CSPC
CANADIAN SCIENCE POLICY CENTRE

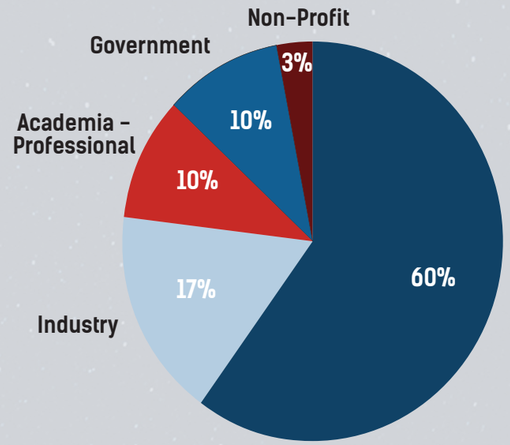
The Canadian SCIENCE POLICY

-Magazine-

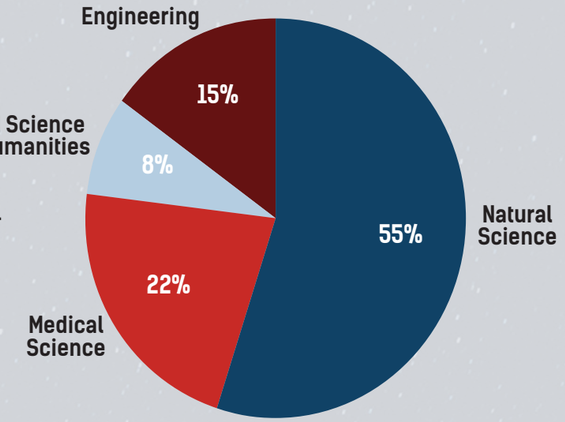
ISSUE 03

BUILDING FORWARD BETTER

WHO ARE OUR VOLUNTEERS?



Volunteer Occupation



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SCIENCE AND THE NEXT GENERATION

Message from the Editorial Committee

Policy always has some element of building the rails as you drive down them, but this year has been a case study in figuring things out on the go. It has been a year where the voice of experts can make or break our recovery. We must listen to their knowledge, often knowledge we didn't know existed or ways of knowing that we hadn't expected.

As the title of the magazine states – we're looking to build forward better while in the middle of a pandemic that has not yet abated. The process of selecting authors for the magazine is always a delicate balance, and we wanted to provide a sampling of the diverse voices that are guiding Canada's future, while dealing with the issues of the present.

This magazine would not be possible, however, without the world of CPSC's volunteers – specifically the editorial team who took the time to select, process, and assemble the articles. And to our authors, thank you so much for your time, your work, and your visions for a future where we are all building forward better.

Sarah Laframboise
Production Director, CSPC Editorial Chair, Canadian Science Policy Magazine Chief Editor

Alessandra Zimmermann
CSPC Editorial Chair, Canadian Science Policy Magazine Chief Editor

CSPC EDITORIALS

CSPC aims to promote the voice of the Canadian public, calling for members of the science and policy communities to publish their thoughts on pertinent issues with us. The Editorial Committee is in charge of both the annual magazine that you are reading as well as our editorial calls. Previous editorial calls have included the creation of the Canada's Chief Science Advisor position, the G7 Summit, the Cannabis Act, and in 2020 we had a 4-volume, 70+ editorial series on the COVID-19 pandemic – our largest editorial call yet.

Editorials are published year-round, through open calls or individual submissions and available at sciencepolicy.ca/editorials

If you have an opinion you feel the CSPC community should hear, we welcome submissions to editorial@sciencepolicy.ca.

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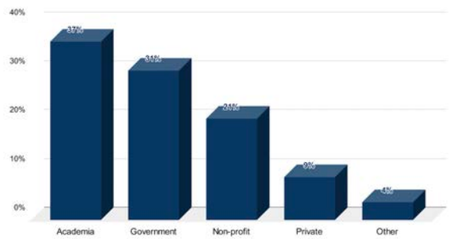
To be inspired from career trajectory of leaders of science and innovation policy

SYMPOSIUM ON FEDERAL BUDGET 2021

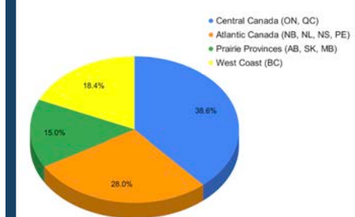
A comprehensive analysis of the Federal budget and the reactions across various sectors

Keynote talk by David Watters, President & CEO, Global Advantage Consulting

Who was in the audience?



Attendees were well-represented across different regions of Canada.



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ESSENTIAL INGREDIENT FOR BUILDING FORWARD BETTER

Mehrdad Hariri

President and CEO of Canadian Science Policy Centre

History shows that large scale tragedies have often brought profound changes in the way societies work and relate to each other. They have spawned new discourses, institutions, governance mechanisms, and creation of whole nation states. The global COVID-19 pandemic has similar disruptive potential. Will we seize it to build forward better? How can we do so, particularly the way we govern ourselves and set policies?

Tragic dimensions notwithstanding, both World War one (WWI) and World War two (WWII) instigated the creation of new multilateral institutions. WWI resulted in the creation of the League of Nations, while WWII led to the creation of the United Nations and the Universal Declaration of Human Rights. WWII resulted in a whole new dimension of culture and understanding the world we live in, and the need for better coordination and collaboration. These were not entirely unifying, however, as we also saw the emergence of two nation blocks with radically distinct ideologies – the democratic West versus The Communist East. Western liberal democracies that embraced the new human rights doctrine and took a more open and flexible stance in social and economic spheres prospered much more so than those who adopted a command-and-control system.

The COVID-19 pandemic was and, in some instances, remains a full-scale tragedy with similar disruptive potential. It has impacted almost all countries on the planet and has disrupted the world as we knew it. Millions of lives have been lost and many more lives impacted in a myriad of other ways. National and global economies have undergone a sea change of sorts, characterized by bloating budget deficits, global supply chain disruptions, and rising inflation. The pandemic has also impacted our collective psychosocial status as human beings, with unforeseen consequences. It has once again highlighted that large-scale tragedies demand coordination, collaboration, dealing with complexities, and open exchange of information and knowledge. This time, however, the dimensions of complexities are enormous. We are facing existential threats such as climate change. Every single aspect of our life is shaped by complex technologies and having to deal with and make sense of tremendous amount of data that is being generated. Citizens are far more engaged in the public sphere through social media than was possible only two decades ago.

