2010 CSPC | Canadian Science Policy Conference

2010 CPSC | La Conférence sur les politiques scientifiques canadiennes

Conference Proceedings
Final Report

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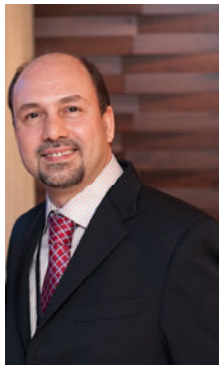
Message from the CSPC Chair: Mehrdad Hariri



Dear Colleagues,

It is with great pleasure that I present you with the conference proceedings report for the second annual Canadian Science Policy Conference (CSPC), held October 20-22, 2010 in Montréal, Québec.

Spurred on by a belief that Canada deserves an annual forum dedicated to science policy issues, the 2010 Conference's motto was "Building Bridges for the Future of Science Policy." CSPC 2010 featured more than 60 speakers, 13 panels and 3 workshops, branded across 5 themes, along with hundreds of delegates representing numerous stakeholders who discussed critical issues in Science and Technology (S&T) policy in Canada.

The CSPC 2010 themes highlighted some of the most important issues of our time. Addressing the linkages of science, technology and economics and global affairs is timely and critically important. The status of biosciences in Canada, science policy in the context of federal and provincial affairs, and ways to develop a culture of science entrepreneurship were among the many exciting subjects at this year's conference. None of this could have happened without the generous support of 32 organizations and the endorsement and guidance of the members of advisory and honorary committees, all of whom are listed at the end of this book. I sincerely thank them all.

The CSPC has provided a unique opportunity for inclusive national dialogue on the main issues of science policy across Canada, helping to forge stronger ties between diverse science policy stakeholders. In order for CSPC to sustain the relationship with the community, and act as a hub for science policy discourse in Canada, we have proposed the establishment of the first Canadian Science Policy Centre. The idea is that the Centre could work across sectors to enhance networking, collaboration and cooperation among big business, SMEs, academia, governments, and different research sectors to create an integrated model of innovation, an imperative for a knowledge-driven, innovation-based economy. The Centre would aim to create and enhance efficient channels of communication amongst science policy stakeholders, and to support and promote various initiatives in science policy. Finally, and perhaps most ambitiously, the Centre would create and maintain mechanisms for training a new generation of scientists to better understand the science policy process. We believe that the complexity, multidisciplinarity, and ever-changing nature of science and technology of the 21st century requires efficient, energetic, and agile institutions to ensure the interconnection among various elements of Canada's innovation system, including society at large. The Centre will strive to be all those things and more.

Building the Canadian Science Policy Centre is well justified: the Science, Technology and Innovation Council, in its 2008 state of the nation report, points to the insufficient channels for interaction among various stakeholders. Canada must upgrade the mechanisms for coordination and collaboration across areas of research, between science and policy, and among academia, government, business and the philanthropic sectors. The report indicates that sustaining high levels of interaction among stakeholders is a challenge for Canada's S&T community, and that building innovation networks beyond our borders is an important key to success.

The benefits to Canadians in pursuing this approach will be many. Leveraging our science and innovation agendas will support the continuing development of a knowledge-based economy that will facilitate improved wealth generation, living standards, education, health care, and our ability to contribute to global economic development.

CSPC, as Canada's most comprehensive annual forum on science policy, aims to contribute to building a robust science policy network in Canada. I look forward to receiving your comments and suggestions for the betterment of our collective effort, and hope to see you at the next conference, CSPC 2011, in Ottawa.

Sincerely,

Mehrdad Hariri - Chair, Canadian Science Policy Conference 2010

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Issues of Our Time: Rethinking Agriculture for a Hotter, Drier World

Chair
Pierre Noreau - President, Association francophone pour le savoir (ACFAS)

Speaker
Dr. Nina Fedoroff - Willaman Professor of the Life Sciences, Evan Pugh Professor, Huck Institutes of the Life Sciences, Penn State University

Dr. Nina Fedoroff, Penn State professor, former Science and Technology advisor to the US Secretary of State, a 2006 National Medal of Science winner in the field of biological sciences, and incoming president of the American Association for the Advancement of Science, gave the first keynote address at CSPC 2010. Her address focussed on what she called "arguably the biggest challenge of the century": producing food for a growing population while not destroying what is left of our planet's biological heritage and vital ecosystems. Given the reality of ensuing climate change, we cannot expect to feed the world's future population with the current agricultural and transportation systems, as today's agricultural practices will not suffice in the coming climate. Dr. Fedoroff posed the question, "How do we, as scientists and policy makers, begin to think and act on such a global scale to address such complicated crosscutting problems?"

Food security, Fedoroff pointed out, is an old problem: in the early 19th century, science entered agriculture in earnest when scientists such as Evan Pugh made breakthroughs in analyzing the fundamental nutritional requirements of plants, and agricultural advancements have been driven by science and technology ever since. New technologies and applications, such as commercialized fertilizer production and the mechanization of crop harvesting, have increased crop yield while reducing manual labour. Well before these advancements, Fedoroff reminded everyone, humans increased crop yield through selective breeding. For example, our ancestors created corn as we know it today from a species of grass.

Presently, Fedoroff pointed out, we find ourselves in a tough position. The human population of our planet is a little over 7 billion, and the complex environments that used to occupy vast tracts of land have given way to the monoculture of farming and livestock. The biodiversity that once thrived, Fedoroff claims, has given way under the stress of feeding such a large human population. The loss of biodiversity, she says, is already at catastrophic levels and continues to accelerate. This is not only apparent on land, but also in our water systems, as the use of fertilizers has taken its toll on our oceans, rivers, and lakes.

Whereas we once had on average an acre of arable land per person, we now have only a half-acre of arable land per person. With the population continuing to rise and urbanize, we can only expect those numbers to decrease further. Fedoroff cautioned us to avoid the slippery slope of inaction that would allow climate change to exacerbate the problem of food security. Unless greenhouse gas reduction plans are maximally effective, we expect to see a rise in the amount of CO_2 in our atmosphere beyond the presently high levels. A rise in CO_2 will mean a rise in global mean temperature, which could have a debilitating effect on our crops. Importantly, seasonal high temperatures may even rise beyond the point optimal for photosynthesis. This rise in temperature might also lead to crops developing more quickly, leaving less time to accumulate the starches and proteins that comprise the bulk of the grain. Fedoroff

also pointed out that the change in climate could bring about drought, an obvious obstacle to food production.

Fedoroff then asked the obvious question: what do we need to do? Her answer is that we need to reduce our ecological footprint of our agriculture, reduce the use of fresh water, reduce agricultural pollution, and, importantly, to adapt our crops to a hotter and dryer world. Perhaps the largest obstacle is that we need to do all this while simultaneously doubling the global food supply. Fortunately, Fedoroff claims, we have developed new technological tool kits that can help us deal with these problems, most notably the tools of genome sequencing and recombinant DNA technology, which we can use to modify plants to, for example, confer pest-resistance and increase crop yield.

However, some countries are resistant to modifying crops using these technologies, and have established regulatory structures to stop genetically modified organisms (GMOs) from entering the food supply because they were thought capable of harming human and animal health, as well as decreasing biodiversity. Fedoroff said than none of the hypothetical risks have proved to be real risks; no health problems have arisen from GM crop consumption. The claim that GMOs diminish biodiversity could not be further from the truth, Fedoroff claims, because GMO crops use less fertilizer and toxic pesticides, thereby preserving and promoting biodiversity. As a result, she argues, we should dismantle much of this regulatory structure built around unfounded fears so as to realize the substantial benefits of GMO crops. The simple fact is that farmers migrate to GMO crops because their yield increases while cost decreases, and such yield increases are exactly what we will need in the future.

The challenges Dr. Fedoroff sees to increasing food production are difficult to meet, but not impossible. We need to make crops more tolerant to heat, flooding, and salinity, all while reducing our reliance on toxic chemicals that kill insects and pests to preserve our crops. An even deeper challenge is to increase the efficiency of photosynthesis, the process by which plants convert light energy to chemical energy. We also need to use green technologies to provide energy to agriculture, and to develop new ways to use “greywater” in irrigation systems.

Fedoroff challenged everyone to realize that the time has come to take a broader view of agriculture as a system that encompasses ecology, hydrology and energy, not just food production. We cannot step back to old methods that fed an ancient world, but we can integrate ancient wisdom while proceeding through science- and evidence-based policy making. We must make better use of nutrients, energy and water in agriculture. She concluded by remarking that this “is a tall order, but if there is ever an area that is right for science policy, it is this one.”

Why does an ex-astronaut get involved with politics?

Chair
Yves Joanette - Président-directeur general, Fonds de la recherche en santé du Québec

Speaker
Honourable Dr. Marc Garneau - Former Astronaut, Member of Parliament for Westmount Ville-Marie

The Honourable Dr. Marc Garneau, former astronaut, Navy Captain, Member of the Order of Canada, and current Member of Parliament for Westmount Ville-Marie, spoke for the first time at the CSPC. Garneau started by addressing the question "Why does an astronaut become a politician?" Wrapped up in the answer to that question is the history of the Canadian space program and the need for science policy, so the majority of Garneau's talk focused on both of those two themes.

Canada, Garneau said, created a space program for scientific reasons: Canadian scientists wanted to explain what caused the aurora borealis, which they had observed for some time. Scientific theories had arisen, but it was difficult to confirm any of them while grounded on Earth. Canada, motivated by the wonder of the aurora, became the third country to have a satellite in space, and has continued their drive into space as technology has progressed. Canada was one of the first adopters of communication satellites after realizing they had significant advantages in enabling communications to the remote areas of the country; space science and technology in Canada had been aimed directly at connecting Canadians.

Canada has gone on to do outstanding things in space, Garneau claimed. There are currently two radar-based satellites in orbit, built by Canada, for the explicit purpose of remote sensing and monitoring everything from vegetation to the flow of ice. To be sure, Garneau reminded us, this is the result of a federal policy put in place to actualize the multifaceted benefits of space technologies. Space technology is a political and scientific issue, and the Government of Canada must always pay attention to it, said Garneau.

"I went into space three times," he exclaimed. "I saw our planet, and I realized we are damaging our planet," though not on purpose of course, Dr. Garneau qualified; there are just so many of us living here now, and there is only a finite amount of abuse the planet can take. "I remember on my first flight, seeing a million square kilometres of burning forest over Brazil … being done to provide land to farmers," said Garneau, going on to say that seeing things like this inspired him to bring the issue of environment to his political career. Garneau stated that there are two reasons he is in politics: one is because there are not many scientists in the House of Commons, but that is where decisions are made, and the other is his strong commitment to the environment. Canada is, for example, the second largest producer of CO_2 (per capita) in the world, and Garneau feels very strongly that we need to do our part to help in what is a global challenge.

Garneau then turned back to science policy more generally, reminding us that we must remember both federal jurisdiction and provincial jurisdiction when discussing these matters. The federal government must lead when it comes to research, he argued, and we need to have a robust federal science policy.

Science policy, Dr. Garneau claimed, has to be formulated in a way that advances knowledge in the social sciences and humanities in addition to the basic and applied sciences; for as Garneau points out, a

society must evolve on all fronts, and thus all fields are important. Basic and fundamental scientific research is especially important, Garneau claimed, because breakthroughs in these areas can be just as important as those in the applied sciences.

But, Garneau cautions, science cannot operate in a vacuum. The process must serve society, such as when there is a need to focus more attention on specific areas arising from government interests. Garneau said that this shift of focus, however, should never be at the expense of other areas of science.

Garneau then raised some major concerns for Canada, and proposed that good science policy could be a step towards solutions. His central message was that there is an extremely delicate balance to be struck between energy production, the environment, and the economy. We have to deal with the messy realities and come up with pragmatic solutions, he claimed. Developing green energy is important for the environment and the economy, and it is an area where science and policy can help us out a great deal. Canada must display environmental leadership, Garneau argued, and not wait to harmonize with the United States. Currently, provinces are going ahead with environmentally progressive legislation, but the federal government is doing nothing.

Responsible development of the oil sands is also a necessary component to meeting our energy needs, Garneau stated, and science is paramount in determining how to properly handle the oil sands. In meeting our energy needs, Garneau said, we also cannot rule out the use of nuclear energy, as we may not meet our environmental goals if we do not invest in clean nuclear energy. This is a big policy decision, and it is a tough one, he said, but nuclear power needs to be part of the mix, even if it is just temporary. The NRU reactor needs to be brought back to running order, he argued, because while Canada has been a pioneer in building heavy water reactors and producing medical isotopes, we cannot continue to be a leader in this area if we do not have an operable research reactor.

Garneau also spoke of his concern for the lack of participation by scientists in science policy development. The government needs to consult scientists, Garneau warned, rather than simply giving them mandates – which he sees as the current government's approach. Canada must allow all scientists to speak freely, and to tell the government what they are doing right and what they are doing wrong. After all, Dr. Garneau claimed, the scientists are the experts, and we should be listening to them. The position of national science advisor no longer exists in Canada, but it should be the case, like in the United States, that the prime minister hears from the chief scientists in the country, who are of course getting their information from other scientists. There needs to be a scientific advisory body, Garneau claimed, for only they can tell the government what it needs to hear when it comes to the science behind policy.

Garneau also said the government needs to hear stronger arguments from the scientific community about why it is important to do fundamental research. If those arguments are not heard, then the government may make the wrong decisions. The reason he is in politics, Garneau said, is because science policy is important, and there should be more scientists in politics. Garneau concluded by saying we need more scientists in policy-making and in the House of Commons, because only then will science have a greater impact on the legislation passed.

Above: Hon. Marc Garneau (left), Dr. Nina Fedoroff (right), and CSPC Chair Mehrdad Hariri (center) have a conversation following Garneau's Keynote Presentation

Special Keynote Address by the Minister of State (Science and Technology)

Speaker
Honourable Gary Goodyear - Federal Minister of State (Science and Technology), Member of Parliament for Cambridge & North Dumfries

The Honourable Gary Goodyear, Minister of State for Science and Technology within the Harper government, spoke for the second consecutive year at the CSPC. Even in the short year that has elapsed between the first and second conference, Goodyear said he already sees the impact of the conference; it has brought together stakeholders from across Canada and is making a significant contribution to science policy discussion across the country. The conference, he says, is about bringing together policy, government, industry, and academia.

Goodyear noted that 2010 has been a great year for research in Canada. In the past year crucial research was carried out in our country, with researchers from across the world coming to take part in it. This seems to be the opposite of the 1990's "brain drain," as the government has established Canada as a place where the best minds come to research.

Goodyear said that a significant turnaround came about two years ago when the Harper government launched the new science and technology strategy, the goal of which was to create jobs, strengthen our economy, and make life better for all Canadians. The strategy emphasized keeping the best and the brightest researchers in Canada. That was not just something done on paper, Goodyear said, as rather substantial changes have already been realized. Science and technology has received more funding than any department in these most difficult economic times, making sure that our Canadian colleges and universities are plugged into the innovation system to ensure that Canada continues to lead the way in science and technology.

But Canada still faces challenges, Goodyear said, as R&D in the business sector is severely lacking, a fact continually addressed throughout the proceedings of CSPC 2010. We need to remain globally competitive, but businesses have not reinvested the gains made after the recent economic recovery that would allow them to compete in the future. This is why Mr. Goodyear is looking to make support for R&D more efficient at the commercial level, launching a governmental review last year to address this issue.

The focus of the R&D review will be on federal programs and activities that promote private-sector infrastructure. In a year, the panel will report to Goodyear, hopefully leading to better alignment between industry and the government that supports it so as to improve the overall position of Canada's companies in the global marketplace. The stakes are very high, Mr. Goodyear pointed out, and the timing is quite critical. Economies that apply R&D to their products will become the future's economic leaders. Leading the way in these areas will ensure Canada's prosperity.


