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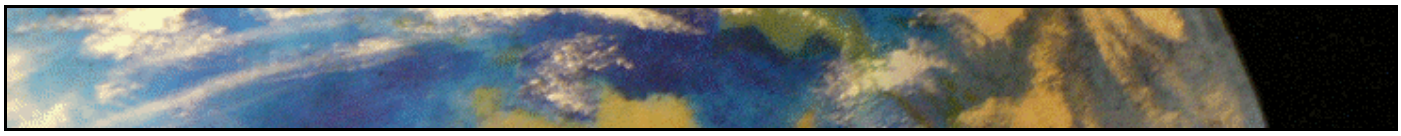
Update on a Framework for Canadian Nanotechnology Policy:

A Second Discussion Paper



March 2008

Update on a Framework for Canadian Nanotechnology Policy:

A Second Discussion Paper

by Susan Holtz
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March 2008

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About the Canadian Institute for Environmental Law and Policy (CIELAP)

Founded in 1970, as the Canadian Environmental Law Research Foundation (CELRF), the Canadian Institute for Environmental Law and Policy (CIELAP) is an independent, not-for-profit professional research and educational institute committed to environmental law and policy analysis and reform. CIELAP is incorporated under the laws of the Province of Ontario and registered with Revenue Canada as a charitable organization. Our registration number is 11883 3417 RR0001.

CIELAP provides leadership in the research and development of environmental law and policy that promotes the public interest and sustainability.

About the Author

Susan Holtz is a policy consultant to CIELAP on issues related to sustainable development, water and energy. She also works on related issues as a mediator, facilitator, and editor. Ms Holtz was the founding Vice Chair of both the Canadian and Nova Scotia Round Tables on the Environment and the Economy. Ms Holtz was also instrumental in setting up the Canadian Environmental Network (CEN). She has served on many advisory bodies and boards, including the Auditor General of Canada's Panel of Senior Advisors and the Commissioner of Environment and Sustainable Development's External Advisory Panel.

Summary

On February 22, 2008 CIELAP held its second workshop on nanotechnology policy, a year after its first workshop on the topic in early 2007. This present document is an update of CIELAP's March 2007 *Discussion Paper on a Policy Framework for Nanotechnology*.

A number of nanotechnology policy-related developments during the past year are noted in four areas: public information and engagement; technical and scientific matters; regulatory arrangements; and voluntary initiatives. Among those mentioned are:

- A Canadian public nano portal website, under development at the time of this writing;
- Ongoing technical standards work under the auspices of the International Standards Association (ISO) and other international technical groups, with leadership and involvement from a number of Canadians, federal and provincial governments, and agencies like the National Research Council (NRC) and the Canadian Standards Association (CSA);
- International collaboration on testing 14 representative nanomaterials;
- Work toward finalizing a Health Canada policy framework for addressing the products of nanotechnology;
- An Advisory posted by Environment Canada under the Canadian Environmental Protection Act (CEPA) stating that manufacturers and importers must address CEPA regulations that apply to new substances for any nanomaterials which have a novel molecular structure and are not on the Domestic Substances List (DSL). Environment Canada is also looking at CEPA's Significant New Activity (SNAc) provisions as they might apply to nanomaterials.

Recommended Strategic Priorities

CIELAP recommends four broad strategic priorities for government:

1. **maintaining a sense of great urgency** and a commitment to making recommended policy initiatives happen very quickly;
2. **increasing scientific research and addressing technical issues**, along with building overall nano-related policy capacity within government;
3. **designating an institutional centre** within government for overall policy leadership and coordination; and
4. **developing a public engagement strategy** with a strong commitment to government openness and transparency.