An obvious outcome of the pandemic has been the critical role that science and evidence play in responding to pandemics. We have seen what happens when policy follows credible scientific evidence and when it does not. We have seen that building consensus across our communities and political parties is critical, especially in emergencies. Indeed, In Canada, we witnessed an unprecedented level of cooperation between municipal, provincial, and federal governments. At the global level, the pandemic has also once again demonstrated the importance of global cooperation related to global health, but also other challenges such as climate change, poverty alleviation and many more.

A key question going forward is whether and the extent to which the pandemic will have lasting impacts on our governance systems and policymaking at local, regional, national, and global levels. The COVID-19 pandemic has provided a window of opportunity for us to profoundly change the way we engage in policymaking. A major shift in our mindset and profound changes in our institutions are needed to ensure that we avail ourselves of opportunities to adopt new mechanisms of knowledge processing capacities at our disposal that can inform policymaking with greater precision and impact.

A key aspect that has become apparent is the need for knowledge generation and analytic capacities that provide credible and timely scientific knowledge to inform policymaking. The COVID-19 pandemic has proven that the need for more sophisticated and robust mechanisms to effectively translate scientific knowledge to guide policy development is real and pressing. Global and national challenges of climate change, population growth, rapid urbanization, and many others have strong scientific as well as sociopolitical dimensions. These all have global and local implications that are inherently intertwined. While the climate crisis is a global challenge, actions that must be undertaken are local and must account for contextual idiosyncrasies. As such, policy coordination across different levels of government is now more critical than ever

We must strengthen our capacities to ensure that we can integrate various dimensions and involve different constituencies. Much more remains to be done to provide policymakers with high quality and credible scientific information in a timely and accessible manner. The establishment of the position of Chief Science Advisor was a recognition of this need and a major milestone, aimed at providing the Prime Minister and the cabinet with access to credible information. However, currently, there is no similar source for legislatures at various levels; national, provincial, territorial, and municipal, to get credible and timely scientific information, which is offered in a language and format that can be used in policy development.

The COVID-19 pandemic will not be the last global health crisis. The climate crisis is gathering steam and its impacts are far reaching; cybersecurity threats and safeguarding citizens' privacy are among many live challenges we actively grapple with. Scientific data on related matters is vast, growing and can be overwhelming to process effectively without adequate and appropriate resources. We nonetheless must expand the capacities to digest scientific insights and translate them to inform policy. If such capacities were viewed as a luxury in the past, the pandemic has certainly shown that such capacities are necessities going forward.

Finally, two very important aspects are noteworthy; first that the reference to science here is not limited to natural and medical sciences and engineering. It also refers to social sciences and humanities. The COVID-19 pandemic has had many impacts on our society, the impacts of which have yet to be studied and understood. Second, finding ways to incorporate perspectives of diverse constituencies into policymaking, in particular those of indigenous communities, is critical to our collective future. The need for integration of indigenous knowledge into policymaking is equally if not more important than the integration of what we think of as conventional science.

In conclusion, a key lesson from the COVID-19 pandemic is that we do better when our policies account for scientific and indigenous knowledge and perspectives of different communities. We must get serious about building institutional capacities that enable better and more efficient integration of scientific and indigenous knowledge into policymaking. A better and more sustainable future depends on this integration. Let's build forward better.

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Science Meets Parliament, organized in partnership with the Office of the Chief Science Advisor, aims to strengthen the connections between Parliamentarians and scientists, social scientists, and engineers. The program provides an excellent opportunity for researchers to learn about government and facilitates mutual exchange between the two communities, supporting evidence-informed decision-making for the benefit of all Canadians.

For more information about the 2021 cycle of this program, please visit https://sciencepolicy.ca/

The program provides an excellent opportunity for researchers to learn about the inclusion of scientific evidence in policy making in Parliament.

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CANADA'S FEDERAL GRANTING AGENCIES:

OPENING UP THE WORLD TO CANADA'S RESEARCHERS

Among the many indelible imprints of the global pandemic has been a shared sense that humanity is one interconnected species inhabiting one interconnected planet. As we recover from this global crisis and strive to build a better world moving forward, it is clear that international cooperation and collaboration will be the keys to our prosperity, health, and happiness.

This is certainly the case when it comes to research investment. No single country can meet and overcome the challenges that we face today – nor those that await us in the future – while working in isolation. If this paradigm was not already fully embraced before the global pandemic, it surely will become the predominant ethos of the post-pandemic era of research.

Through the Canada Research Coordinating Committee (CRCC), Canada's federal granting agencies (the Canadian Institutes of Health Research, the Natural Sciences and Engineering Research Council, the Social Sciences and Humanities Research Council, and the Canada Foundation for Innovation) are working hard to promote international collaboration in research. While these agencies have worked tirelessly throughout the pandemic to ensure that Canadian researchers have the resources necessary to contribute to the international efforts to combat the pandemic, the CRCC has provided an invaluable forum to not only identify pressing research questions, but also to consider carefully how Canadian researchers will collectively emerge from this difficult period of time. First and foremost amongst such considerations is the fact that Canada has an enormous amount of research talent and expertise that we eagerly wish to share with the world. The challenge is to find ways to build meaningful, sustainable international relationships that open up the world to our Canadian researchers and allow the world to benefit from our greatest asset – our people.

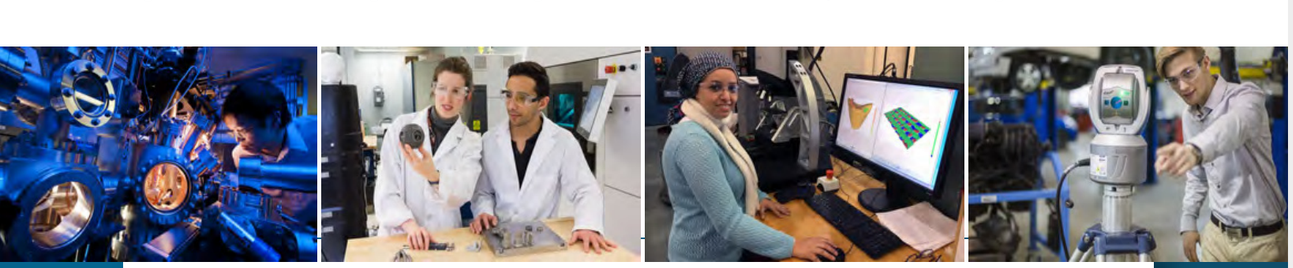
Working through the CRCC, we have followed a highly collaborative approach to international engagement that builds on existing relationships developed by the agencies, some of which go back decades. We have also used these opportunities to further promote the importance of equity, diversity, and inclusion as integral components of a strong research enterprise. These engagements include hosting brainstorming sessions with the main science funding agencies around the world, with recent guests including agency heads from the United Kingdom (UKRI), France (CNRS), Germany (DFG), and the United States (NSF). These meetings have provided an opportunity to take stock of existing collaborations while seeking new engagement via a "Team Canada" approach.

