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Chair

Mrs. Joy Smith

Standing Committee on Health

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● (0735)

[*English*]

The Vice-Chair (Ms. Joyce Murray (Vancouver Quadra, Lib.)): Good morning, everyone. I'm convening meeting 23 of the Standing Committee on Health.

Welcome to the guests who are here to help us understand nanotechnology. Thank you for taking your time to be here with us.

Mr. Roco, thank you for being with us from Washington.

Dr. Mihail Roco (Senior Advisor for Nanotechnology, National Nanotechnology Initiative, National Science Foundation, As an Individual): Good morning. I'm glad to be here.

The Vice-Chair (Ms. Joyce Murray): Good morning.

This is a round table format, not the regular committee format. That means we will start with five-minute introductory statements from each of the visitors. After that, committee members will engage you in a dialogue and ask questions based on your statements, and we'll have a discussion.

We will begin with Claude Ostiguy, director of the research and expertise support department of the Institut de recherche Robert-Sauvé en santé et en sécurité du travail.

Mr. Ostiguy.

[*Translation*]

Mr. Claude Ostiguy (Director, Research and Expertise Support Department, Institut de recherche Robert-Sauvé en santé et en sécurité du travail): Thank you, Madam.

[*English*]

Good morning, everyone.

[*Translation*]

The Institut de recherche Robert-Sauvé en santé et en sécurité du travail, or IRSST, was created 30 years ago and contributes, through research, to the prevention of industrial accidents and occupational diseases as well as to the rehabilitation of affected workers.

The IRSST has been interested in the nanotechnology field for more than five years. Nanotechnologies—

[*English*]

The Vice-Chair (Ms. Joyce Murray): Excuse me, Mr. Ostiguy. I neglected to mention that we have translation for our guests.

Thank you. Please continue.

Mr. Claude Ostiguy: As time is very limited, I will just read the papers you probably already have. They are available in English and in French.

The Vice-Chair (Ms. Joyce Murray): We're aiming for five minutes for the statement.

Mr. Claude Ostiguy: I'll probably read relatively quickly, because I must have enough for six or seven minutes.

[*Translation*]

Nanotechnologies are an emerging field with a potential for enormous economic and social development. The reason is very simple: the unique properties of nanoparticles (NP) should allow products with innovative characteristics to be developed, resulting in a multitude of applications in all fields of human activity.

Already, more than 1,000 products containing NPs are commercially available. They are offered by close to 500 companies located in 24 countries. The development and production of these new products should involve an increasing number of Canadian workers. The people potentially exposed to the highest concentration of nanoparticles can be found in the following three groups: researchers who develop new products; employees in companies that synthesize nanoparticles; and employees in companies that purchase nanoparticles for the purpose of introducing them into their production lines in order to create value-added products.

The IRSST's research work has allowed it to assess the state of current international scientific knowledge in the field of health risks related to nanoparticles in the workplace.

First, the concept of risk, i.e., toxic risk, has to be well understood. Toxic risk is the product of two components. The first component, toxicity, is a function of the nature of the product and the characteristics of the substance. The second component is related to the worker's level of absorption of this substance, which is directly linked to the level of air contamination and the worker's exposure time. Consequently, the toxic risk, or health risk, is the product of the toxicity (hazard) and the level of exposure. That can be summed up in a simple equation that clearly shows that, even in the presence of a potentially toxic product, the risk will be minimal if there is no worker exposure.

What do we know about the toxicity of nanoparticles? It is important to mention first that toxicological studies aiming to establish whether nanoparticles demonstrate some toxicity cover only a small proportion of existing nanoparticles. Second, for those that are documented, knowledge is generally insufficient to be able to accurately quantify the hazard. NPs that are insoluble or not very soluble in biological fluids are of the most concern because they can remain in the body for a long time, whereas the toxicity of soluble nanoparticles will mainly be a function of their chemical composition, not their size.

Nevertheless, currently available data show a behaviour that is often unique to NPs. At equal mass, several nanoparticles demonstrate a higher toxicity than the same chemical product of larger size. The measured toxic effects are poorly correlated with the mass. They are better correlated with different parameters, namely the number of particles, size, surface area and some surface properties. Several factors seem to contribute to the toxicity of these new-generation products. Given our fragmentary knowledge, it is currently impossible to weight their respective importance or to accurately predict the toxicity of a new NP.

The behaviour of nanoparticles in the body can be different from that of larger-size particles. In the pulmonary alveoli, our defence mechanisms are less efficient in eliminating nanoparticles than larger size particles. Some NPs can overcome our different defence mechanisms in the lungs, gastro intestinal tract or skin, enter the blood in solid form and from there travel through the body and accumulate at specific sites (liver, kidneys, etc.). Others can travel along the olfactory nerves and enter the brain directly, or even cross cell barriers and reach the cell nucleus.

In animals, a number of studies have demonstrated toxic effects in several organs, including the heart, lungs, kidneys and reproductive system. For example, some particles cause granuloma, fibrosis and tumour reactions in the lungs. Very little is known about the long-term effects of nanoparticles. In most cases, it will be difficult to quantify the specific toxicity of the nanoparticle to which workers are exposed.

The second risk component is related to the worker's exposure, namely to the contamination of the air that he or she breathes. There are numerous instruments for determining certain workplace exposure parameters, such as mass, dimension, number of particles and specific surface. However, few data exist on workplace exposure levels, and research in this field is just beginning to produce its first results.

Nevertheless, two important observations are emerging: the total lack of information on the level of exposure in the great majority of workplaces; and the lack of consensus within the scientific community about the parameters to measure that are representative and that link the exposure level to the product's toxicity.

● (0740)

[*English*]

The Vice-Chair (Ms. Joyce Murray): Excuse me, Mr. Ostiguy. Could you do a concluding statement and then the additional information can come out in the discussion?

Thank you.

Mr. Claude Ostiguy: Okay, I will conclude.

[*Translation*]

I will wrap up quickly.