In its previous policy framework CIELAP identified 12 topics needing attention, along with recommended approaches to them. There was general support in the workshop for that framework and for CIELAP's recommendations, with two exceptions. CIELAP's proposal for

required labeling of consumer products with deliberately introduced nanomaterials, as well as for a legislated strict liability regime, raised both questions and debate. In this document, priorities are discussed for all 12 topics. However, the topics have been grouped under three larger headings, with notes on general priorities for the three as follows:

- Institutional Developments for Nanotechnology Governance and Leadership. This broad area requires initiating many actions immediately, but it is crucial to get these institutional developments right, so foresightful thought and consultation are needed.
- Knowledge and Information Needs. This is a high priority, as many other actions depend on it. Since the necessary information and knowledge is cumulative, much will depend on the amount of effort and resources provided.
- Addressing Social, Commercial and Economic Concerns. While they are important, satisfactorily dealing with these topics is more about the quality of problem-solving and the breadth of input than the speed of resolution.

Timeline Benchmarks

The discussion paper concludes with timeline benchmarks, all within eight months to two years, for seven of CIELAP's recommendations for government action. These recommendations are for

- the designation of a government institutional **nano coordination centre/ "champion" (May '09)**;
- the completion of a **public engagement strategy (May '09);**
- the creation and publication of a **Canadian inventory of nano activities and products (May '09)**;
- the development of an **Environment Canada scientific research strategy (May '09)**;
- the development and promulgation of **worker safety and public health guidelines for research and industry (Aug '09)**;
- the **banning of nanomaterials** in food and some food packaging **(Nov '09)**; and
- the **mandatory labeling of nanomaterials** in cosmetics, personal care products, and cleaning agents **(May '10)**.

1. Introduction and Background

On March 16, 2007, CIELAP held a workshop in Toronto to explore the creation of nanotechnology[i] policy for Canada. Based on those discussions and its own research, CIELAP subsequently published its *Discussion Paper on a Policy Framework for Nanotechnology*[ii] (hereafter referred to as CIELAP's *Nano Policy Framework*). This March 2007 document presented a policy framework that included a list of the topics that needed to be addressed, along with CIELAP's perspective on those matters in particular and on an overall approach to this new and swiftly developing field. The paper noted that the policy challenges in nanotechnology are currently dominated by a lack both of scientific information and also of such basic policy tools as technical definitions and metrology; a legal and regulatory framework; and structures and resources for public engagement. At the same time, the document stated, nanotechnology's ongoing and extremely rapid commercialization requires an unprecedented sense of urgency by government in the creation of policy for this area. Moreover, as the discussion paper pointed out, the situation in which this technology development is happening is characterized by the fact that

> *...the environmental and health effects of nanomaterials are largely unknown, although in a number of studies nanoscale particles have been found to be more toxic and reactive biologically than larger particles of the same material. It is generally believed that nanotechnology is a "platform" technology that will affect virtually every sector of society, and that its development will be important to the economic success of Canada in the future....Developing countries, though, are concerned about being left out of the benefits..., and also about the displacement of their workers in traditional sectors. Such economic impacts could occur in regions or industries elsewhere as well.*

A year later, on February 22, 2008, CIELAP held a second workshop to consider recent policy developments and further requirements and priorities for action in Canada.[iii] This event provided much information and thoughtful commentary, bringing the participants closer to a shared understanding of where nanoscience, nanotechnology, and the creation of nano-related policy actually are at present. Along with other research, the workshop provided the basis for this updated report.

In the following document we first review some of the recent developments in different areas of this field. Following that is a discussion of strategic priorities that explicitly or implicitly emerged in the workshop and elsewhere for attempting to manage this technology, with all its actual and potential risks and benefits, in a responsible manner. Finally, we use a version of the previously published policy framework topics to structure CIELAP's updated comments and

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[i] Nanotechnology is based on the quickly advancing ability of humans to manipulate and utilize materials at the nanoscale, essentially at the molecular level. One nanometer is a billionth of a meter, which is about a hundred thousand times smaller than the cross section width of a human hair, and a thousand times smaller than a red blood cell. The nanoscale level is conventionally considered to range from one to one hundred nanometers. At this scale, many substances exhibit different properties from the ones they have at the ordinary or macro scale. These can include novel electrical, magnetic, mechanical, or thermal properties, among others; making use of these unusual properties in various applications is the reason for employing deliberately created nanomaterials.