The CRCC has also implemented a unique framework through the New Frontiers in Research Fund (NFRF) to support Canada's research community in a multidisciplinary, international effort to tackle climate change, the existential crisis of our time. In addition to its flagship Exploration and Transformation funding

competitions which facilitate global collaboration by welcoming applications from Canadian and international co-applicants, the NFRF's International stream has also opened the door to Canadian participation in major funding programs outside Canada, most notably Horizon 2020 and Horizon Europe. In addition, the CRCC is developing a competition this year in support of the United Nations Research Roadmap for COVID-19 recovery, as well as a major international call next year on climate change. This latter framework will allow us to engage with agencies around the world to offer significant joint funding that will enable scientists and engineers in Canada to collaborate with international partners on developing the science and technology required to address this global emergency.

Canada has now emerged as a leading voice in marshalling resources and expertise to develop lasting solutions to issues such as climate adaptation, achieving net zero carbon dioxide emissions, and ensuring the availability of clean drinking water – goals that can only be achieved when we agree to work together as a united, global research community. As an example, the CRCC members joined the CFI and the European Union in welcoming over 600 researchers, government officials, facility managers, policy experts, and innovators from around the world to the International Conference on Research Infrastructures – a virtual event broadcasted from Ottawa. The topics covered during the lively exchanges included climate change, food security, clean energy, and poverty. All of these issues were considered in the context of the pandemic, which has spurred a sense of urgency and strong desire to work together across geographic boundaries to address the global challenges that we face.

We often hear it said that the world needs more Canada – and we certainly agree with that premise. But more than that, the world needs more collaboration in general – the uniting of great minds and the sharing of great ideas. Canada's research communities have much to offer in this context and the CRCC is proud to create the linkages that are connecting Canadian thought leaders with their counterparts across the globe.



CIHR IRSC
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A Vision for a Healthier Future

CIHR is investing in research to support the recovery from COVID-19 and address its wider impacts. This research is providing evidence to improve the health of Canadians and strengthen health care in Canada.
At the same time, CIHR is working to create a more equitable, diverse, and inclusive health research ecosystem in this country.

Learn more about CIHR's investments in COVID-19 research:
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En savoir plus sur les investissements des IRSC dans la recherche sur la COVID-19 :
https://cihr-irsc.gc.ca/COVID19FRA.html

Vision pour un avenir en santé

Les IRSC investissent dans la recherche pour atténuer les vastes conséquences de la COVID-19 et favoriser le rétablissement postpandémique. Les études financées génèrent des données qui permettent d'améliorer la santé de la population canadienne et de renforcer les soins offerts au pays. Parallèlement, les IRSC s'efforcent de rendre l'écosystème canadien de la recherche en santé plus équitable, plus diversifié et plus inclusif.

Canadian Institutes of Health Research | Instituts de recherche en santé du Canada

Canada

RISING TO THE NEED FOR OPEN SCIENCE AND SECURE RESEARCH

Mona Nemer

Chief Science Advisor of Canada

This past September, I had the honour of co-hosting the highly successful international INGSA 2021 conference with my colleague the Chief Scientist of Quebec. With more than 2000 delegates from 50 countries, the meeting was a much anticipated occasion to engage with the science advice community from around the world on important global issues and to shine a light on some emerging topics in science and policy.

One of the discussions that garnered much attention was on the value of open science

in addressing global crises. Throughout the pandemic, open collaboration between scientists has been instrumental in developing diagnostics, treatments, and vaccines at an unprecedented speed, and open access to Covid-19 research has guided public health policy in real time. Sharing knowledge and working together across disciplines and national borders has saved lives and brought solutions to one of the greatest health crises the world has faced in a century. And in turn, people are increasingly recognizing the value of open science for advancing knowledge and building public trust.

Yet, despite this progress, questions persist around how to ensure continued benefits of openness in a time of increasing global competition. In today's highly interconnected world, how do we reconcile the enormous benefits of scientific collaboration with the risk of research security threats? How do we create a research framework that balances the need for openness, transparency and trust with proper safeguarding against theft and misuse of scientific information?

After all, science and the good it generates are things we need to protect. Doing so requires frank discussions about research security, perhaps most urgently in those areas with the greatest transformative or innovative potential. Advanced technologies, from quantum computing to biotechnology, with their immense impact on health, food and national security, attract attention.

Consequently, we need balanced approaches and tools that assess risks to research integrity – from data quality to the scientific process itself – and safeguard research while fostering collaborations. Scientists have long supported the idea that scientific knowledge is universal. Ideas should be judged on their own merit, separate from the institutional or political contexts in which they have been generated. Collaboration with like minded partners is appealing, but we need to be wary of isolating ourselves in echo chambers.

This is because diversity of perspectives is essential for scientific progress. Research security should not become a reason or an excuse for turning inward, limiting dialogue and preventing scientific cooperation. In fact, science is a formidable diplomatic tool for keeping communication channels open between countries. Over the years, scientific collaboration has supported

peace and often opened the way to economic and political dialogue and partnerships. Witness the human genome project, or the International Space Station, or the more recent development in 2018 of SESAME, the particle accelerator in the Middle East, whose motto is "science for peace."

For this reason, any discussion of research security needs to be framed within open science and scientific integrity contexts. All three need to form a cohesive triad that enables research, protects the integrity of research outcomes, supports knowledge dissemination and maximizes the benefits of research and innovation for the world.

Finding the right balance, however, will depend on adjusting for different disciplines, different institutional contexts, and different research questions. An accepted approach will require the combined complementary perspectives of practitioners, ethicists, and legal and management experts. Assumptions and solutions need to be grounded in the reality of research and respect for democratic values. And above all, it requires buy-in from researchers.

Moreover, different areas of research have varying degrees of security requirements and collaborative output. One way of addressing this may be to establish risk assessment frameworks that adopt the "variable geometry" principle – an approach that would allow some flexibility in integrating standards and norms of a security framework. Given that it is virtually impossible to track every area of research, it is certain that some call for more scrutiny than others.

