International Handbook on Regulating Nanotechnologies

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19 The role of NGOs in governing nanotechnologies: challenging the 'benefits versus risks' framing of nanotech innovation

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19.1 INTRODUCTION

Against the backdrop of very low levels of public awareness, non-government organizations (NGOs) have struggled to put wide-ranging public interest issues associated with nanotechnology onto the radar of those charged with decision-making about governance issues. These include the need to go beyond a narrow discussion of 'benefits versus risks' to consider the broader social, economic and political dimensions of nanotechnology, to implement precautionary management of nanotechnology's health and environment hazards, and to involve the public in decision-making. However, as the first sectoral regulatory responses to nanotechnology emerge, it is apparent that very few of NGOs' governance proposals are being enacted.

This chapter will outline the public interest issues identified by NGOs, provide an overview of their governance proposals, and evaluate the extent to which NGOs have been effective in framing the nanotechnology debate, securing precautionary management of risks and challenges, and obtaining meaningful public involvement in decision-making. Whereas NGOs have achieved some degree of public visibility in the emerging nanotechnology debate, we argue that their influence on governance has been more muted. Governments have been unwilling to slow the rapid pace of nanotechnology commercialization to address basic safety issues, let alone to support rigorous assessment of broader social, economic and democratic challenges identified by NGOs and others. Governments continue to actively resist NGO or wider public involvement in critical reflections regarding nanotechnology assumptions, institutions, funding or governance. Meanwhile, financial, promotional and political support from governments and industry for rapid nanotechnological development remains strong.

19.2 FRAMING THE NANO-DEBATE

As with other recent technological innovations and applications – such as the genetic engineering of crops – the dominant discourses and the emerging regulatory responses to nanotechnology are so far largely contained within a narrow 'benefits versus risks' framework.[1] What we are referring to as the 'benefits versus risks' framework is situated within the dominant ideology of technological progress, whereby technological innovations are assumed to be inherently beneficial and progressive, with the exception of some unintended 'side effects' or the deliberate 'misuse' of the technology. Within this framing, proponents have claimed wide-ranging economic, social and environmental benefits of nanotechnological innovations (see, for example, Department of Innovation, Industry, Science and Research, 2009; Department of Industry, Tourism and Resources (DITR), 2002; International Food Policy Research Institute, 2008). Rather than also acknowledging and assessing the potential for economic, social and environmental 'costs' or detrimental consequences of nanotechnology development, potential 'downsides' are largely ignored, or narrowly defined – primarily as toxicological health and environmental 'risks'. In this sense, 'benefits versus risks' framing is narrower than the more conventional – though also problematic – 'benefits versus costs' framing. Benefits versus risks framing is used to suggest that with the aid of evidence-based scientific assessment, any safety risks can be 'balanced' against predicted wide-scale benefits, thereby delivering a 'trade-off' or compromise between benefits and risks. This assumes a strong ability to predict and control risks, overlooking systematic uncertainties and ignorance (Doubleday, 2007).

A major weakness of the 'benefits versus risks' frame – and one of the key reasons that substituting a 'benefits versus costs' frame would be similarly problematic – is that such framing ignores the ways in which new technologies do not simply 'add on' benefits, risks or costs, but may significantly transform existing social, economic and ecological relations, in ways that cannot be addressed adequately by the benefits/risks/costs discourse. This is particularly pertinent to nanotechnology, given that it is predicted to act as a platform technology that enables breakthroughs in a range of techno-scientific fields, and drives large-scale disruptive change. For both proponents and critics, nanotechnology's key significance lies in its transformative potential (see, for example, Roco and Bainbridge, 2002; Shand and Wetter, 2006).

A further core problem with benefits versus risks framing is the focus on the potential *impacts* of technology on society, which excludes a broader discussion about the *interactions* between technologies, science

and society. Scientific practice and technological development are often viewed as existing outside of social processes (Wynne, 1993). NGOs and social scientists have raised critical questions related to: the scope, direction and purpose of nanotechnology research and commercial development; the assumptions of government, industry and scientists; which groups, institutions and individuals are entitled to participate in decision-making; whose interests nanotechnology is managed in; and the mutability and controllability of its development trajectory (Hepburn, 2006; Friends of the Earth Australia (FoEA), 2007b, 2009; Kearnes et al., 2006a, 2006b; Loka Institute, 2003, 2007; Macnaghten et al., 2005; Mohr, 2007; Sparrow, 2007; Stilgoe, 2007). Yet these issues receive little attention in the dominant policy discourse around nanotechnology. Benefits versus risks framing fails to acknowledge, or to open up for interrogation, the social, economic and political values and structures that shape the processes of technology innovation and governance. Socio-economic assessment and critique are excluded from innovation and regulatory processes, rather than being recognized as core aspects which require consideration at each step of the innovation cycle (Doubleday, 2007; Kearnes et al., 2006a; 2006b; Macnaghten et al., 2005; Mohr, 2007; Stilgoe, 2007).

The inconsistencies inherent in benefits versus risks framing have implications for nanotechnology governance. Discordant evidentiary standards are applied to innovation and regulatory policy. Innovation policy, including generous government support for nanotechnology research, and industry development and promotion, is underpinned by widely claimed, but poorly scrutinized predictions of economic, social and broader benefits. The perceived value of these benefits underpins practical and financial government support for rapid nanotechnology commercialization, and forestalls precautionary scientific risk management. Yet claimed benefits remain largely unexamined and outside the scope of any systematic assessment; the inevitability of these benefits is assumed. Conversely, regulation is considered legitimate only to address proven examples of toxicological risk. Contrary to the lax evidentiary standards applied to claims of benefits, risks must be definitely proven and quantified before regulation will be enacted to protect public health and safety, and even before nano-specific safety assessment of new products will be required. Broader costs, challenges and social dimensions are generally ignored by both innovation and regulatory policy.

19.3 NGO EFFORTS TO MOVE BEYOND THE 'BENEFITS VERSUS RISKS' FRAME

Benefits versus risks framing is ubiquitous among governments, industry, most nanotoxicologists, some social scientists and even many NGOs. For some NGOs, using benefits versus risks framing may reflect an uncritical acceptance of this dominant discourse, while for others, the use of this frame and the focus of campaign activities on technical risks is a strategic decision. For practical as well as political reasons,[2] it is easier for NGOs to argue for regulation based on technical criteria than to argue for a critical evaluation of the assumptions and motivations that underpin and shape nanotechnology development.[3]

Nonetheless, growing numbers of NGOs have attempted to challenge the dominant benefits versus risks frame. In January 2007, a broad coalition of nearly 70 civil society, public interest, environmental and labour organizations released a declaration on *Principles for the Oversight of Nanotechnologies and Nanomaterials* (NanoAction, 2007). This group of NGOs included:

- technology-oriented groups such as the International Center for Technology Assessment and the ETC Group
- environmental groups such as Friends of the Earth (FoE) (Australia, Europe and the United States (US)), Greenpeace International and AccionEcologica (Ecuador)
- food NGOs such as the Soil Association (UK), the Center for Food Safety (US), the Institute for Agriculture and Trade Policy (US) and the Forum for Biotechnology and Food Security (India)
- toxic chemical and safety campaigns such as the National Toxics Network (Australia), the Silicon Valley Toxics Coalition (US) and the African Centre for Biosafety; workers' unions such as International Trade Union Confederation and the Australian Council of Trade Unions
- groups focused on Southern and global justice issues, such as the Third World Network (China) and the Institute for Sustainable Development (Ethiopia), and
- indigenous groups including the Tebtebba Foundation Indigenous People's International Centre for Policy Research and Education (Philippines).