[ii] This and other CIELAP documents are available on CIELAP's website at www.cielap.org.

[iii] The Proceedings of that workshop are also available through CIELAP.

specific recommendations. We conclude with a proposed timetable for implementing seven of CIELAP's recommended actions.

2. Recent Nano-Related Developments

As discussed earlier, the pace of nanotechnology's use in commercial products and in research ultimately intended for commercial development has been extraordinarily rapid, and may even be accelerating. One workshop speaker noted that at this time, the Woodrow Wilson Center in the U.S. lists on its ongoing nanotechnology-based Consumer Products Inventory some 580 products, made by 305 companies in 20 countries. In Canada, Industry Canada has identified about 80 companies having products with nanomaterials. Many of the products in use now are consumer goods such as wrinkle- and stain-resistant fabrics, sunscreens, coatings to reduce glare on eyeglasses, and tougher materials in sports equipment like bicycles and tennis rackets. However, arguably more socially important applications are coming now or in the immediate future in fields like medicine, renewable energy technologies, and energy efficiency. Moreover, the complexity of nano applications has been increasing over time, from individual particles through nano-molecules and devices in medicine (the "lab-on-a-chip" for medical diagnostics, for example) to nano-biological assemblages. Even more complex applications, such as artificial tissue, are expected within the next decade.

As CIELAP pointed out in its *Nano Policy Framework* document, this use of nanomaterials in commerce is taking place, worldwide, in the near-total absence of regulatory oversight, and with little or no public information or public engagement. As well, there is little scientific information on the ecological and human health effects of nanoparticles and nanomaterials. Science, governments, and civil society organizations are all playing catch-up in their efforts to create the tools, knowledge, and institutional arrangements to reap the benefits of this technology while avoiding its potential negative impacts. As a result, there have been a number of recent developments in Canada and elsewhere, most since CIELAP's 2007 workshop, with relevance to this effort to assert reasonable foresight and social control over a burgeoning new technology. The following are a selection of some of these events, especially ones affecting Canada. However, with as many players involved and as much happening as rapidly as it has been, no such discussion is either comprehensive or up to date for very long.

Public Information and Engagement

- A study by a University of Wisconsin - Madison group found that, while more than half to three quarters of people in the U.K., Germany, and France thought that nanotechnology was morally acceptable, only a third of Americans thought that it was. But a study reported in the journal *Nature Nanotechnology* in November 2007 found that, atypically, scientists are more concerned about nanotechnology's potential hazards and risks than is the larger public. CIELAP's perception is that public interest in and knowledge about nanotechnology in Canada is only just now beginning to develop.
- By the beginning of February 2008, more than 70 civil society groups worldwide, such as environmentally concerned professional organizations, labour unions and large

environmental groups, have signed on to a comprehensive statement of *Principles for the Oversight of Nanotechnologies and Nanomaterials*.[1] First published on July 31, 2007, the statement had 46 initial signing organizations.

- A public nano portal website is being developed by Health Canada, to be in operation in 2008.

Technical and Scientific Developments

- Governments and regulatory agencies around the globe have recognized that no single country can effectively investigate and regulate nanotechnology products on its own. The Organization for Cooperation and Development (OECD), the International Standards Organization (ISO), the American Society for Testing and Materials International (ASTM), and the International Electrotechnical Commission (IEC) have all initiated work on the development of standards for nanomaterials. As an example, the ISO standards development work addresses terminology and nomenclature, measurement and characterization, and the health, safety, and environmental aspects of nanotechnologies. Canada is supporting these international activities, both in practical assistance and as an appropriate approach. Federal and provincial regulatory agencies, including Environment Canada and Health Canada, as well as officials, scientists, and researchers from Industry Canada, the Canadian Standards Association (CSA), the National Research Council (NRC), and Canadian universities are among those involved. The CSA serves as the secretariat of the Canadian Advisory Committee for ISO/IEC work, helping to build the positions to be taken and the team of experts that speaks for Canada. In international programs, Canada is actively engaged in the OECD Working Party on Nanotechnology and the Working Party on Manufactured Nanomaterials, and is the Convenor for the ISO TC229/ IEC TC 113 Joint Working Group on Terminology and Nomenclature. Canadians are providing scientific expertise on various work items and within the Joint Working Group on Measurement and Characterization.