Potential dual-use technologies may require further agility. Again, a layered or modular approach that allows sector-specific frameworks could help achieve the objectives and produce greater collaboration across sectors. In other words, solutions will need to be tailored. By analogy to precision medicine, we should consider adopting "precision frameworks" to provide sustainable solutions. We need to be wary of one-size-fits-all approaches.

Ongoing success will require trust and collaboration between the scientific and security communities. This is where international organizations like INGSA can have an important role in bringing representatives together to identify common interests. Canada and other countries share many priorities, such as health security, clean technology and digital technologies. Establishing lists of these commonalities would help to create coherent approaches and accelerate best practices. More proactive engagement between researchers, funding agencies and the intelligence community will also have the benefit of increasing mutual understanding across the sectors and empowering researchers to protect their research, for both the national interest and the sake of science itself.

Overall, ensuring these security frameworks are practical and grounded in the reality of research will help achieve voluntary adherence and greater compliance among researchers and administrators. Success is important because openness, integrity and security in research generate trust in the scientific process and in scientific knowledge. Developing balanced and internationally recognized research security standards will make us better prepared for future global crises, and ensure that science can continue to deliver life-saving technologies and innovations that improve our world.

NO ONE IS SAFE UNTIL EVERYONE IS SAFE: GLOBAL RESEARCH FOR GLOBAL CRISES

Pressing global crises, in particular climate change, and the COVID-19 pandemic, require urgent global action. Efforts to address them should draw on knowledge, innovation, and experiences from all parts of the world. However, efforts to overcome these crises are constrained by the under-representation of voices from the Global South in research and knowledge ecosystems.

The extent of the disparity is stark.

While over three quarters of the global population live in Asia and Africa, over three quarters of the scientists on the Reuters' hot list of climate scientists are in Europe and North America [1]– revealing a staggering imbalance. As CBC reported in October 2021 [2], a new study published in Nature Climate Change [3] found that far more climate studies have been published on impacts in developed countries than developing countries. Using machine learning to examine over 100,000 scientific papers worldwide, the research found that nearly 30,000 studies looked at impacts in areas in North America compared to only 10,000 in Africa, which has more than double the population.

While there is some good news from a paper published in the Climate and Development journal [4] earlier this year, namely that there has been an increase in empirical climate adaptation research in the global South from 2010 to 2020, it also highlights that large geographic and thematic gaps remain. For example, large swathes of sub-Saharan Africa and the Middle East/North Africa remain severely under-researched.

Unequal research conditions and systemic biases within research ecosystems are not unique to the climate crisis. In January of this year, BMJ Global Health published a commentary on African authorship during the COVID-19 pandemic [5]. It reported that while 1.3 billion people – or 17% of the world's population – live in Africa, only 3.9% of articles on COVID-19 published in the top 10 medical journals contain content related to Africa or a specific African country.

Photo Credit: M. Valberg

Jean Lebel

President
International Development Research Centre (IDRC)

These imbalances limit our ability to tackle critical and accelerating global challenges and simultaneously risk leaving behind those most impacted. Research from the Global South is urgently needed to produce local, evidence-based solutions, and to connect with research elsewhere that will inform international responses.

As a Canadian Crown corporation that invests in research in the Global South, the International Development Research Centre (IDRC) is working closely with researchers, funders, and other stakeholders to address these issues.

In climate change hotspots – places where strong effects of climate change coincide with large vulnerable populations – there is a great need for innovative and locally-tailored solutions. Much of Africa, low-lying coastal areas in Asia, parts of the Middle East and Latin America, and small island developing countries have low levels of investment, but also much knowledge and experience to offer. IDRC has supported the science and evidence behind more than 35 national-level adaptation plans in hotspots working to integrate tailored solutions that are equitable and sustainable. For example, research on how labour migration contributes to social safety nets and climate resilience informed Tajikistan's National Adaptation Plan, and the resulting Local Adaptation Plans of Action. [6]

Localized evidence of what works, what doesn't, and how to better adapt and build resilience is needed to drive responses to the climate crisis before it's too late. Yet this knowledge is also needed globally. Southern research and researchers are earning international recognition, for example, through important contributions to the pivotal reports produced by the Intergovernmental Panel on Climate Change (IPCC). The 6th assessment report has citations from multiple climate leaders from the Global South, including over 20 IDRC-funded publications, contributing to a much stronger and truly international assessment.

COVID-19 also underscores the need for Southern research to generate local, tailored approaches, and inform global response. It has highlighted multiple vulnerabilities as many low- and middle-income countries face a devastating combination of crises – including a global health pandemic, the growing impacts of climate change, rising levels of public debt and food insecurity. We are working alongside researchers, funders, and policymakers to generate research and evidence, inform global approaches, and develop contextualized responses. For example, over the past year and a half, restrictions and lockdowns disrupted food systems in many parts of the world – reducing production and access to food. In Pakistan, the Sustainable Development Policy Institute produced a tool to directly aid the real-time management of food supply, shortages, and price inflation. The Food Security Dashboard offers the Ministry of National Food Security daily national, provincial, and district-level views, allowing them to correct activities such as hoarding before they lead to food crises.

At the global level, the UN Research Roadmap for the COVID-19 Recovery [7] is a strong demonstration of

Canada's leadership in identifying research priorities to respond to the crisis. Developed at the request of the UN deputy secretary-general by a team led by the Canadian Institutes of Health Research (CIHR), the roadmap aims to ensure the COVID-19 recovery is informed by the best available evidence. IDRC actively facilitated participation by research partners from around the world who generated important recommendations. This commitment extends across our investment of nearly CA$55 million in more than 65 low- and middle-income countries as part of Canada's response.

Canada's science policy community can be proud of the efforts undertaken so far to support and learn from diverse and innovative research from the Global South. But more progress is needed in the face of crises on the scale of climate change and COVID-19. The under-representation of voices from the Global South in research and knowledge ecosystems must be addressed to produce innovative, inclusive, and sustainable solutions. Across these and other crises, we all benefit from making use of international research and science, and we must strive to fill gaps and inequalities in the knowledge ecosystem where they clearly exist.

