



**ROYAL COMMISSION ON ENVIRONMENTAL POLLUTION**  
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26 April 2007

Dear Sir / Madam,

**ROYAL COMMISSION ON ENVIRONMENTAL POLLUTION**

**NOVEL MATERIALS STUDY**

**INVITATION TO SUBMIT WRITTEN EVIDENCE**

The Royal Commission on Environmental Pollution's current study is investigating the environmental effects of novel materials and novel applications of existing materials. Our aim is to provide an authoritative framework for thinking about and addressing the impacts of such materials. To help with this task, the Commission is keen to hear the views of organisations and individuals with an interest in novel materials and applications.

The Royal Commission on Environmental Pollution is an independent standing body established in 1970 to advise the Queen, the Government, Parliament and the public on environmental issues. The Chairman is Sir John Lawton CBE FRS. Members of the Commission are appointed by Her Majesty The Queen on the advice of the Prime Minister and serve part time.

The Commission's advice is mainly in the form of reports, which are the outcomes of studies that review and anticipate trends and developments in environmental policies, identifying fields where insufficient attention is being given to problems, and recommending action that should be taken. The Commission generally selects its topics for study through consultation exercises. Previous studies have investigated the marine environment, chemicals and their regulation, transport issues and genetically modified organisms.

We would be especially interested in receiving your evidence on the detailed questions listed in **Annex A**. Please illustrate your answers with examples from areas with which you are familiar. It is not necessary to address all the issues listed, indeed you may wish to provide evidence on only a few. It would be helpful if you could use the numbering given in Annex A to indicate which of the issues your response addresses. You may also wish to go beyond the attached list, as it is not designed to be exclusive and if you feel there are important points which we have not covered, then we would be very pleased if you would draw these to our attention. The list of questions occasionally provides in *italics*, a commentary which reflects our initial thinking, and is designed primarily to illicit a response from consultees rather than to suggest that we have already closed down on our thinking. We would be pleased to know whether you agree with our initial thinking and if not, where you differ and why.

You will see that the scope of the study relates to novel materials and their applications. There is some discussion of this in relation to the first question posed. Our aim is to include not only nanotechnology but also to cover other areas. We are aware that there are other significant areas of innovation and that

many elements, which have largely been restricted to the academic laboratory, or older materials now finding new applications, are now entering products and these will ultimately lead to potential exposures of the wider environment and the general population. We therefore wish to consider these issues as well as those specific to nanotechnology in our work.

**The deadline for responses is 20<sup>th</sup> July 2007.**

It would be appreciated if submissions could be sent to us by e-mail at the following address: [Jo.Bray@rcep.org.uk](mailto:Jo.Bray@rcep.org.uk). Printed reports and references can be sent separately by post, using the address at the top of this letter. If you have any queries about what the Commission is seeking, please contact me either by e-mail or by telephone on 020 7799 8976.

The Royal Commission operates on the basis of transparency and it is our normal practice for all evidence sent to us to be made publicly available. The most likely method of such dissemination is through publication on the Commission's website. If for any reason you do not wish us to make all or part of your response publicly available, then please make this clear in your response so that we can take it into account.

This letter has been sent to a wide range of stakeholders and interested parties, listed in **Annex B**. If there are people whom you would have expected us to contact that are not on this list, please get in touch and draw this to our attention. This is a wide field and we want to ensure that we have contacted as many people as possible who can help us with this important work.

If you want to learn more about the Royal Commission, there is further information available on our website at <http://www.rcep.org.uk/>

I look forward to hearing from you. Please do not hesitate to contact me if you wish to discuss something about your evidence or this letter before replying.

Yours faithfully,

A handwritten signature in black ink, appearing to read 'Jo Bray', written in a cursive style.