- The OECD has developed a proposed testing program on health and safety aspects of nanomaterials identified as priorities. Environment Canada supports this approach and will cooperate with the U.S. Environmental Protection Agency (US EPA) and others in testing 14 representative materials, a very large task. Environment Canada is proposing to improve its research capacity in this field, and will need to develop a research strategy to guide it.

- More information on the toxicity of nanomaterials is only starting to accumulate. The specifics of toxicity vary not only with the substance itself, but with nanoparticle surface properties such as size, shape, and surface charge. According to Günter Oberdörster of the University of Rochester,[2] in the context of potential nanomedical uses, it appears that, among nano metals, in cells copper is highly toxic, silver quite high, titanium dioxide not very, and gold least toxic. Nanomedical uses have enormous potential, but much work will need to be done first to gain an understanding of such things as cellular responses, translocation, and clearance from and persistence in the body.

- Nanoparticles have been understood to be the key to the mechanism through which the statistically well-recognized link between air pollution and heart disease occurs. When taken into the lungs, nanoparticles, created mainly though inadvertently by combustion in vehicle engines, cause oxidative injury. This creates irreversible damage in DNA, which is passed on to daughter cells. These can pass into the bloodstream and become plaque, which builds up in blood vessel walls. Plaque build-up is implicated in vascular disease and heart attacks.[3]

Regulatory Arrangements

- The federal government's *Mobilizing Science and Technology to Canada's Advantage* strategy document commits the government to develop a plan to ensure that nanotechnology, along with biotechnology and information and communications technology, are regulated in a timely manner that draws on best practices. The role of Health Canada, in coordination with other federal regulatory departments and agencies (Environment Canada, the Canadian Food Inspection Agency, and Fisheries and Oceans) is to develop this plan.

- Health Canada has been reviewing government policy/regulatory frameworks around the world, noting similarities and different emphases in them. A comparison document on this topic is now being finalized. Some of its findings are that no one thinks that a completely new regulatory regime is needed, since existing approaches can be adapted for nanotechnologies; that most agencies will evaluate different applications in different types of products on the basis of those specific classes of products; and that there are differing sets of tools used or preferred depending on whether the product is evaluated pre- or post-market.

- Health Canada's Healthy Environments and Consumer Safety Branch and its Health Products and Food Branch have been asked to lead and work with other agencies to develop a Health Canada framework for addressing policy issues concerning the products, broadly defined, of nanotechnology. All aspects of Health Canada's various roles will be addressed, including science and research; education, communications, and public engagement; health care and the delivery of health services; and regulation. Health Canada's regulatory focus will be on specific products and consequences. The framework is also intended to reach out to key stakeholders, build relationships, and engage with other federal departments in the interest of coordinated action.

- Environment Canada began working on the issue of nanomaterials in 2006. In 2007 the Department published a paper titled *A Proposed Regulatory Framework for CEPA* [the Canadian Environmental Protection Act, which regulates toxic substances]. CEPA 1999 is the major regulatory legislation in Canada that is and will be used to address nanomaterials as specific individual substances.