Minister Goodyear speaks with the press following his CSPC 2010 address

Special Keynote Address by Minister of Economic Development, Innovation, and Export Trade (Québec)

Speaker
Honourable Clément Gignac – MNA for Marguerite-Bourgeoys, Minister of Economic Development, Innovation, and Export Trade

The Honourable Clément Gignac spoke during a special lunch session at CSPC 2010. Due to some miscommunication between the CSPC organizing committee and Gignac's office, the Minister's attendance and address was unexpected, and he humorously apologized for his presence. Gignac then discussed Québec's S&T goals and strategies, stating that CSPC 2010 was a unique opportunity for everyone to share ideas and discuss science policy in Canada, and to reinforce the ties between stakeholders and decision makers.

Québec has been active in setting up science policy for many years, Gignac noted. In the 1960's the Québec government set up structures and programs aimed at, among other things, fostering cooperation between colleges and their industrial and community partners. It was the 1970's that began Québec's development of research-oriented structure, leading to the establishment of the Québec system of innovation. Québec undertook a massive catch-up effort during the 1980's, investing in industrial R&D and innovation systems. Since then these strategies have been consolidated, and in 2006 the government established the first Québec innovation strategy, aiming to make research and development the basis of competitiveness and job creation in Québec.

Gignac commented that his job, as a politician, is not to make friends, but to lay the foundations for increased wealth creation. Innovating in Québec means growing, increasing productivity, and creating jobs, because Québec needs to face international competition. Québec and Ontario are sometimes seen as in competition for talent, but Gignac emphasized that the provinces together compete for talent in the global market, and that their interests are therefore aligned. To utilize their shared advantages, Ontario and Québec need to work together to develop their shared R&D and S&T resources, and Gignac invited us to watch his government execute this inter-provincial strategy to attract talent to Canada's research centres in the years to come. Connecting his speech to Goodyear's speech the day before, Gignac asserted Québec's commitment to investing in fundamental research, and to this end, said the Québec government will invest more than $1.1 billion by 2013 to mobilize Québec, promoting innovation and prosperity.

Gignac then discussed the enigma that, despite high relative investments in R&D, Québec has lower productivity gains than other parts of Canada. He suggested that a greater focus on innovation and commercialization could solve this problem as Québec seeks to use S&T investment to brand itself as "the place in North America … with the lowest carbon footprint."

Québec's surprising gain in jobs after the recession, relative to the US and Ontario, can be attributed to a low reliance on manufacturing, and a high reliance on S&T research. Asserting their "green" brand, Québec researchers are developing green aircrafts, buses, and other products to position Québec as a centre for developing green technologies. These strategies, along with measures meant to attract foreign talent to Québec, stimulate entrepreneurship, and the coming appointment of a provincial science officer should together ensure the research excellence of Québec in the years to come.

Special Lunch Presentation by Council of Canadian Academies

Moderator
Margaret McCuaig-Johnston - Executive VP,
Natural Sciences and Engineering Research Council of Canada (NSERC)

Speaker
Paul Davenport - Chair of the Expert Panel on Research Integrity, Council of Canadian Academies

Dr. Paul Davenport, former President of the University of Western Ontario, recently chaired a panel of experts that produced a report entitled "Honesty, Accountability and Trust: Fostering Research Integrity in Canada," at the request of the Council of Canadian Academies. This report was designed to examine and analyze academic integrity in Canada, as well as make recommendations based on that analysis.

The current landscape of academic integrity in Canada is best described as local and non-legislative, claimed Davenport. Unlike the United States, for example, which has a national policy with legislation to enforce it, Canada's approach centers around the local rules and influence of research institutions. The fundamental conclusion of the report is that all the actors partaking in research, from individual researchers to government agencies, must come together under a unified approach to maintaining academic integrity.

Davenport said the report found significant gaps in the current policy. To fill the gaps, there needs to be a common set of values and principles that balance transparency with privacy. To achieve that, a centralized way of handling academic integrity needs to be established; in the long run, however, education about the rules of academic integrity will be the best protection against plagiarism.

The report recommends the creation of a new entity, the Canadian Council for Research Integrity, whose primary purposes would be facilitating research integrity practices and supporting the research community. This would be a non-governmental organization that would, while leaving rule creation and enforcement to local institutions, take the lead in integrity education and outreach.

In conclusion, Davenport said, we need a positive, value-based approach to research and integrity in Canada. Such a system must be unified and bring all the actors together. All those that take part in research, in any way, have a great stake in the integrity of the process, and a great responsibility to maintain it. Our future success as a prosperous nation depends on our ability to produce and implement good science, and if Canada were to have research integrity issues, there would be a great loss in the public confidence of our science. Davenport notes that we have seen these problems in other parts of the world, and that we want to be sure that they do not come to Canada.

During a brief question period, Yves Gingras questioned the motivation for creating the oversight council that Davenport's report ultimately recommends. If there is no issue of integrity loss in Canada, he argued, it makes little sense to start importing practices from elsewhere meant to deal with the idiosyncratic issues of academic and research integrity faced by other nations. Davenport admitted that there is no evidence of significant breaching of integrity in Canada, but argued that having a council to monitor and maintain research integrity would ensure it never becomes a serious problem in Canada.

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FOR GLOBAL HEALTH

The Challenge
We live in a world where there is a large gap in the life expectancy between those who live in rich, developed nations and those who live in poor, developing nations. This is neither morally acceptable nor socially sustainable. We know that the potential for innovation by those living in the developing world – scientific, institutional, technological, social, and business – can narrow this gap significantly. At the McLaughlin-Rotman Centre for Global Health, we are focused on closing this gap by developing locally-relevant and empirically-grounded models to facilitate developing world innovation in global health.

Who We Are:
The McLaughlin-Rotman Centre for Global Health is based at the University Health Network and the University of Toronto. We develop and evaluate new models of global health innovation and, working with partners, facilitate their adoption where they are most urgently needed. Our comparative advantage lies in our strong focus on engaging and supporting "voices of the south" to generate domestic solutions for domestic problems and the bright young minds of our graduate students and trainees.

Our Vision, Mission and Strategy:
Our **Vision** is a world where everyone benefits from new diagnostics, vaccines, drugs, devices and other life science solutions.
Our **Mission** is to develop and evaluate new models of global health innovation and facilitate their adoption where they are most urgently needed.
Our **Strategy** is built around four pillars, each of which represents a critical dimension of the solution to the challenge of improving the health and lives of people in the developing world. Each pillar is ultimately focused on developing locally-relevant and empirically-grounded models to facilitate developing world innovation in global health. The four pillars are:

1. **Global Grand Challenges Pillar**, which helped establish Grand Challenges Canada. Grand Challenges Canada is a unique and independent not-for-profit organization dedicated to improving the health and well-being of people in developing countries by integrating scientific, technological, business and social innovation. Grand Challenges Canada works with the International Development Research Centre and the Canadian Institutes of Health Research and other global health foundations and organizations to find sustainable long-term solutions to the most pressing health challenges. Grand Challenges Canada is hosted at the McLaughlin-Rotman Centre for Global Health. This pillar is focused on ***institutional innovation***.

2. **Translational Research Pillar**, which is focused on biomedical research for new diagnostics and interventions for infectious diseases such as malaria, HIV, tuberculosis and sepsis, and translating new discoveries into clinical trials. This pillar is focused on ***technological innovation***.

3. **Ethics Pillar**, which develops and brings forward social and institutional innovations designed to overcome ethical, social and cultural barriers to the acceptance of new medical technologies and to improve the diffusion and delivery of these technologies. This pillar is focused on ***social innovation***.

4. **Commercialization Pillar**, which develops financial and collaborative models to enhance the domestic and commercial production of health technologies in developing countries. This pillar is focused on ***business innovation***.

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Increasing Canadian Productivity with Science and Technology

the Canadian Science Policy Centre
better policies, better science

Science and Technology as Agents of Economic Recovery

Economic downturns can be viewed as an opportunity for thinkers and innovators to establish new paths for commercial success. In a knowledge-driven society research, development, and enabling policies are key components of this new growth. This panel explores ways to capitalize on an economic downturn to increase growth in science, technology, and commercialization.

Universities as Economic Powerhouses

Technology transfer offices and science parks are springing up across Canada and globally. At the same time, more and more academics are looking to industry for jobs, while industry looks to academia for the next big idea. With this in mind, this panel explores and evaluates models for capitalizing on the research output from universities.

Encouraging Investment in Science and Innovation

In order to remain competitive in science and technology on a global scale, it is becoming increasingly important to have strategic flow between business and science at the local, national, and international levels. It is critical to ensure appropriate investment in science and innovation. As part of this strategy it is important to ensure our system enables and encourages Canadian and foreign investment. This panel explores and assesses various models and programs that could encourage investment in science and innovation and enable quicker turnover from scientific discovery to implementation and economic gain.

Plenary: Science and Technology as Agents of Economic Recovery

Moderator
Gilles Patry - President and CEO, Canada Foundation for Innovation (CFI)

Panellists
Chad Gaffield - President, Social Science and Humanities Research Council of Canada (SSHRC)
Heather Munroe-Blum - Principal and Vice-Chancellor, McGill University
Robert Prichard - Chair, Torys LLP and Vice-Chair, Science, Technology, and Innovation Council (STIC)
Genevieve Tanguay - Ministry of Economic Development, Innovation and Export Trade, Quebec

The session moderator, Gilles Patry, began with three questions for the panellists to use to frame their talks: is science and technology an agent of economic recovery? If so, how so? If not, how can it become one?

Heather Munroe-Blum, Principal of McGill University, emphasized how quickly the major economic powers on the world stage are changing, the importance of innovation in driving economic growth, and the importance of academia, industry and government in innovation. Emerging economies are currently making substantial investments in education and R&D, she said, increasing their competitiveness on the global stage by making investments to increase their production of masters and PhDs. As such, Canada must continue to support the development, retention, and attraction of world-class masters and PhD students.

Despite past investments, R&D as a portion of gross domestic product has dropped since 2004, and the amount of R&D conducted by Canadian small and medium enterprises (SMEs) remains low. Canadian universities need to reach out to SMEs and adopt similar strategies as, for example, Scandanavian countries and India. These nations have developed successful strategies to connect university research with the needs of industry, and these strategies are worth emulating. Munroe-Blum argued that provinces need to adopt long-term science and technology policies so as to avoid "roller coaster" funding that invests heavily in creating organization and institutions that are later eliminated due to lack of support. Additionally, provinces need to work together to develop policy frameworks for innovation that inter-connect provinces and link in to federal policies. Finally, Munroe-Blum argued that Canada needs to develop a common intellectual policy framework that protects students, protects the right to publish, and allows ideas and talent to flow freely.

Robert Pritchard, Vice-Chair of the Science, Technology, and Innovation Council, explained STIC's role to advise the government through the Minister of Industry on matters related to Canada's science and innovation agenda. Pritchard commented that Canada has done well through the global financial crisis, and is in a position of relative strength with its abundant resources, well educated population, diverse and globally connected citizenry, and strong public finances; nevertheless, he cautioned, we should not be complacent in our position. We are challenged by an aging population, lagging productivity, and a significant shift in the focus of global business away from the United States, our largest trading partner. Science and technology must be the agency of economic recovery, as it is the only sustainable strategy. Canada cannot compete on its size alone, but must work on being smart and innovative.

Canada has gotten a lot of things right: strong universities, top researchers, and a suite of programs to improve our research capacity (such as those detailed by Munroe-Blum). But, Pritchard argued, we are struggling with encouraging businesses to invest in R&D, despite high government subsidies; and despite much research on this issue, there is no clear answer on how to proceed. But since it takes decades to create institutions and build clusters, we must remain consistent in our approach and look for innovative policies focussed on competition and investment, not on entitlements. This will mean only picking winners, because attaining world-class quality requires us to focus on building and maintaining *successful* clusters. Government should produce policies that help share risk with entrepreneurs while engaging in strategic procurement to help create market demand. There is also a need to simplify and standardize how we connect industry and universities, particularly with intellectual property. According to Pritchard we should try to generate a culture of innovation and winning by celebrating these achievements, and taking pride in success.

Genevieve Tanguay discussed some of the initiatives taken in Quebec to support innovation. These initiatives are organized around four main policy axes: making research more productive and competitive; producing, attracting, and retaining talent; assembling tools that bridge the gaps between research and SMEs; and investing in key mobilizing projects that leverage Quebec's existing areas of excellence. Quebec has made a substantial investment in innovation, providing the largest tax credit system for R&D, reinforcing public research, encouraging the amount of research conducted by businesses, and reinforcing technology transfer mechanisms. Quebec has recognized that it cannot change its strategy every three years, but instead needs to invest in a long-term strategy by focussing on the province's strengths. Thus, Quebec has undertaken four new projects building on Quebec's strengths in aerospace, the life-sciences, internet and communications technology, and green technology.

Chad Gaffield next argued that Canada must begin to re-imagine innovation and develop a new vocabulary with new metaphors, re-imagining innovation as something new for the 21st century. The 20th century model of innovation was linear, with innovations pushing out from the laboratory to the marketplace. The 21st century model of innovation is a people-centred model, representing a paradigmatic shift in how we think about innovation. This requires a redefining of the university campus as existing at the heart of innovative communities, as well as finding new modes of engagement to bring together the private, public, and not-for-profit sectors.

During the question period, Alex Bielak of the United Nations University Institute on Water, Environment, and Health asked what is being done in Quebec to facilitate knowledge translation and knowledge brokerage. Tanguay responded by saying Quebec has a strong network of organizations that are responsible for working directly with industry, particularly SMEs, and discussing with them the kinds of university research being conducted and its value for industry.

Danielle Tonguay of Trema Management Consultants asked for a specific example of an avenue of action that would translate science and technology into economic and social innovation, suggesting that the movement of graduate students into the receptor community might be an example. Heather Munroe-Blum suggested that the notion of using graduate students beyond our institutions and putting them into industry is a strategy we have not used in Canada, but that it has been used effectively in Scandinavian nations. Genevieve Tanguay noted, however, that they have been using this strategy in Quebec, though it has been slow in starting because a) professors want their students to focus on finishing their studies on time, and b) industry is, unfortunately, rarely prepared to accept those students.

Universities as Economic Powerhouses

Moderator
Graham Bell - President of the Academy of Science, Royal Society of Canada

Panellists
Janet Walden – Vice-President, Research Partnership Program, Natural Sciences and Engineering Council of Canada (NSERC)
Lorne Whitehead - Professor & 3M Industrial Chair in Structural Surface Physics, University of British Columbia
Paul Doherty - Director Center for Business, Entrepreneurship and Technology, University of Waterloo
Kamiel Gabriel - Professor, University of Ontario Institute of Technology

Janet Walden began the session by providing an overview of NSERC's programs to build academic-industry interactions, suggesting that the strength in Canadian R&D is within our higher education sector. Despite built-up advantage in the Canadian higher education sector, however, many of the reports released over the past few years suggest that we are not making use of this advantage. One of the ways, Walden argued, that we might address the innovation challenges in Canada is to connect the higher education sector's strength in research with the needs of our industrial sectors. Canada, she said, should encourage more public-private collaborations, noting that NSERC is already developing and implementing a strategy to this effect.

NSERC's strategy is focussed on connecting and applying Canada's research strength to address local innovation challenges. NSERC is currently the largest single source of grants for public-private partnerships in Canada, investing over $330 million annually. Industry is involved and highly committed to devoting resources to these relationships, a key benefit of which is the training of students. Each year, approximately 7,000 students are trained by working each year in industry through NSERC's partnership programmes. NSERC has traditionally worked on building a world-class research base, but is now emphasizing building bridges and applying that research capacity. NSERC has developed four themes through consultation with small and large businesses: building sustainable relationships between industry and universities; helping industry access research; eliminating barriers that keep industry from accessing students and researchers at the public research institutions; and increasing industry's impact on research areas that will be critically important to Canada in the future.

Lorne Whitehead next proposed a new approach to improving university-industry technology transfer: by encouraging more PhD student projects to focus on short-term, applied research projects. Industry and universities often work on very different timeframes. Whereas universities tend to conduct research that will take a long period of time to realize benefits, industry is, by necessity, interested in conducting narrow research with promises of immediate benefits. The result, however, is a gap in the kinds of research that gets conducted in the three-to-ten year period.