These groups represent a broad range of public constituencies and are far from homogenous in terms of their political orientations and approaches to technological innovation. The coming together of such a large group

of diverse NGOs on a statement of principles regarding nanotechnology development is remarkable. This may in part have been prompted by years of frustration with government and industry handling of toxics, genetic engineering, food sovereignty, nuclear issues and global trade policy – many of the signatory NGOs have long-standing projects in these areas. It is also possible that the scale of the public interest challenges NGOs have identified in nanotechnology is itself unprecedented. After all, proponents predict that nanotechnology 'has the potential to fundamentally alter the way people live' (DITR, 2006: 1). Greenpeace UK's Doug Parr (2003) has argued that

> What marks out nanotech is that its potential is so huge for either good or bad, getting it right is a prize worth working for . . . The bigger issue is how nanotechnology is going to be deployed, to what purposes and in whose interests. If nanotech is going to be as big as many think, then it's a question that every person on Earth has a stake in.

The signatory NGOs – currently over 80 in number – have agreed to a set of eight fundamental principles that they believe 'must provide the foundation for adequate and effective oversight and assessment of the emerging field of nanotechnology, including those nanomaterials that are already in widespread commercial use' (NanoAction, 2007). The principles are:

I. A Precautionary Foundation
II. Mandatory Nano-specific Regulations
III. Health and Safety of the Public and Workers
IV. Environmental Protection
V. Transparency
VI. Public Participation
VII. Inclusion of Broader Impacts
VIII. Manufacturer Liability

In this document and in their other individual and collective campaign work, these NGOs have expressed a wide range of concerns. One set of substantive issues relates to the new forms of health and ecological hazards and risks associated with the manufacture and use of nanomaterials and products of nanotechnology. Workers involved in the manufacture and use of nanomaterials potentially have a high level of direct exposure, including: scientists, maintenance and cleaning staff working in laboratories; people involved in manufacturing, transporting or packaging products that incorporate nanomaterials (including, for example, cosmetics, sunscreens, paints, textiles, building equipment and appliances); and people

who use or handle products containing nanomaterials in their workplace (in, for example, factories sewing nano-treated clothing, on building sites using nano-paint, cutting and shaping carbon nanotube-reinforced plastics and specialty car parts). Consumers of nano-products may have direct contact with nanomaterials through foods, 'health' supplements, cosmetics, clothing, cleaning and painting products. Discarded products may also release their nanomaterials into the environment and thereby contaminate soils, waterways and food chains. Threats to other animals and ecosystems from nanomaterials include wastes from factory emissions and domestic streams, and their use in agricultural inputs, environmental remediation projects, and for geo-engineering or climate-manipulation experiments. NGOs (see, for example, FoEA, 2007b; Loka Institute, 2007) have also challenged the legitimacy of proponents' attempts to use claimed benefits to counter-balance risks, particularly given that the qualitatively new types of hazards associated with the techno-sciences of the twenty-first century demand a greater use of precaution than ever before (Ravetz, 2005).

Another broad set of substantive issues relates to NGOs' concerns that nanotechnologies may exacerbate rather than alleviate existing socio-economic inequities and ecological problems. Should nanotechnology become the 'enabling' or 'platform' technology that its proponents predict, countries and corporations which are making early investments and patenting aggressively are likely to cement and expand their control of key industries and trade (Corporate Watch, 2005a; ETC Group, 2001, 2005a, 2005b, 2008; FoEA, 2006a). Nanotechnologies may thereby enable corporations to extend their control over markets and other producers, via proprietary control of essential platform techniques and products of nanotechnology (ETC Group, 2005a).

Proponents predict that nanotechnology will deliver breakthroughs in medicine, energy, agriculture and communications. Yet nanotechnological innovations – as with previous technical breakthroughs – may be inaccessible to poor or marginalized groups (Royal Society and Royal Academy of Engineering, 2004). Global inequity increased during the 1990s – a period of wide-ranging technological development (Invernizzi et al., 2008). At the same time, novel nanomaterials and nano-innovations may disrupt or displace the markets for existing products, commodities, services and technologies. This could have a disproportionate impact on Southern economies which are heavily reliant on commodity trade, and which may lack the capacity for rapid transformation in the face of new economic circumstances (ETC Group, 2005a, 2005b; NanoAction, 2007). Southern countries may also find themselves disproportionately shouldering nano-risks, by becoming manufacturing centres for nano-products

that Northern workers would prefer not to handle, or else as dumping grounds for nano waste.

Next generation nanotechnology applications in the field of therapeutic or human 'enhancement' are predicted to alter people's cognitive and physical capacities. NGOs and bioethicists have warned that nanotechnology 'has the potential to challenge our understanding of what it means to be human, what it means to have impairments, to differ from the norm or to be different' (Cabrera, 2009: 1) and to expand social inequalities (ETC Group, 2003a, 2003b; FoEA, 2006a; Wolbring, 2002, 2008). Human enhancement could create new elite minorities of wealthy citizens who have access to the technology, and a new majority of people who are seen as 'impaired' or 'disabled' because their 'performance' has not been nanotechnologically 'enhanced' (Wolbring, 2002, 2008). The application of nanotechnology and other converging technologies in the quest to 'eliminate' disabilities or different biological realities could also further marginalize disabled people.

More generally, NGOs are challenging some of the broader technological and economic paradigms within which nanotechnologies are being developed and applied. NGOs have questioned nanotechnology's capacity to offer a 'techno-fix' to the food, climate, ecological and energy crises without addressing the root causes of global economic inequities and unsustainable over-consumption and over-production (FoEA, 2008a; International POPs Elimination Network (IPEN) and European Environmental Bureau (EEB), 2009; SmartMeme, 2009). 'We have the knowledge and technology to feed everyone [already], but it doesn't happen' because of political and financial factors (Parr, 2003). NGOs have argued that nanotechnology may in fact entrench and extend existing tendencies and problems in global industry, trade, environmental and military practices (Corporate Watch, 2005a; ETC Group, 2003b, 2004, 2008; FoE, 2008). In food production, NGOs are critical of the large-scale input and capital-intensive, export-oriented, and corporately-controlled paradigm of food production which nanotechnologies are primarily being used to support and extend (ETC Group, 2004; FoE, 2008; Nyéléni, 2007). Similarly, despite promised efficiencies in the consumption of energy and materials for manufacturing and using nano-products, NGOs have warned that nanotechnology threatens to underpin further growth in consumption and production, while still demanding large energy, water and chemical inputs for nano-fabrication (FoEA, 2008a; IPEN and EEB, 2009). Furthermore, they warn that nanotechnology will further commodify the natural world, by facilitating an overall expansion in the range and quantity of natural materials able to be transformed and used for the industrial production of an ever-expanding array of products (Loka Institute, 2003; Scrinis, 2006). Finally, NGOs

have highlighted the more overtly destructive applications of nanotechnology, such as the large proportion of research and development funding directed towards military applications in the US, China, Russia and elsewhere (ETC Group, 2003b; Miller, 2008; NanoAction, 2007).