**Jo Bray**  
**Assistant Secretary to the Commission**

## Study on the Environmental Effects of Novel Materials and Applications – Questions for Written Evidence Exercise

Novel materials, along with new forms and applications of existing chemicals are continually being developed to help make technological advances and improve performance. An example of such a development is rhenium, which has previously been just a waste product from copper mining. It is now used in nickel alloys for jet engines, enabling them to fly at temperatures significantly higher than previously, so lowering fuel consumption. Nanotechnology and nanoscience are also developing at a rapid pace.

Although there is a large body of work which looks at the effects of the environment on novel materials, there are very few studies on the environmental impacts of novel materials. The study could therefore be usefully broken down into three broad themes:

- Scene-setting: what are novel materials and what developments are likely over the next 5-10 years? Which ones should be investigated for the purposes of the study?
- Environmental and health impacts of novel materials
- Governance and regulation issues

Theme 1: Scene-setting: what are novel materials and what developments are likely over the next 5-10 years? Which ones should be investigated for the purposes of the study?

1. What do you understand by the term novel material? How might novel materials best be classified? What novel materials should be included in the study?

*We have deliberately framed our inquiry to extend beyond nanotechnology per se. However, we do not intend to address all innovation and in particular, do not feel that it would be appropriate to cover the large number of organic molecules introduced each year particularly those produced in small quantities in highly regulated and specialists sectors. This includes the pharmaceutical and biocide industries where the biological activity, at least (though not the full spectrum of potential environmental effects) is characterised as part of the product development and approval process. In our view the study should be based on a working definition of novel materials which would encompass:*

- *New uses for existing materials where the new usage may lead to substantially different exposures and hazards than current uses so that experience based on the current usage may not be a good indication of potential problems.*
- *New forms of existing materials: this is intended to include nanomaterials where significantly different functionalities are developed as a result of changing the scale and shape and arrangement of the particles at the nanolevel, e.g. the expression of significant chemical activity at the nanoscale of materials such as noble metals which may exhibit significant chemical reactivity or biocidal effects which are not manifested in the bulk form.*
- *Use of new materials such as metallic elements (Rhodium, Yttrium etc) and compounds derived from them. There is likely to be some interplay between all these categories, for example some nanotechnology products will include not only new forms of existing*

*materials, but also other new substances, either as adjuncts, dopants or ligands and both new materials and nanoproducts may both be ultimately incorporated in new devices such as ICT equipment.*

2. At what point does a novel material cease to be novel?

*What lies behind this question is to some extent an exploration of the degree to which unexpected environmental consequences may not emerge until some considerable time after the material has been in widespread use. The effect of refrigerant gases on the ozone layer is clearly one example but the developing evidence about the long term effects of non-degradable plastics particularly in marine and aquatic environments may well be another. The issue also relates to questions of what mechanisms might be set in place to monitor environmental impacts to give warning (even if not always early warning) of potential difficulties as materials enter the environment and, even if they do not degrade, change in form through weathering and mechanical break up into smaller particles over time.*

3. What sort of materials and technologies are being developed – over the next 2, 5 and 10 years?
4. What are the drivers for the development of novel materials? What are the potential benefits of novel materials and the drivers for these?

*What we have in mind here is essentially to try to tease out the underlying functionalities and products or improved performance which the use of new materials is seeking to deliver for society. Therefore it is part of the process of trying to identify the potential benefits which are discussed in more detail in Theme 2 below.*

5. Can the development of novel materials have an impact on resource depletion?
6. Are issues of re-use and recycling considered when developing novel materials – e.g. could the phasing out of metals for composites make recycling difficult?
7. Are novel materials likely to alter the amount of waste generated and the ways in which it has to be handled?

## Theme 2: Environmental and health impacts of novel materials

8. What are the most important impacts that novel materials could potentially have on the environment and human health? What are the main mechanisms and pathways for those impacts? How do we begin to conceptualise environmental impacts when we are in such unknown territory?