Uncertainty must be managed and that is what we must do with nanoparticles. Therefore I would refer you to page 4 of my opening remarks where I make four recommendations to the committee: to promote and support the responsible and safe development of nanotechnologies; to facilitate the funding of certain research infrastructures so that those involved in research can implement effective preventive approaches; require adequate labelling so that any product or mixture of products containing nanoparticles is clearly identified so that workers know that they may be exposed to those products, and last, to promote the production and dissemination of best-practices guides for the workplace.

Thank you, Madam Chair.

[*English*]

The Vice-Chair (Ms. Joyce Murray): Thank you very much.

We'd like to hear from Mr. Nils Petersen next.

Dr. Nils Petersen (Director General, National Research Council Canada, National Institute for Nanotechnology): Good morning.

My name is Nils Petersen. I did not prepare a formal brief for you, but I would like to just give you a brief background on myself and then also make three points.

I'm a physical chemist. I run an institute in Edmonton called the National Institute for Nanotechnology, where we currently have about 350 people working on various aspects of nanotechnology, all the way from applications in energy to applications in health and ICT, information communications technology, and biomaterials.

The three points I'd like to make are the following. First, nanotechnology is inevitable. It is something we cannot get away from, I think, and I'll speak a little bit more to it in a moment. The second point is that it will be everywhere. It's going to be pervasive. The third point I'd like to make is that while scale is an extraordinarily important component of nanotechnology, it is not the only component. I think we need to understand that when we deal with the risk aspect of it.

Why is it inevitable? It's inevitable because it is a new way of thinking from a scientific perspective. It is a new way of looking at creating new materials, designing new constructs, and thinking about the convergence of chemistry, physics, and biology in medicine and in all of the different disciplines we can think about. We are now working with a different mindset of designing building materials from a molecular scale up to structures that we design so that they have a particular functionality. It is a different way of thinking, and I think it is therefore also becoming very exciting for many people. I think it will be inevitable that we will be using that kind of thinking as we go forward.

It's going to be everywhere, because it is a platform; it is not an industry in its own right, it is a technology that can be applied in a number of different areas. We see it already in applications in energy fields, where we have catalysts that provide better utilization of oil. We have structures of surfaces of pipes that are making them more corrosion- and wear-resistant. We have in the environmental areas sensors that are detecting small amounts of other kinds of pollutants. We are seeing it in the health area as drug delivery mechanisms. We are seeing it as diagnostic tools. So we're seeing it in all kinds of different areas. We can therefore expect having a very complex environment in which to think about this kind of technology.

The third point is that it is not just about scale. It is clear that we think about nanotechnology as something in the order of 100 nanometers or less. That has a particular significance for some of us as scientists because it is bigger than the molecular scale and smaller than many of the things we normally have been working with. What's particularly important about this is that at that scale we start seeing new properties. It is not just because of the size. There is no magic number that will say the properties will appear at 100 nanometers, or 50 nanometers, or whatever. It is basically a scale at which we can think about materials having different kinds of properties. I'll give you an example. If you take a metal like gold and you melt it, it will melt at a particular temperature. When it gets very small, all of a sudden it will melt at a much lower temperature, and that's because the surface volume ratio changes quite significantly. We'll continue to see surprising and different kinds of properties.

All of this comes to the conclusion that when we think about risk management, we do not think about it as something we manage by saying “anything less than 100 nanometers we need to worry about”. We need to worry about each of the different applications and each of the different products in a different way. It doesn't make it easier. It makes it a lot more complex. But I think it's important that we think about this area from a product perspective rather than from a scale perspective. Unfortunately, there have been jurisdictions around the world where people have been thinking about trying to do regulation or whatever based simply on scale. I think that's the wrong path.

I'll leave it at that.

● (0745)

The Vice-Chair (Ms. Joyce Murray): Thank you for your opening remarks.

Dr. Claude Emond, a toxicologist from the Department of Environmental and Occupational Health at Université de Montréal.

Dr. Claude Emond (Toxicologist, Department of Environmental and Occupational Health, Université de Montréal): Thank you, Ms. Murray.

Today, as a Canadian researcher, I'm going to talk about my own perception of this issue, but first I want to introduce myself. I have an affiliation with the University of Montreal as a clinical adjunct professor and also as an associate professor at UQAM. I'm part of the Science Advisory Board for the U.S. EPA for the Exposure and Human Health Committee. I also coordinate the risk assessment and acceptability access, a new provincial network called NE3LS, which is the acronym for Nanotechnology Ethical, Environmental, Economic, Legal and Social Issues. I also started as a team leader in the International Team in Nanosafety a couple of years ago. This is a group from five different countries, France, Japan, U.S.A., Germany, and Canada. Recently, we added another platform called Nanotechnology Environmental Society and Health, which is led by Professor Louise Vandelac from UQAM.

During the last few years I have participated in several workshops and meetings in the U.S., Canada, Germany, and Japan, and these are my observations from this participation, discriminating between the pros and the cons of nanotechnology.

● (0750)

The Vice-Chair (Ms. Joyce Murray): Excuse me. The translators are asking you to slow down just a little bit.

Dr. Claude Emond: I have only five minutes, so I was trying to get it all in there. Okay.

The Vice-Chair (Ms. Joyce Murray): You want your words understood, though.

Dr. Claude Emond: Okay.

The pros for nanotechnology are that the nano-particles generate products with unique, useful, and sometimes surprising properties. What is frequently observed is the chemistry at the nano-size is not the same as at a larger size, as Dr. Ostiguy said before. Also, the government and the private sector have spent a lot of money to develop this technology, which might be good for the economy. The concern with the development of nanotechnology is the way it works now. This will probably come with a lot of problems, I guess.

So the money also exclusively supports the development of nanotechnology in commercialization, but there is not enough on the health effects of the presence of nano-particles. We have no idea about the potential leachability and migration of nano-material from consumer products.

Many pieces of the puzzle are missing. Some nano-products are used directly in human consumer products—for example, personal care—and also in food, but we know almost nothing about that. We don't know what is the best metric to characterize the toxicity. Should we use weight? Should we use the surfaces? There is some deficiency in metrology, characterization, and toxicology that I will also point out during these discussions.