19.4 NGO ACTIVITIES

NGOs have pursued wide-ranging activities to draw attention to nanotechnology's public interest issues. They have produced detailed reports on nanotechnology's current and future applications and related public interest issues (see, for example, Arnall, 2003; Corporate Watch, 2005a; ETC Group, 2003b). NGOs have hosted websites with nanotechnology news and discussion, for example the Meridian Institute, the Nanotechnology Citizen Engagement Organization and the Center for Responsible Nanotechnology. They have also published magazines (see FoEA, 2006b), journal articles, internet blogs (including posts to the Natural Resources Defense Council's (NRDC) 'Switchboard' or Environmental Defense Fund's 'Nanotechnology Notes') and written opinion pieces in mainstream and community media.

NGOs have conducted industry surveys and published consumer guides (see, for example, Friends of the Earth US (FoEUS), 2007; FoEA, 2008b; Which?, 2008). The Consumers Union US commissioned its own testing of sunscreens for nanoparticle content.[4] NGOs have brought products of particular concern, or dubious legal standing, to the attention of regulators, including via legal petitions (ICTA, 2006, 2008) – although this has resulted in limited legal action by regulators. Many NGOs and trade unions have produced nanotechnology policies (including, for example, the International Union of Food, Agricultural, Hotel, Restaurant, Catering, Tobacco and Allied Workers' Associations (IUF), 2007; European Trade Union Confederation, 2008); others have made or endorsed detailed statements about the regulatory response required from governments (see NanoAction, 2007). Environmental Defense collaborated with DuPont to design its own nanotechnology risk assessment scheme. The US Joint NGO NanoAction Group produced its own model nanotechnology legislation. NGOs have lobbied bureaucrats and decision-makers, made detailed written submissions and given aural evidence to numerous parliamentary, congressional and government inquiries. They have also contributed to Organisation for Economic Co-operation and Development (OECD) and International Organization for Standardization (ISO) technical working groups, as well as international and national chemical safety, measurement and standardization initiatives.

NGOs have been participants in many public 'dialogues', as well as initiating their own, for example the 'nano cafes' run by the Citizen Engagement Organization, participatory research initiatives supported by Fondation Sciences Citoyennes, or citizens' 'NanoJury' in the UK. NGOs were key organizers of the two-day science and democracy forum which preceded the 2009 World Social Forum in Brazil. NGOs have also used creative means to communicate with wider publics, such as the Angels Against Nanotechnology (2004) in the UK and the ETC Group's competition to design a nano-hazard symbol and to propose the most 'pie in the sky' geo-engineering scheme.

Some NGOs have also engaged in direct action protest. Members of THONG (Topless Humans Organized for Natural Genetics) stripped down to their underwear to protest at a US NanoBusiness conference (THONG, undated). A nanotechnology conference at Leeds in the UK was disrupted by stink bombs, and protesters took over the sound system to read out a communiqué (IndyMedia UK, 2004). Demonstrators in Grenoble, France, occupied cranes building Europe's biggest new nano-centre (Corporate Watch, 2005b); over 1000 people subsequently protested its opening (Earth First! undated).

NGOs have played a pivotal role in compiling information, public interest advocacy, media communication and public outreach on nanotechnology issues. Some NGOs have dedicated considerable time to technical committees and reviews, to lobbying parliamentarians or to participating in conferences and 'stakeholder' workshops. Others have taken a more 'grassroots' approach, concentrating on compiling consumer guides and fact sheets that are of interest to the wider public. A smaller number have initiated protests that challenge the status quo. A challenge common to all NGOs working on nanotechnology is the breadth of the issues it poses, the low levels of public awareness, and the steadfast commitment of governments to facilitating rapid industry commercialization. All NGO activities have contributed to deepening our understanding of nanotechnology's public interest issues, and to informing and catalyzing public debate. However, none appear to have had a substantive impact on government policy.

19.5 REGULATORY AND GOVERNANCE PROPOSALS OF NGOs

In response to nanotechnology's wide-ranging public interest challenges, NGOs have called for wide-ranging governance measures that challenge the benefits versus risks framing. These include: nano-specific

regulatory frameworks capable of managing the risks and challenges of both first generation nanomaterials and next generation nanotechnology; the precautionary management of health and environment risks; life-cycle environmental assessment of nanomaterials and nano-products; the mandatory disclosure of nano-ingredients in products and workplaces; assessment within regulatory regimes of broader socio-economic, ethical and democratic dimensions; the containment of nano-weaponry development; and the opening up of technology assessment, development and governance to democratic deliberation and control (FoEA, 2007a; NanoAction, 2007). NGOs have also stressed that dramatic reform of intellectual property and patenting systems is essential if nanotechnology is not to further magnify existing economic inequities (ETC Group, 2005a).

Given the scale of predicted nanotechnology-driven social change and the significant public funding dedicated to nanotechnology development, a key NGO demand has been the involvement of civil society stakeholders and wider publics in nanotechnology decision-making regarding the allocation of research funding, government policy, information and education initiatives on nanotechnology, and regulatory measures (NanoAction, 2007). Some NGOs have argued that governments should not start from an assumption that nanotechnology development is inevitable or desirable, and that government support for it is assured. Instead they have argued that the public should be involved in identifying innovation priorities, and in decision-making about technological and non-technological options to address our most pressing social and environmental needs – including options that may or may not include nanotechnology (ETC Group, 2003b; FoEA, 2008c; Loka Institute, 2003). That is, in addition to calling for technology assessment of likely *implications*, NGOs have also called for the public to be given a role in constructing the technological *options*, and in shaping nanotechnology's development trajectory.

A key NGO concern is that nanotechnology development and commercialization is far outpacing any effective form of government oversight, risk management or public debate. Those who stand to gain least from nanotechnology's premature commercialization – workers – remain entirely unprotected. Despite high profile revelations that some carbon nanotubes can cause mesothelioma, no government has taken action to protect workers by mandating notification to workers handling nanotubes, requiring appropriate engineering control systems and personal protective equipment to limit exposure, or demanding monitoring systems to quantify exposure. NGOs have warned that we are walking into a repeat of the asbestos tragedy (Australian Council of Trade Unions, 2009; FoEA, 2008d).