*Embedded in this question are several issues. On the one hand there are fairly straightforward issues related to potential negative impacts through the biological effects of new materials on organisms (plants, animals and micro organisms) in soil and water. Beyond this there is also the question of chemical and other interactions with parts of the environment such as the depletion of the ozone layer. There are also potential positive impacts where the use of the new material may allow the replacement of existing technologies which have significant negative impact on the environment. In addition potential uses also exist for new materials in remediation and improvement of water and soil quality and improvements in the efficiency of processes such as energy generation and power transmission. New materials may also have indirect effects on the environment. For example, certain materials may be able mobilise substances in soil in*

*advantageous ways, but they could also lead to the mobilisation of hazardous material. These are intended only as examples and we would be very grateful for further thoughts on these issues.*

9. Do novel materials have the potential to help 'solve' environmental problems, e.g. land contamination, energy generation? If so, how and are there potential risks?
10. Do we have sufficient research and monitoring in terms of understanding toxicology and exposure in place in order to understand the effects of novel materials on the environment and human health?
11. Are current testing protocols 'fit for purpose' to test the potential environmental and health impacts of novel materials? If not, what needs to be developed or are there other strategies needed to address this issue?
12. Do we have adequate methodologies and instrumentation to detect and monitor engineered free nanoparticles in the environment?
13. Are the full life cycle impacts of novel materials being considered in terms of their potential effects on the environment and human health?

*We are particularly concerned here about potential exposures through manufacture, use and disposal both in relation to the regulated official disposal routes (for instance for electronic products) and illegal or accidental losses e.g. leakage from accidents, disposal direct to land/water. There are also issues about products which constantly abrade during use, creating dust or other mobile forms of release into the environment, even for products which are manufactured to be essentially fixed but may wear away in use.*

14. How can you look at the effects of novel materials as a coherent whole, if they are even more difficult to categorise than nanomaterials?
15. Are there lessons to be learned from 'green chemistry' – and ways that manufacturing could be made more benign?

### Theme 3: how to manage novel materials in society: governance and regulation

16. Is REACH the right framework for regulating novel materials and nanotechnologies?
17. Are the regulations which affect novel materials fit for purpose? Is existing legislation sufficient to deal with potential problems that could arise during the different stages of the novel material's life cycle, i.e. manufacture, use and disposal?
18. Is the UK, EU and global science and knowledge base sufficient to support current legislation frameworks and any future regulation? Where are the gaps and what are the research priorities?
19. Is the UK's and EU's research funding sufficient in this area? Is it being delivered in the right way?
20. Can novel materials and technologies be effectively governed and regulated if it is not possible to obtain exposure data before products containing novel materials are produced and made available to consumers?

*We have been made aware that even within carbon nanotubes there are potentially at least 10,000 possible formulations due to variations in substances added to the tubes and the actual physical size of the tubes themselves: all of these can affect functionality and potentially their environmental and biological behaviours. It is clearly not possible to apply conventional testing protocols because of the sheer numbers of formulations involved. If the industry is to develop it is inevitable that there will be a degree of uncertainty. Although research can seek, and is seeking, to derive certain basic parameters to help identify and predict which materials may be problematic, some degree of uncertainty and ignorance is likely to remain. The social need is to develop regulatory mechanisms which reduce the risk of deleterious outcomes, while permitting the process of innovation to develop new materials for social benefit. The precautionary principle in its various formulations has been seen as one possible approach; would it be appropriate in this case or are there other approaches which would be preferable.*

21. What is the role for engaging the range of different interests and perspectives, commercial, political, public and societal, on the development of novel materials in the context of global markets?
22. Are there general lessons to be learned from the development and use of other novel technologies, e.g. the development of genetically modified organisms?
23. How can an appropriate balance be achieved in the design of regulatory systems to effectively manage uncertainty?
24. What are the implications for liability when problems arise even if procedures are properly followed in good faith: who should bear responsibility and what issues arise for insurance and redress?
25. How would you apply the precautionary principle to the management and regulation of novel materials?
26. In debate about new technologies, questions of need and control, as well as questions about consequences, have emerged as being important. To what extent should our study engage with questions about the need for novel and novel uses of materials; about who exercises control over such technologies; and about public trust in the institutions involved?