I will not cover all that the literature says about nanotechnology, but the absorption occurs principally by inhalation but can also occur by cutaneous and oral exposure. The nano-particles are distributed on the entire organism. After that, if it's not trapped by a specialized cell, a nano-particle can cross the blood-brain barrier, which is important to note here. They decrease the cell viability: DNA damage, oxidative stress, blood thrombosis, inflammation, and all these effects.

So what do we need? We need a national strategy in regard to nanotechnology development, maybe a CNI, Canadian nanotechnology initiative. We don't need to repeat what NNI has done so far, and they actually have done very well. The NNI is the National Nanotechnology Initiative in the U.S. So we may just need to start where they are, or closely collaborate in a complementary way with them.

On monetary resource equilibrium between the development of nanotechnology and the evaluation of toxicity, the federal government already works at the international level with the OECD. I think this is a good idea, but other initiatives should also be encouraged.

I say yes to the precautionary principle, but improving the knowledge and doing a real assessment of the risk is better in the long run.

The Vice-Chair (Ms. Joyce Murray): Please can you speak a bit more slowly? The translators are not working from your notes, so that makes it a little more—

Dr. Claude Emond: Okay. I'm worse in French.

The different meetings I attend point out the necessity to integrate the social communication transparency education aspect in nanotechnology development, so many structures already exist around the words. As I said before with OECD, NNI, we also have ISO 229. Now we have a network called NE3LS in Quebec, and we also have this international team we created a few years ago, which I spoke about.

A Canadian strategy initiative in nanotechnology can be inspired by a group above. In closing the discussion, I want to say there is an urgent need to coordinate the national development of nanotechnology and more particularly in parallel with the nanosafety issue, including research, characterization exposure, toxicology, and assessment. I would like to conclude by saying that Canada has to assume leadership in nanosafety and contribute to this international community rather than wait and see.

Thank you very much.

● (0755)

The Vice-Chair (Ms. Joyce Murray): Thank you very much.

Our next guest is Françoise Maniet, lecturer and research agent at the Centre de recherche de l'Université du Québec à Montréal. Welcome.

[*Translation*]

Ms. Françoise Maniet (Lecturer and Research Agent, Centre de recherche interdisciplinaire sur la biologie, la santé, la société et l'environnement (CINBIOSE) et Groupe de recherche en droit international et comparé de la consommation (GREDICC), Université du Québec à Montréal): Good morning and thank you for your invitation. I hope that I will manage to speak slowly because one does have to move quickly when one only has five minutes.

I'll start by introducing myself. Currently I am working under the direction of Louise Vandelac, at UQAM, in a team that is conducting research under a much broader, international project on nanotechnologies. I am collaborating on this with Claude Emond and Simon Beaudoin.

For 15 years I was a consultant for the European Commission examining issues of consumer and environmental health. I collaborated on, among other things, the development of guidelines for consumer product safety. I am currently a research assistant at UQAM, for both the Department of Legal Sciences and for CINBIOSE with Louise Vandelac.

I am finishing a master's in environmental sciences at UQAM and within my master's program I undertook a comparative analysis between the legal framework for nanotechnologies in the European Union and that of Canada. Today I'm going to share some thoughts, ideas and issues that struck me when I was conducting that comparative analysis.

It appears that in the area of nanotechnology the European Union is quite different from Canada and much further ahead. The European Union seems to have a legal framework that focuses more on the protection of the environment and health.

However, if one goes beyond political pronouncements and good intentions and one looks at measures currently actually being applied, the European Union and Canada seem to overlap in many respects.

My opening remarks will be divided into two parts. I'm first going to try to show you where the European Union and Canada differ in how they regulate nanotechnologies. Then I will talk about where they overlap.

Where they first differ is in their definition of an overall consistent policy that applies to nanotechnology. Second, the societal debates on nanotechnologies are at different stages. Third, there is a difference in how ethical principles are respected or affirmed. The fourth point of difference, and the one I will spend a little more time on, relates to the general mechanisms that are used to prevent harm caused to health and the environment by chemical substances and consumer products.

When one analyzes European legislation that applies to chemical substances, consumer products and cosmetics, one sees several major differences between Canada and the European Union. Generally speaking, I would say that the requirements that are imposed on economic operators, producers, distributors, and importers, are clearly more restrictive in the European Union than they are in Canada.

I'll give you a few examples that I looked into in somewhat more depth: regulations on chemical substances along with, in the European Union, the adoption of a system in 2007, the REACH system, that I'm sure you have heard about and that imposes much more restrictive requirements for marketing chemical substances.

Furthermore, in December 2009 a regulation was implemented for cosmetics in the European Union which strengthens those requirements for economic stakeholders, and that—and this is what is new—contains a clause specifically for nanotechnologies. Four points are included in this regulation: a common definition of nanomaterials, the requirement for labelling so that consumers can easily identify nano-ingredients, a requirement for a European catalogue of cosmetics that contain nanoparticles and the requirement for a risk assessment prior to marketing products that contain nanomaterials and have specific uses. I think that this is rather innovative.

The third type of legislation that strikes me as being more protective, is the legislation on the general safety of consumer products, that has been in effect in the European Union since 1992 and that not only includes general safety requirements for all producers, importers and distributors of consumer products but also includes another series of major requirements such as the follow-up of a product once it has been marketed, the obligation to inform the administration of any risks that that product may present and the obligation to withdraw or recall dangerous products.

● (0800)

Furthermore, government officials also have a range of powers allowing them to deal with potentially hazardous products. In Canada—

[*English*]

The Vice-Chair (Ms. Joyce Murray): *Excusez-moi*, Madame. Could you make your concluding remarks, please? Then your other comments can come out in the discussion.

[*Translation*]

Ms. Françoise Maniet: In Canada, we know that Bill C-6 was unfortunately withdrawn. We hope that the bill will soon be revived so that Canada may have a legislative framework comparable to that of the European Union.