- It must be recognized that CEPA itself came into existence as the belated attempt to control the risks of toxic substances in the environment at a time when there were already tens of thousands of chemicals in use. Thus the regulatory approach was to separate substances currently in use from newly introduced substances. The latter, depending on

the quantities involved, must first comply with various testing requirements before being marketed commercially. As a result of those test findings, new substances may have restrictions imposed on their usage or even be banned. Substances that were already in use when the legislation was introduced have been placed on the Domestic Substances List (DSL). There have been processes to prioritize some of these substances for evaluation, but the others have continued to be allowed in commercial use. In the absence of a technical system to identify and classify nanomaterials as such, nanomaterials had been treated simply as the same substances as at the macro scale, despite having different properties. (For instance, nano silver or nanoparticles of titanium dioxide were regarded simply as silver or titanium dioxide and treated either as new or existing substances depending on the status of the everyday macro-scale material.)

However, this past summer, Environment Canada posted an Advisory Note, signed in June 2007, to manufacturers or importers of nanomaterials that have "unique structures or molecular arrangements" and are not on the DSL. Such nanomaterials are now subject to the New Substances Regulations under CEPA. The Advisory noted that this requirement would apply to materials like deliberately fabricated fullerenes, which have a novel molecular structure. It would not apply, for example, to titanium dioxide nanoparticles. These do not have a different molecular structure from macro-scale titanium dioxide, which also is already on the DSL.

- Environment Canada has now developed a two-phase approach (short-term and longer-term) to the regulation of nanomaterials. In Phase 1 Environment Canada intends to inform companies of their obligations under CEPA; gather information on materials already in commerce through a CEPA Section 71 survey and a voluntary challenge; consider whether changes to CEPA are needed; and use Significant New Activity (SNAc) provisions for new nanomaterials where applicable. Environment Canada plans to issue a survey to begin to gather information in September 2008. Phase 2 will involve considering more elaborate regulatory changes for nanomaterials treated as new substances, and will consider using SNAc provisions for existing nanomaterials.

Voluntary Initiatives

- In the last year a number of voluntary approaches or guides have been developed and published on such nano matters as risk assessment or best practices for laboratory or industrial workers dealing with nanomaterials. Few think that such initiatives will or should prevent the development of mandatory measures. Rather, these voluntary efforts try to address the present regulatory gap, since it is likely that comprehensive regulations will not be in place for some time. One such example is the *Québec Guide of Good Practices for the Safe Handling of Nanoparticles* that is intended to be presented at an April 2008 technological innovation conference in Montréal.

- Another example is the U.S. National Institute for Occupational Safety and Health (NIOSH) brochure, "Safe Nanotechnology in the Workplace - An Introduction for Employers, Managers and Safety and Health Professionals," released in February 2008. The short document is available online through the Centers for Disease Control and Prevention (CDC) website.

3. Broad Strategic Priorities in Policy Development for Nanotechnology

CIELAP was encouraged by the amount of government action that has occurred in the last year. However, **in the rapidly developing field of nanotechnology, a continuing sense of great urgency and a commitment to making things happen much more quickly than is normal for governmental and bureaucratic action is the most important priority**.

This is not matter of environmental rhetoric. In no other situation are the basic regulatory tools such as nomenclature, metrology, and classification as well as fundamental science-based information required for responsible regulatory oversight simply not yet available. Moreover, the tasks involved, particularly the acquisition of knowledge about appropriate scientific testing methods and actual studies on such vital topics concerning nanomaterials as toxicity, behaviour in the body, environmental fate and persistence, and ecotoxicity all inherently take considerable time.

For that reason, it is important not to wait until the tools and the science, which are the logical starting point for regulatory action, are fully in place before addressing other policy topics, such as developing and implementing a public engagement approach. **Increasing scientific research and addressing technical issues are a strategic priority, but building *overall* capacity within government to deal effectively with all aspects of nanotechnology must also be seen as a priority**.