And finally:

27. Are there any other major questions or issues that the Commission should examine?

**LIST OF ORGANISATIONS AND INDIVIDUALS INVITED TO SUBMIT WRITTEN EVIDENCE**

**Organisations**

Advanced Materials Research Institute, Northumbria University  
AEA Technology Environment  
Airbus UK  
American Embassy, UK  
Biffa Waste Services Ltd  
Bionanotechnology Interdisciplinary Research Centre, University of Oxford  
Biotechnology and Biological Sciences Research Council (BBSRC)  
BNFL plc  
BOC Edwards  
Boeing UK  
British Embassy, Beijing  
British Embassy, Tokyo  
British Embassy, Washington  
British High Commission, New Delhi  
British Medical Association  
British Standards Institute  
CBI, Northern Ireland  
CBI, Scotland  
CBI, Wales  
CEFIC, AISBL  
Central Laboratory for the Research Councils (CCLRC)  
Centre for Nanoscale Science, University of Liverpool  
Centre for Sustainable Chemical Management, Lancaster Environment Centre  
Chemical Industries Association  
Confederation of British Industry (CBI)  
Council for Science and Technology  
Cranfield Health, Cranfield University  
Cranfield Nanotechnology Centre, Cranfield University  
Defence Science and Technology Laboratory (DSTL)  
Demos  
Department for Environment, Food and Rural Affairs (Defra)  
Department for International Development (DfID)  
Department for Transport (DfT)  
Department of Enterprise, Trade and Investment, Northern Ireland  
Department of Health (DH)  
Department of the Environment, Northern Ireland (DOENI)  
Department of Trade and Industry (DTI)  
Directorate General Enterprise and Industry, European Commission  
Directorate General Environment, European Commission

Directorate General Health and Consumer Protection, European Commission (DG SANCO)  
Directorate General Research, European Commission  
ECETOC AISBL  
Economic and Social Research Council (ESRC)  
Engineering and Physical Sciences Research Council (EPSRC)  
Environment Agency  
Environment and Heritage Service, Northern Ireland  
Environment, Planning and Countryside Committee, National Assembly for Wales  
Environmental Defense  
ESRC Centre for Analysis of Risk and Regulation (CARR), London School of Economics and Political Science (LSE)  
European Nanotechnology Trade Alliance (ENTA)  
Food Standards Agency (FSA)  
Foreign and Commonwealth Office  
Forum for the Future  
Friends of the Earth  
Friends of the Earth Cymru  
Friends of the Earth Scotland  
German Advisory Council for the Environment (SRU)  
Green Chemistry Institute, USA  
Green Chemistry Network  
Greenpeace UK  
Health and Safety Executive (HSE)  
Health Protection Agency (HPA)  
House of Commons, Environmental Audit Committee  
House of Commons, Select Committee on Environment, Food and Rural Affairs  
House of Lords Science and Technology Select Committee  
ICI Measurement Science Group  
Institute for Materials Research, University of Leeds  
Institute for Materials, Minerals and Mining  
Institute for Nanoscale Science and Technology, University of Newcastle Upon Tyne  
Institute of Nanotechnology  
Institute of Occupational Medicine  
Institute of Photonics, University of Strathclyde  
Institute of Physics  
Institute of Polymer Technology and Materials Engineering, University of Loughborough  
IOP: The Packaging Society  
Joint Research Centre, Ispra  
Kingfisher PLC  
Kodak Ltd  
Materials and Engineering Research Institute, Sheffield Hallam University  
Materials KTN  
Medical Polymers Research Institute, Queen's University of Belfast