I now come to the issue of convergence. I would simply like to point out the areas of convergence between the European Union and Canada. If we consider only those measures that have been implemented today, i.e., concrete measures, we find that there is not much of a difference between the European Union and Canada in the area of nanotechnologies, since there are no general regulations, with the exception—as I have already indicated—of the cosmetics and food additive industries—but there is not enough time for me to address that.

There is no common definition or classification of nanomaterials. Neither is there any pre-market control mechanism. Risk assessment methods are somewhat inadequate. There is no mandatory labelling and no transparency in terms of nanotechnology uses and applications. All of those issues are unanimously recognized as priorities on which we have to start working. All experts agree on that.

Thank you.

[*English*]

The Vice-Chair (Ms. Joyce Murray): Thank you very much.

Our last guest is with us by video conference. He is Mr. Mihail Roco, senior advisor for nanotechnology at the National Nanotechnology Initiative, National Science Foundation.

Thank you, Mr. Roco.

Dr. Mihail Roco: Good morning. Thank you for the opportunity to testify—

Ms. Joyce Murray: Excuse me, Mr. Roco. We have to stop for a moment. There is a technical problem hearing you and translating your remarks. We'll hold until we've sorted that out.

As a default, is everyone able to follow the English without translation, if necessary?

● (0805)

Ms. Megan Leslie (Halifax, NDP): We could ignore the French and just bring the interpreter to the table.

The Vice-Chair (Ms. Joyce Murray): The translators will be using your text and translating from the text because they can't catch your words orally.

Please commence. I appreciate your patience.

Dr. Mihail Roco: All right.

First of all, I would like to present an overview of different themes in the United States, and thereafter make some recommendations, some ideas for the future.

The 2011 presidential budget request provides around $1.8 billion for the National Nanotechnology Initiative. This support to 25 federal agencies is based on nanotechnology's potential to significantly improve our understanding and control of matter at the nano-scale, leading to a revolution in technology and industry for the benefit of society.

While NNI remains focused on basic research, infrastructure development, and technology transfer, the proposed investment for 2011 places an increased emphasis on innovations in support of national priorities. The NNI is also increasing its investments in nano-EHS by requesting $117 million, or 6.6% of the total budget.

More aptly, investment in this field for nano-EHS, since 2005, now totals more than $480 million. The three agencies making the most investment in this area are the National Science Foundation, the National Institutes of Health, and the Environmental Protection Agency.

NSF's portfolio is shaped by a long-term perspective in nanotechnology R and D. The investment in environmental and societal aspects of nanotechnology began in 2001. In fact, I have with me a so-called strategic view for ten years ahead that is still in application. It was prepared in 2001, and we are now preparing a new document for 2011 to 2020.

NSF has an overall budget request for nanotechnology of $400 million. For nano-EHS, it is $33 million, or about 8% of the total budget. It includes development of predictive methods for toxicity, for exposure. We have three dedicated centres at Rice University, Duke University, and the University of California, Los Angeles. We have two academic user facilities and about 60 smaller groups working in this field.

The National Institutes of Health has a budget of about $382 million, relatively close to NSF, in 2011. It sponsors three networks: one on excellence in nano-medicine, one on cancer research, and one on heart, lung, and blood.

The EPA has a budget request of about $20 million for nano-environmental, health, and safety research and regulatory activities.

What is new in 2011 is that both the Food and Drug Administration and the Consumer Product Safety Commission have been added to the NNI budget: for the Food and Drug Administration, $15 million for testing new materials or new products in nano; and for the Consumer Product Safety Commission, $2.2 million.

Collaborative activities play an increasingly important role among NNI agencies. Also, there is a lot of interaction at the international level, including with the Organisation for Economic Co-operation and Development's working party on manufactured nano-materials and the International Organization for Standardization.

The NNI activities are evaluated each year by Congress and the Office of Management and Budget, and every three years by the President's Council of Advisors on Science and Technology and the National Research Council of the National Academies.

● (0810)

There are several needs with higher priorities for the next year: to continue to combine nano-EHS implications research with environmental and biomedical applications research. That means do not separate nano-EHS research from core research.

The Vice-Chair (Ms. Joyce Murray): Excuse me, Mr. Roco. If you can come to your concluding remarks, the other points can come out in the discussion.

Thank you.

Dr. Mihail Roco: I would like to say, in conclusion, that it's important to have an anticipatory, participatory, and adaptive governance approach to nanotechnology in order to capture the new developments and also to prepare people, tools, and organizations for the future.

Thank you.

The Vice-Chair (Ms. Joyce Murray): Thank you very much. Sorry about the confusion at the beginning.

Dr. Mihail Roco: No problem.

The Vice-Chair (Ms. Joyce Murray): By about halfway through, the translation was working as hoped for, so that means your comments during the course of the discussion will be able to be translated.

Dr. Mihail Roco: Also, I would like to mention that I sent a written statement with several diagrams, showing the trends in funding nano environmental health and safety and overall nano investments in the U.S. This will be translated in the next two or three days, as I understand.

The Vice-Chair (Ms. Joyce Murray): Thank you.

We will now have comments from the committee members, starting with Ms. McLeod.

Mrs. Cathy McLeod (Kamloops—Thompson—Cariboo, CPC): Thank you, Madam Chair.

I actually have two questions or comments, so I'll put them both on the table, and leave them open.

First, because I am someone who is somewhat new to the understanding of this issue, could we take an example of either a cosmetic or a food or something that's commonplace and follow it through from development into the product so I could understand the pathway of a nanoparticle in a cosmetic product or food?

Second, we have a local issue that has caused a great deal of angst in our community. They were looking at having a gasification process for creosote railway ties. Locally, the provincial Minister of the Environment approved it because of the emissions. A lot of the backlash from the community was related to the fact that while the emissions might be small to gasify creosote, we really don't know what the nanoparticles would be, and what the issues would be with the nanoparticles.

I guess I'd like to hear perspectives on both those trains of thought.

The Vice-Chair (Ms. Joyce Murray): Who among the visitors would like to take a shot at those questions?

Mr. Ostiguy.

● (0815)

Mr. Claude Ostiguy: I can try to answer at least part of the first question.