Whitehead suggested that PhD dissertations on innovative, applied research might fill this gap. To do this, dissertations would need to be high-quality, highly innovative, and deal with a significant problem. These kinds of dissertations, if conducted in greater numbers, could even act as a catalyst within university departments, potentially building up general respect for this kind of research.

There appear to be barriers, however, that get in the way of increasing the number of PhD dissertations that might fill this gap. There are, for example, concerns that applied

research could come to dominate the research agendas of most universities. But, Whitehead argued, the increase in applied research on university campuses has not taken away from basic research; if anything, it has added more resources to the university. Applied research is often perceived as being trivial; but, he argued, applied research often contributes to basic science by identifying additional problems that need to be solved. Whitehead also suggested that universities can de-select the most entrepreneurial people, and that there ought to be more value placed on entrepreneurial outputs from applied research, such as patents and prototype development.

The Centre of Business Entrepreneurship and Technology (CBET) is a science program located within the Faculty of Arts at the Stratford Campus of the University of Waterloo, which has gone from being an engineering-oriented university to an opportunity-oriented one. Despite lacking a business faculty, Paul Doherty noted that Waterloo has become particularly interested in the development of sustainable businesses capable of surviving all the stages between early product development and large market penetration. The CBET is working to help address what is needed in universities and industry to help companies grow, acknowledging that entrepreneurs tend not to be that strong academically, and that engineering students often lack the necessary networking skills and general business skills.
CBET developed an applied masters program that gives entrepreneurial students the connections and skills sets needed to help them get a new idea from an early product development stage to the market. The program is based around a practicum where the students form a multi-disciplinary team and take forward an idea by developing a business model, pitching the project, getting funding, and trying to commercialize the idea.

The program has put through about 250 students, and 74% of them have been involved in one (or more) start-up(s) since graduation. Doherty said, "The practicums have not done very well, but there have been multi-start-ups in all areas that have moved forward," showing the success of the program at creating a certain kind of risk-taking entrepreneurial talent. Doherty attributed the program's success to Waterloo's vibrant, connected, and entrepreneurial culture, with lots of people who want to help new ventures. This gives student the opportunity to work with a multi-disciplinary team, and get the vital experience of taking an idea forward.

Kamiel Gabriel discussed some of the broad challenges facing innovation in Canada and the uptake of innovation. He explained some of the reasons why Canada continues to rank 14th or 15th in most of the OECD's innovation-related indicators, despite major policy initiatives to improve our standing.

One of the long-standing problems facing Canada is our historical reliance on natural resource exports to drive our economy. Natural resources represent two-thirds of current exports, and that is up by one-third over the last decade. He also pointed out that Canadian business has a long-standing productivity gap with other nations that results from, generally, the failure to adopt innovation-oriented business strategies.

Gabriel pointed out that Canada has one of the most educated workforces in the G7, world-class educational and research institutions, strong industrial clusters, a competitive business climate, and comparatively good access to capital. Yet, he also noted, we have weaknesses: we tend to lack policy focus, we spread money thinly across many different programs, and we fail to use policy levers such as strategic procurement.

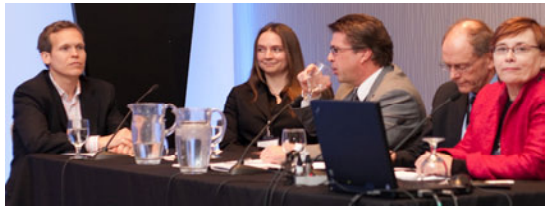
To address these failures, Gabriel suggested that universities focus on a new model of engagement that puts the community at the center of everything that they do, integrating research functions with regional business and social communities, in alignment with the community's strategic growth opportunities. This means focusing on a more systematic approach to innovation policy rather than just funding specific innovation programs. Graduate students, he suggested, are the key feature of this approach as the "conveyor belt" that takes ideas out into the marketplace.

Questions addressed scientists' concerns that applied research careers were fruitless, and issues of which intellectual property regime best promotes innovation and collaboration.

Encouraging Investment in Science and Technology

Moderator
Jeremy Grushcow - Partner, Ogilvy Renault LLP

Panellists
Chummer Farina - Vice-President, Canadian Space Agency
Jean-Francois Groux - Director, Risk Capital, Venture Capital Group, Business Development Bank of Canada
Jean-Louis Legaul - President, l'Association des Directeurs de Recherche Industrielle du Québec (ADRIQ)
Susan Gorges - CEO, SpringBoard West Innovations Inc.
Trina Foster - Vice-President, Business Development, Science-Metrix



Susan Gorges began by describing her group SpringBoard West Innovations, an association of serial entrepreneurs and market research analysts that work to surround intellectual property with viable businesses; that is to say, they work on technology commercialization. They help clients produce a fundable business case by working to identify a target market, creating the channel to that market, and then doing the financials, including developing the operations and recruiting a management team. This is a useful service, Gorges argued, because inventors often do not provide a clear case for the fundability of their idea, and are therefore generally discounted by financiers. The SpringBoard program, Gorges explained, has three elements: technology maturation, commercial maturation, and competitive intelligence.

Gorges suggested that, although robust funding for basic research in Canada generates many new ideas, bringing these ideas to the market can be challenging. Venture capitalists tend to invest in relatively mature projects with a proven market, management team, business plan, and exit strategy. However, "angel investors" are needed to bridge the "Valley of Death" between early-stage investment from entrepreneurs' friends and family, and late-stage investment from venture capitalists – and such angel investors are in short supply. Gorges argued that Canada should develop a technology acceleration fund to help entrepreneurs obtain the financing they need during this crucial period.

Chummer Farina began by noting that the Canadian Space Agency coordinates its operations with over 200 companies, universities, and research centres. Most of the design and manufacturing work is done by the private sector, generating approximately $2.8 billion a year, half of which comes from exports, and employs approximately 7,000 people. But Canada's space industry is more important than its direct economic benefits: space research attracts scientific and engineering talent, brings international recognition to Canada as a space-faring nation, and stimulates R&D investments by industry that spill over into other areas.

Space allows us to do things that you cannot do any other way. For example, the Earth observation satellites often provide key information: it was a Canadian satellite that provided data during the Haiti disaster to identify where malaria would break out, allowing disaster relief teams to prevent that from happening; the CSA has also developed technology that allows them to detect spills from ships from space; and advancements in agricultural management allow more informative soil data to help examine the impact of moisture levels, deforestation, as well as information to support the application of fertilizer to maximize yield. Satellites provide communication technologies that allow Canadians to communicate across the vast geographical expanse of Canada,

particularly in the far North, and global positioning systems have become very important for global commerce. Thus, for a variety of reasons, investing in space infrastructure should be fruitful for Canada.

Jean-Louis Legaul primarily discussed the nature and mandate of his organization. ADRIQ was formed in 1978, made up of research directors of large corporations along with university administrators who did not believe they had a voice influencing government policy on science and innovation. Between 1978 and 1991 they acted primarily to lobby the government, but discovered they could also provide other valuable research- and innovation-related activities. ADRIQ is now the main Quebec innovation network, with 60% of the 4200 memberships of the organization now made up of enterprises.

ADRIQ, as a networking organization, connects supplier and customers vertically within value chains, and organizations horizontally within clusters. It also links clusters between sectors and regions. The main impact of ADRIQ is near Montreal and Quebec City, but the organization is active across the province.

Jean-Francois Groux discussed the role of the Business Development Bank of Canada (BDC) in helping to create and support Canadian business through financing, venture capital, and consulting services, with a focus on small and medium-sized enterprises. The BDC's role is to take more risk that is normally taken by the market, and fill some of the gaps in the financial community in Canada. Groux pointed out that the point of venture capital is to build a successful company, not necessarily commercialize an idea. This requires the financier to be close to the company and work closely with management and co-investors, which is why foreign investors rarely enter in at the early stages of corporate development. Venture capitalists need to assess the likely return on investment, the capability of the management team, the quality of the technology, the competitiveness of the company, and whether the product fits into a clear market with the potential for sales growth over time. On average, a company takes 4-7 years to build an early-stage technology company and bring it to market successfully.

Mr. Groux agreed with The Impact Group's 2009 report suggesting that early-stage and start-up R&D performing companies typically fail because they do little work to identify and engage with potential customers during the product-development phase. Most early-stage entrepreneurs do not understand how their technology can be translated into other verticals so as to expand market share and move into new markets over time.

Trina Foster discussed how Science-Metrix performs research evaluation: primarily through bibliometric analysis, intellectual property measures, licensing, and qualitative measures to examine the impacts of research. The company, Foster explained, investigates how "the public investments and strategy at the federal level in terms of investments in R&D impact how the linkages play out and what the outcomes are at the end." In general, she reports, the federal commitment to R&D is increasing. Investments are being made towards expanding the labour pool, developing clusters, and bolstering public-private collaborations – but are these strategies having an impact?

Foster gave Genome Canada as a case-study of measuring funding impacts by examining whether or not Genome Canada's goal of identifying leading researchers and funding the best research in genomics had been met. Science-Metrix identified that through Genome Canada's funding, the impact of papers produced went up, but the researcher impact did not. So, while these initiatives are not changing what researchers are actually investigating, they are identifying strong researchers, with a good paper impact, helping them do good research that makes them more active on the international stage, and more involved in collaborations. What the Genome Canada case-study demonstrates is that providing funding on a large scale with a long-term, continuous commitment has an impact when compared with other initiatives that have been funding smaller, focused projects with short-term commitment. It also demonstrates, however, that stars shine, regardless of the amount of money is provided to them.

Global Perspectives in Science and Technology

the Canadian Science Policy Centre
better policies, better science

Advancing Science and Fostering Innovation through International Cooperation

Globalization has generated new patterns of networking and changed the way knowledge is generated. International collaboration between scientists, policy makers, governments, businesses, and non-governmental organizations is increasingly important for scientific research and innovation in the 21st century. This panel discusses issues related to international S&T collaboration, innovation, and sustainable development.

The Global Research Infrastructures, Research Collaboratories, Network-Enabled Science

Research infrastructure plays an invaluable role in connecting scientific communities across the globe, and is instrumental in data-driven research, "big science" projects, and global R&D collaborations. A strong research infrastructure enables researchers to connect and collaborate as advances in information technology provide scientists with new capabilities of data storage, acquisition, and sharing. This panel discusses issues related to the global dimension of research infrastructures, drawing on representative examples from Canada, US, and Europe.

Canada's Role in Science Diplomacy: Applying Science to International Challenges

As an emerging field, science diplomacy has increasingly attracted politicians, foreign relations experts, and scientists. The U.S.'s American Association for the Advancement of Science (AAAS) and the U.K. Royal Society's Science Policy Centre have established special programs on science diplomacy, and President Obama has accorded science a special place in his foreign policy. Canada – with its international legacy as a peacekeeper and its multicultural society – has much to offer in this field. This panel discusses Canada's opportunities for leadership in science diplomacy.

Plenary: Advancing Science and Fostering Innovation through International Cooperation.

Introductory Remarks
Chad Gaffield - President, Social Sciences and Humanities Research Council of Canada (SSHRC)

Chair
John McDougall - President, National Research Council of Canada (NRC)

Panellists
Joseph Hubert - Vice-President, Research and International Relations, l'Université de Montréal
Howard Bergman - Vice-President and Scientific Director, Fonds de la recherche en santé du Québec (FRSQ)
Peter Singer - CEO, Grand Challenges Canada
Ilse Treurnicht - CEO, MaRS Discovery District

The panel and its chair John McDougall, president of the National Research Council (NRC) were introduced by Chad Gaffield, who emphasized the role of the NRC in building our current "made in Canada" voice on research. Gaffield presented plenary chair John McDougall's work ensuring the NRC fulfills its role of fostering innovation.

McDougall began by describing CSPC 2010 as an exciting conference with an important topic, building on the previous year, and attracting many interesting people from government, academia, industry, and science policy. For the NRC as well as for science and technology, international collaboration is essential for creating and enhancing value and building win-win opportunities between Canada and the world. We need access to the global knowledge pool, and to advance science and foster innovation we need to share understanding of how networks work.

Joseph Hubert described several different models of collaboration. "Classical" models involve collaboration between individuals, and the exchange and co-supervision of students, while "classical extended" models involve collaboration between labs, centers, and institutes. The further extension of this model includes international laboratories (for example, INSERM and CNRS) that involve much larger collaboration, bringing together different areas of knowledge with an exchange of scientists between the laboratories. Transportation studies coming from l'Université de Montréal and l'Université de Laval are two examples of such international "collaboratories": the Centre Interuniversitaire de recherche sur les réseaux d'entreprise, la logistique et le transport (CIRRELT), and the Centre of Excellence for Early Childhood Development (CEECD). CIRRELT involves research centres in Finland, Montreal, and Norway. The results of this collaboration, in addition to standard academic output, have been the application of innovative industrial research in freight transportation planning for Norway.

CEECD, on the other hand, is an example from the social sciences. CEECD was created in 2001, conceived under the premise that children experience accelerated growth during their first five years, and that the education, care, and attention they receive during this period has a decisive effect on their future. The centre's aim is to improve and

disseminate knowledge about children's social and emotional development, so it is crucial that they get this information to policymakers and parents. The original national consortium produced an online encyclopedia of early childhood development, whose results were used for Canadian policy. This project was eventually expanded, offering customized results in Spanish specifically for Chilean society, and in Portuguese for Brazilian society. A partnership was eventually created with a Dutch private international foundation to focus CEECD's work on childhood development in underdeveloped countries, and an international network was launched for a new consortium with the aim of enhancing network expansion for increased global impact on the way people do research.

CEECD's innovation is to transfer knowledge of best practices that are adapted to the countries in which it will be applied, as well as to train early-career researchers in an international environment. International collaboration has increased the quality and local relevance of the encyclopedia, which is now used by over a quarter of a million people.

Howard Bergman's talk described the work of the FRSQ and the integration of Quebec researchers internationally. The FRSQ is not just where scientists go for funding, he said, as it has concrete responsibilities to plan, coordinate, support, and animate Quebec's health research sector, to develop partnerships, and to reap the benefits of health research for citizens. Its core programs support 19 research centers in Quebec university hospitals, as well as grants for students at many levels and career research awards. The FRSQ also has strategic structured research groups and 18 themed networks (including aging, cardiovascular health, cancer, pain, and suicide). These networks have a bottom-up structure uniting the "best of Quebec" in particular domains.

Bergman argued that research can no longer be done in isolation; it must be multidisciplinary, interdisciplinary, and part of university, national, and international networks. The FRSQ was the first provincial research foundation to have an impact at the national and international level - building innovative thematic networks and programs, helping Quebec scientists integrate into such networks, and targeting themes aligned with government priorities. For example, the FRSQ has bilateral targeted partnerships with France (Alzheimer's, personalized health care) China (progressing from a biannual colloquium on genetic medicine to a collaborative model targeting reasonable priorities) and Israel (drug discovery and development, as well as partnerships with industry). Through these partnerships, the FRSQ was challenged by needing distinct ways of functioning within foreign countries, even in France where the language was the same. The FRSQ's plan is to build on its existing themes and to develop new ones, as well as develop partnerships with India and the United States. Connecting to the European Research Area Network (ERA-NET) will both integrate scientists and facilitate Canadian and provincial funding organizations' fostering of multi-level collaboration via large research networks.

Bergman concluded that research in Quebec and Canada has to be seen in its developing international context. Research themes are too complex for one lab, one province, or one country. We must compete with and be compared with the best internationally, and federal and provincial funding agencies need to develop strategic priorities for collaboration. This strategy must draw from our own research community of experts; we have the responsibility to orient, facilitate and fund scientists' international collaboration, being careful that their funding applications do not make their lives too difficult. We must be aware of and respect their needs, and support their collaborative partnerships.

Peter Singer started by calling the CSPC a great, bottom-up, grassroots effort from young people, acknowledging the organizers as doing something very worthwhile, and encouraged sponsorship and support from organizations for next year's conference. For Singer, talking about international cooperation is a very patriotic thing, for it's really about how we see Canada's role in the world. How well have we elaborated our role?