Medical Research Council (MRC)  
Medicines and Healthcare Products Regulatory Agency (MHPRRA)  
Merck Chemicals Ltd  
Ministry of Defence (MOD)  
Nanotec Northern Ireland, University of Ulster  
Nanotechnology Industries Association (NIA)  
Nanotechnology Issues Dialogue Group  
Nanotechnology Research Co-ordination Group  
Nanotechnology Stakeholders Group  
National Consumer Council  
National Institute of Occupational Safety and Health (NIOSH)  
National Physical Laboratory  
National Society for Clean Air and Environmental Protection (NSCA)  
Natural England  
Natural Environment Research Council (NERC)  
Nokia  
Northern Ireland Centre for Advanced Materials, University of Ulster  
Northern Ireland Technology Centre, Queen's University Belfast  
OECD  
Office of Science and Innovation  
Oxonica  
Packaging Materials and Technologies Ltd  
Parliamentary Office of Science and Technology (POST)  
Particle Physics and Astronomy Research Council (PPARC)  
Polymer IRC, University of Leeds  
Polymer Processing Research Centre, Queen's University of Belfast  
QinetiQ  
QUESTOR Centre, Belfast  
Research Councils UK  
Research Services Division, University of Cambridge  
Rolls Royce Group  
Science and Innovation Network, Foreign and Commonwealth Office  
Scottish Environment Protection Agency (SEPA)  
Scottish Executive – Environment and Rural Affairs Department  
Scottish Executive – Health Department  
Society of Chemical Industry  
Society of Motor Manufacturers and Traders (SMMT)  
Soil Association  
Sustainable Development Commission  
Swiss Reinsurance Company  
Syngenta  
The British Academy  
The Centre for Environment, Fisheries and Aquaculture Science (CEFAS)  
The Centre for Materials Research, Queen Mary London

The Engineering Forum  
The Green Alliance  
The Nanotechnology and Integrated Bioengineering Centre, University of Ulster  
The National Assembly of Wales  
The Polymer Centre, University of Sheffield  
The Royal Academy of Engineering  
The Royal Society  
The Royal Society of Chemistry  
The Royal Society of Edinburgh  
The Scottish Parliament  
The Scottish Parliament, Environment and Rural Development Committee  
The Sussex Nanoscience and Nanotechnology Centre, University of Sussex  
The Welding Institute  
Thomas Swan and Co. Ltd  
UK Energy Research Centre  
UK Environmental Law Association  
UK Microsystems and Nanotechnology Manufacturing Association (MMA)  
Unilever  
US Environmental Protection Agency (US EPA)  
Welsh Assembly Government  
Wolfson Centre for Materials Processing, Brunel University  
WWF-UK

## **Individuals**

Baroness O'Neill of Bengarve, House of Lords  
Dr Aldo Boccaccini, Imperial College of Science, Technology and Medicine  
Dr Andrew Maynard, Woodrow Wilson International Center for Scholars  
Dr Angela Wilkinson, James Martin Institute, University of Oxford  
Dr Barbara Karn, Woodrow Wilson International Center for Scholars  
Dr Eva Valsami-Jones, Natural History Museum  
Dr Fengge Gao, Nottingham Trent University  
Dr Gjalt Huppes, University of Leiden  
Dr Jamie Lead, The University of Birmingham  
Dr Jerome Ravetz, James Martin Institute, University of Oxford  
Dr Kerry Kirwan, University of Warwick  
Dr Liane Benning, University of Leeds  
Dr Martin Dove, University of Cambridge  
Dr Neil McMurray, University of Wales, Swansea  
Dr Nicole Grobert, University of Oxford  
Dr Paul Reip, QinetiQ Nanomaterials Ltd  
Dr Peter Hatto, Ionbond Ltd  
Dr Philip Ball  
Dr Raymond Oliver, Cenamps  
Dr Richard Handy, University of Plymouth