NGOs are similarly concerned at the lack of interest governments have

shown in supporting genuine public involvement in nanotechnology policy development. Governments blithely predict that nanotechnology will transform every aspect of our lives (DITR, 2006; National Science and Technology Council, 2000). But they have been unwilling to provide opportunities for wider public involvement in the co-creation of our future. No government has yet linked development of nanotechnology innovation and regulatory policies to public participation programmes.

A growing number of NGOs and public interest organizations have called for a moratorium on commercial use of nanotechnology until public participation programmes are established to direct nanotechnology development and until meaningful governance measures are implemented to protect people and the environment, to address social dimensions and challenges, and to involve wider publics in decision-making[5] (see Table 19.1).

19.6 SERIOUS EROSION OF THE PRECAUTIONARY PRINCIPLE – A KEY LOSS BY NGOS

Application of the precautionary principle to manage nanotechnology risks has been one of the most consistent calls of NGOs. The joint NGO *Principles for the oversight of nanotechnologies and nanomaterials* calls for the burden of proof of safety to be placed with nanotechnology product manufacturers and distributors, for nanomaterials to be classified as new substances for assessment purposes, and for mandatory nano-specific legislation (NanoAction, 2007). FoEA (2007b) has suggested that a broader application of the precautionary principle would also see nanotechnology's wider social, economic and ethical dimensions examined, and public participation in decision-making regarding its development.

The 1992 Rio Declaration on Environment and Development describes the precautionary principle as follows:

> Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost effective measures to prevent environmental degradation.

There is preliminary evidence of serious nanomaterial health and environment risks (Royal Commission on Environmental Pollution, 2008; Scientific Committee on Emerging and Newly Identified Health Risks, 2009), acknowledgement by leading researchers that the extent of uncertainty is such that even design of reliable risk assessment systems for nanomaterials is impossible (European Food Safety Authority, 2009; Hansen,

Table 19.1 Examples of NGOs or public interest organizations who have called for a moratorium on commercial use of manufactured nanomaterials

Name of organization	Description of organization	Date of call	Scope of moratorium call	Conditions of moratorium call
Animal Aid (UK)	UK's largest animal rights organization	June 2006	Commercial and environmental release of engineered nanomaterials	'Until and unless there is a robust body of scientific knowledge on the health and environmental impacts, a moratorium should be put in place on the commercial and environmental release of engineered nanomaterials, particularly free-engineered nanoparticles. This is particularly urgent for products intended for consumption, application to the skin or release to the environment.' Also calls for the following: – A review of the level of scientific uncertainty and the ability to reliably assess the safety of existing products – Comprehensive well-funded research into the health and environmental risks and other potential impacts posed by nanomaterials. This should include human and environmental risk assessment that relies on sound scientific principles not dependent on animal tests – Mandatory reporting, safety assessment, emissions minimization, labelling and liability – Post-market monitoring

				– Evaluate and address wider impacts of the new and especially proprietary nanotechnologies beyond nanosafety questions (particularly impact on trade, livelihoods, human rights and justice).
Beyond Pesticides (US)	'National coalition against the misuse of pesticides'. Works with allies in protecting public health and the environment.	January 2009	Nanoproducts with pesticidal properties	Suspend registration of nano-products with pesticidal properties, and remove untested products from the market. Direct EPA to develop a clear testing protocol that identifies the full range of potential adverse health and environmental effects of nano-products with pesticidal properties.
Corporate Watch (UK)	Research group supporting the anti-corporate movement	June 2006	Commercial and environmental release of engineered nanomaterials	See entry for Animal Aid
ETC Group	Research-driven NGO with a special interest in the socially responsible development of new technologies. Staff in Canada, the US, Mexico and the Philippines.	May/June 2002	The use of synthetic nanoparticles in the lab and in any new commercial products	'Best practices' for laboratory work should be adopted, including clear monitoring mechanisms and reporting procedures. Establishment of legally-binding mechanisms at UN level to consider wider health, socioeconomic and environmental implications. International regulations should be incorporated under a new International Convention for the Evaluation of New Technologies (ICENT).

Table 19.1 (continued)

Name of organization	Description of organization	Date of call	Scope of moratorium call	Conditions of moratorium call
FoE (Australia; England, Wales and Northern Ireland; Europe; Germany and US)	International NGO dedicated to ecological sustainability and social justice. The world's largest grassroots environmental network, active in over 70 countries world-wide.	2006, 2007	The commercial release of manufactured nanomaterials and products that contain them.	Please note: FoE International does not have a universal policy on nanotechnology. FoE Australia: until a comprehensive, national regulatory framework is established that specifically addresses issues of nanotoxicity as well as broader social and ethical issues. Public participation should underpin the framework's development and future nanotechnology policy. Moratorium call also applies to commercial research and development. More detail in 2007 policy. FoE England, Wales and Northern Ireland – as per Animal Aid entry. FoE Europe – until a regulatory framework is created, or the existing legislation is adapted, to ensure the safe development of nanotechnologies. FoE Germany – mandatory labelling of nano-ingredients and mandatory assessment of nano-ingredients as new chemicals before products can be sold; moratorium on release of new nanoproducts that present direct exposure risk for consumers, and withdrawal of existing products. FoE United States: until nano-specific safety laws are established and the public is involved in decision making.

	GeneEthics (Aust)	National non-profit educational network of citizens and public interest groups working for a safer, more equitable GM-free society.	July 2005	All research, development, commercial production and sale of synthetic nano-technologies, nano-particles, other nano-materials and products that contain them	Until new nano-specific laws and a regulatory system are developed and implemented
	Greenpeace International	Independent global campaigning organization that acts to change attitudes and behaviour, to protect and conserve the environment and to promote peace. Active in 40 countries world-wide.	July 2003, with specific policy released February 2007	The release of nano-technological materials and products	Until hazards are characterized, understood and regulated. Greenpeace recommends the development of comprehensive national and/or international regulation that specifically addresses issues of nano-toxicity as well as the broader social and ethical issues related to the research, manufacture, consumption and environmental release of nanotechnological products. Detailed conditions are specified in 2007 policy.