We have so much innovation that "Canada as Innovator" could be our brand. But do we really have a strategy? Singer suggested that we do not. In global health, Canada has never taken a strategic look at our role in innovation. While we are currently launching an assessment of our role in global health, we ought to also consider how we want others to see us. Our comparative advantage is not necessarily power, but innovation, and grassroots meetings such as the CSPC are important for contemplating our international image and strategy.

One nimble, quick, and flexible way to do international cooperation is the "grand challenges" approach. Grand challenges have a history in mathematics, beginning with David Hilbert's challenge to solve his list of unsolved problems in mathematics at the beginning of the 20th century. Many people are still actively working to solve some of the unsolved problems Hilbert had listed; others have been solved in the 100 years since he posed them. The pressing problems of global health demand a shorter timeline, however, and in 2003, Bill Gates launched the Grand Challenges in Global Health, resuscitating this approach. The critical aspect of a grand challenge is its critical barrier that remains to be overcome (for example, discovery science, downstream delivery, or social issues).

Grand Challenges Canada launched in May, 2010; the first time that a country has funded a grand challenge in its foreign aid envelope. Following Canada's lead, USAID launched a service delivery grand challenge in maternal and neonatal health in September 2010. This is a prime example of an innovative role for Canada being followed by others. Yet the challenges to global health remain immense, including vast international imbalances in child and maternal mortality. Singer argued that this is neither fair nor right; thus, we need to do things differently and better, and this is both the definition and the role for innovation. In the 2008 budget, the Development and Innovation fund was meant to support the world's best minds, to bring about enduring changes for the lives of millions of people in poor countries; language like this is, unfortunately, not found in the foreign aid envelope of any other federal budget.

Grand Challenges Canada's mission is to identify global grand challenges in health, fund a global research community, and support the implementation of emerging solutions. It is the first non-governmental organization to take this approach, seeing grand challenges as addressing specific critical barriers that, if removed, would help solve important health problem in the developing world. Canada's core concept of grand challenges is one of integrated innovation between science and technology innovation, social innovation, and business innovation. The advantages of the grand challenges approach are that it provides focus; brings the best minds to the table; creates collaborative, global, and interdisciplinary communities; recruits new talent; captures public imagination; and provides a platform for global governance.

Singer concluded by situating the grand challenges approach as an opportunity for G8/G20 countries to pursue global health innovation and to rally around common goals, in a platform for cooperation and global governance.

Ilse Treurnicht first asked what fostering innovation through international cooperation means for technology and social businesses in Canada, and how this will influence policy. She argued that globalization of innovation is both an enormous threat and an enormous opportunity for emerging technology and social businesses in Canada, which inhabit a complicated landscape. The pace of innovation is accelerating, and many emerging companies have concurrently had to put the brakes on their development due to a lack of funding or early adopter struggles. Additionally, R&D drivers are shifting, and the flow of information around the world has

changed the way young companies work, as the barriers to entry have been lowered significantly. We must correspondingly rethink how we invest in, build, and capture value. The increasingly skilled talent pool in emerging economies has changed the way young companies think about talent. If entrepreneurial talent is the driver of global innovation, then the emerging economies are now a force to be reckoned with. The availability of risk capital is moving towards China, India, Brazil; venture capital used to be local, but now we can invest far from home. As a result, our young companies can and must look elsewhere for early adopters; however, since our border to the south has thickened, we are forced to look beyond the United States. We also must understand that a strong, outstanding scientific research base is needed for table stakes at the global innovation game.

Treurnicht's observations lead to the policy recommendation that Canada has to match our areas of excellence with what the world needs. We need to think about how we extend our national and international networks; if we can build a true collaboration model across this country to allow us to contribute to both national and international innovation systems, that collaboration will enable our collective success. We also need, she argued, to not only look at how our programs attract the best minds in the world to come to Canada, but also to augment our training of students through cross-cultural training and internships so our students are equipped to work both nationally and internationally. Expansion of business development is also needed, but there are problems in achieving this end: we currently do business too far removed from our customers, and our funding programs enable hiring another R&D person while not necessarily enabling the hire of a business development person. We need to build a risk capital system, and we need local partners to co-invest with other investors. Finally, we must diligently watch for complacency, despite Canada having emerged from the recession in a relatively strong position. Our innovation challenges and opportunities have only been studied pre-crash, requiring a deeper level of analysis of the subsectors where we may have a competitive advantage. We need to think about emerging economies and converging technologies, and seek and develop strategic foresight about where the world is going and how we can benefit.

To conclude, Treurnicht described how Canada is at a fork in the road: we must ask whether we are going to be a provider or a buyer of solutions. There are good reasons to build a global company from Canada in Canada today, so we can approach this challenge with some confidence, but we must move from blunt and superficial policy analysis toward deeper analysis identifying subsets of businesses, their needs, and their potential as drivers of job growth in the future. The next generation of Canadians needs us to focus on the challenge of growing "sticky" companies with deep roots.

The session ended with a question period focussing on Canada's competitiveness, our grandiosity problem (meaning that we need to execute on very specific focused challenges, rather than speaking overly abstractly about vague goals and agendas), our potential for development of innovative collaboration, and how we can accelerate our achieved export of excellence. Chair John McDougall finished the session by remarking that, through these kinds of discussions, we all come to better understand how innovative collaboration works and how Canada can be a part of it.

The Global Research Infrastructures, Research Collaboratories, Network-Enabled Science

Moderator
Paul Dufour - Principal, Paulicy Works

Panellists
Jim Roche - President and CEO, CANARIE Inc
Susan Baldwin - Executive Director, Compute/Calcul Canada
Martin Taylor - President and CEO, Ocean Networks Canada

Jim Roche first provided a brief overview of CANARIE and explained the importance of the network, both as an internet communications infrastructure and as an internet technology research testbed.

CANARIE is an "advanced digital infrastructure," providing a high-capacity, high-bandwidth internet backbone connecting research institutions around Canada. CANARIE also supports specific sorts of research, particularly on infrastructure-related applications that are not in the mandate of the Tri-Council organizations. Additionally, CANARIE funds equipment upgrades, connects new institutions as nodes, and funds projects that enable greater access to the CANARIE network.

CANARIE provides the robust internet communications network needed by researchers. This network allows researchers to collaborate over distances and run experiments remotely; and with the increasing use of physical data collected by remote sensors, networks such as CANARIE allow for the transmission of this sensor data to multiple-research sites. CANARIE also works on developing "middleware" (integrated technologies that are both hardware and software). For example, CANARIE works to develop technology capable of providing cloud computing services, as well as technologies capable of providing long-term storage of data from scientific experiments, openly available to the scientific community for future use.

Roche also discussed the benefits of CANARIE for innovation in Canada. One of the weaknesses of the Canadian digital infrastructure is that there is not a single group responsible for developing that infrastructure. The CANARIE network itself provides a test-bed for new internet-related hardware and software technologies, reducing the development costs for domestic internet communications technology firms. So not only does the network itself allow for the training of new employees on the leading edge of internet technology development, but it can also act as an accelerator or catalyst for innovation in Canada.

Whereas CANARIE provides the physical infrastructure to move data around the country, Susan Baldwin discussed the organization charged with creating Canada's supercomputing capacity: Compute/Calcul Canada. Its mission is to create a national platform of high-performance computing (HPC) and data-sharing services and to develop the personnel to use and maintain those computing systems. The organization provides not only the physical computing capacity, but also the service personnel to help researchers apply the correct

methodology to analyze their data, making that analysis much more effective and efficient.

Compute/Calcul Canada, Baldwin says, is working toward establishing HPC-related internships in businesses and small and medium enterprises (SMEs) to help connect those businesses with HPC resources and help generate a receptor community, thereby connecting computing graduates with SMEs who can use their talents. They also run a series of workshops across Canada to help researchers understand how to connect to HPC resources and how they can best utilize that computing capacity. Compute/Calcul Canada is involved in many major national and international scientific collaborations, including CERN and a project run by NSERC that works with other G-8 nations to examine and develop potential for exascale computing.

Baldwin explained that a lack of sustained funding has been one of the main challenges facing Compute/Calcul Canada, making it difficult for the organization to enter international agreements and develop long-term plans. HPC infrastructure in Canada has been treated as a short-term project, rather than as a fundamental, shared infrastructure needed by researchers, both industrial and academic, moving forward. Baldwin argues that Canada needs to continue to invest in HPC as major research projects will increasingly demand HPC capability, and that continuing to invest in this area will provide as essential infrastructural capacity to our academic and industrial researchers.

Martin Taylor began by using his own organization, Ocean Networks Canada (ONC), as an example of an international collaboration that makes use of the kinds of infrastructure provided by CANARIE and Compute/Calcul Canada. “We are an example of the kind of network that has been enabled [by this infrastructure]” he said, as the role of ONC is to support and develop NEPTUNE Canada and VENUS as world-leading underwater ocean observatory networks. The instrumentation and physical infrastructure was designed for the project through an international consortium, and represents a complex array of new technologies and applications. These projects strive to develop transformative ocean research, provide data that can inform public policy, inspire public engagement in our ocean environments, and stimulate commercial development. The network consists of a series of nodes connecting seismic, chemical, visual, and fluid flow instruments. The cable backbone that relays the signals back to a shore station connects to the University of Victoria, on the mainland, via the CANARIE network.

ONC also connects with the numerous federal agencies responsible for managing oceans, and is working with those agencies to find new kinds of relationships and modes of communication that help break down some of the inherent barriers that exist when large, diverse organizations attempt to coordinate large projects. ONC is also connected with the U.S. Ocean Observing Initiative, which is developing its own Pacific West Coast observation array, and the European Ocean Observatory, but Canada is on the leading edge of wiring the oceans, preparing both for further expansion of under-sea internet cabling and new power generation efforts such as off-shore energy generation.

During the question and answer period, Michelle Burns from the Department of International Development in the U.K. asked how the organizations represented by the panel are dealing with the challenge of constantly being asked to document the impact of their projects. Taylor responded that the Canadian Foundation for Innovation has set out criteria subject to international peer review used for ongoing measurements of assessment, so the process is relatively streamlined. Another question asked how the infrastructure built by these organizations might sustain the withdrawal of financing by the governmental funding bodies. Taylor said that it depends on whether you’re considering the people or the physical infrastructure. One consequence of short-run operating funding is that if senior employees who are in high demand begin to fear for the sustainability of their jobs, they often move on to other opportunities, leaving key voids in the organization. The physical infrastructure lasts longer. Susan Baldwin then pointed out that Compute/Calcul Canada’s funding also pays for ongoing operations.

Canada's Role in Science Diplomacy: Applying Science to International Challenges

Moderator
Valérie La Traverse - Deputy Director, S&T Relations, Foreign Affairs and International Trade Canada

Panellists
Naser Faruqui - Director, Innovation, Policy, and Science, International Development Research Centre (IDRC)
Daryl Copeland - Author, Professor, and former Diplomat, University of Toronto
Nina Fedoroff - Willaman Professor of the Life Sciences, Evan Pugh Professor, Huck Institutes of the Life Sciences, Penn State University

Daryl Copeland started his talk by saying there is something unique about the way science diplomacy works, for there is a disconnect between how science works on one hand, and how diplomacy works on the other. He argues in his book *Guerrilla Diplomacy* that if development has become the new security, then diplomacy must replace defence at the center of international policy. Copeland defines "diplomacy" as an approach to international relations characterized by dialogue, engagement, and communication to implement world order without war. In this formulation, public diplomacy in particular is placed front and center, meaning that science policy, when a component, is also front and centre.

Traditional diplomacy differs from public diplomacy, Copeland claimed, for traditional diplomacy is when government bodies speak to each other, whereas public diplomacy directly connects the government with the public. In order to demonstrate Canada's role in this kind of diplomacy, thinking in terms of hard vs. soft power proves useful, where hard power is the ability to bring about one's wishes through coercion, and soft power is getting what you want through attraction, influence, or persuasion. Soft power, in short, is about getting what you want because people like you, rather than through threats and strong-arming people.

Canada does not have many hard power options, so soft power and public diplomacy are really our only option, Copeland claimed. Canada enjoys a significant advantage in terms of soft power, Copeland argued, as we do not carry significant colonial baggage, and we have an overall positive global reputation as nice and non-threatening. Canada has the soft power elements, the capacity, and the representational capacity in the Foreign Service necessary to make a contribution to science and technology development and security. In order to achieve this, the Foreign Ministry must be re-imagined so it will be able to handle science and technology issues.

Since the real threats to world order reside in a global suite of challenges driven by technology and rooted in science, science diplomacy needs to be used to solve them. What is necessary, Copeland said, is the ability to generate and absorb science knowledge in diplomacy to help avoid underdevelopment and insecurity. He went on, saying that science policy should obviously occupy a central role in this. Yet science and technology remain unfortunately alien to many governments and institutions, for science is often seen as complex and impenetrable. Few diplomats are scientists, most diplomatic agencies are woefully under-trained and under-prepared to handle scientific issues, and most governments are

spending far more on defence and security than on science, technology, and R&D.

To meet these challenges, the department of foreign affairs will need to create a science advisor, and we also need to create a new bureau dealing with science and technology issues, located between the trade side of the house and the political side of the house. Professor Copeland summarized and concluded his talk by saying that Canada could address these global challenges through the soft power of science diplomacy. Given our resources and political will, these investments could pay handsome returns.

Although he does not describe himself as a diplomat, Naser Faruqui has spent a significant amount of time on the ground in developing countries working on scientific-based outreach. His talk focused on the role the IDRC has played in scientific diplomacy in developing countries, where it cooperates with developing countries to solve practical problems with science and technology. Many problems in today's world flow freely between borders, and we all have a stake in solving them, claimed Faruqui, meaning solutions can come from anywhere. Hence, the IDRC promotes global collaborations to facilitate cutting-edge research. IDRC also aims to build local capacities to meet challenges in the developing world, e.g. regarding the impregnation of bed nets with insecticides. A pilot program for these bed nets appears to have lead to significant decreases in diseases like malaria.

The IDRC also goes beyond simply funding research. IDRC staff scientists, for example, engage and mentor scientists in the field. They also have a responsibility to broker knowledge, i.e. to make sure that researchers and policy makers have access to the necessary information. Additionally, the IDRC supports programs like the Young Einstein program, which takes the highest-achieving university students from across Africa and places them in a one-year intensive mathematics course in the hopes of unlocking scientific talent in Africa. This support should help to alleviate local problems by supplying locals with mathematical tools needed to solve them. Such investments are the right thing to do, Faruqui stated, but it is also an investment in Canada's future prosperity as it assists Canada's strategic interests. Development aid allows Canada to create highly skilled partners with whom we can communicate and innovate. Furthermore, Faruqui claimed, Canada can also learn from less developed countries, e.g. from Jordan's innovative greywater technologies. In conclusion, Faruqui reiterated three reasons to collaborate with developing countries: to tackle shared challenges, aid development, and to build trust and openness. All three of these enhance global stability while helping Canada achieve its own interests, so "science collaboration with developing countries is cost-effective with high returns."

Nina Fedoroff started her talk by saying that she was excited to take part in a panel where the global vision of science diplomacy was already being borne out. Science has been used historically to gain a competitive advantage in the military sphere, economic sphere, and most recently in space, but U.S. science diplomacy is moving away from its focus on weapons towards supporting scientific collaboration.

Focussing on her own experiences with collaborative programs as part of the U.S. State Department, Fedoroff stated that the basic mission of the U.S. Science Advisor is to increase literacy about science and technology in the State Department. In particular, when acting in this role, Fedoroff worked to provide a science background to those entering the Foreign Service. The program connected diplomats with scientists and alerted them to the problems that occupy the intersection of science and policy. Her office also organized workshops and hosted scientific briefings, such as an international conference that brought university presidents together to talk about the university's role in science policy and diplomacy.

Fedoroff closed by mentioning President Obama's recent speech in Cairo, Egypt, which promoted collaborative communication with Islamic countries regarding science and technology. The program that was referenced in that speech, the Science Envoy program, has recently been gaining a lot of traction, as the first two envoys have been well received and a third will soon depart.