From both a governance and social perspective, nanotechnology is not one single or simple thing. Assessing individual nanomaterials and their properties for regulatory purposes as will happen through CEPA is about concerns that are similar to those in assessing individual macro-scale chemicals. The difference is mainly that nano-related protocols and other information needed for such screening must still be developed. But nanomaterials currently used in consumer products may introduce another set of questions related to particular products, while medical uses, more complex bio-nano assemblages, military applications and potential accidents and deliberate misuse raise other social and ethical issues, including implications for international development and social equity. As well, there is a natural tension between pushing forward with new technology to gain economic benefits and taking action to reduce and manage risks with appropriate precaution. The policy challenge is to deal effectively with specific issues in detail, but at the same time to make sure that the right hand of government knows what the left hand is doing. **Designating an institutional centre within government for overall leadership and coordination, combined with good mechanisms for agency and departmental interaction on many specific issues are strategic priorities for immediate institutional development.**

And of course government is not the only actor involved.

Much discussion at the workshop centred on the need for public education. It is understandable that people working in this field are concerned about the lack of awareness and knowledge that the general public has about nanotechnology. Knowing how media coverage often sensationalizes

technological risks, many fear that an accident or other negative event could turn public opinion entirely against everything "nano." But many in the public react – sometimes rightly – to government public education programs on potentially controversial topics as an attempt to manipulate public opinion by presenting only government's chosen side. Although "public education" as a general topic is discussed in CIELAP's *Nano Policy Framework*, our present view is to be more precise in our terminology than in the earlier document. We would encourage government to critique "public education" as a questionable term that may invoke a sometimes problematic model for information that is aimed at a broad general public. The term "public education" is rightly used when information is targeted to a clear need by specific groups, such as industrial or laboratory workers or health and safety professionals.

That said, CIELAP believes that bringing the public (actually, individuals from a number of different publics) early into policy development in many different areas of nanotechnology will be extremely important. Not only will this bring valuable outside perspectives into decision-making, but it also signals that government actions in this field will involve openness, transparency and dialogue with civil society. Rather than a public education program, **as a strategic priority CIELAP recommends developing a public engagement strategy with a strong commitment to government openness and transparency, to providing public access to technical as well as more general information, and to creating a variety of formalized avenues for public involvement in different areas of decision-making about nanotechnology.**

4. Framing and Prioritizing Canadian Nanotechnology Policy

There was much support expressed for CIELAP's *Nano Policy Framework* document of last year. The 12 topics listed there as necessary pieces of a comprehensive policy framework are (1) Assertion of societal goals for the technology; (2) Public education and engagement; (3) Creation of an inventory of activities and information sources; (4) Designation of lead agencies; (5) Resolution of technical issues such as terminology and metrology; (6) Determining and implementing a regulatory approach, including science, risk assessment, and stakeholder involvement; (7) Labeling and consumer information and protection; (8) Liability and intellectual property regimes; (9) Science and research support; (10) Commercialization and social and economic benefits; (11) Training, including worker safety; and (12) Addressing military uses and security concerns.

Workshop participants agreed with the inclusion of all these topics, but some suggested that they could be grouped under a smaller number of major headings. We will take that approach here, organizing the above numbered topics under three main headings: Institutional Developments for Nanotechnology Governance and Leadership; Knowledge and Information Needs; and Addressing Social, Commercial and Economic Concerns.

In general, most participants agreed with most of the actions CIELAP recommended. Indeed, a number of the specific actions have been or are being implemented. Rather than reviewing in detail all of these topics and all our previous recommendations, we will comment on recent actions or the lack thereof; contentious recommendations; and shorter- and longer-term priorities. In a final section, we include a suggested timeline for seven of our recommendations.

Institutional Developments for Nanotechnology Governance and Leadership

Topics (1), (2), (4), (6). **This broad area requires much very thoughtful action. It should be a high priority to initiate such actions immediately, but it is crucial to get these institutional changes right, as they will influence the oversight and development of nanotechnology for many years.**

(1) Goals. In a national, federal, or provincial nanotechnology strategy, any statement discussing its purpose should be explicitly linked to sustainable development and its values. It is not clear whether it is worthwhile to put great effort into developing an actual public strategy document (as opposed to the definite need to identify and implement all the actions and initiatives required for responsibly dealing with nanotechnology). Nevertheless, a commitment to those sustainable development values – human well-being and ecological health and protection, equally – should inform all nanotechnology initiatives. It was pointed out by one workshop participant that it has been said that nanotechnology could make vital contributions to every one of the Millenium Goals; that kind of thinking should be encouraged and also thoughtfully critiqued.