REFERENCES

1. The Conversation. Reuters' Hot List of climate scientists is geographically skewed: why this matters. Published June 15, 2021. https://theconversation.com/reuters-hot-list-of-climate-scientists-is-geographically-skewed-why-this-matters-161614
2. CBC News. Singh, Inayat and Alice Hopton. Global south suffering gap in climate change research as rich countries drive agenda, studies suggest. Posted October 17, 2021. https://www.cbc.ca/news/science/global-south-climate-science-1.6212471
3. Nature Climate Change. Callaghan, Max et al. Machine-learning-based evidence and attribution mapping of 100,000 climate impact studies. Published October 11, 2021. https://www.nature.com/articles/s41558-021-01168-6
4. Climate and Development. Vincent, Katharine and Georgina Cundill. The evolution of empirical adaptation research in the global south from 2010 to 2020. Published February 4, 2021. https://www.tandfonline.com/doi/10.1080/17565529.2021.1877104
5. BMJ Global Health. Naidoo, AV, Hodkinson P, Lai King L, et al. African authorship on African papers during the COVID-19 pandemic. Published March 1, 2021. https://gh.bmj.com/content/bmjgh/6/3/e004612.full.pdf
6. This research was conducted through the Collaborative Adaptation Research Initiative in Africa and Asia (2012 - 2019). IDRC. Collaborating for adaptation: findings and outcomes of a research initiative across Africa and Asia. Published July 7, 2020. https://issuu.com/idrc_crdi/docs/idl_-_58971
7. See UN Research Roadmap for the COVID-19 Recovery: https://www.un.org/en/coronavirus/communication-resources/un-research-roadmap-covid-19-recovery

NEXT STEPS TO NET ZERO – THREE CONSIDERATIONS ALONG THE PATH

Eliane Ubalijoro
Global Hub Director in Canada for Future Earth & Executive Director of Sustainability in the Digital Age

Andréa Ventimiglia
Advancements Manager, Future Earth Canada Hub & Sustainability in the Digital Age

On the heels of the latest UN Climate Report [1] showing that climate change is "widespread, rapid and intensifying," global post-pandemic reconstruction must incentivize strong reductions in carbon emissions. COVID-19 travel restrictions have shown that we can be productive while travelling much less. As of this year, at least one-fifth (21%) of the world's largest public companies now have net zero commitments, along with 61% of countries and 13% of cities over 500k in population. [2] So while there is still much work to be done, there is a clear opportunity now to set a new paradigm for human productivity that can reduce our carbon footprint, encourage equity, and restore the balance with nature.

Future Earth Canada and Sustainability in the Digital Age have been exploring three interconnected paths on the road towards net zero, namely 1) balancing the risks of the digital age with the potential for climate action, 2) scaling up nature-based solutions, and 3) incorporating alternative perspectives into this work. All of these avenues are connected, collaborative, and critical to drive the large-scale societal transformations [3] that are needed to achieve the Paris Agreement on Climate Change and the UN Sustainable Development Goals (SDGs).

OVERCOMING RISKS OF THE DIGITAL AGE

The time is right to encourage new forms of collaboration [4] and steer the digital disruptions underway towards a sustainable, climate-safe, and equitable world. However, this will only be possible if there is a concerted effort to overcome the risks associated with digital age transformations, [5] which include the ecological footprint of digital technologies and threats to privacy and human dignity.

With respect to the former, 2015 estimates showed that information and communication technology (ICT) accounted for up to 5% of global energy demand and that by 2030, ICT is projected to account for 7%. [6] Adding nuance, researchers from Facebook and Harvard have demonstrated that, "over the last decade, hardware manufacturing—as opposed to operational energy consumption—has increasingly dominated the carbon footprint of mobile systems" as opposed to data centers, which are increasingly employing renewable energy. [6] As such, solutions can seek ways to reduce carbon emissions deeper into the manufacturing supply chain, and must consider that the environmental impact of computing systems is multifaceted, spanning water consumption and the use of other natural resources.

Regarding privacy concerns, there has been limited discussion about deploying digital tools in support of climate action. Yet, many respondents to a three-phase international survey we conducted are open to the use of digital surveillance to monitor individual carbon footprints; Across nearly 3000 respondents, 50% support implementing limits to individual carbon emissions. [7] This work raises a key question – is it worth exploring digital surveillance tools as part of a socially acceptable response to the climate crisis?

SCALING UP NATURE-BASED SOLUTIONS FOR CLIMATE

There has also been growing attention in policy circles on how to address the climate challenge with nature-based solutions (NbS). NbS are "actions to protect, sustainably manage, and restore natural or modified ecosystems, that effectively and adaptively address societal challenges while providing human well-being and biodiversity benefits." [8] NbS have the potential to supply up to 37% of our climate change mitigation needs, [9] but to date NbS have not been able to deliver on this potential because projects are not large enough in scale, the NbS approach is insufficiently integrated into policy, and because more collaborative NbS projects are needed for increased efficiency. [10]

One area we are exploring currently is the scale-up of NbS solutions in Canada via the application of machine learning and digital innovation. Scientific knowledge on carbon cycle modelling and monitoring has advanced greatly in the last decades, yet there continue to be data gaps both spatially and over time. [11,12] It is essential to provide a robust understanding of the current state of the terrestrial carbon and water cycles, combined with knowledge and even foresight of how these systems will respond to management actions aimed at enhancing land-based carbon storage. To do so, we can use a combination of climate and carbon cycle models, remote sensing data, GIS mapping, and in situ sampling of soil and vegetation types, building on advances in the use of machine learning and satellite imagery to assess land-atmosphere carbon exchanges. Some of the broader questions we hope to answer include:

- How can we create and enforce nation-wide networks and protocols for carbon, water and ecosystem monitoring?
- How can we ensure that such networks include high-quality, updated data at all times?
- How can such networks implement artificial intelligence or machine learning technology to make better estimates?
- How can we use these tools to drive further investment in and use of NbS to mitigate and adapt to climate change?

INCORPORATING INDIGENOUS SCIENCE AND WORLDVIEWS

A final but no less valuable consideration on the path to net zero is how to fully address the social equity dimensions of climate change in Canada and elevate Indigenous concepts of nature-based solutions.

Federal climate plans over the past five years have made clear that Indigenous Knowledge and Indigenous leadership is vital for building just and effective climate solutions. As noted in a recent Environment and Climate Change Canada report, "Indigenous Knowledge systems, built upon generations of relating to, observing, understanding, and living off of the land, are not static, and they continue to evolve and be developed. These knowledge systems are critical for identifying and adapting to changing environmental conditions. First Nations, Métis, and Inuit have unique relationships with lands, waters, and ice, distinct from other Canadians [...] As such, it is critical that their voices, worldviews, and knowledge are given space to lead in climate change science and knowledge decisions." [13]

One successful example is the Great Bear Forest Carbon Project, [14] an Improved Forest Management program which generates emission reductions by protecting forest areas that were previously designated for commercial logging. The program is unique in that it is the only Improved Forest Management project of its scale that has equal involvement with the First Nations and the Government of British Columbia, strong legal and policy foundations, and robust data to support the quantification of ecosystem services.