Creating and Retaining Scientific Talent in Canada

the Canadian Science Policy Centre
better policies, better science

Science Policy in a Diverse Society: Canadian Challenges, Canadian Solutions

Canada is becoming one of the most diverse countries in the world, and our science policy must reflect this diversity. It is no longer sufficient, if it ever was, to view science policy from solely a federal government perspective. Our science policy must build bridges not just across all levels of government and all sectors of the economy, but also with all parts of our multilingual, multicultural society. This panel explores the challenges and opportunities related to building a strong science culture in our diverse society.

The Making of a Science Entrepreneur

The Federal Science and Technology Strategy speaks of fostering in Canada "a culture that values and rewards ingenuity and entrepreneurship." This workshop provides an interactive opportunity to examine the concept of Science Entrepreneurship. Participants explore the potential of scientists as entrepreneurs and the role of entrepreneurship in science. What are we trying to achieve by promoting this concept? Should science entrepreneurship be built into our educational pipeline, and if so, how? How can we best foster science entrepreneurship at the provincial and federal levels?

Career Development Workshop

This is an interactive workshop for those interested in careers in science policy, but not sure where to turn. The workshop explores career possibilities and job-seeking strategies in science policy, giving participants the opportunity to hear from and interact with a variety of science policy professionals at various stages of their careers, who all have walked quite different paths to get to where they are. Whether your background is in the sciences, engineering, public policy, or anything else, if you have an interest in working in science policy this workshop is an excellent opportunity to expand your professional network. The workshop is also your opportunity to suggest how the Canadian Science Policy Centre can best support your career development needs and aspirations in science policy.

Science policy in a diverse society: Canadian challenges, Canadian solutions

Moderator
Ursula Gobel - Director of Communications, Social Sciences and Humanities Research Council of Canada (SSHRC)

Panellists
Yves Gingras - Canada Research Chair in History and Sociology of Science, département d'histoire, Université du Québec à Montréal (UQAM)
Denise Amyot - President and CEO, Canada Science and Technology Museums Corporation
Raymond Lauzier - Chair, Science Advisory Committee, Professional Institute of the Public Service of Canada (PIPSC)

Yves Gingras started the session with a spirited talk focussed on the maximization of results from federal funds marked for educational advancement. He first gave two conditions for good policy-making for science: understand the social system of science, and make decisions based on evidence, including a serious analysis of unintended consequences. For despite our good intentions, using policy to intervene in complex social systems can sometimes have negative effects we did not intend.

Scientists, Gingras noted, are primarily motivated by symbolic recognition, rather than high salaries; if one wanted to be rich, one would not dream of being a scientist. Scientists want good laboratories, resources to carry out their projects, and other job-related perks. Scientists do not change jobs or institutions because of a higher salary; rather, they do so because they could not carry out their research where they were. However, many current policies for science were made under the false assumption that scientists are primarily motivated by money. As a result, these policies have had unintended negative consequences that often go unacknowledged.

Gingras gave three examples of funding policies for science that had negative, yet generally unacknowledged, unintended consequences: the Vanier Canada Graduate Scholarships, the Banting Postdoctoral Fellowships, and the Canada Excellence Research Chairs (CERCs). In each of these examples there is a trend: policy decisions were heavily informed by lobbying and other organizations, and lacked Tri-Council input.

The idea behind the Vanier awards was to motivate Canada's best and brightest to stay in Canada to conduct their research by giving top students awards of $50,000/yr, which dwarf other student awards; yet when we understand the social systems of science, it becomes clear how the best in science will not be attracted by the best money. The unintended consequence here is that you change the notion of "the best" from the most novel or inventive to the highest paid. You also end up with an uneven structure in the system: a $50,000/yr PhD student may make more than a faculty member in the same lab. Similar criticisms were made of the Banting Postdoctoral Awards. In this case, Gingras claims, the decision to create this award was not made on basis of real evidence about the needs and motivations of committed and impassioned scientists; rather, it was created for politicians to gain visibility, meaning that "politics was brought to the sciences in the worst way." Gingras argued that CERCs, as large sums of money given to well-established, outstanding scholars, offer diminishing returns, for in selecting the most excellent scholars the policy picks out those that have already made their major contributions, dumps money on them, and simply asks them to be more excellent, despite already being quite excellent.

Implicit in all these policies for science, Gringras points out, is a transformation from symbolic incentives to economic incentives. These policies try to get scientists to act and value themselves in terms of dollars rather than in usual standards of scientific success. Yet economic gaps between scientists produce social gaps, which is not conducive to the success of modern science, which always takes place in collaborating groups. The most efficient way of spending money, Gingras argued, would be to give small gifts where it can make the difference between having an adequately funded project and no project at all; as it stands, Canadians are not maximizing the impact of their investments because policies have been based on visibility and lobbying, not evidence.

Raymond Lauzier's talk focused on the balance of the three pillars of Canadian science and technology: institutions of learning, business enterprises, and government research and design. The importance of striking a balance pertains to a variety of goals, such as promoting economic prosperity, preserving the environment, and protecting Canadians. In response to the underperformance of the country's innovation record in the 1990's, there was a shift of resources to universities and university research. The result, claims Lauzier, was world-class Canadian universities.

Yet concern over research and innovation continues, said Lauzier, and metrics show that, compared to the U.S. and the OECD average, Canada lags behind while funding in Canada remains well below the G7 average as the gap increases. Furthermore, Canada's S&T policy has moved government funding away from research and design, leading many scientists to begin claiming that infrastructure is eroding. Infrastructure erosion is an important political issue, internationally speaking, because it impacts Canada's ability to meet international collaborative research obligations.

In Canada, Lauzier noted, scientific capacity is linked to public service renewal. Our scientifically trained civil servants are aging quickly, yet in the 2010 budget, the government cut the amount given to science-based public service. Federal S&T policy, Lauzier argued, should focus on recruiting new scientists to public service; but even with an infusion of new blood, they cannot fill all the open positions throughout the hierarchy, so even mid-career scientists will have to be recruited to the top jobs. Lauzier finished by cautioning that few voices speak on behalf of the public, that Canadians need to stand up and engage their government to create science policy that can help the public, and that public science remains part of a solution to Canada's productivity and innovation problems.

Denise Amyot began by stating that innovation is a contributor to our well-being, and that a lack of it is a detriment. She pointed out that Canada has a long history of innovation, from the alkaline battery to the zipper, so one would think and hope the future will be good; but, Amyot claimed, the future doesn't look that good, as we face a generational challenge. Who will innovate if all our scientists simply leave the country due to brain drain? This is a problem for the public, too, as we all need scientists in order to make evidence-based decisions. The government needs to pursue the creation of knowledge, and determine how to apply that knowledge, and for that they need scientists. Yet the actual workings of science are underappreciated: most people don't know or care until they have difficulty applying it.

Amyot proposes that we emphasize creativity in science at an early age, permeating Canada's educational curriculum with science, from kindergarten and grade school, not just in university, and that we need new models of public engagement with science. The national museums can help engage the public in science in several ways: with "virtual hubs" that link various users that help populate the hub with information, serving as an aggregator of information necessary for cross-institutional engagement. Another example is the pan-Canadian energy literacy initiative, a six-year program where a network of institutions will contribute to the dialog on energy. It is a physical and virtual space designed to help citizens know what energy is about, showcase new energy technologies, and to engage the public in changing their relationships with energy. Amyot concluded by noting that, at the end of the day, if the public is not with science, neither science nor the job market will flourish.

Workshop: Career Development

Workshop Leaders
Jeffrey Kinder - Manager, Science and Technology Strategy, Natural Resources Canada
Eric Gagné - Director, Science Policy Division, Environment Canada

Invited Participants
Eleanor Fast - Program Director, Council of Canadian Academies
Marcius Extavour - AAAS Science and Technology Policy Fellow, United States Senate Committee on Energy and Natural Resources
Jen Hiscock - Science and Technology Advisor, Natural Resources Canada

Jeffrey Kinder opened the session on career development by introducing himself and his co-participants. After Kinder reminded the group that science policy includes both policy for science and science for policy, Eric Gagné gave a welcoming in French as a way of encouraging participation in either official language. Both Kinder and Gagné explained that the session was only going to be profitable if the group participated, so they continued this highly successful workshop with an icebreaker.

Everyone was asked to stand up and locate themselves on an imaginary map of Canada. The map quickly had to expand since there were participants from Boston and Washington D.C. present, along with a nearly complete cross-section of Canada. Once people were situated, Kinder and Gagné invited everyone from East to West to introduce themselves to the room. The participants were largely doctoral students and post-docs, mainly from Montréal, Ottawa, and Toronto. There were also several participants on the employment side of the equation, from places like university administration and government.

After the icebreaker the participants were invited to go to one of four writing easels situated in the four corners of the room and brainstorm, in small groups, a response to the question "What do you need to get into science policy?" Each group wrote their responses to the question and then nominated one person to present their findings to the room. As the summaries were presented it became obvious that each of the four groups had interpreted the question differently. Some groups had chosen to focus on the skills required for a career in science policy (communication and subject knowledge), others had focussed on job searching (cover letters and resume building) or career paths (government, media, or university). This resulted in a rich variety of answers, with one answer constant to all four groups: networking. Everyone in the room agreed that meeting and connecting with people in science policy was the best way to get into a career in science policy.

Both the session organizers and the three invited participants then gave a summary of how they got into science policy, describing their varied but similar backgrounds. All five of them started in science and engineering degrees, and all of them realized while pursuing their education or sometime early in their career that what really excited them were the consequences of science and technology, rather than the actual practice of science or engineering. Every single one of them used 'passion' to describe how they knew they had found the perfect career path for themselves. They described how the combination of luck, networking, being in the right place (Ottawa) at the right time, and hard work had got them started in their career path, and they described the varied ways to get into science policy (further education, fellowship, internship, volunteer work, Engineers without Borders, or even a seemingly unrelated government contract). The variety of careers the five participants represented demonstrated how exciting and challenging the field of science policy can be.

Following these personal histories the full group was again put to work brainstorming questions regarding what challenges each person thought they might face in getting a career in science policy. Kinder and Gagné split the questions into four categories: “networking,” “can I do it?”, “information,” and “education.” Everyone was asked to go to the category that appealed to them most and to brainstorm answers and solutions to each of the questions. Once the groups were finished coming up with solutions they were asked to go around the room marking the four boards with stars for their preferred strategies in each category.

Each of the four categories focused on similar solutions, with networking remaining a key component at all four stations. Given the prevalence of networking in both discussions the whole group then brainstormed ways that the Canadian Science Policy Centre (CSPC) and Conference in 2011 could improve networking opportunities. While it was generally agreed that the 2010 conference provided a great opportunity for networking, it was also suggested that the CSPC could perhaps maintain a job bank, acting to facilitate one-on-one connections between experienced policy workers and aspiring policy wonks. This might include a type of mentorship where experienced members of the science policy community could reach out to the more junior members, answering questions they might have about career possibilities. In order to kick-start some of the potential networking initiatives, Kinder and Gagné collected the names and email addresses of everyone present.

Another suggestion to come out of the workshop was that science graduate degrees could make room for a communication or policy requirement within the degree; this was taken as a suggestion that the CSPC could work with universities to have some such requirement added to curricula. It was not expected that the CSPC could actually alter the degree requirements of any university, but it was suggested that the CSPC could gradually build an argument in favour of such requirements.

In the last few minutes of the session Kinder explained what a day in his life looks like, so that attendees would know what sort of work environment they were striving to get in to. The day previous he had participated in an interdepartmental Assistant Deputy Minister meeting at 8:30am, which happens every other Tuesday and includes the twelve government departments with science mandates. Following this meeting he had to deal with urgent "fire-fighting": issues that are not anticipated to be part of his daily agenda, but crop up on a regular basis and have to be answered in time to prepare the Minister for question period. In this case, he had to deal with the recent negative press NRCan received due to the “muzzling” of government scientists. His afternoon was spent in a workshop devoted to integrating science and policy more effectively.

The session was even more popular than the organizers had anticipated. Over 35 people attended. It was widely agreed that this workshop, or a variation of it, should be held as part of every future Canadian Science Policy Conference. It was also the general consensus that 2010 conference had provided many opportunities for networking, but that the Centre could, given adequate resources, take specific actions to connect senior and junior members of the science policy community for career coaching, both during future conferences and in between annual conferences.

Workshop: The Making of a Science Entrepreneur

Organizer
Jeffrey Kinder - Manager, Science and Technology Strategy, Natural Resources Canada

Moderator
Shiva Amiri - Science and Innovation Officer, British High Commission

Panellists
Bonnie Schmidt - President and Founder, Let's Talk Science
Peter Hackett - Executive Professor and Special Advisor, Vice-President of Research, School of Business, University of Alberta

Shiva Amiri opened the session by introducing the two speakers and their topics. Schmidt was to talk about the science half of making science entrepreneurs and Hackett was going to cover the entrepreneurial side. Before getting started with the talks, Amiri queried the audience to get a sense of their backgrounds, revealing that they were overwhelmingly from the university sector.

Schmidt spoke about the difficulties of teaching science entrepreneurship. She explained that the current method is to attempt to layer additional skills onto scientists. She pointed out that, with a few exceptions, this method simply does not work when trying to convert scientists into entrepreneurs. And not only that, but Canada is currently producing less scientists and engineers according to the latest OECD reports. She added one complaint about the OECD report: it does not count *college* students who are in science, technology, and engineering streams.

Schmidt's preferred method for imparting science entrepreneurial skills is not to give business skills to PhD candidates, but to use outreach at much younger ages. Let's Talk Science goes to elementary and high schools to give students hands-on experience with science, which she feels is valuable because teachers generally do not accommodate the kinaesthetic, hands-on learners. These tactile learners tend to be the kind of tinkerers who could simultaneously be effective scientists and entrepreneurs, but they often do not discover a love of science in the current educational system. Schmidt is convinced that outreach is highly effective in increasing the number and variety of capable students pursuing science and engineering degrees.

After her description of Let's Talk Science and her efforts at outreach, Schmidt then asked the audience to discuss five questions in small groups: What are three practices to increase youth engagement? What are three characteristics of a successful entrepreneur? What are three ways to teach entrepreneurs? What are the top three measures of success? Who should be teaching entrepreneurial skills, and where should they be taught?

The group's answers followed the lead provided by Schmidt in her talk. Three practices that increase youth engagement listed by the audience were: mentorship, science fairs. and learning modules. The audience came up with more than three, somewhat conflicting characteristics of a good entrepreneur: stubbornness, a broad perspective, an open mind, an ability to communicate, and a willingness to take on risk. Five useful teaching practices that the audience came up with were: discussion of case studies, mentorship, cooperative programs, workshops, and competitions. For the fourth question the audience suggested five possible measures of success: number of

companies, number of repeat or serial entrepreneurs, social and economic impact or value of innovations, the diversity of entrepreneurial ideas, and the increased productivity of the Canadian economy. It was widely agreed that entrepreneurial skills could be successfully taught in different ways, by people operating at all levels of education.

Hackett's main point was that Canada is a place, currently, with a lot of barriers preventing effective entrepreneurship. His talk was a whirlwind of examples and statistics in support of this claim. He gave a definition of entrepreneurship as the act, by a company, of commercializing as a product what was previously only a technology. For entrepreneurship to occur, creativity is absolutely essential and a person must want to "win" rather than simply be right. Hackett listed seven other necessary conditions for entrepreneurial success: having experience, customers, sales, mentors, being smart with money, having access to capital and talent.

Hackett then discussed two measures indicative of Canada's poor performance. First, Canadian venture capitalists tend to make a two percent return on their investment, ten times less than their American counterparts. Second, Canada is consistently producing fewer PhD's than other countries; this, at best, will replace the existing professors. He also pointed out that the current education system has a tendency to teach the skills required in the past, not the ones that will be needed in the future.