Table 19.1 (continued)

Name of organization	Description of organization	Date of call	Scope of moratorium call	Conditions of moratorium call
International Center for Technology Assessment (US)	Non-profit, bi-partisan organization committed to providing the public with full assessments and analyses of technological impacts on society.	Unknown	Commercialization of nanotechnology	Until products containing nanoparticles have been proven safe. CTA also seeks to force federal regulatory agencies to adopt an accurate and standardized definition of nanotechnology and to regulate emerging nanotechnologies as they would other materials whose safety has not been determined.
International Federation of Journalists	The world's largest organization of journalists. Represents around 600 000 members in more than 100 countries	June 2006	Commercial and environmental release of engineered nanomaterials	See entry for Animal Aid
International Union of Food, Agricultural, Hotel, Restaurant, Catering, Tobacco	Federation of 336 trade unions, representing over 12 million workers in 120 countries		Food and agriculture	– Until safety is proven and an international system of nano-specific regulation is established. – Suspension of patents related to nanotechnology in the food industry and agriculture, until the countries affected and social movements can carry out an evaluation of their impact. – World Health Organization (WHO) and the United Nations Food and Agriculture Organization

and Allied Workers' Associations				(FAO) to update the Codex Alimentarius, regarding nanotechnology in food and agriculture. – WHO to initiate short and long-term studies into the potential effects of nanoparticles on the health of the technicians and workers that produce them, users and consumers. – International Labour Organization (ILO) to carry out an urgent study into the possible impact of nanotechnology on conditions of work and employment in agriculture and in the food industry. Following completion of the study, a Tripartite Conference to be convened as soon as possible.
Loka Institute	Focused on making science & technology responsive to democratically-decided social and environmental concerns	August 2007	Production, marketing, and purchasing of nano-engineered materials and products	To enable democratic deliberations, sensible precautions, and essential research to clarify issues of risk.
Nyéléni World Forum for Food Sovereignty	Civil society meeting of 500 delegates representing peasants, family farmers, fisher people, nomads, indigenous and forest peoples, rural and migrant	February 2007	Nanotechnology in food and agriculture	Unconditional moratorium, on the basis of new threats to health, the environment and peasant and fishing economies.

Table 19.1 (continued)

Name of organization	Description of organization	Date of call	Scope of moratorium call	Conditions of moratorium call
	workers, consumers and environmentalists from across the world			
Pesticide Action Network for North America	One of five PAN Regional Centres worldwide. Works to replace the use of hazardous pesticides with ecologically sound and socially just alternatives.	January 2009	Nanoproducts with pesticidal properties	See entry for Beyond Pesticides.
Practical Action (UK)	Development charity that works with poor people to develop appropriate technologies in food, energy, transport, water, sanitation and other areas.	June 2006	Commercial and environmental release of engineered nanomaterials	See entry for Animal Aid

The Soil Association (UK)	UK's largest certifier of organic farms, food and other products. Over 200 staff and certifiers.	June 2006	Commercial and environmental release of engineered nanomaterials	See entry for Animal Aid

Note: This list is not comprehensive and is restricted to groups whose calls for a moratorium have been made in English

2009; Oberdörster et al., 2007) and predictions that validated nano-specific risk assessment methodologies may take up to 15 years to develop (Maynard et al., 2006). NGOs have asserted that it is for circumstances such as these that the precautionary principle was developed.

The 1992 Rio Declaration on Environment and Development was adopted by 178 national governments. Yet for the most part neither national governments nor United Nations bodies have been prepared to suggest that the precautionary principle could have a role to play in relation to nanotechnology risk management. In much of their communication the word 'precaution' is conspicuously absent. The 2008 Intergovernmental Forum on Chemical Safety (IFCS) in Dakar was a notable exception. A statement calling for precautionary management of nanotechnology was adopted by 71 governments, 12 international organizations and 39 NGOs (IFCS, 2008).

In lieu of a commitment to the precautionary principle, the much weaker concept of 'responsible development' – supporting risk research alongside or in the wake of nanotechnology product commercialization – has instead attracted considerable support from government and industry proponents (see, for example, Australian Office of Nanotechnology, undated; Business and Industry Advisory Committee to the OECD (BIAC), 2009; Europa, 2007; National Nanotechnology Initiative (NNI), undated). However, responding to early warning signs of serious harm by calling for further research, in many instances after nano-products are commercialized, while doing nothing to stem the flow of nano-products about which safety concerns exist, is a serious undermining of the precautionary principle. Hansen (2009: 72) observes that

> many governments still call for more information as a substitute for action, and there are indications that understanding and managing the risks of engineered nanomaterials is being paralyzed by analysis.

The scientific justification for requiring proponents to demonstrate the safety of nano-products before they can be sold was accepted in 2004 by the RS-RAE. In their report the RS-RAE (2004) recommended that:

- nanomaterials be treated as new chemicals
- nano-ingredients in products be required to pass rigorous safety assessment before commercial use is permitted
- nano-ingredients in products be labelled
- nanomaterials in factories and workplaces be treated as if they were hazardous, and
- the environmental release of nanomaterials be avoided as far as possible.

Global reinsurance agent Swiss Re (2004: 47) called even more explicitly for precautionary management of nanotechnology risks:

> In view of the dangers to society that could arise out of the establishment of nanotechnology, and given the uncertainty currently prevailing in scientific circles, the precautionary principle should be applied whatever the difficulties.

In contravention of the precautionary principle, calls from NGOs, the RS-RAE and Swiss Re, many nanotechnology companies and regulatory bodies have taken the view that nano-specific regulation of nanomaterials should not be introduced until more scientific evidence demonstrates they may be harmful and 'evidence-based' regulations can be established (Helland et al., 2006). This removes the burden of proof from nanotechnology proponents. It also establishes as a prerequisite for governance a level of knowledge regarding nanomaterial risks that experts believe may be many years away, if adequate investment is made in risk research. The very limited funding allocated by government and industry for nanotechnology risk research further delays the possibility of 'evidence-based' governance. In the US, only 1–4 per cent of the total NNI budget is allocated to risk research (Maynard, 2006). A survey of German and Swiss companies found that 65 per cent did not perform any risk assessment of their nanomaterials (Helland et al., 2008).

There is a strong economic motivation for nanotechnology proponents to resist the precautionary principle. Given that validated, nano-specific safety assessment measures do not exist, the application of the precautionary principle to nanotechnology – even in a narrow sense as recommended by the RS-RAE – would halt the sales of nano-products. A moratorium on the sales of nanotechnology products until reliable safety assessment, metrology, measurement, monitoring and labelling systems can be developed is warranted by the scientific evidence available to date. But its price tag appears too dear to governments unprepared to stem the sales of nano-anti-ageing creams, odour-eating socks, flat-screen televisions and diet-replacement milkshakes. In the wake of two separate studies (Poland et al., 2008; Takagi et al., 2008) showing that exposure to multi-walled carbon nanotubes can cause asbestos-like pathogenicity in mice, the failure to halt commercial use of nanotubes until safety assessments can determine if any level of occupational exposure to nanotubes is safe is particularly abhorrent.

A number of NGOs including, for example, Environmental Defense (2007), FoEA (2009) and the Natural Resources Defense Council (Sass, 2008), have suggested that governments have a conflict of interest as key nanotechnology proponents, major funders, risk assessors, regulators and public 'educators' and that their quest for economic competitiveness in

nanotechnology is a major reason for the abandonment of the precautionary principle (FoEA, 2007b). The concern that governance of nanotechnology risks may be compromised by the economic motivations of both government and industry has been echoed by scientists:

> . . . when the promoters of nanotechnology – whether government or industry – have a strong influence on oversight, independent regulatory decision-making becomes compromised. Perhaps more insidiously, research and development decisions end up being influenced by what will ultimately promote the technology, rather than what will protect producers, users and the environment (Hansen et al., 2008: 3).