If you take, for example, titanium dioxide, which is used in sunscreens, when you use particles that are not in the nanometric size but that are larger, you have a cream that is white. When you decrease the size of the particle to the nanometric size, that cream can become completely colourless, so from the point of view of marketing, it is extremely interesting. Then, when you look at the efficiency of intercepting UV rays, the efficiency will increase with nanoparticles as compared to with micrometric particles. So you have an increase in the efficiency and also a benefit from the point of view of marketing.

This is applied on the skin. However, you can look at, for example, toxicity in the lungs. Regarding the toxicity of titanium dioxide, when you expose rats or animals to titanium dioxide through the lungs, it is normally considered to be a rather inert particle. When you decrease the size of the titanium dioxide to nanometric size, the toxicity increases enormously.

In the U.S. about three or four years ago, NIOSH—the National Institute for Occupational Safety and Health—made recommendations that the standard for workers' exposure to titanium dioxide in the workplace be lowered from 1.5 milligrams per cubic metre down to 0.1 milligrams per cubic metre. This suggests that the toxicity of titanium dioxide would increase by a factor of 15, just due to the size of the particle. If you exposed a worker to the same mass through the lungs, you would substantially increase the toxicity.

What we find in the literature is that almost all of the particles that are in the nanometric size will be more toxic than will be the same mass of particle in micrometric size. So we have to take care of potential risks related to the size of these particles.

The Vice-Chair (Ms. Joyce Murray): Dr. Petersen, did you want to add to that?

Dr. Nils Petersen: Yes. I think you asked me about the pathway as well. What I wanted to add is that you can make nanoparticles in fundamentally two different ways. You can either grind things down, making them smaller and smaller as you go along, or you can make them by assembling things into particles of a certain size. The two things are different in the way you would actually make them and also the circumstances under which you would do them.

A specific example is Xerox, which makes toners for printers. Many years ago they started making a toner by simply taking the colourant and grinding it down, making smaller and smaller particles and going down into the micrometre scale. They then subsequently found that they could actually assemble that same kind of particle with much better precision by taking components and putting them together in a particular process. All of that is done in a manufacturing environment in which they of course try to make sure that there is minimal exposure to the people who do that. Once they've made it, they can then put it into the printer cassette, and that will go through and be used in a particular environment.

In the case of cosmetics, they take that nanoparticle and put it into the cream formulation at a factory site. Then it normally comes out to the consumer encapsulated or protected in one way or another.

In general, in those kinds of manufacturing environments the risks are at the start of the process, when you are making the particles and incorporating them into a material, and possibly at the end of the product's life, when you're disposing of it. It might then be released in ways that you might not have anticipated—for example, through the wearing down or opening of the cassette of toner or whatever.

I think those are the two areas. Most consumers would see a product in which nanoparticles are encapsulated or incorporated—maybe inside a cellphone, or something like that—and often not be exposed in that way.

I hope that addresses part of your question.

The Vice-Chair (Ms. Joyce Murray): Mr. Emond, you wanted to add to that.

Dr. Claude Emond: Yes, please.

I want to talk about your second question about commercialization. Commercialization is a little tricky in Canada compared to the United States, because in Canada you have the New Substances Assessment and Control Bureau, which is there to accept or refuse this new product. For example, if I come with a new product and I say it's not dangerous at all, the new substances office has to prove this is dangerous. If they don't have any proof, they have no choice but to accept it. What we have here—and we said this a couple of times—is we don't have all the pieces of the puzzle to correctly characterize nanotechnology and nanoparticles.

In the U.S., the EPA has to look at this commercial product. If they don't have enough information, they will return the folder to the company and say they need more experimental data to be able to assess this new commercial product. We don't have this procedure here. It's regulated by law, so I think something needs to be done to be sure we will protect Canadians.

● (0820)

The Vice-Chair (Ms. Joyce Murray): Thank you.

Go ahead, Mr. Malo.

[*Translation*]

Mr. Luc Malo (Verchères—Les Patriotes, BQ): Thank you, Madam Chair.

Do we know how micro-materials affect health and the environment? There is a lack of information on the effects of transforming micro-materials into nanomaterials. That is a first, relatively general question.

Ms. Maniet, you spoke to us about European regulations, which are much more stringent. I would like to know if that is only in terms of labelling or if that is also the case with the identification of hazardous products. You have the good fortune to be sitting directly beside the parliamentary secretary to the minister. He will be able to tell you whether the former Bill C-6 was re-introduced yesterday and provide you with much more specific information.

My final question is for Mr. Roco.

Given the amounts invested in the United States for research into determining the impact of nanotechnologies, I would like to know whether that research yielded interesting results.

[*English*]

The Vice-Chair (Ms. Joyce Murray): Mr. Malo, to whom was your first question directed, or was it general?

Does anybody want to take this?

Okay, Madam Maniet; go ahead.

[*Translation*]

Ms. Françoise Maniet: As for the impact of nanoparticles on health and the environment, given the number of studies that have been done, there is a scientific consensus that has existed for quite some yearsnow—perhaps Mr. Emond could confirm this—on the toxicity of certain nanoparticles, both for health and the environment. We know that this is certain. For most nanoparticles, there is, it is true, a great deal of uncertainty. I would like to remind you that we are talking about nanoparticles and nanotechnology, however, essentially, there are five that are the most often used in consumer products. These are nanoparticles of gold, silver, carbon, zinc and selecium. So, as Mr. Petersen said, we can zero in on the problem to some extent, although everything depends on the way that they are used. Already we can start investigating toxicity based on the use of these five nanoparticles in consumer products. Nevertheless, we are no longer simply asking questions; now there are some certainties. We have a lot of questions and many uncertainties, but as far as toxicity is concerned, we do already have some certainties.

The European legislation is also stricter, for example, in the area of chemicals, because the manufacturers and importers there have primary responsibility. As Mr. Emond, said, in Canada, it is primarily up to the government to prove that substances available on the market are toxic. In Europe, they are starting to make the producers and importers prove the safety of their products, whether they be chemicals that are normal in size or at the nanoparticle level.