So, the next steps to net zero must build on examples like these – where converging Indigenous practices and Western techniques for high-quality data collection, monitoring, and knowledge synthesis – facilitate equitable access to carbon markets and ultimately strengthen Indigenous governance by supporting the co-managed agreements.

DIALOGUES TO MOVE US FORWARD

To bring all these themes together, during September and October 2021, Future Earth's Sustainability in the Digital Age initiative and the Canadian Science Policy Centre (CSPC) will be hosting a new online dialogue series across Canada, Canada's Sustainable Future – Creating a Digital Action Plan. The series aims to a) raise public awareness of the SDGs and Canada's progress on the 2030 Agenda, b) foster new conversations and partnerships across sectors on the digital revolution for sustainability, and c) collect recommendations on Indigenous Science and Knowledge driving transformative solutions, to share with policy-makers.

Funded by the Government of Canada's Sustainable Development Goals Funding Program, we look forward to insights from this series to support Canada's 2030 and 2050 sustainability goals respectively related to protecting 30% of land and reaching net zero. Full results will be presented at CSPC2021.

REFERENCES

1. IPCC, "Climate Change: Widespread, Rapid, and Intensifying." Published online Aug 9, 2021 at https://www.ipcc.ch/2021/08/09/ar6-wg1-20210809-pr/
2. Energy & Climate Intelligence Unit, "Taking Stock: A Global Assessment of Net Zero Targets." Published online Mar 23, 2021 at https://eciu.net/analysis/reports/2021/taking-stock-assessment-net-zero-targets
3. O'Brien, K. L. "Climate Change and Societal Transformations: Is it Time for a Quantum Leap?" WIREs Climate Change, 7(5), 618-626, 2016. https://doi.org/10.1002/wcc.413
4. Sustainability in the Digital Age, "Digital Disruptions for Sustainability: D^2S Agenda." Published online 2020 at https://sustainabilitydigitalage.org/d2s-agenda/
5. David Jensen, "The Promise and Peril of a Digital Ecosystem for the Planet." Published Sep 11, 2019 at https://medium.com/@davidedjensen_99356/building-a-digital-ecosystem-for-the-planet-557c41225dc2
6. Gupta, U. et al. "Chasing Carbon: The Elusive Environmental Footprint of Computing." arXiv, 2020. https://arxiv.org/pdf/2011.02839.pdf
7. Garard, Wood, et al. 2021. "Should digital surveillance tools be deployed to respond to the climate crisis – or is this an unacceptable risk for society?" (Manuscript submitted)
8. International Union for Conservation of Nature, "Nature-based Solutions." Published at https://www.iucn.org/theme/nature-based-solutions
9. Griscom, B. W. et al. "Nature Climate Solutions." PNAS, 114(44), 11645-11650, 2017. https://doi.org/10.1073/pnas.1710465114
10. Cohen-Shachem, E. et al. "Core Principles for Successfully Implementing and Upscaling Nature-based Solutions." Environmental Science & Policy, 98, 20-29, 2019. https://doi.org/10.1016/j.envsci.2019.04.014
11. Liu, Y. et al. "Field-experiment Constraints on the Enhancement of Terrestrial Carbon Sink for CO2 Fertilization." Nature Geoscience, 12, 809-814, 2019. https://doi.org/10.1038/s41561-019-0436-1
12. Friedlingstein, P. et al. "Global Carbon Budget 2020." Earth System Science Data, 12, 3269-3340, 2020. https://doi.org/10.5194/essd-12-3269-2020
13. Environment and Climate Change Canada, "Climate Science 2050: Advancing Science and Knowledge on Climate Change." Published April 3, 2013 at https://publications.gc.ca/site/eng/9.892783/publication.html
14. Coastal First Nations Great Bear Initiative, "Carbon Credit Landmark Agreement." Published at https://coastalfirstnations.ca/our-land/carbon-credits/

SUSTAINABILITY IN THE DIGITAL AGE

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CSPC | CANADIAN SCIENCE POLICY CENTRE

Canada's Sustainable Future - Creating a Digital Action Plan

Symposium: November 18, 2021
12 - 3:30 PM (EST)

Canada has less than 10 years to deliver on its commitments for the UN Sustainable Development Goals (Canadian Indicator Framework for the SDGs), and to meet national climate and biodiversity targets such as protecting 30% of land by 2030 and hitting net-zero emissions by 2050.

To catalyze action and achieve these ambitions, we must foster cross-sectoral and interdisciplinary collaborations that merge digital innovations with sustainability science and increase collective awareness at this interface. Canada is well-positioned to become a "first mover" on digital innovations for the SDGs and for scaling-up nature-based solutions as pathways to decarbonization.

To explore this topic further, Future Earth and Sustainability in the Digital Age will be hosting a half-day symposium at the 13th Canadian Science Policy Conference. This symposium will bring together panelists with diverse expertise, covering policy analysis, climatology, digital innovation, sustainable development, private sector partnerships, Indigenous driven transformative solutions, education and youth development.

CANADA NEEDS TO MOVE FROM THE WHAT TO THE HOW ON ENERGY AND CLIMATE

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As global leaders convened in Glasgow for the 26th United Nations Climate Change Conference of the Parties (COP26), momentum for climate action was at an all-time high. Last summer's report of the Intergovernmental Panel on Climate Change underscored again the urgency to act. [1] And the International Energy Agency released a study last spring laying out a proposed pathway to global net zero GHG emissions by 2050. [2]

Here in Canada, we are at a hinge point on energy and climate: there is far greater consensus among Canadians, governments and industry about the need to reduce emissions, and there are myriad opportunities for Canadian energy in domestic and global markets.

Canada now has a carbon tax that applies across the country, has put in place a comprehensive climate plan [3]– including ambitious targets for methane, clean fuels and electric vehicles, and strategies for hydrogen, small modular nuclear reactors (SMRs), energy storage, critical minerals and carbon capture, utilization and storage (CCUS) – and has legislated net zero by 2050. [4]

The country has made great progress laying the groundwork to bend our emissions curve downwards and capitalize on our energy potential.

But Canada has a long history of making ambitious climate commitments then failing miserably at achieving them. Last spring the government boosted Canada's climate targets from a 30% reduction of 2005 levels by 2030 to a 40–45% reduction. But emissions haven't budged in the last fifteen years: they were the same in 2019 as they were in 2005.