Hackett then listed his four barriers to successful entrepreneurship in Canada. Culturally, Canada has always been a resource-producing country. Government and university policies also do not support industry or venture capitalists, having over-regulated the potential for spin-offs. Intellectual property rights, claimed at numerous other points during the conference to be a problem area in Canada, were also seen as a problem by Hackett. Last, he noted that there are often idiosyncratic barriers.

Hackett then asked the groups to discuss four questions: What are three ways to improve the culture of support? What three actions could be taken to remove barriers in academic institutions? What three actions that could be taken to remove barriers in government agencies? And, like Schmidt, what are the three best measures of innovation?

The audience came up with a variety of interesting answers that went beyond Hackett's and Schmidt's talks. Three ways to improve the culture of support that the audience raised were: to encourage the raw energy of highly skilled immigrants rather than putting barriers up to prevent competition with existing Canadians, using taxes and tax breaks to incentivize returns rather than only investments, and to think globally. Regarding barriers within academia the audience had several suggestions: fix the rewards system by including patents as well as publications, encourage cross-disciplinary problem-solving, award business sabbaticals, clear up ownership of intellectual property, reduce the time-consuming overhead of winning and maintaining grants, realign faculties for the 21st century, and broadcast success stories with a national award of high honour. The audience had less to offer for the barriers within government agencies: they suggested only that there should be a more intelligent granting system and that public service should be of the highest quality. For the final question on measures of innovation, the audience added some new possibilities to those previously discussed, including exports, job creation, and the lifespan of companies.

Hackett and Schmidt then asked for three main messages that could be passed along to the CSPC from this workshop. The audience responded that there needs to a way to bridge the science and entrepreneurship within government, academia, and industry. The audience also agreed that it was important to point out that there is a lot more at issue here than money. Finally, the audience suggested breaking down all the barriers discussed, especially those associated with granting and peer review; creativity of all types should be rewarded.

In the ensuing discussion, Andrew Munro noted that there was no discussion of research within industry, and that most of the examples discussed during the workshop were not researchers. He suggested that a better understanding could be gained by comparing locations with low barriers (Waterloo) and high barriers (Guelph).

The Next Big Questions

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Major Issues in Canadian Science Policy

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better policies, better science

Arctic and Northern Science Policy: Canadian Responsibilities

Canada's North is a unique part of our planet's diverse biosphere. At the same time, its expansive geography and remoteness present Canadian industry and researchers operating in the North with many challenges and opportunities. The ecological significance of Canada's North, especially its Arctic and Polar regions, also presents Canadians with certain environmental responsibilities. As we come to understand the wide variety of data coming in about the Northern regions of our planet as a result of the International Polar Year (2007-2008), Canada's role in Arctic research, industry, and environmental stewardship becomes clearer. This panel explores Canada's science policy in the Arctic, addressing the issues and concerns of the wide variety of stakeholders in this resource-rich region.

Educating Socially Engaged Scientists and Engineers

Successful science policy requires all stakeholders to communicate and interact effectively. Socially engaged scientists and engineers share this responsibility and must be adequately prepared for the task. Unfortunately, the status quo in Canada is inadequate in educating future scientists and engineers to become socially engaged leaders. This panel dissects current shortcomings and discusses helpful models and possible solutions to this important Canadian issue.

Federal-Provincial-Municipal Governments: Where is the science policy nexus?

Coordination among different levels of governments is important to ensure the implementation of effective science policy, as lack of such coordination will often negatively affect innovation and commercialization. This panel discusses deficiencies in our decentralized system and suggests models for improvement. As part of this strategy it is important to ensure our systems enable and encourage Canadian and foreign investment.

Arctic and Northern Science Policy: Canadian Responsibilities

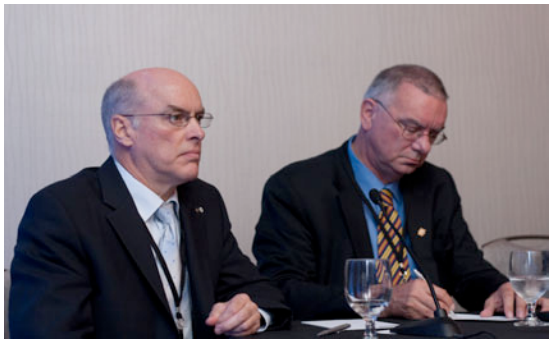
Moderator
Anita Dey Nuttall - Associate Director, Canadian Circumpolar Institute, University of Alberta

Panellists
David Hik - Professor, President of the International Arctic Science Committee, University of Alberta
Louis Fortier - Professor, Director of Arctic Net, Université Laval
Stephen Bocking - Professor and Chair, Environmental and Resource Studies Program, Trent University
Peter Harrison - Professor and Director of the School of Policy Studies, Stauffer-Dunning Chair in Policy Studies, Queen's University

Anita Dey Nuttall opened the session by introducing each of the speakers, and thanking the CSPC organizers for the inclusion of a session on Arctic and Northern Science. She stressed the importance of this panel, as it comes in the midst of the analysis of the data accumulated in the International Polar Year of 2007-2008. She then suggested that there are subtle but important distinctions between Arctic, Northern, and Polar issues. She expressed the opinion that the more important unifying question the panel would answer was “why doesn't Canada have an Arctic/Northern/Polar policy?” rather than “why should Canada have such a policy?”

David Hik spoke first, arguing that Canada needed a Northern policy responding both to climate change and issues of sovereignty, economic and social development, and environmental protection. To do this, he argued, we first need a strategy to sustain and enhance knowledge. Second, we need to build research capacity in the North. Third, we need to find a way of enabling science policy. Hik emphasized that Canada had assumed a leadership role in the International Polar Year by contributing in excess of $156 million, but we still have a lot of work to do in managing and analyzing the data collected so as to implement a policy that integrated international collaboration, national and territorial needs, and scientific support.

Louis Fortier followed Hik, reinforcing many of the same points. Fortier claimed that Canada currently has advisors, but is nevertheless in serious need of policy. Canada needs policy to ensure that the advice is followed, and so that we can build on the existing blueprint. The Arctic Net, International Polar Year, and Canada Excellence Research Chairs were all examples of successes in Northern science, but they need to be built on. Climate change is having an impact on the Inuit as well as opening up new seaways and access to the oil reserves. Canada needs a science policy to deal with all of this, and it must, in particular, be integrated with a policy for transportation and science for transportation.



Stephen Bocking spoke third, departing from the rest of the panel (and much of the rest of the conference) to give a historical perspective on science policy in Northern Canada. Bocking spoke about science,

especially environmental science, in the Arctic from the 1940's to the 1980's. Explaining how and why there has never been an integrated Arctic science policy, Bocking discussed how Arctic science in Canada's North has nevertheless been shaped by several specific policies, ideas, and understandings of the Arctic, as well as by the various unique opportunities presented to scientists by Canada's North. He also suggested that the science done in the Arctic has influenced how we think about the Arctic. The North has gone from contested terrain, to resource frontier, to domesticated landscape, to fragile wilderness, to indigenous homeland, and finally to a global laboratory. In short, the policies and priorities of the federal government (from continental defence, to Northern development, to environmental protection, to Aboriginal self-governance and land claims negotiations, to globalization and resource management) have shaped the science done in the North, which in turn has shaped policies and priorities.

Fourth and finally, Peter Harrison spoke. He reminded the audience that 40% of Canada is in the Arctic or Subarctic, and that unlike most other countries, Canada maintains a significant human population in its northern regions. Because of the relevance of this human dimension in Canada's North, Harrison pushed for including such issues in the upcoming International Polar Year Conference (to be held in Montréal in 2011), in addition to the normal concerns about domestic and foreign affairs. He felt that the main challenge of the International Polar Year was that scientists, rather than policy-makers, were the ones planning the event. The ongoing challenge for science policy in the Arctic, he argued, is going from knowledge to action, a challenge that Harrison suggested was shared by the Canadian Science Policy Conference, where knowledge has to be made useful and digestible for those who can act. To encourage people to attend the upcoming conference in 2012, Harrison described the four themes that the International Polar Year shares with CSPC: highlighting successes, synthesizing findings, linking knowledge with users' needs, and advancing science education and outreach.

The panel then received questions from Martin Taylor, Jean-Philippe Lebleu, and Duncan Stewart. Taylor's question was about building and incentivizing a network of scientists. Lebleu and Stewart were interested in managing and balancing science, development projects, external demands for resources, and the concerns of Northern populations. Fortier answered the first question by explaining that money was available from places like the Canada Foundation for Innovation, and that this was an extrapolation of Geneviève Tanguay's talk in the morning plenary about building from areas of strength. The panellists responded to the other set of questions by looking at examples of big projects from the past that ignored local concerns in favour of meeting national energy requirements and the regulation required for these projects; the panel welcomed the increasing inclusion of Northern Canadian communities in the discussions, taking such inclusion as a sign of social justice and good national policy. Dey Nuttall wrapped up the discussion by suggesting that the conversation of Arctic/Northern/Polar policy is only just beginning, and that the data gathered during the International Polar Year will present new challenges for science policy discourse in Canada.

Educating Socially Engaged Scientists and Engineers

Moderator
Josée Nadia Drouin - Writer/Blogist, Director, Agence Science-Presse

Panellists
Govind Gopakumar - Assistant Professor, General Studies Unit, Concordia University
Jonathan Fishbein - Coordinator, Curriculum Enhancement, Engineers Without Borders
Hans Hilgenkamp - Professor of Physics, University of Twente and Leiden University, Netherlands, Co-Founder of The Young Academy of the Royal Netherlands Academy of Arts and Sciences
Amir Khadir - Member of National Assembly for Mercier

Josée Nadia Drouin began with an introduction of all the speakers, a welcoming of the audience, and a description of the topic of the panel: a discussion of our vision for scientists' social engagement. How can we teach, foster, learn, and encourage our engineers and scientists to work towards socially just and equitable solutions?

Govind Gopakumar spoke first about efforts to formally alter engineering education. He argued that the world is becoming increasingly global, and that the complexity of our policy issues is increasing as the environment becomes increasingly central. Given this, engineers need to assume positions of public leadership, and policy-makers need to devise a framework for analysing public education. Gopakumar has developed such a framework, and has used it to analyze three different engineering programs. His framework has three components: the topic of interest, the praxis of intervention and the leadership philosophy. He produced a nice tabulated summary of his study, reproduced here:

	Topic of Interest	Leadership Philosophy	Praxis of Intervention
Engineering Public Policy, **Carnegie Mellon**	Policy	Expert Engineer	Case Study
Science & Technology Studies, **Rensselaer Polytechnic**	Society	Thoughtful Engineer	Design
Technology Dynamics and Sustainable Development, **Technical University of Delft**	Sustainable Development	Reflexive Engineer	Project Planning and Implementation

Gopakumar argued that there are options available to meet the existing need for socially engaged engineers, and that his framework can be used to evaluate competing programs.

Jonathan Fishbein began by discussing an engineering project with the best intentions that nevertheless went awry. Play pumps were introduced to Africa as a way to provide clean water by utilizing the willingness of children to play on a carousel; the project had all the best intentions of using science and technology in socially beneficial ways. Later studies found that the play pumps were not being used, however, as local communities preferred the older manual pumps. The study found two problems with the play pumps. First, they were more complicated machines than the traditional pumps, and the communities did not possess the parts or expertise to repair them. Second, the daily lives of the communities were not optimal for their use. Women collect water in the morning, but the pumps required hours of play by children before there would be

sufficient water in the reservoir. Since children do not play overnight, the reservoir was empty when the women of the community went to collect water and they either had to “play” on the carousel themselves or else go to the nearest traditional pump. The issue was thus that the developers did not understand the societal context, nor did they adequately communicate with the community. Fishbein explained how Engineers Without Borders was working to change the existing developmental aid model by improving communication skills, working in an interdisciplinary team, embracing social responsibility, encouraging entrepreneurship, and fostering systems thinking. Engineers Without Borders is not only tackling projects around the world, but also doing outreach in Canada to alter the education system so as to a) teach the required skills for socially engaged engineers, and b) start thinking about tomorrow's problems rather than yesterday's.

Hans Hilgenkamp spoke next about how the Netherlands (and several other nations) has altered the structure of its academic society to harness the energy of young academics. Most academic societies are an end-of-career achievement, and the members are asked to take an active role in policy and consultation because of years of proven expertise. The Germans were the first to find a way to harness the energy of young researchers, and the Netherlands copied them. The Young Academy recruits members who have recently achieved a Ph.D or equivalent in any field, who are demonstrably brilliant, and who have a commitment to service. The Young Academies (including the Global Young Academy) have four goals: to give a voice to young scientists, to promote science as a career, to narrow the gap between the developed and the developing world, and to encourage novel interdisciplinary approaches to international problems. The Young Academies reach these goals by fostering stimulating interdisciplinary interactions between the members of the Young Academy, by interacting with the Senior Academy on questions of science policies, and through outreach efforts such as school visits and an interactive website.

The final speaker of the session was Amir Khadir. Khadir described how the social status quo primarily benefits the first world, and even more specifically the elite of the first world. Such people, Khadir argued, have little motivation to seek radical solutions to social engagement and responsibility. He described a disconcerting attitude among working scientists, most of whom come from wealthy first world backgrounds. Murray Gell-Mann is representative of this attitude, having often claimed that his job as a scientist was not to deal with the consequences of his research because science was a self-serving quest for knowledge; this despite the fact that Gell-Mann was funded by the United States military for much of his work. Khadir argued for a radical solution to this problem, one where scientists maintain their independence to direct their research yet also contemplate the consequences of their endeavours. One way to accomplish more socially engaged science was for scientists to pursue elected offices in order to influence the funding priorities of science.

Numerous people posed questions and offered comments for the session. These comments and questions all attempted to get the panellists to provide more details on how to get their ideas implemented in Canada, and how they have overcome resistance to change. Gopakumar, Hilgenkamp and Fishbein stressed that part of the solution had to be grassroots; socially engaged and energetic people have want to work on projects of international significance, and they have to convince professors and politicians that the problems and approaches to those problems are worth undertaking. Khadir stressed that much could be done if the Canadian government would meet its previous promises for international development and aid. The panel agreed that social engagement was essential, and that any avenue to have it added to the political and educational agenda would hopefully be beneficial, and definitely worth pursuing.

Federal-Provincial-Municipal Governments: Where is the science policy nexus?

Moderator
J. Adam Holbrook - Adjunct Professor and Associate Director, Centre for Policy Research on Science and Technology, Simon Fraser University

Panellists
Louise Shaxson - Director, Delta Partnership, United Kingdom
Marc Fortin - Assistant Deputy Minister, Federal Ministry of Agriculture
Geneviève Tanguay - Assistant Deputy Minister,Québec Ministry of Economic Development, Innovation and Export Trade
Allison Barr - Director, Research Branch of the Ontario Research Fund, Ontario Ministry of Research and Innovation [in place of George Ross, Deputy Minister, Ontario Ministry of Research and Innovation]

Adam Holbrook opened the session and introduced each speaker, announcing a change in the panellists owing to George Ross's unavailability; in his place Allison Barr was present to discuss the Ontario Ministry of Research and Innovation's activities. Holbrook pointed out that the title of the session was therefore somewhat misleading because none of the panellists were drawn from municipalities

The first speaker was Louise Shaxson, who summarized her recent work analysing the different models and frameworks being used in the U.K. to assess the impact of actions and policy changes. These models and frameworks are being used to solve problems involving people from a broad range of interests with varying and complex working relationships. The old model was a logical framework: policy input and activities result in external interaction and influence, and outputs that can be measured through outcomes and impacts. In this traditional model, accountability is hierarchical, with actors at the input position ultimately responsible for outcomes. Shaxson argued that this old method has been known to be ineffective for some time, and that we should be (and are) moving towards a social model with distributed responsibility that looks more like an ecosystem than a linear heirarchy. This new conception of science policy-making would require messy partnerships, efforts to modify and assess the behaviour of different actors in the network, and an understanding of the larger social context. She concluded by saying that there is no nexus, but rather a complex and evolving landscape in which science and a variety of complicated relationships coexist.

Shaxson's talk, in essence, argued that actors throughout the science policy-making process need to be responsibilized to allow them to make sustainable and informed decisions about their own behaviour during the process of science policy-making.