Dr Rob Doubleday, University of Cambridge  
Dr Sam Shaw, University of Leeds  
Dr Vicki Colvin, Center for Biological and Environmental Nanotechnology, Rice University  
Mr Mike Barry, Marks and Spencer  
Mr Paul Collins, Bond Pearce LLP  
Professor Alan Atkinson, Imperial College of Science, Technology and Medicine  
Professor Alan Irwin, University of Liverpool  
Professor Alan Windle, University of Cambridge  
Professor Andrew Briggs, University of Oxford  
Professor Andrew Stirling, Science and Technology Policy Research Unit (SPRU), University of Sussex  
Professor Ann Dowling FRS, University of Cambridge  
Professor Anthony Seaton CBE  
Professor Anthony Walton, University of Edinburgh  
Professor Anthony West, University of Sheffield  
Professor Bernie Binks, University of Hull  
Professor Brian Wynne, Centre for the Study of Environmental Change, Lancaster University  
Professor Charles Tyler, University of Exeter  
Professor Chris Binns, University of Leicester  
Professor Chris Grovenor, University of Oxford  
Professor Christopher Hood, University of Oxford  
Professor Colin Humphreys CBE, University of Cambridge  
Professor Daniel Sarewitz, Consortium for Science, Policy and Outcomes, Arizona State University  
Professor David Bird, University of Bath  
Professor David Schiffrin, University of Liverpool  
Professor David Stephenson, Cranfield University  
Professor Derek Fray FEng, University of Cambridge  
Professor Frank Kelly, King's College London  
Professor George Attard, University of Southampton  
Professor George Smith FRS, University of Oxford  
Professor Gunter Oberdorster, University of Rochester  
Professor Howard Colquhoun, University of Reading  
Professor Hugh Clare, Director of Micro & Nanotechnology Network  
Professor J S Abell, The University of Birmingham  
Professor Jacquie Burgess, University of East Anglia  
Professor Jane Plant, Imperial College of Science, Technology and Medicine  
Professor Jeremy Ramsden, Cranfield University  
Professor Joe Tidd, Science and Technology Policy Research Unit (SPRU), University of Sussex  
Professor John Beddington, Science Advisory Council  
Professor John Irvine, The University of St. Andrews  
Professor John Kilner, Imperial College of Science, Technology and Medicine  
Professor John Pethica FRS, Visiting Professor, University of Oxford

Professor John Sullivan, Aston University  
Professor Jon Preece, The University of Birmingham  
Professor Ken Donaldson, MRC / University of Edinburgh for Inflammation Research  
Professor Lindsay Greer, University of Cambridge  
Professor Mark Spearing, University of Southampton  
Professor Mark Welland, IRC in Nanotechnology, University of Cambridge  
Professor Nick Pidgeon, Centre for Environmental Risk, University of East Anglia  
Professor Nikolay Zheludev, University of Southampton  
Professor Ortwin Renn, University of Stuttgart  
Professor Paul Bellaby, University of Salford  
Professor Paul Hogg, Queen Mary University of London  
Professor Peter Dobson, Oxford University Begbroke Science Park  
Professor Peter Foot, Kingston University  
Professor Peter Friedmann, University of Southampton  
Professor Peter Goodhew FEng, University of Liverpool  
Professor Peter Sheel, University of Salford  
Professor Pierluigi Nicotera, MRC Toxicology Unit, University of Leicester  
Professor R J Warburton, Heriot-Watt University  
Professor Rex Godby, University of York  
Professor Rob Flynn, University of Salford  
Professor Robert Maynard, Health Protection Agency  
Professor Robert Young, University of Manchester  
Professor Robin Grimes, Imperial College of Science, Technology and Medicine  
Professor Roland Clift, Centre for Environmental Strategy, University of Surrey  
Professor Roy Harrison OBE, The University of Birmingham  
Professor Saul Tendler, University of Nottingham  
Professor Sir David King, Chief Scientific Adviser, Office of Science and Innovation  
Professor Sir Harry Kroto FRS, The Florida State University  
Professor Sir John Beringer, University of Bristol  
Professor Steven Banwart, University of Sheffield  
Professor Terry Tetley, National Heart and Lung Institute, Imperial College  
Professor Vicki Stone, Napier University  
Professor Sheila Jasanoff, Harvard University