(2) Public engagement. As discussed in this document's Section 3, developing a public engagement strategy with new institutional arrangements and resources for public involvement is a high priority for action. Several federal departments will need to be involved.

(4) Lead agencies. Key agencies now are Health Canada and Environment Canada, as recommended in CIELAP's earlier document. Other agencies also have important roles. However, as Section 3 recommends, designating an institutional centre in government to take a leadership role in organizing and coordinating overall initiatives and multi-agency actions is a strategic priority. Such a centre should not be a champion in the sense of being the promoter of the technology, but it should be a champion of the need for effective, responsible action and the resources to make that happen. Its role should include making sure all priorities are attended to and gaps are addressed.

(6) Regulatory issues. Regulatory action is moving forward under CEPA, and that is appropriate. However, more work is needed now to prepare for regulatory approaches for the next generations of medical and nano-bio devices, likely under other regulatory or licensing regimes. Life cycle analysis of products, including medical devices and pharmaceuticals, should be part of those regulatory assessments, as well as CEPA's evaluation. Producer responsibility should be embedded in all regulatory approaches. As one participant commented, for many nano assemblages, it should be possible to build in a capability for safe self-destruction: "self-composting" nano devices!

Knowledge and Information Needs

Topics (3), (5), (9), (11). **This area is a high priority for immediate action, as many other actions depend on it. A strong sense of urgency is needed. However, much of this essential**

information and knowledge is basically cumulative, and depends on the amount of effort and resources put into it.

(3) An inventory. There is still no publicly available Canadian inventory of nanotechnology activities and commercial products; this should be a high priority.

(5) Resolution of technical questions. It is encouraging that technical issues are being addressed internationally, and that Canada is supporting this effort. Continuing such support and encouraging short deadlines for action and results must be an immediate priority.

(9) Science and research support. Although there is good international collaboration on scientific research on risks and hazards to the environment and human health, such research takes time. But it is one of the highest priorities for immediate action, and it is apparently further slowed because of a lack of interest in the research community in such studies. As a priority matter, there should be more resources and incentives to undertake such studies in Canada.

(11) Training. As an immediate priority, more effort is needed to address worker safety and public health in existing research laboratories, other facilities, and industries using nano materials. In the medium and longer term, there will need to be greater capacity to recruit and train scientists and technicians in this field.

Addressing Social, Commercial and Economic Concerns

Topics (2), (7), (8), (10), (12). **While none of the topics in this general area should be ignored or even put on the back burner, addressing them adequately is more about the quality of the problem-solving and the breadth of input into it than the speed of resolution. Openness, transparency and public involvement in developing initiatives are important.**

(2) Public education/engagement. This topic has been addressed earlier. However, the general subject of "social and ethical concerns" should **not** be relegated to academic research, especially not such research done through polls and surveys. For CIELAP it sounds self-serving, but in our view it is a fact that direct government engagement with various publics through work with civil society organizations, including adequately resourced public participation in workshops, advisory activities, and consultations provides far more valuable input about these and other topics. As well, the latter approach develops more knowledgeable opinion leaders in civil society. Economic implications and social equity issues related to nanotechnology in the developing world should be matters for discussion, consultation and research by institutions like the International Development Research Centre (IDRC) and others, perhaps in consultation with the proposed "nano champion/centre."