Detractors have argued that use of the precautionary principle can be arbitrary, 'anti-science', deployed to the detriment of useful innovation, or vulnerable to pressure from 'interest groups' (Charnley and Elliot, 2002; Clarke, 2005; Marchant et al., 2008). However, those levelling these accusations leave themselves open to the same charges. The jettisoning of the precautionary principle in favour of 'responsible development' of nanotechnology and the insistence on 'evidence-based' risk management are values-based rather than scientific decisions. They embody the assertion of economic values over public health and environmental safety. The failure of NGOs to secure government support for precautionary management of nanomaterial risks is significant.

19.7 BROADER SOCIAL, ECONOMIC AND DEMOCRATIC ISSUES ARE SEEN AS PERIPHERAL TO THE MAIN NANOTECHNOLOGY DEBATE

There has been a prominent (rhetorical) commitment by governments and industry internationally to 'engage' with broader societal issues at an early stage of nanotechnology's development (Sandler and Kay, 2006; Joly and Kaufmann, 2008). Nevertheless, there appears to be little willingness on the part of decision-makers to open up their assumptions, institutions, nanotechnology practices, funding or governance to critical public or NGO questioning. There has been an extensive series of well-publicized public 'engagement' forums in OECD countries (see below). However, these do not appear to have been designed with any intention of incorporating community views into government or industry nanotechnology research or governance strategies, or of involving the broader community in the process of imagining and constructing their technological futures.

Discussion of nanotechnology's 'societal issues' remains largely divorced from questions of innovation policy, research funding and governance. An exception is the proposed amendments to the Novel Food Directive from Members of the European Parliament that nanomaterials used in food production should face ethical assessment additional to nano-specific safety testing (European Parliament, 2009). Yet even this proposal is limited to examining ethical aspects of products at their point of commercial sale, rather than opening up research agendas and innovation strategies to ethical or broader social inquiry. Despite nanotechnology's development being driven by public funding, governments have failed to acknowledge that its development trajectory is mutable, and could be shaped to maximize social utility, or better reflect community preference (Sparrow, 2007).

Governments have largely been unwilling to undertake systematic technology forecasting and assessment of social dimensions in order to inform decision-making about the prioritization of nanotechnology research funding or governance. Davies (2009: 31) asserts that, 'what is needed is a capability to consider the overall impacts of major new technologies and to do so while there is still time to deal with the impacts' (see, also Davies, 2010). Notwithstanding, he acknowledges that in the US – a country with an enormous investment in nanotechnology research – institutions capable of conducting forecasts and assessments of social dimensions are 'weak or non-existent'. NGOs (Hepburn, 2006; Loka Institute, 2003; Miller, 2008) and social scientists (Kearnes et al., 2006b; Keller, 2007; Mehta, 2004; Wolfson, 2003) have observed that whereas nanotechnology is new, many public interest issues it raises have been faced before – such as in relation to biotechnology and nuclear power – and that we should learn from mistakes made there. Research into 'ethics', public 'values' and even community preference has arguably received greater attention and funding in relation to nanotechnology than in relation to other new technologies. In some instances social scientists have even been employed to act as 'mediators' between nano-scientists and public debate (Doubleday, 2007). However, the role of 'ethics', public 'values' and even social preference is still largely seen as peripheral, or a 'footnote', to the key questions of technology development and governance (Stilgoe, 2007). Worse, the purpose of social science research is commonly framed as promoting public acceptance of nanotechnology in order to avoid a repeat of the 'biotechnology backlash' (Sandler and Kay, 2006).

NGOs have criticized the timid voice of social scientists on new technologies and their tendency to avoid conflict with technology promoters (Loka Institute, 2003). Nevertheless, attempts to use social issues research or public engagement to 'smooth the way' for the nanotechnology industry

have been resisted by some social scientists. A number of social scientists have warned that social and ethical research should not be viewed simply as a means to build public support for industry development (Kearnes and Wynne, 2007; Kyle and Dodds, 2009; Rogers-Hayden et al., 2007; Sandler and Kay, 2006). Randles (2008: 271) argues against the use of 'a spoonful of ethics' to make nanotechnology more palatable to the public: 'market opening under the guise of ethics, it could be argued, is the very antithesis of ethics'. Wynne (2007: 75) has called for disruption to conventional models of public engagement where 'the expected role of the social sciences is tantamount to delivering a quiescent public for commercially exploitable scientific knowledge'. Other social scientists have drawn attention to how industry goals are constraining the parameters of social science research. For example, the US NNI promotes itself as 'Leading to the next industrial revolution' (National Science and Technology Council, 2000). Yet Macnaghten et al. (2005: 7) have observed that in its failure to support ethical or sociological inquiry into this core aim, 'the envisaged role of the social sciences can be seen as a social lubricant in the drive toward industrial success and commercialization'.

At a time of unprecedented food, ecological and climate crises, nanotechnology's most important socio-economic and ethical issues arguably relate to whether or not it will: further concentrate Northern corporations' control of trade; magnify existing socio-economic inequities between and within countries; further jeopardize the livelihoods and resilience of poor people; add to their pollution burden; and further undermine the ability of communities to retain local control and ownership of food production (ETC Group, 2005a, 2005b; Invernizzi and Foladori, 2005; Invernizzi et al., 2008; Mooney, 2006; Nyéléni, 2007; Scrinis and Lyons, 2010). As discussed earlier, NGOs including Corporate Watch (2005a), ETC Group (2001, 2005a, 2005b, 2008), FoEA (2006a) and the 80 NGO signatories to the *Principles* document (NanoAction 2007) are concerned that nanotechnology will widen inequity in these areas.

19.8 ALL TALK AND NO ACTION: NGO FRUSTRATION AT 'PUBLIC ENGAGEMENT' ON NANOTECHNOLOGY

'Public engagement' has been defined as 'a form of two-way communication between the public and those who have knowledge of, or power over, the particular issues at stake' (Joly and Kaufmann, 2008: 226). Since 2003 in many OECD countries there has been a proliferation of government-backed public engagement activities on nanotechnology

– workshops, opinion surveys, deliberative exercises such as citizens' juries or consensus conferences, science exhibitions, public seminars and public debates (Bowman and Hodge, 2007; Citizens Participation in Science and Technology (CIPAST), 2008; Nanoforum.org, 2008). Sometimes the general public is the focus of the 'engagement', other times the engagement is promoted as a 'stakeholder dialogue' where in addition to government, business and scientific 'stakeholders', NGOs may be invited to attend as 'civil society' stakeholders. NGOs have championed public participation in nanotechnology decision-making. However, many NGOs are critical of public engagement initiatives' under-funding, poor design and conduct, pro-industry bias and failure to have any bearing on governance outcomes (Angels Against Nanotechnology, 2004; FoEA, 2008e, 2009; Joint NGO NanoAction Group, 2008; PMO, cited in Joly and Kaufmann, 2008; SmartMeme, 2009).