Marc Fortin's talk, entitled "Clocks to Clouds," was about shifting from hierarchical modes of thinking to cross-sectoral innovation clusters. He opened by claiming that science is excellent at solving problems that involve the application of protocols, such as mapping the human genome. Complex (rather than complicated) problems like obesity, by contrast, require a collection of solutions. Fortin called the former 'ordinary' solutions, while the latter are 'extraordinary.' For Fortin, his job, and the job of other

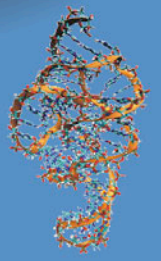
managers, is to be a catalyst for change from the old system of clockwork hierarchy to a new system that functions more like a cloud where responsibility, empowerment, and control are distributed amongst various stakeholders. He then spoke, in general terms, about initiatives within his ministry to change the conversation from one of spending and accountability to what he called 'appreciative inquiries.' Fortin summarized his role in this nicely by saying that his job is to manage relationships, not people; if he manages the relationships well, then every stakeholder will have been engaged in the process of coming up with a solution.

The third speaker was Geneviève Tanguay, who spoke about innovation in Québec, the new inter-governmental (i.e. inter-provincial) mechanism, and the regional approach. She gave a brief history of the Québec government's initiatives to gain control of innovation and the economy since the 1960's; she went through the Quiet Revolution, 1970's Québécois politics, 1980's economic development, 1990's innovation, and the consolidation of innovation and Québécois policies in the 2000's. This historical narrative culminated in 2006 with the Stratégie Québécois de la Recherche et de l'Innovation (SQRI). The SQRI is unique, she argued, because it is integrated with economic society and culture, it is integrated with innovation, and there is a chain from innovation and accountability. Québec's strategy, as she emphasized in her previous talk during the Plenary on Universities as Agents of Economic Recovery, was to focus on areas where there was existing competence that could be mobilized and focussed on a competitive, innovative, and productive project. Since 2008, Québec has taken the lead in collaborating with the other provinces, taking a regional approach to solve the big problems.

Allison Barr was the fourth and final panellist. Barr's current mandate regards the Ontario Research Fund and cancer research, but she and the Ontario Ministry for Research and Innovation are in the midst of a policy review of the Ontario innovation agenda according to five themes: supporting excellence, producing targeted investments, leveraging skills and knowledge, acknowledging the business climate, and being a catalyst for innovation. Like Shaxson and Fortin, Barr described the science policy network as a complicated ecosystem, saying that it often gets represented as linear for simplicity and clarity.

Barr also spoke about collaboration with other provinces and within a regional approach, like Tanguay before her. She gave examples of the regional approach in Ontario, such as the Ontario Network of Excellence, the MaRS Discovery District, and Ontario Centres of Excellence. All of these initiatives aim to harness existing expertise, in a network with multiple entry points and relationships that are centrally coordinated by the government; they also have an ambition of creating global excellence and lucrative entrepreneurship.

Holbrook posed the first question to the panel, asking them to give an immediate response to their colleagues and to reflect on the under-representation of municipalities in this panel. Shaxson and Fortin discussed the important point that although the clouds, ecosystems, and networks of science policy-making need to be more accessible, the main responsibility still lies with government, if only because it is elected to lead. Fortin pointed out that the federal government often tries, sometimes problematically, to spread out its facilities (and employment) as much as possible to meet the needs of communities. Alex Bielak pointed out that too much of the discussion was abstract and that it would have benefited from some concrete examples. Fortin and Barr offered examples from their own ministries as illustrations, e.g. about the complex relationships at play between dairy producers and dairy processors who have been brought together with consumer and health organizations to do more than simply figure out the best prices. A comment was made that the recent Science Policy Exchange at McGill University was a municipal initiative, and the panel was asked about the roles universities could play in developing complex relationships. The panel suggested that universities have an agenda to push their own research, but that they can sometimes serve as a neutral space for analyzing relationships.



A Glance at Bioscience in Canada

the Canadian Science Policy Centre
better policies, better science

Biotechnology and Pharmecutical Industry: Challenges, Opportunities, and Policy Options

Biotechnology continues to advance new frontiers in medical science. Many Canadian pharmaceutical companies stand out as global competitors in this industry, making a major contribution to Canada's economy. Nurturing and regulating such technology inevitably presents both opportunities and challenges, and the potential of providing the proper incentives for researchers is paramount. This panel investigates which incentives are needed to overcome challenges and capitalize on the prospects offered by Canadian innovation in this sector.

Bioenergy is an emerging field: Is it the coming revolution in energy production?

Often hailed as the coming revolution in energy production, bioenergy is an emerging field grappling with several key issues of science policy. The development of bioenergy technologies promises to solve several important problems facing Canada and the world, making it necessary to bring emerging technologies from the lab to the marketplace quickly and effectively, and to anticipate and create appropriate kinds of infrastructure to help overcome initial market barriers. This panel investigates how we can balance the needs of public policy leaders with industry stakeholders, while facing up to society's need to have such technologies commercialized.

Biodiversity: Are existing policies adapting to current challenges?

Deemed the "International Year of Biodiversity," 2010 is an opportune time to reassess Canada's science policy for biodiversity research. Given how ecologically diverse Canada's vast geography is, and how difficult and dynamic ecological research is, science policy in this domain must remain adaptive enough to address and predict new disciplinary challenges. Successful study of Canada's biologically diverse ecology requires various disciplines to communicate effectively across national borders that are necessarily and readily crossed by both critical species and scientific knowledge. This panel investigates how scientists and science policies can adequately adapt as the subjects they study are experiencing increasingly rapid rates of change.

Biotechnology and Pharmaceutical Industry: Challenges, Opportunities, and Policy Options

Moderator
Christopher J Paige - Vice-President, University Health Network

Panellists
Marc-André Gagnon - Assistant Professor, School of Public Policy and Administration, Carleton University
Michele Savoie - General Manager, Montreal Invivo
Mark Lievonen - President, Sanofi Pasteur Limited
Rahim Rezaei - PhD Candidate, McLaughlin-Rotman Centre for Global Health, University of Toronto

This panel was tasked with discussing and identifying which policies could achieve tighter connections between academics and the biotechnology and pharmaceutical industry in Canada. Moderator Christopher Paige started by suggesting that there needs to be close links between academics and industry, and that clusters around the world show how well such connections work.

Michele Savoie began with some of the challenges and opportunities facing the biotechnology and pharmaceutical sector in Canada, and provided some policy suggestions that could help foster the development of the industry. The key challenges facing the industry, she said, include: 1) the average cost to develop a new product is increasing, 2) the number of new molecules being approved by regulators is decreasing, and 3) many pharmaceuticals are coming off patent, threatening companies' revenue streams. These are in addition to more general challenges facing industry in Canada such as the aging population, reduced supplies of credit and venture capital following the global financial crisis, a lack of skilled management talent, and increased competition from emerging economies.

Two opportunities for the industry include a shift in the pharmaceutical industry's R&D model to one that outsources more R&D at earlier development stages, giving small firms access to research dollars. Second, the personalized medical field is growing quickly, and will likely continue to do so for at least the next 5 years. Canada has a strong biotechnology and pharmaceutical industry, good universities, an attractive tax rate, and sound finances in place to exploit these opportunities, but other developed countries also see bio-pharmaceutical sectors as a key area to grow their economy. Leadership from both the provincial and federal governments is necessary to exploit these opportunities.

Key policy suggestions presented by Savoie included expanding the pool of risk capital at all stages of firm development, from seed capital, venture capital, and through mature growth; strengthening the links between universities and industry by helping to eliminate cultural barriers to encourage more collaboration; speeding the adoption of innovative products and services through government procurement policies that make federal and provincial governments first-adopters, thereby helping to develop the market scale needed to penetrate global markets; addressing the lack of experienced entrepreneurial talent in private-sector firms; nurturing and strengthening clusters of interrelated firms; and making good choices about which sectors to support.

Mark Lievonen provided the panel with an industry perspective, using Sanofi Pasteur as

an example of a firm that does substantial R&D investment in Canada. Pharmaceutical firms like Pasteur Sanofi are facing the "patent-cliff" as many products are coming off patent between 2010-2014. This provides more money to health care as generic drugs will reduce expenditures, but reduced revenues will drive down the available resources for R&D and investment. At the same time, industry in Canada is facing a few key challenges with respect to the regulatory approval process and the existing intellectual property regime. The regulatory approval costs have reached 1 billion dollars, and approval currently takes nearly ten years on average (up from 7-8 years); intellectual property policies could therefore stand a patent term restoration, extending the life of patents to make up for the increased approval period. Canada has moved to 8 years on data protection, but the E.U. has adopted data protection of 11 years, and the U.S. is moving to 12 years; approving longer data protection, he argued, is a strategy from which Canada could also benefit.

Canadian innovation in the biotechnology and pharmaceutical industry could also benefit from a greater focus on clustering. There are strong clusters in place thanks to good universities and industry presence; but, he argued, these need to be reinforced to help support and attract additional investment in the region. Additionally, the government should look at strategic procurement practices to support new firms and build market scale. Additional public-sector support is valuable, as it helps fund new ventures and move through strong candidate products that currently lack funding. Additional investment by banks and pension plans would be useful, as there is currently a lot of dialogue around innovation, but little action. Capitalizing on the buzz around the issue and moving forward with small steps will help lead to larger, bolder steps later on.

Marc-André Gagnon provided an alternative perspective, examining the cost of innovation policy and questioning the government's return on investment. Gagnon pointed out that current policies to encourage innovation provide tax credits to companies to encourage R&D investment, ensure fifteen years of exclusivity for drugs in Quebec, and artificially inflate drug prices. Furthermore, Canada's adoption of best-practice policies around drug approval and therapeutic assessment could significantly impact health care costs.

Gagnon then examined the costs of these programs. Most intended to promote a business environment that encourages R&D and the development of drugs in Canada. All told, these programs cost $4.9 billion. Gagnon, however, estimated that the value added by companies in the pharmaceutical industrial group Rx&D is approximately $4.8 billion. After examining direct and indirect employment by these firms and the average firm, Gagnon calculates that the cost of innovation policies is approximately $85,000 dollars per employee. Gagnon argued that the innovation policies put in place to support the bio-pharmaceutical industry are, therefore, not necessarily justified, as the calculated benefits do not warrant the costs. Gagnon questioned whether the money spent on supporting innovation in Canada could not best be served in other ways to improve health outcomes, especially since most new drugs "do not bring any therapeutic advance over what is currently in the market."

Rahim Razaei reported on research he conducted on the emerging bio-pharmaceutical markets of India, China, and Brazil. The Chinese market, as an example, was estimated to be a $21 billion market in 2008, and is forecasted to become a $50 billion market by 2013. China has made significant investments in R&D and is building manufacturing and research infrastructure, e.g. by investing in science parks and developing human resources to produce a lot of new graduate students. These three nations have traditionally been a destination for manufacturing, but Razaei said that they are increasingly becoming a destination for medical trials and R&D services. As such, these nations are growing competitors that have access to large domestic markets and thereby have a better chance of developing their own products through domestic innovation pathways. One emerging trend that Razaei sees is the growing fragmentation of the drug development value-chain. A possible future strategy for Canada, he suggested, is to find a competitive niche within that value chain.

Bioenergy is an emerging field: Is it the coming revolution in energy production?

Moderator
Marc Saner - Director, Institute for Science, Society, and Policy, University of Ottawa

Panellists
Alison Ouellet - Director, Government Affairs, Canadian Renewable Fuels Association
Catherine Cobden - Vice President, Economics and Regulatory Affairs, Forest Products Association of Canada (FPAC)
Celine Bak - Russell Mitchell Group, 2010 Sustainable Development Technology Canada Cleantech Growth & Go-To-Market Report

Marc Saner opened the panel on bioenergy by raising the provocative question of whether bioenergy is the coming revolution in energy production. With a huge desire within Canada, and amongst her trading partners, for green and clean energy, the fact that Canada's ecology also maintains an enormous biomass compared to other countries makes this a pressing question for Canada.

Alison Ouellet spoke first, remarking that science stands at the centre of the current renewable fuels industry, and that new technological advancements promise still greater benefits. The bioenergy landscape is driven by the achievement and innovation of the renewable fuels industry, along with a massive change in consumer behavior, public policy, and commercial expansion. Ouellet anticipates a coming biofuels revolution as significant as the information revolution of the 1980s. The central concept of this coming revolution, according to Ouellet, will be "sustainability."

Sustainability, in essence, is a capacity to endure, to last, and to carry on. Since the world simply cannot endure while relying on crude oil, the prospects for sustainable energy production presented by biofuel innovation becomes especially significant. While we can debate the specifics, few would debate that in the coming decades, more people will be competing for fewer and scarcer energy resources, with inevitable economic and environmental consequences. Canada has moved in the right direction, Ouellet argued, by mandating a Renewable Fuel Standard, which requires a minimum amount of ethanol and biodiesel to be blended into gasoline. This policy will cut emissions equivalent to one million cars per year from our roads, as well as provide jobs.

While there is no question that oil will be with us for a long time, renewable fuels bring sustainable sources to the table: switchgrass, biomass, forest residues and even municipal solid waste. Ouellet emphasized the connections between parts of the living world, especially the connection between the use of renewable fuels and the reduction of pollution and greenhouse gas emissions. She also drew attention to the connection between sustainability and opportunity, especially in the developing world. Severing the reliance of developing countries on crude oil prices will benefit economies, farmers, and the environment, leading to what some call a green revolution in Africa that combines energy, agriculture, and technology to offer economic and social hope. In short, Ouellet argued, biofuels are a huge opportunity for people in developing countries as well as at home, rooted in scientific advancement and discovery.

The panel's second speaker, Catherine Cobden, began by arguing that Canada was beginning a period of economic renewal with

regard to forest products. The Canadian forest industry, through partnerships with environmental organizations and communities, has remained committed to improving its environmental credentials, aiming to be the best in the world in forest management practices. Cobden went on to describe a strategic push to simultaneously protect and maximize value from Canada's amazing forest resource, and began asking how best to support the forest industry during this transformation.

The Canadian forest business model is, Cobden claimed, simply broken. Cobden asked how we can support the forest industry during its coming transformation, what role bioenergy will have in the future, and how to best craft public policy for the forest industry. To answer these questions, FPAC ran a collaborative study including 65 experts, provincial and federal governments, academics, and technology suppliers examining nearly 60 emerging bioenergy technologies. First, they inquired about the readiness of these technologies. Further analysis was only carried out if technologies were already beyond the R&D phase; this separated innovations that offered viable solutions from those that were untested ideas.

The study then compared 32 traditional and emerging uses of forest products in different areas of Canada, at different scales, and through two business cycles in an attempt to determine how to use these technologies to benefit the Canadian forest industry. Their results showed that certain technologies did not meet a cost-to-capital threshold and would never be profitable, but that combinations of existing and emerging technologies could be, such as combining large sawmills with pyrolysis oil production. Sawmills are the key economic driver for this industry and FPAC study supports the claim that they will continue to be the driver for bioenergy in the future, as mills converted to bioenergy and biochemistry production show a high potential for profit.

One of Cobden's key messages was that there is no direct way to get biomass to bioenergy producers; it is essential that policymakers working on wood allocation be aware of the need for collaboration. But the bottom line is that integrating bioenergy with forest product operations offers a sustainable and profitable future for the Canadian forest industry, involving new collaborations and partners, as well as protecting and increasing employment in our rural communities. The Canadian advantage may well be that we are prepared to move on these emerging technologies first.

Celine Bak gave the final presentation of the panel, which concentrated on clean technology. Bak described a report she helped produce, developed in conjunction with the federal and provincial governments as well as regional and industry partners, which offers a fact-based analysis and unified narrative of the complex clean technology industry in order to offer policy platforms in terms of science, technology and innovation, energy and economic productivity, and greenhouse gas reduction. Bak argued that, from a political perspective, all of these things are worth talking about together. The report aimed to take a census of the small and medium technology companies in Canada, and to broadly understand their capacities, growth rates, investments and exports. A database was also produced to collect the surprising amount of information offered and collected from these companies to help decision-makers dealing with both individual companies and the industry as a whole.