This has not gone unnoticed by Canadians. Recent polling by the University of Ottawa's Positive Energy program and Nanos Research reveals that Canadians' desire for climate action has surged throughout the pandemic, but most have little confidence that Canada can actually reduce emissions. [5] They see government as part of the problem – not the solution.

Will now be any different? Maybe.

Success will hinge on whether Canada can successfully move from the 'what' to the 'how' on climate.

Modelling suggests the government's new targets are likely achievable [6], but there is an enormous gap between the simulated worlds of emissions and macroeconomic impacts and the real worlds of politics, federal-provincial relations, reconciliation with Indigenous Peoples, investor confidence, energy security, and oil and gas production. This is where the rubber meets the road on energy and climate.

What actions are needed to move successfully from the what to the how?

First and foremost, **focus on implementation**. Implementation is the 'dismal science' of public administration. The title of a landmark American book on implementation in the 1980s sums it up well: *Implementation: How Great Expectations in Washington are Dashed in Oakland*. [7] More recently, eminent political scientist Francis Fukuyama lamented that policy schools are failing society because they train students to conduct policy analysis but don't teach them how to implement policy in the real world. [8]

Canada has a persistent implementation blind spot on energy and climate. Take infrastructure projects. Climate plans depend on the rapid development and widespread deployment of lower emitting energy sources and technologies like solar, wind, hydro, nuclear power, CCUS, and hydrogen, along with mining operations for critical minerals.

Will communities support building all this new infrastructure? Maybe. But it takes time to foster local support, and support increasingly hinges on building successful partnerships with Indigenous communities. This rarely happens on the rapid timelines envisaged in climate plans and models. Most major projects take a decade or more (i.e., beyond 2030) to plan, finance and permit, much less build.

Which brings us to the second action item: **expand the focus on technological innovation to institutional innovation**. Technological solutions to energy and climate challenges will be crucial, but so too will be institutional innovation to support technology adoption, deployment and scale-up. This means policy and regulatory systems that support emissions reductions, innovation and new technologies, and that secure the confidence of innovators, investors and communities alike. Decision systems need to strike a workable balance between economic, social and environmental imperatives that stands the test of time.

Third, **integrate energy and climate policy**. Climate and energy policy and the surrounding policy/expert communities exist in silos. This can lead to a lot of needless friction and missed opportunities to align energy and climate

objectives. Take energy security. Reliable affordable energy will be essential to building and maintaining public, industry and political support for emissions reductions, but climate plans tend to overlook energy availability/reliability and affordability. Without energy security, ongoing support for emissions reductions will be difficult to maintain. Integrated policy approaches are key.

Fourth, **make collaboration the cornerstone of energy and climate action**. This is key for innovation. Canada rarely has the pipelines of collaboration needed to move ideas from the lab bench to start-up to scale-up to widespread deployment. This is a big weakness that hamstrings rapid effective action. We need deep strategic collaboration between federal, provincial-territorial, municipal and Indigenous governments, academia, industry, and civil society.

Finally, Canada needs a **robust policy discussion about the role of oil and gas in the country's energy and climate future**. This will be especially important given the Federal Government's commitment to net zero by 2050 in the oil and gas sector. [9] This aligns with industry objectives, notably the Oilsands Pathways to Net Zero initiative. [10] But debates over oil and gas in Canada tend to be polarized and simplistic, even though these resources will continue to be produced globally for decades to come (the IEA net zero report sees oil production at 24 million barrels per day in 2050 and natural gas at 1,750 billion cubic metres). Canada has struggled to articulate a short- and long-term role for the oil and gas sector in domestic and international energy markets.

At long last, Canada is poised for success on energy and climate – it may finally be possible to achieve ongoing progress on emissions reductions and capitalize on the country's vast energy potential. Moving from the what to the how will be pivotal to realizing the country's energy and climate potential.

REFERENCES

1. https://www.ipcc.ch/report/sixth-assessment-report-working-group-i/
2. https://www.iea.org/reports/net-zero-by-2050
3. https://www.canada.ca/content/dam/eccc/documents/pdf/climate-change/climate-plan/healthy_environment_healthy_economy_plan.pdf
4. https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan/net-zero-emissions-2050/canadian-net-zero-emissions-accountability-act.html
5. https://www.macleans.ca/society/environment/the-urgency-to-act-on-climate-is-surging-in-canada/
6. https://policyoptions.irpp.org/magazines/septembe-2021/assessing-climate-sincerity-in-the-canadian-2021-election/
7. https://www.amazon.ca/Implementation-Expectations-Development-Administration-Sympathetic/dp/0520053311
8. https://www.the-american-interest.com/2018/08/01/whats-wrong-with-public-policy-education/
9. https://liberal.ca/our-platform/cap-and-cut-emissions-from-oil-and-gas/
10. https://www.oilsandspathways.ca/

CANADA SHOULD LEAD ON GLOBAL COVID-19 VACCINE EQUITY

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Canadians are lucky. Canada is among the leading wealthier nations having the highest vaccine coverage with more than 80% of the population over the age of 12 fully vaccinated. The same cannot be said for 3.5 billion people, largely in low-income and middle countries (LMICs), who are waiting for their first dose of the COVID-19 vaccine. Only 2% of the population in low income countries had received both doses and only 3% of the African population has been vaccinated. Though manufacturers are scaling up vaccine production, LMICs are still waiting for vaccines as COVAX donations trickle in, just as they have been so often in the past at the mercy of high-income nations. Without a high vaccination coverage, no country can deal with the delta variant.

Canada has prioritized their own political interest and tapped into the scarce supply of COVAX doses themselves, despite being among the high-income countries (HICs) that have secured most of the world's available vaccines. Canada today is being called the world's leading vaccine hoarding nation. Through bilateral deals with pharmaceutical companies, Canada has enough vaccines to inoculate its entire population several times over and offer COVID-19 booster shots. Political leaders have demonstrated hesitancy in sharing surplus vaccines quickly and pushing for manufacturing capacity with other countries. This was clear when India was undergoing a deadly surge in infections by withholding their AstraZeneca doses which Canada no longer administered. As of November 2021, Canada has only delivered about 5 million doses of the 200 million doses pledged to the COVAX Facility by the end of 2022.

Unhindered spread of the coronavirus is one of the main reasons for the development of the lethal and more transmissible delta variant – a situation that could have been controlled by global vaccine equity. Without widespread vaccination, millions of people will die, trillions will be lost in the economy, and the world simply cannot end this global crisis.