NGOs have been strong advocates of involving wider publics in nanotechnology decision-making:

> Proponents of a nanotech revolution predict it will cause dramatic and sweeping changes globally in every aspect of human life. That makes the general public of every nation, their children, and their children's children the key stakeholders in this potential revolution. Accordingly, the general public everywhere must be continually informed, and a range of deliberative processes must empower them to be heard and heeded in major local, national, and international decisions about how – and whether – to design and use nanotechnologies (Loka Institute, 2007).

> What we want to avoid is the situation where a small group of financially and technologically interested people develop something and thrust it on the rest of the world (Greenpeace UK's Doug Parr, cited in Regaldo, 2003).

Nonetheless, the role of NGOs as 'civil society' stakeholders or public interest advocates in nanotechnology debates is also important given common barriers to effective participation of wider publics (information, time, money, familiarity with specialist language and literature). Sometimes resources are dedicated to help members of the public overcome these structural inequalities (for example during consensus conferences or citizen juries). Where they are not, the general public may have a more limited capacity to participate in detailed policy discussions, and to engage in debate on a comparable footing with business, academic and government stakeholders who have a professional or financial interest in the debate at hand (Ferretti, 2007).

Some observers have criticized NGOs as emphasizing their own concerns in technology debates, and representing their own interests rather than those of wider publics (Burke, 2004; Sheetz et al., 2005). Biotechnology

proponents have accused NGOs of focusing on 'unscientific' concerns in relation to genetically engineered foods, or of having stalled a promising new technology (Burke, 2004; Ferretti, 2007; Mandel, 2005; Marchant et al., 2008; Mohr, 2007). Similarly, Mark Modzelewski, executive director of the NanoBusiness Alliance, characterized a Greenpeace report advocating a precautionary approach to managing nanotechnology as 'industrial terrorism' (Small Times, 2003):

> No wonder they are into [nanotechnology] now. It's a great way to raise new funds and pretend they care about something . . . They saw how it worked on genetically modified foods, and so this is a great way for them to do the exact same thing (Small Times, 2003).

However, despite the scepticism of industry, public opinion surveys suggest that the public has confidence in NGOs to articulate public interest issues associated with new technologies. A survey commissioned by the Australian government shows that the public has far greater trust in NGOs to disclose risks, compared to the nanotechnology industry, and slightly greater trust in NGOs compared to governments and regulators (Market Attitude Research Services, 2008). In relation to genetic engineering (GE), Eurobarometer surveys have shown high trust in NGOs compared to political institutions (Gaskell et al., 2006).

The participation of NGOs and lay people in policy development – and criticism of the tokenism or disingenuous nature of many measures to support such participation – is not new (Arnstein, 1969; Beder, 1999). Nonetheless, nanotechnology marks one of the first instances where the need for 'upstream engagement' has become part of the 'master narratives of public policies' in many countries (CIPAST, 2008; Joly and Kaufmann, 2008). This has been motivated in large part by proponents' wish to avoid a repeat of the backlash that greeted genetically engineered foods. The stated objective of many countries' public engagement programmes on nanotechnology is to build public acceptance (CIPAST, 2008). However, NGOs are concerned that public consultation is primarily for public relations value, and is irrelevant to nanotechnology decision-making.

Among others, UK think tank Demos has argued that 'public engagement is only really worth doing if it makes a substantive difference' (Stilgoe, 2007: 73). But there has yet to be a nanotechnology public or stakeholder dialogue with explicit links to decision-making within government, industry or the scientific community. In its survey of 70 international public engagement initiatives on nanotechnology, CIPAST (2008) notes that many rate poorly on Arnstein's (1969) 'ladder of citizen participation'. That is, using Arnstein's ladder, nanotechnology engagement efforts are more accurately described as 'manipulation', 'therapy'

or 'informing'. Rather than offering 'citizen power', nanotechnology engagement generally constitutes 'non-participation' or 'tokenism'.

There is a lack of meaningful institutional support for public engagement on nanotechnology. Powell and Colin (2008: 133) note that whereas the US government engages in

> cheerleading about the importance of public engagement, less than 1% of the approximately 1.5 billion dollar U.S. government nanotechnology funding was allotted to societal projects that *might* include citizen engagement efforts.

Notwithstanding, even long-term, funded public engagement activities such as the UK's two-year nanotechnology engagement programme have had little demonstrable impact on governance outcomes (Gavelin et al., 2007).

Observers acknowledge that the huge obstacles to 'translation' of the outputs of public engagement into practice are

> blind spots of the upstream engagement discourse, which does not provide many hints on the relations between public deliberation, power structures, policy-making, and innovation processes (Joly and Kaufmann, 2008: 127).

The need to identify and interrogate the unacknowledged political and economic forces shaping development of new technologies and constraining the outcomes of public engagement has been emphasized by social scientists (Irwin, 2006; Mohr, 2007; Rogers-Hayden et al., 2007; Wynne, 2007). Unsurprisingly, this is also a key concern for NGOs, who point out that economic pressures, and the unacknowledged role of governments as technology proponents, can fatally constrain and compromise the capacity of public engagement to affect the decision-making process (FoEA, 2009).

Many nanotechnology public engagement activities appear somewhat aimless. Powell and Colin (2008: 127) observe that

> few academics and governments attempting to 'engage in engagement' are clear about their goals and desired outcomes, and whether or not the processes they facilitate are likely to meet these ends.

This is a concern shared by other observers (Jones, 2007; Joly and Kaufmann, 2008; Stilgoe, 2007). The burgeoning yet unfocused public engagement on nanotechnology could therefore be perceived as harmless – albeit a waste of resources and a potential loss of participants' goodwill. But a commonality amongst nearly all public engagement exercises is that irrespective of their capacity to meet other objectives, they are seemingly designed to boost public acceptance and the perceived legitimacy of government oversight (CIPAST, 2008).

NGOs have questioned the value of taking part in a steady stream of 'dialogue' activities in which they are not permitted to query government's core commitment to nanotechnology, or to affect any substantive change to industry development or governance (FoEA, 2008e, 2009). French NGO Pièces et Mains d'Oeuvres (PMO) has simply refused to take part in dialogue, given that government promotion of nanotechnology was not up for discussion and that all the key decisions had been made already (PMO, cited Joly and Kaufmann, 2008). The UK Angels Against Nanotechnology (2004) similarly declined the Institute for Nanotechnology's offer of dialogue. In addition to concerns about legitimizing flawed or disingenuous dialogue activities, NGOs must also consider the opportunity cost of their participation. At a time of low general public awareness of nanotechnology, NGOs are sometimes forced to choose between spending their time participating in elite 'stakeholder' workshops, where their views appear to be largely ignored, or engaging in media or public outreach work with their core constituents that could better raise the public profile of their concerns.