Bak compared the data in the report with a similar report of U.S. companies, and showed that the Canadian clean technology industry is more globally competitive in terms of exports. Still, we need to be better at valuing, adopting, and investing in Canadian technologies in order to reap the benefits of our own innovation.

Moderator Marc Saner summarized that all presenters seemed to be in agreement about the potential of bioenergy in Canada, in accordance with their specific mandates. The question period focussed on discussing different priorities for the bioenergy industry, the role public policy should play in supporting industry innovation and bridging the innovation-market gap, Canada's potential as a clean technology leader, and concerns over the reliance of biofuel on agriculture.

Biodiversity: Are existing policies adapting to current challenges?

Moderator
Rees Kassen - Chair of the Partnership Group for Science and Engineering (PAGSE)

Panellists
Gunilla Öberg - Director, Institute for Resources, Environment, and Sustainability, UBC
Murray Rudd - Professor, Environment Department, University of York, United Kingdom
Andrew Gonzalez - Professor and Director, Quebec Centre for Biodiversity Science, McGill
Luc Brouillet - Conservateur, Marie-Victorin Herbarium, Institut de recherche en biologie végétale, Université de Montréal

This panel consistently pointed out that Canada's biodiversity community faces many challenges, but ought to remain optimistic about opportunities at the intersection of research, policy, government, and the public. Rees Kassen began by noting that 2010 had been declared the international year of biodiversity by the U.N., which resulted in both international and Canadian initiatives for recording and preserving biodiversity. He introduced the new Science Pages initiative, which aims to provide strong, credible, and non-prescriptive science briefs for MPs that can enable debate and provide graduate students work opportunities at the interface of science, policy, and communications.

Gunilla Öberg spoke first, describing biodiversity scholars as often feeling frustrated at politicians who don't appreciate the importance of their work. She suggested that instead of blaming their audience, the biodiversity community ought to reflect on how they communicate their message to public and government stakeholders.

Öberg identified two types of challenges for biodiversity researchers: interdisciplinary challenges (academic challenges involving the integration of knowledge from different fields) and trans-academic challenges (issues of collaboration between academic insiders and outsiders). Biodiversity researchers must meet both types of challenge to get their message across to stakeholders. The first sort of challenge requires biodiversity researchers to somehow integrate findings from the history, philosophy, and sociology of science that have shown how research is, in fact, always impregnated with values. By examining the values implicit in biodiversity research, researchers will be able to better integrate their knowledge with their peers'. The major trans-academic challenge, on the other hand, is one of knowledge translation. Biodiversity experts generally have a naïve understanding of science-policy interactions, and don't really understand politicians' needs. This, Öberg argued, needs to change, but these challenges can be met if biodiversity researchers become more reflective about what they do, and better understand the needs of their audience. As a first step, Öberg recommended that we stop fixating on the ideal of a pristine wilderness and instead focus on actual, evolving ecologies.

Murray Rudd described an exercise he led, which identified "Canada's Top 40" research questions that could a) align biodiversity research with the needs of policy-makers, and b) increase communication between the conservation biology community and policy-makers' tasked with designing policies to protect Canada's biodiversity. It began by soliciting almost 400 candidate questions nationally from scientists and policy-makers that, if answered, would determine the scientific basis for decision-making regarding biodiversity conservation in the face of current and future environmental stressors.

The questions were then winnowed down to only 40 through a process involving a collaborative synthesis with representatives from academia, the federal government, industry, and NGOs.

The 40 questions fall under eleven main themes: ecosystem structure and function; land cover and habitats; populations and species; resource-based industries; parks and protected areas; environmental change; environmental values; economic benefits and costs; individual and community well-being; adaptive management; and issues of policy and governance. Some of these themes overlap with those generated in a parallel American exercise, while others are different: Canadian biodiversity priorities tend to focus on governance and adaptive management crossing jurisdictions, including aboriginal engagement, whereas in the United States the focus was on environmental stressors and land cover changes in resource industries. The second phase of this project, beginning January 2011, will prioritize these questions, examine possible constraints to biodiversity research, and assess conservation researchers' policy impacts. Rudd expects that increasing clarity about biodiversity research priorities can both increase knowledge and enhance policy relevance. The future conservation and management of Canada's biodiversity requires a balance of aligned and unaligned research in natural science and policy, and an understanding of the values underlying attitudes towards biodiversity in Canada.

Andrew Gonzalez spoke of "Canada's Biodiversity Opportunity." Like Öberg, Gonzalez claimed that biodiversity has conventionally been an isolated, "silo" science, with not enough transdisciplinary partnerships. Despite a huge audience interested in the work of biodiversity scientists, doing aligned research and organizing the biodiversity community at a national level is challenging work.

Human activity currently drives biodiversity loss more than at any other time, but the Canadian biodiversity policy-research interface is not ready to meet this challenge, being hampered by 4 major factors: a limited knowledge of Canadian biodiversity; a slow rate of discovery compared to the rate at which the environment is changing; an inability to undertake trans-disciplinary studies of the ecological, economic, and social impacts of biodiversity change; and the lack of a national program for biodiversity involving long-term funding collaborations between researchers, businesses, government, and NGOs. Gonzalez believes the solution to the Canadian biodiversity research challenge the implementation of such a program.

Canadians know the value of biodiversity, Gonzalez noted, and prioritize protecting it above all quality-of-life indicators except poverty reduction. Politicians ought to be aware of this latent support for protecting biodiversity, and should see this as a win-win opportunity since economic inequality positively correlated with biodiversity loss.

Luc Brouillet spoke last, describing how various levels of government have taken responsibility for biodiversity, conservation, management, and use, but must provide enough support to science to meet their commitments; governments are committed to specific actions, but these require scientific knowledge and input to be accomplished. Brouillet provided a few examples of small-scale situations where these commitments require additional support. First of all, Canada needs to leverage its untapped knowledge base from our natural history collections to meet the needs of our unique ecosystem: it is estimated that we possess over 50 million specimens which are currently inaccessible, which must be made public and digitized so that governments have something on which to base their biodiversity decisions. These data must also make their way into international databases. A new network, Canadensis, will be used to compile and present this data, but there is as of yet no long-term support. In all of Brouillet's examples, the impact of our government's well-meaning policies will be strongly limited by insufficient funding; if Canadians want the research to adequately inform policy implementation, more support is required.

Special Workshop on Knowledge Translation and Brokering

Organizer
Environment Canada's Science and Technology Liaison Division,
ResearchImpact and the Canadian Water Network in collaboration with York University,
Canadian Health Services Research Foundation, and the British High Commission

Moderator
Alex Bielak, Senior Advisor, United Nations - Water and Senior Fellow and Knowledge Broker UNU-INWEH

Speakers
Melanie Barwick - Psychologist and Associate Scientist, Community Health Systems Resource Group and Scientific Director Knowledge Translation, CHES–Research Institute, The Hospital for Sick Children
Leah Brannen - A/Director, Science and Technology Liaison Division, Environment Canada
Andrew Campbell - Managing Director, Triple Helix Consulting, Australia
David Clements - Director, Corporate Planning and Accountability, Canadian Institute for Health Information
Eric Gagné - Director, Science Policy Division, Environment Canada
Javier Gracia-Garza - Director General, Science and Technology Strategies Directorate, Environment Canada
David Phipps - Director, Research Services & Knowledge Exchange, York University
Courtney Price - S&T Liaison Officer, Science and Technology Liaison Division, Environment Canada
Karl Schaefer - Senior Advisor to the Director General, Water Science and Technology Directorate, Environment Canada
Andrei Sedoff - Knowledge Mobilization Officer, York University
Louise Shaxson - Director, Delta Partnership, United Kingdom
David Yetman - Director, Programs and Knowledge Mobilization, Canadian Institute for Advanced Research

Dr. Alex Bielak welcomed participants to the workshop and introduced Dr. Andrew Campbell, the keynote speaker. Campbell's captivating address spanned an array of practical experiences in knowledge translation and brokering, citing Land and Water Australia as a case study. The keynote gave an international dimension to the workshop, with relevance to the Canadian landscape, addressing concerns such as:

- How can applied research investors and managers create conditions conducive to the production of influential research?
- How can research funders, brokers and communicators add value, without being overly prescriptive or stifling the creativity and serendipity that often characterizes the best scientific inquiry and discovery?
- In particular, what knowledge brokering and translation strategies work at the rarely elegant interface between science and policy?

Campbell reflected on his seven years of experience as CEO of Land and Water

Australia, a time at which the corporation established itself as a respected knowledge brokering organization managing knowledge assets from twenty years of research and more than 1600 projects. Drawing on some powerful lessons learned from his experience, Campbell offered these astute words for the audience to contemplate during the remainder of the workshop; knowledge brokering and translation within a well-designed system can be immensely useful and valuable. It cannot be an add-on; it needs to be part of the organization.

Eric Gagné facilitated the Knowledge Café, a dynamic, interactive forum in which participants travelled from table to table to discuss their choice of 10 priority items on knowledge translation and brokering. The session was arguably one of the most engaging, deemed by the majority of participants to be an effective way to network and explore a wide range of topics in a short time. The facilitated discourse drew participants into a lively exchange of ideas and recommendations on such topics as: a suite of products and tools, community of practice, targeted dissemination, program design, performance metrics, and human resources and training. The dialogue stimulated much discussion and provided a unique opportunity for participants to share their thoughts and forge new networks within the knowledge translation and brokering community.

Recognizing that knowledge translation and brokering is a relatively new field and participants have different levels of understanding and practical application, a choice among three skill- and capacity-building sessions was offered to provide hands-on learning experiences. Dr. Melanie Barwick, David Yetman and Dr. David Phipps presented "Making Sense of Knowledge Mobilization," a combination of structured and improvised learning that introduced the concept of knowledge mobilization from three professional perspectives and then opened the floor to stimulated discussion and questions from the audience. Dr. Leah Brannen, Courtney Price and Andrei Sedoff delivered a hands-on session, "Effective Written Communication to Targeted Audiences," to sharpen participants' instincts when identifying targeted audiences and exploring what aspects of research "speaks" to different audiences. The session also sought to improve participants' ability to craft written communication products to meet users' needs. Facilitated by Louise Shaxson, the "Finding the Right Tools" session addressed the struggle to identify appropriate

knowledge brokering tools to actively engage with a specific user community. The interactive session provided participants with a broad overview of tools currently in use and drew on the collective experience to explore the boundaries of a knowledge brokering toolkit and what types of tools might populate such a toolkit.

A highlight of the workshop was the Expert Panel session moderated by Bielak and featuring three of Canada's leading experts in knowledge translation and brokering. Phipps spoke to the practitioner's perspective; David Clements gave voice to that of a non-government organization in the field of health, and Karl Schaefer imparted his views as a senior federal government employee. After a brief presentation by each, a lively exchange of opinions, concerns, and ideas ensued, prompted by provocative questions from the moderator and the audience. Several key messages emerged. Among them: move beyond debates about terminology and "just do it"; measure impact at the user level and acknowledge that measures can be qualitative; recognize models and practices of commerce, marketing, technology transfer, and funding and grant application procedures to act as drivers and to legitimize activities; don't expect a cultural change valuing little-C over Big-C communication to be delivered from the top-down in large organizations; and, develop a cohesive voice before entering into an international arena, as we have a lot more considerations to sort through, including the rules of engagement.

Before, during and after the workshop, participants and other interested individuals relayed insights and provided updates on the event through an active social network using blogs and a discussion forum on the workshop's website. Over the course of the day, a volley of Twitter messages relayed interesting observations and added to conversations about the sessions. To foster continued dialogue among participants post-event, the workshop's network website (http://researchimpact.othree.ca/ktkb2010) remains open to attendees and other members of the knowledge translation and brokering community. The lessons from the workshop were relayed to, and built upon, at a subsequent workshop entitled 'Improving the impact of development research through better communication and uptake', held in the United Kingdom in November 2010.

Prior to closing remarks by Bielak, Campbell returned to the podium to present a Listener's Report that reflected on the day. Campbell congratulated the organizers on a job well done, noting an overwhelmingly positive impression of the workshop. He stated that the cross-sectional nature of the participants in the workshop was an enormous strength and a lot could be gained by ongoing networking and communities of practice across the mix of sectors, organizations and institutions represented at the event.

This Special Workshop on Knowledge Translation and Brokering was hosted by the following partners:

Environment Canada's Science and Technology Liaison Division

Canadian Water Network

ResearchImpact

And was organized in collaboration with the following partners:

York University

Canadian Health Services Research Foundation

British High Commission

Ways Forward: Closing Remarks and Reflections on CSPC 2010, Prospects for CSPC 2011

The final session was a chance for all delegates and participants to provide feedback about CSPC 2010, to offer ideas to improve the conference next year, and to discuss ways of taking Canadian science policy forward in lights of what was learned at this year's conference.

Much of the feedback focussed on congratulating the CSPC committee for organizing CSPC 2010. There was a broad consensus that the Canadian Science Policy Centre needs help promoting itself and telling the story of its organization, as most participants were not aware that it is a small group of volunteers in need of resources and connections to the science policy community. It was hoped by all that further support would improve this already excellent conference in the future. One suggestion inspired by the career development workshop was a CSPC mentorship program, whereby people working in science policy would agree to be paired with people looking for a mentor.

A recurring theme in the closing comments revolved around the need for a fresh perspective. This could be achieved by having a public panel with "monsieur et madame tout-le-monde" to explore the relationship between science and the public, and perhaps holding the CANARIE science fair in a public venue. Similarly, while the first few years of the CSPC benefited from well-known speakers to help establish its credibility and legitimacy, next year's conference should aim to bring in fresh voices. This could be achieved by inviting students familiar with science and policy, thereby encouraging a new generation of scientists to understand policy issues from the university level onwards. CSPC could also become a venue where scientists could interact with high school students, to engage young people in science and policy early on.

Other groups that were suggested as important invitees for next year's CSPC were the provincial associations of science teachers, a selection of lighthouse examples of leading scientific efforts in Canada, students of international science policy, the new science media centre, and industry representatives including small and medium enterprises in science-related fields. The Canadian science policy community would clearly benefit from more interactions with these stakeholders, and more strident efforts need to be made to appropriately engage them.

In the future, if the Canadian Science Policy Centre receives the support it needs, the conference could serve as its progress report, a follow-up on its work of promoting entrepreneurship, developing socially engaged scientists, reaching into schools, and supporting graduate students with science policy fellowships. To that end, the conference should be a venue where the Centre could share its results and the challenges it faced over the year, moving the conference away from pure theory and towards active participation in an ongoing experiment and practice of supporting science policy work in Canada.

Finally, there were suggestions for new sessions for next year's program. Participants wanted to see a panel describing how Canada's science policy can reflect our cultural and intellectual diversity, a panel about building bridges across all levels of government and sectors of the economy, and a panel encouraging people to come practice and study science in Canada so that they might eventually become ambassadors engaged in science diplomacy. Another panel could be devoted to legislative or regulatory science-relevant activities to improve our understanding of the policy process. There was even a suggestion to invite a futurist to describe how science policy might look in the next few decades. It was also hoped that next year's parallel sessions could report back to each other with the key points from their discussions, so that the entire conference could benefit from those conversations.

Interviews and further coverage of CSPC 2010 are available online at: www.sciencepolicy.ca

the Canadian Science Policy Centre
better policies, better science

During the Course of CSPC 2010, the CSPC Organizing Committee had the pleasure of sitting down for interviews with many distinguished delegates and participants. Please find these interviews online, and help us carry on the conversation.

CSPC 2010 Organizing Committee

The following individuals establish the main Organizing Committee for CSPC 2010. On behalf of all stakeholders involved with this important event, we thank you for your tireless efforts, and invaluable insight. Without you this event would not be possible. Thank you!

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The organizing committee would like to offer special thanks to our many excellent and dedicated volunteers. Without you, this event would not have been possible.

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We look forward to see you at

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Nov 16-18

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