(7) Labeling. Required labeling of nanomaterials in consumer products was one of two contentious CIELAP recommendations. For Health Canada, labeling should contribute to personal ability to manage health. Since little is known about the health impacts of nanomaterials, no labeling is (yet) needed. CIELAP, however, takes a different view. In the face of unknown risks to health and also the environment, CIELAP believes consumers should have the right to make up their own minds about whether those unknown risks are acceptable. CIELAP thus

continues to urge that, until safety can be demonstrated, there should be a ban on products where deliberately manufactured nanomaterials are actually ingested (food and neutriceuticals) or come in contact with food or beverages (packaging). In other products where manufactured nanomaterials will come in contact with skin, specifically cosmetics, personal care products, and household cleaning agents, labeling of nanomaterials should be required. CIELAP recommends that this topic of labeling should be more widely discussed and considered and that broader input should be sought.

(8) Legal aspects, including legislated liability and intellectual property. CIELAP recommended that strict producer liability legislation for nanomaterials should be considered, and that any intellectual property regime should, as much as possible, encourage open access to scientific information. Like labeling, liability legislation also proved to be a topic that raised many questions. Both liability and intellectual property questions should also be matters for further study and public discussion and involvement.

(10) Commercialization and social and economic benefits. CIELAP recommended that targeting particular nanotechnology applications for development because of their social or economic benefits in Canada should be reviewed. In fact, there have been such discussions under the auspices of the now-dissolved Office of the Science Advisor. Apparently in those discussions it was generally felt that most research efforts should go to areas where Canadian capacity was traditionally strong, such as health research. While further discussions could take place by such agencies as Industry Canada, the granting councils, or the as-yet undesignated "nano champion/centre," this is not a high priority matter.

(12) Military applications and potential security risks. These are also matters for research and public discussion and consultation through suitable forums. They are emerging topics for careful consideration, not immediate action.

Timeline Benchmarks

For some of CIELAP's recommendations, especially those related to resolving technical and scientific questions, proposing a timeline for results is not something that can be done intelligently by an outside organization. However, for other CIELAP recommendations that are about initiating various government actions, CIELAP suggests the following seven timeline benchmarks, using the topic numbers of the previously discussed recommendations:

May '09: **Nano coordination/ "champion."** Recommendation (4) on lead agencies; also a Strategic Recommendation: 8 - 12 months to designate and implement;

May '09: **Public engagement strategy.** Recommendation (2) on public engagement; also a Strategic Recommendation: 12 months to complete;

May '09: **Inventory.** Recommendation (3) on creating a Canadian inventory: 12 months to complete and publish on a public nanoportal;

May '09: **Environment Canada scientific research strategy**. Recommendation (9) on science and research support and noted as an intention under Section 2,

Scientific and Technical Developments; also a Strategic Recommendation: 12 months to develop;

Aug '09: **Worker safety and public health guidelines for research and industry.** Recommendation (11) on training: 12 - 15 months to develop and promulgate, with regular review and updating when necessary;

Nov '09: **Ban on nanomaterials in food and packaging in direct contact with food.** Recommendation (7) on labeling: 18 months to explore and then create an interim means to ban these applications while further research on safety is being carried out and evaluated;

May '10: **Labeling of nanomaterials in cosmetics, personal care products, and cleaning agents.** Recommendation (7) on labeling: 18 - 24 months to investigate and make the announcement of a mandatory requirement to label nanomaterials in these products.

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[1] "Principles for the Oversight of Nanotechnologies and Nanomaterials," first published on July 31, 2007 by the International Center for Technology Advancement. Document can be downloaded from: http://www.icta.org/pubs/publications.cfm?page_id=15&section_title=Nanotechnology.

[2] Symposium 3: Nanotoxicology and Potential Health Effects, Northern Lights Scientific Conference, University of Waterloo, June 20 - 22, 2007.

[3] This description is condensed from the keynote address, "The Effects of Environmental Pollution on Human Health," by Dr. Ted Boadway, Chair, Ontario's Executive Committee on Trans-Boundary Air Pollution and former Executive Director of Health Policy, Ontario Medical Association, given at the EnviroPharm 2007 Conference (April 30, 2007, Novotel, Toronto).