Although NGOs are often better placed than members of the public to participate in policy debates and dialogue activities, resource constraints hamper the contribution of some NGOs, especially smaller organizations (for example, where they are required to pay for conference fees or travel costs to attend forums and government meetings, or where there are very short deadlines to deliver input to – often unexpected – 'stakeholder consultations' or inquiries). In many sectors, a principle in searching for the public interest is to ensure that advocacy groups have the capacity to put their views forward and comment on regulatory options (Braithwaite, 2004). Recognizing that broad social inclusion and the contestation of public policy can deliver better outcomes, some European countries provide grants or project funding to enable NGOs to advocate for the public interest on issues identified as priorities. It could be useful for governments elsewhere to consider this also.

19.9 CONCLUSION: NGOs HAVE HAD A LIMITED IMPACT ON GOVERNANCE DEBATES AND REGULATION ITSELF

In this chapter we have outlined the three principal governance demands of NGOs: for nanotechnology's broader social, economic, ecological, ethical and public policy dimensions to be examined alongside basic safety issues; for precautionary management of health and environment risks; and for public involvement in nanotechnology decision-making.

As with the debate over genetically engineered foods, broader social, democratic, ethical and public policy concerns remain marginalized by the dominant benefits versus risks frame used by nanotechnology proponents. Sectoral regulation is emerging to address nanotoxicological risks. However, claimed economic, social and environmental 'benefits' still remain largely unexamined and their assessment is outside the scope of regulation. Yet the perceived value of such 'benefits' drives broader governance of nanotechnology, affecting public research budgets, practical and financial government support for rapid nanotechnology commercialization, and acting as a reason to stall precautionary scientific risk management. Meanwhile, whereas broader social, democratic, ethical, and security 'costs' and 'challenges' are the subject of some debate in social science literature, they are largely excluded from the governance debate, and rarely figure in regulation.

Given NGOs' focus on the need for precautionary management of health and environment risks, the failure to secure nano-specific regulations that require companies to demonstrate the safety of nano-ingredients before they can be used commercially is particularly significant. This failure is the more striking because in addition to – and clearly more important than any NGO efforts in this area – the emerging nanotoxicological literature demonstrates that many nanomaterials now in commercial use could pose serious health and environmental risks. Furthermore, there is growing recognition that the extent of uncertainty precludes development of nano-specific risk assessment regimes in which we can have confidence. Despite this, decision-makers have not been prepared to slow the rapid pace of nanotechnology commercialization to address basic safety issues.

The securing by NGOs of a symbolic 'stakeholder's' seat at the dialogue table, and the unprecedented commitment of governments to public engagement on nanotechnology, may seem to constitute an achievement in itself. Nevertheless, despite the inclusion of NGOs in dialogue activities, it is apparent that NGOs are not accorded the same value attributed to other stakeholders in nanotechnology decision-making. Governments consult widely with the research community and industry in developing nanotechnology strategies, research budgets, public information materials, high school curricula, industry promotional opportunities and regulation. NGOs are rarely invited to participate in these activities. Despite the participation of NGOs in hundreds of 'dialogue' activities over the past five years, it is not apparent that this, or the proliferation of government-backed engagement activities that involve wider publics, has resulted in any substantive governance outcomes.

At heart there is a struggle over whose interests should drive technological development; whether nanotechnology will offer solutions to the

world's most pressing problems or merely magnify them; whether nanotechnology proponents or the community should bear the burden of proof of safety; whether predicted social benefits or costs are more likely and whether these should be permitted to 'offset' potential risks; and whether or not affected publics should have the right to be involved in decision-making. Despite the efforts of NGOs, most of these questions remain marginal in the nanotechnology governance debate, and excluded from the emerging sectoral regulation of nanomaterial toxicity.

As growing numbers of NGOs identify nanotechnology issues of interest or concern to their constituencies, it is likely that NGO participation in nanotechnology debates will increase. In a best case scenario, governments and industry will not only make considerable efforts to address the public interest issues identified by NGOs, but will do more to ensure that both wider publics and NGOs play a substantive and ongoing role in nanotechnology debates, policy development and regulatory oversight. In a worst case scenario, governments and industry will continue to ignore the need for urgent action to address the public interest issues identified by NGOs, and their engagement with NGOs will continue to be superficial and tokenistic.

Whereas NGOs currently have limited political leverage in nanotechnology debates, this could readily shift as public awareness of the issues grows. Nanotechnology is attracting increasing prominence in the news media, and surveys indicate that public awareness is increasing, from a low base. If governments do not do a far better job in their handling of nanotechnology, it seems reasonable to suggest that they will be held accountable for their omissions and failures in the near future, as understanding of the implications grows. Whether that results in a critical interrogation of the technological optimism of governments, and a re-imagining of the role of technology in responding to the urgent social and ecological crises of our time, remains to be seen.

NOTES

1. Social scientists have criticized the common scientific and public policy practice of framing social dimensions of technology development as 'risks' or 'impacts', or of ignoring social dimensions altogether to acknowledge only technical or safety risks (Kearnes et al., 2006a, 2006b; Macnaghten et al., 2005; Mohr, 2007).
2. Reasons include: the immediacy of risk issues – people and environmental systems are facing exposure already; the compelling nature of preliminary scientific evidence of potential harm; greater ease of communicating risk issues to decision makers, journalists and publics than concerns related to wider social and economic relations in which nanotechnology is embedded; the usual restriction of regulatory structures and product assessment to technical risks; and the political context in which non-technical concerns

about technology development have been effectively marginalized as being 'unscientific' or 'ideological'.

3. This phenomenon is not specific to nanotechnology. Kearnes et al. (2006a) observed a similar phenomenon during the United Kingdom (UK)'s genetic engineering (GE) controversy in the mid-late 1990s. Even though wider publics were seriously concerned about broader issues surrounding the introduction of GE crops, at that time Greenpeace UK made a decision to limit its campaign policy to technical risks alone, and to omit any 'values' based discussion; Friends of the Earth England, Wales and Northern Ireland similarly focused exclusively on technical risk issues in the first years of its campaign.
4. In its testing, Consumers Union US found that four out of five sunscreens promoted as being 'nano-free' actually contained nanoparticles.
5. FoEA (2007b) has suggested that meaningful governance measures would include: robust public participation programmes to inform development of nanotechnology strategies that reflect community priorities and to identify any potential 'no go' areas; early stage technology assessment to identify challenges as well as opportunities, and to guide technology development to maximize social and environmental utility; life cycle assessment to identify whether or not any safe levels of exposure to nanomaterials exist and legislation of new permissible exposure levels; introduction of new nano-specific safety assessments and metrics; legislation of workers' and consumers' right to know.

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