representations to the Commission in this regard.

### ***OSI Regulatory Overview***

36. In addition to the specific reviews by the relevant departments and agencies, NIDG agreed that OSI would commission a short study to provide an overview of the potential regulatory implications for the UK of developments in nanomaterials across all product and activity types and regulatory areas. This will identify any significant existing or future likely regulatory gaps, inadequacies or inconsistencies. The review has begun and a report will be available in December 2006.

### ADVISORY COMMITTEES AND HORIZON SCANNING

#### *EU committees*

1. We have discussed with the European Commission and our European partners the most effective mechanisms for ensuring that the relevant scientific advisory committees undertake a full safety assessment of manufactured free nanoparticles in cosmetics and other consumer products. The European Commission has now mandated two committees to consider the use of nanotechnology –

(a) the SCCP is seeking to identify ways of assessing ingredients in cosmetics in nanoparticulate form. This is currently a priority for the SCCP; and

(b) the new Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR) is treating the potential health risks of nanomaterials as a high priority. In Sept 2005 it adopted an opinion on “The appropriateness of existing methodologies to assess the potential risks associated with engineered and adventitious products of nanotechnologies”. More recently the European Commission has requested an opinion from the SCENIHR on the appropriateness of risk assessment methods in the technical guidance documents for new and existing substances for assessing the risks of nanomaterials. That opinion is awaited, as is subsequent action.

#### *UK committees*

2. There are nine national advisory committees who between them advise a number of Government departments and agencies in areas relevant to nanotechnologies<sup>26</sup>.

3. The NIDG Chair wrote to the secretaries of these committees in November 2005, drawing their attention to the need for regulatory bodies and their respective advisory committees to include future applications of nanotechnologies in their horizon scanning programmes. The committees were asked about: their terms of reference; their arrangements for horizon

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<sup>26</sup> Advisory Committee on Animal Feedingstuffs (ACAF);  
Advisory Committee on Hazardous Substances (ACHS);  
Advisory Committee on Novel Foods and Processes (ACNFP);  
Advisory Committee on Toxic Substances (ACTS) - the Working Group on Actions to Control Chemicals (WATCH), an ACTS sub-committee, advises the HSE, the HSC and ACTS on issues relating to the assessment and control of health risks from chemicals;  
Air Quality Expert Group (AQEG);  
Committee on Carcinogenicity of Chemicals in Food, Consumer Products and the Environment (COC);  
Committee on Medical Effects of Air Pollutants (COMEAP);  
Committee on Mutagenicity of Chemicals in Food, Consumer Products and the Environment (COM);  
Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment (COT).

scanning; and the availability of adequate nanotechnology expertise. The overall response was as follows -

- the committees felt that their existing terms of reference were broad enough for them to adequately consider nanotechnology issues, except Defra's Advisory Committee on Hazardous Substances (ACHS) which changed its terms of reference and the expertise of the committee in 2006 to address nanotechnologies;
- horizon scanning generally seemed to be done as a regular and fairly formal exercise. It primarily relied on the independent experts on the committees raising issues and identifying gaps. This was augmented by input from the Secretariat and their contacts with Government Departments & Agencies, researchers and industry; and
- the committees did not seem to have difficulty identifying and obtaining adequate expert input on nanotechnology issues through their normal network of contacts. Additional experts could be invited to assist the committee in various ways, for example: by becoming *ad hoc* members, by being co-opted to a working group, by writing a paper, or by attending a specific meeting. Also, in some cases, the committees drew on the advice of other more specialist committees.

### ***Horizon scanning***

4. Since its launch in March 2005, the OSI Horizon Scanning Centre (HSC) has created bodies of evidence and analysis in two strategic scans –

- the Delta (science and technology (S&T)) scan, which provided a quality assured synthesis of expert views covering key emerging S&T topics; and
- the Sigma scan, which provided a quality assured synthesis of the best globally available horizon scanning data, addressing social, economic, environmental and political trends, as well as high-level technological issues.

5. These scans have been used to support the HSC's work in informing cross-Governmental and Departmental strategy formulation, priority setting, and policy formulation, as well as in defining and spreading good practice in horizon scanning across Government. They are an integral evidential component of work to identify the health, safety, environmental, social, ethical and regulatory implications of current, new and emerging technologies.

6. Work on the wider implications of science and technology will be achieved through two related strands of work –

- the Sciencewise-funded programme "Science Horizons .... Shaping our future", which will use the issues and trends identified by the Delta Scan as the basis for a series of informed, deliberative, dialogue events

among citizens and stakeholders. It will gather views from a wider public on the implications of potential S&T developments; and

- a number of workshops run by the HSC involving experts, policy-makers and other stakeholders to identify key emerging issues for Government.

## EXPLANATION OF ACRONYMS

ACAF	Advisory Committee on Animal Feedingstuffs
ACHS	Advisory Committee on Hazardous Substances
ACNFP	Advisory Committee on Novel Food and Processes
ACTS	Advisory Committee on Toxic Substances
AQEG	Air Quality Expert Group
BBSRC	Biotechnology and Biological Sciences Research Council
BSI	British Standards Institute
CEN	European Committee for Standardisation
CHM	Commission on Human Medicines
COC	Committee on Carcinogenicity of Chemicals in Food, Consumer Products and the Environment
COM	Committee on Mutagenicity of Chemicals in Food, Consumer Products and the Environment
COMEAP	Committee on Medical Effects of Air Pollutants
COT	Committee on Toxicology
CSD	Committee on the Safety of Devices
Defra	Department for Environment, Food and Rural Affairs
DH	Department of Health
DTI	Department of Trade and Industry
EA	Environment Agency
ENI	Environmental Nanoscience Initiative
EPSRC	Engineering and Physical Sciences Research Council
ESRC	Economic and Social Research Council
HSC	Health and Safety Commission
HSE	Health and Safety Executive
HSL	Health and Safety Laboratory
ISO	International Standards Organisation
MHRA	Medicines and Healthcare Regulatory Authority
MNT	Micro and Nano Technology Network
NEG	Nanotech Engagement Group
NERC	Natural Environment Research Council
NGOs	Non-Government Organisations
NIDG	Nanotechnology Issues Dialogue Group
NPL	National Physics Laboratory
NRCG	Nanotechnology Research Co-ordination Group
OECD	Organisation for Economic and Co-operative Development
OSI	Office of Science and Innovation
PEALS	Policy, Ethics and Life Sciences Research Centre

RAEng	Royal Academy of Engineering
RCUK	Research Councils UK
REACH	Registration, Evaluation and Authorisation of Chemicals
RS	Royal Society
SCCP	European Scientific Committee on Consumer and Cosmetics Products
SCENIHR	Scientific Committee on Emerging and Newly Identified Health Risks
SIN	Science and Innovation Network
WATCH	Working Group on Actions to Control Chemicals (an ACTS sub-committee)

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