There is another major difference: In Europe, there no longer is a distinction between novel substances and existing substances, meaning that all substances are subjected to the same obligations, or as in Canada, the obligations are much more restrictive for producers of novel substances. In my opinion, this is also hampering technological innovation, since those producers who wish to innovate and invent novel substances that are less polluting or toxic must comply with stricter requirements than those who have been marketing substances that have been around for 20 or 30 years.

These are but a few examples. There are, obviously, others. What I wanted to say, to qualify my comments, is that even if these laws are enforced in Europe and in Canada, the production thresholds that are required to provide information to the government are too high to pertain to nanoparticles. Consequently, in both Europe and Canada, producers are told that if they produce so many tonnes per year of a certain substance, they have to provide information regarding toxicity. In many cases, these ten-tonne or one-tonne thresholds per year are too high to be able to apply to nanoparticles given their small sizes. Consequently, this is not a good approach.

As Mr. Ostiguy said, we must stop thinking in terms of volumes but rather, for instance, in terms of surface. That was what I was trying to say earlier. In actual practice, even in Europe, most nanoparticles slipped through the REACH regulatory safety net, because they are not produced in a volume that exceeds the established threshold. So that is the situation and I hope that this is clear.

● (0825)

[*English*]

The Vice-Chair (Ms. Joyce Murray): Thank you.

Dr. Roco, you also had something to add.

Dr. Mihail Roco: May I respond to the question that I was asked?

The Vice-Chair (Ms. Joyce Murray): Absolutely.

Dr. Mihail Roco: The question was, considering the amount of money invested in nanotechnology, whether there are any results.

First of all, there is investment in nanotechnology not only in the U.S. In fact, government funding in both Europe and Asia is larger than it is in the U.S.

Second, the first activities in nano-EHS started in the U.S. at the National Science Foundation in 2000, when we had program solicitation and a centre created in this area. Initially there was the problem to develop that basic science, and now we have reached the following conclusions. First of all, we have five years of results from a national toxicology program. In 2003 we tested nanoparticles, nanotubes, and quantum dots and we found that the results are so different as a function of particle size that only a predictive approach could address the problem.

Second, you need an integrated approach for different sectors, different materials, and different industries. One cannot solve the problem by testing one by one. This means that one has to develop a system, a theoretical framework, and thereafter have several tests, and the ability to interpolate and extrapolate from that.

At this moment in the U.S., we are also planning to create three centres that are dedicated to modelling and simulation, and that will track predictive approaches for toxicity. The first is at UCLA. The second is at Rice University, and the third is at Duke University. Also, we plan to expand the user facilities where the general knowledge is shared. And we have two user facilities supported by NSF and one by NIH so far.

That means that for the long term, I think more international collaboration is needed because of the large amount of work involved in testing. At the same time, you cannot jump the science. Even if one puts in ten times more money, the advancement will not be ten times faster, because you need to develop that basic knowledge, for instance, about particles and cell interaction, different tools, and different modelling techniques. So I think it is a continuing process.

Thank you.

The Vice-Chair (Ms. Joyce Murray): I have four people who would like to ask questions, and we have about 15 minutes left in our meeting. So I'm going to ask each of the questioners to keep it down to one question. Thank you.

Mr. Dufour.

[*Translation*]

Mr. Nicolas Dufour (Repentigny, BQ): Thank you very much, Madam Chair.

I would like to begin by saying that this is an extremely interesting debate. I am part of a generation which, to some extent, made its appearance at the same time as nanotechnology. This issue is going to become increasingly important. My comments are along the same lines as those made by Mr. Malo, but I will focus more on the economic side of things.

Do we have any idea of the amount of money invested by companies in nanotechnology? Do we know the size and growth of the investment?

Mrs. Maniet, we have, for the past little while, been discussing Canada compared with Europe, but I would be interested in knowing the differences that exist between the U.S. and Canadian regulations.

● (0830)

[*English*]

The Vice-Chair (Ms. Joyce Murray): Dr. Petersen has an interest in responding.

Dr. Nils Petersen: I'll just very briefly respond to the investment side. Today I think it's true that more than half of all investments globally in this technology are by the private sector, so it's clearly a very large amount of money.

The expectation is that there are going to be large profits coming out of this. The current forecast is that it's going to be a multi-trillion-dollar market in the next five or ten years. Mr. Roco might have more specific numbers, but I believe the 2007 profits made out of this were in the multi-hundreds of millions of dollars. People are starting to make money on these things now, so it is an economic driver.

In Alberta alone the aim is to have a $20 billion nano-enabled industry by 2020, so it is a significant economic driver.

The Vice-Chair (Ms. Joyce Murray): Dr. Roco, go ahead, please.

Dr. Mihail Roco: I would just add that industry has exceeded federal public investment in nano research and development in 2006. And now in North America and Japan, industry is spending more than the federal government is. Only in Europe, mainly because they supported industry and as a counter-effect, as a negative effect, industry is funding only about half of public money.

The Vice-Chair (Ms. Joyce Murray): Madame Maniet, you had a comment.

[*Translation*]

Ms. Françoise Maniet: Yes, but I might disappoint you. Indeed, as far as the American system is concerned, I cannot tell you very much, because my comparative analysis really focused on the European Union and Canada. However, I am going to be working on the third aspect, no doubt starting in September, which will focus on the situation in the United States. The little that I do know leads me to believe that the legal system is more advanced than the one in Canada. That is clear. From what I have heard—and Mr. Roco may be able to confirm this—a few months ago, a bill on nanotechnology products was tabled. I think that it will be really worthwhile to follow developments in this area.

To complete what Mr. Roco was saying, generally speaking, environmental and health risks are the subject of numerous studies in the United States. I have noted that it is the United States that is carrying out 56% of the funded studies on health and environmental risks in the world. The Americans really are well ahead of everyone else in terms of the toxicity analysis of nanoparticles.

As for the more economic aspect of the question, I am not in any position to respond because it is really difficult to have an overall view of the investments made in Canada by both the private and public sectors. Indeed, there is no coordinated system for nanotechnology research. However, I do know that in Europe, only 5% of the total nanotechnology research budget is earmarked for health and safety issues. I believe that Mr. Roco talked about 8% in the case of the United States, but perhaps I misunderstood.

In a nutshell, 5% is really very little. The primary focus is the development of nanotechnologies, but the issue of toxicity is set aside. Now I believe that everyone agrees that we need to earmark more money for these issues. That is about all I can tell you on the issue.

[*English*]

The Vice-Chair (Ms. Joyce Murray): Thank you.

Dr. Carrie.

Mr. Colin Carrie (Oshawa, CPC): Thank you very much, Madam Chair.

I will try to be as quick as I possibly can.

I want to thank all the witnesses for finally being here. This is a topic that I've been very much interested in for some time. To have you actually in front of the committee is wonderful. I hope that this is really more or less an introductory group, and that perhaps in the future we may be able to sit down and talk in a little more detail on this.

Some of the reading I've done has had to do with innovation and with the potential for different industries—cancer therapies, pharmaceuticals, things along those lines. I'm wondering if you could tease us a little bit here in committee and just tell us some of the things that you see coming over the horizon, some of the innovation that's happening, some of the successes that we've had around the world.

● (0835)

The Vice-Chair (Ms. Joyce Murray): Would anybody like to address that?

Dr. Petersen.

Dr. Nils Petersen: I'd be happy to stick my neck out first.

Mr. Colin Carrie: Sure.

Dr. Nils Petersen: We think about it in three phases. The first one is products already on the market. These are the low-hanging fruit—the cosmetics industry, some of the food industry, and so on—or what we think about as the trivial applications of nanotechnology.

For the next decade or so, we think about the introduction of new materials, new products, in existing consumer products. It would be a better cellphone, a faster cellphone, or a better computer and what not. It would be developing the technology in a different way within that scale frame of what we know.

When you go another 15 to 20 years down the road, we're looking at what we think about as the transformative aspects of nanotechnology, where we start getting into "smart" things—things that are self-regulating, self-propelling, and what not.

For example, we have at our institute a person who is looking at what he thinks about as an intelligent nanoparticle. It doesn't have self-intelligence, but nevertheless.... The idea is to have multiple functions in it. On the one hand, it will be used as a tool that will target itself to a particular part of the body. When it's there, it will be used as a signal to tell you that it's there, and when it is there and you know where it is, you can use it as a therapeutic agent. So it's building multi-functionality into a small device that can then function in that regard.

I think there's lots of excitement in the health area. I think we'll see lots in the energy sector. We also see an emerging bio-materials sector. We're starting to look at using sustainable green resources, such as trees and plants, to replace the hydrocarbon sources that we're currently using from the oil. This is a matter of trying to get materials into the production line and taking it from sustainable sources.

So there's a....

I could go on for hours, but I won't.

The Vice-Chair (Ms. Joyce Murray): Thanks.

Dr. Duncan, it's your turn.

Ms. Kirsty Duncan (Etobicoke North, Lib.): Thank you, Madam Chair, and thank you to all the witnesses.

This has been wonderful.

I have so many questions. I'm wondering whether I may do a brain dump and just put the questions on the table. May I do that? We could get any of the answers tabled.

Is that okay?

The Vice-Chair (Ms. Joyce Murray): Well, what's the primary question you would like discussed?

Ms. Kirsty Duncan: I think I'd really just like to put a batch of questions out there. Can I do that?

The Vice-Chair (Ms. Joyce Murray): Sure.

Ms. Kirsty Duncan: Okay.

I'm wondering what the long-term health studies are on the issue. Are we getting the first studies out? What do the animal studies show? It's such important technology, but I think we need to know that.

I'm wondering what specific federal agencies are working to address the issues related to the impact of nanomaterials on human health and the environment. What's our current spending on health safety and environmental research and our current spending on nanotechnology research?

I'm wondering what systems, if any, are currently in place for evaluating whether to proceed with projects involving nanoparticles—for example, the DuPont system.

Do cosmetic drugs or other products manufactured with nanotechnology require special regulations or labelling?

There are a couple of others.

What monitoring and protective strategies are already in place, and what might we need for the future of industrial hygiene and nanotech?

What is currently known about engineered nano-material hazards and measures that can be taken to minimize workplace exposures, including occupational health surveillance, exposure assessment, exposure control procedures? And what recommendations has the government made?

I have one last one.

Do we have guidance concerning medical screening of workers potentially exposed to engineered nanoparticles in the manufacture and industrial use of nanomaterials?

The Vice-Chair (Ms. Joyce Murray): Which one of those would you like answered?

Some hon. members: Oh, oh!

Ms. Kirsty Duncan: It's such an important subject. I'll just pick one: the issue around regulation of cosmetics and drugs. What regulations are needed, if any?

The Vice-Chair (Ms. Joyce Murray): Madame Maniet.

[*Translation*]

Ms. Françoise Maniet: I do not want to monopolize the discussion, but I can give you a few opinions on the matter. I would also like to add a few details regarding the previous question, namely the success of nanotechnologies.

To date, we have promised a lot of benefits to consumers. True, when it comes to environmental protection, the fight against climate change, medical care and health care, nanotechnologies are very promising. They are presented to consumers as an asset providing a multitude of benefits, but for the time being, they have not revolutionized very much. An umbrella that does not get wet or nanotechnology underwear or socks that do not smell do not a revolution make. We must ask ourselves the following question: do the risks make them worthwhile, given the tiny benefit they represent, for the time being? I would simply like to share this thought with you.

As for the member's questions, if we consider the number of products currently on the market, we can observe that cosmetics are truly the products containing the most significant number of nanoparticles. Out of all of the consumer products on the market, cosmetics contain the highest percentage of nanoparticles. The United States is preparing an inventory on the number of particles contained in consumer products. Clearly, as far as this issue is concerned, cosmetics exceed all of the other products. If there is one sector where we need to start regulating, it is definitely cosmetics. Moreover, that is why the European Union recently adopted regulations.

As for requirements in the future, we first of all have to know which nanoparticles are contained in given products. We cannot adopt or enforce regulations if we do not know which products contain them. However, at present, we have absolutely no idea, and at times, the companies themselves do not know which nanoparticles are contained in certain consumer products.

In my opinion, the first thing that we need to do is to establish a mandatory notification system whereby producers would be compelled to inform governments that they were using nanotechnologies. The European Union will have such a system for cosmetics. An attempt was made to implement such a system in Great Britain, but this was a voluntary system. It did not work. It was eliminated after two years because few producers complied and informed the administration. In Canada, an announcement was made that such a system was going to be established. I hope that this continues.

The workers are the first to be exposed. Mr. Ostiguy is perhaps in a better position to answer this question.

● (0840)

[*English*]

The Vice-Chair (Ms. Joyce Murray): We have one last questioner, Dr. Bennett.

Dr. Ostiguy, is that an answer to the question around regulation?

[*Translation*]

Mr. Claude Ostiguy: No. I could have discussed issues pertaining to the work place.

[*English*]

The Vice-Chair (Ms. Joyce Murray): I think we'll go to our final question and then we will adjourn the meeting, and if there are some conversations to answer some of the other questions on the list, then of course that will be appropriate.

Dr. Bennett.

Hon. Carolyn Bennett (St. Paul's, Lib.): Yes.

Firstly, I wanted to apologize for being late. I think some of you know it was the tenth anniversary of CIHR this morning, the breakfast, and some of us who were there at the birth were supposed to be there at the birthday party. So my apologies.

What happened on the way in to the breakfast was that I ran into Liz Dowdeswell, from the Council of Canadian Academies, and it seems that they have just done a review of nanotechnology in terms of pros and cons. So I would first ask the clerk and the analyst to circulate that report to the committee, because I think it might be very helpful to us, and then I think it would be interesting to know if the witnesses had seen it and whether they had further comments on whether you felt it was taking Canada in the right direction.

Then just following up on my colleague's question, in terms of the role of government or regulation, are there countries that seem to have gotten this right? Dr. Maniet commented on the U.K., but I was just wondering what you see the role of government to be as we go forward, in view of regulation and what we should be doing.

● (0845)

Dr. Mihail Roco: To make a comment about the international situation, for nano-particles there is a consensus that there is no need for new regulations, it's only new science. This is agreed on in Europe, in the U.S., in Japan, in China.

The main concern, however, is that the new generation of nano-products will be less safe—for instance, the cell generation of artificial organs or nano-robotics on surfaces. They have aspects that are not yet well defined and have a high level of uncertainty, and therefore will require probably some regulations, but at this moment the focus is unfortunately only on the past. Most of the regulations around the world deal with nano-particles, which are the first generation of nanotechnology products, and they are less dangerous as compared to others.

So I think we have to prepare for the future.

The Vice-Chair (Ms. Joyce Murray): Thank you.

Dr. Petersen.

Dr. Nils Petersen: The report you refer to, Dr. Bennett, is indeed a thoughtful piece, and I think it is one that is good for people to reflect on. One of the workers at our institute was involved in creating it, and I believe it has some good elements to it that are specific for Canada as well.

I'm not aware of a government yet that has fully regulated these areas, so I don't know that there are best examples. I do know of some examples that seem not to work. They seem to create a lot of unintended consequences because they're very specifically referring to a scale regulation rather than a product regulation, and I think that's difficult.

Unfortunately, I think the European Union is moving towards that aspect of it as well, but that's still under discussion. I think one of the frameworks that are necessary is being managed by what's called Technical Committee 229 of the ISO, in which they are trying to start with a definition framework and a terminology framework and nomenclature, so people know what they're talking about, and that's almost a prerequisite for being able to do things well.

The Vice-Chair (Ms. Joyce Murray): Thank you.

Dr. Ostiguy.

[*Translation*]

Mr. Claude Ostiguy: I would like to make some comments about regulations, but more from the perspective of occupational health and safety. Several people here have mentioned the significant uncertainty surrounding the issue of toxicity. Indeed, as regards worker exposure in the work place, Mr. Petersen clearly stated that it is the Canadian workers who are potentially the most exposed to nanoparticles.

As for our knowledge on the exposure of these people, the degree of uncertainty is even greater in terms of toxicity. So I think that we really do need to adopt a precautionary approach in Canada. We have the scientific knowledge to design safe places of work. As regards occupational health and safety, if we wanted to change the regulations, it would probably be most important to require the labeling of all products containing nanoparticles. In this matter, companies that purchase such products and integrate them into their production line will know which nanoparticles they are dealing with, the dimensions of these nanoparticles, and will subsequently be able to implement occupational safety measures that will prevent, in the long term, Canadians from developing occupational diseases due to a lack of knowledge about the risks.

[*English*]

The Vice-Chair (Ms. Joyce Murray): Thank you to all of our guests.

Oh, Monsieur Emond—a final comment from the guest panel.

[*Translation*]

Mr. Claude Emond: In my opinion, the development of nanoparticles is inevitable. Indeed, nanoparticles may do a great deal to improve certain technologies, maybe even enable us to come up with new technologies. Nevertheless, we must not forget that we developed flame retardants that were integrated into components that the public is exposed to on an everyday basis. We thought that these flame retardants were stable and they have been used inside residential buildings. Today, we are all being exposed to them and we are just starting to see certain toxic effects in people.

We must also remember that, in the case of many environmental components we are still working on—for instance, PCBs or organochlorine pesticides that were once used and have been banned for many years, 30 or 40 years—we are still able to measure them in the human organism. So these products are still creating disorders, disrupting the endocrine system, etc.

If we want to legislate for health reasons, I think that we need to market—that would be good—but also focus on health and invest in the right places. So a Canada-wide coordinating committee would be the solution.

● (0850)

[*English*]

The Vice-Chair (Ms. Joyce Murray): On behalf of the health committee, thank you very much for coming and for providing us with your experience and your thoughts. We appreciate that.

This meeting is adjourned. We'll recommence at nine o'clock with our next committee meeting.

Thanks.

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