In October 2020, India and South Africa jointly proposed that World Trade Organization (WTO)-enforced intellectual property rights obligations related to patents, copyright, industrial designs, and clinical data should be suspended for the duration of the pandemic. This temporary initiative, called the TRIPS Waiver proposal, would help ensure a rapid, equitable and truly global public health response to COVID-19, which the current WTO intellectual property rights regime impedes. Despite the support from over 100 WTO member governments, including the United States, the debate continues at the WTO's TRIPS Council. Canada claims it does not oppose the waiver, but it has not supported it either, which is hindering global vaccine equity and violates the right to life and health to which every human being is entitled, regardless of where they live in the world.

Canada still has time to be a leader to advance global vaccine equity. Here are ways for Canada to ensure for every person in this world to have a fair chance of receiving a vaccination:

1. Join the United States in supporting President Biden's plan to vaccinate 70% of the entire world's population by September 2022.
2. Support the World Health Organization's call for a moratorium on COVID vaccine booster programs in order to prioritize vaccines for LMICs, given the limited vaccine supply. Currently, the National Advisory Committee on Immunization (NACI) recommends a third dose for immunocompromised people, seniors, residents of long-term care facilities, and frontline healthcare workers, and that is a reasonable thing to do. But giving booster doses to the entire population is not supported by science, and will delay vaccine access to LMICs .
3. Stop stockpiling vaccines and donate the surplus doses to countries that need them urgently for their healthcare workers and most vulnerable.
4. Publicly support the temporary waiver to certain provisions of the Agreement on TRIPS that will enable the widespread manufacturing of COVID vaccines in all countries in all regions of the world by equally sharing formula, know-how, techniques, and ingredients.
5. Amend the Canadian Access to Medicine Regime, and specifically Schedule 1 of the Patent Act Act, to include "COVID-19" vaccine", thereby enabling Canadian manufacturers to apply for a compulsory license to produce and export vaccines.
6. Ensure transparency in any future contracts with vaccine makers to avoid monopoly powers that compromise vaccine availability and access to LMICs.

The reality is "donating" vaccines, an approach pursued by Canada, is not a sustainable solution. The world needs to move away from the charity model to a more equitable, just model. Therefore, the TRIPS Covid-19 Waiver and technology transfer is the longer-term solution, as it will ensure that all countries have the right tools to fight the pandemic.

REFERENCES:

1. Public Health Agency of Canada. Canadian COVID-19 vaccination coverage report. Ottawa: Public Health Agency of Canada; September 10, 2021. https://health-infobase.canada.ca/covid-19/vaccination-coverage/.
2. Houston AR, Murthy S. Canada is no global health leader on COVID-19 vaccine equity. The Lancet. 2021 May 15;397(10287):1803.
3. Hannah Ritchie, Edouard Mathieu, Lucas Rodés-Guirao, Cameron Appel, Charlie Giattino, Esteban Ortiz-Ospina, Joe Hasell, Bobbie Macdonald, Diana Beltekian and Max Roser (2020) - "Coronavirus Pandemic (COVID-19)". Published online at OurWorldInData.org. Retrieved from: 'https://ourworldindata.org/coronavirus' [Online Resource]
4. Patrick Wintour. Joe Biden to Propose target of vaccinating 70% of world in a year. UK: The Guardian; Sept 14 2021. https://www.theguardian.com/world/2021/sep/14/joe-biden-propose-target-vaccinating-world-covid.
5. Chagla Z, Pai M. COVID-19 boosters in rich nations will delay vaccines for all. Nature Medicine. 2021 Aug 31:1-2.

LEVERAGING TECHNOLOGY TO TACKLE WATER ISSUES IN THE CONTEXT OF CLIMATE CHANGE

Naysan Saran

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Earlier this year, Hurricane Ida stunned the U.S. East Coast with record-shattering rainfall, drowning more than forty people in their cars and homes, and leaving more than one million without power. Two months ago, deadly heatwaves scorched Western Canada and the U.S. Pacific Northwest, killing hundreds of people due to heat-related illness and baking crops in their fields. As our post-pandemic world is adjusting to the "new normal," climate scientists warn us that these events are just a glimpse of the other "new normal" that lies ahead if the status quo is maintained.

CHAIN REACTION

That being said, an external observer could still wonder – as almost a fifth of adults do in North America [1]: Is it climate change or is it rough weather? What we know for a fact is that the global temperature has risen by about 0.7°C since the 1960s, and that warmer air absorbs more moisture from oceans, lakes and plants than cooler air does. As a result, when this warmer, wetter air eventually cools down, the extra moisture it carries condenses and falls as rain – or snow – in storms that are greater in intensity than they would have been in a cooler climate. These heavier downpours lead to more frequent floods, and increase surface runoff – water flowing over the ground instead of infiltrating into the underlying soil. But it does not stop there: surface runoff allows nutrients from fertilizers to enter lakes and streams, exacerbating harmful algae blooms. In turn, these algae blooms release toxins that contaminate drinking water, continuing this chain reaction. [2]

In Canada, the average temperature has actually warmed by more than 1.3°C since 1948, which is about twice the global average rate of warming. [3] However, because of the complexity of the factors

involved, the consequences of this warming are expected to vary across the country. According to the Council of Canadian Academies, [4] "increases in precipitation are projected for the majority of the country, with the exception of parts of southern Canada, where a decline in precipitation in summer and fall is projected." [5] Southern and Central Interior Canada are also expected to experience stronger heatwaves during summer. As the Council of Canadian Academies also notes, "a 1-in-20 year extreme hot day is projected to become about a 1-in-5 year event over most of Canada by mid-century." [6] It may therefore come as a surprise that, in the context of the rising impact of climate change, our country needs to prepare both for water quality and water scarcity issues, despite having 7 percent of the world's renewable fresh water.

FIVE HUNDRED YEARS IN A BLINK OF AN EYE

Fortunately, another upward trend makes it possible to turn the challenge posed by climate change into an opportunity for innovation: the exponential increase in computing power and data.

Since the 1960s, the amount of computing power a dollar can buy has been growing by a factor of ten roughly every five years. [7] For example, a program that would have required five hundred years to run in 1960 would need about 0.15 seconds to complete in 2021 -- about the duration of a blink of an eye. In addition, accurate data has become increasingly available to businesses, governments, and utilities through the installation of IoT devices: physical objects embedded with sensors, capable of exchanging data over the Internet. According to a study from Juniper Research, the global number of industrial IoT connections will reach 36.8 billion in 2025. [8]

INNOVATION IN THE WATER SECTOR

When a sufficient amount of environmental data can be analyzed quickly, there is fertile ground for artificial intelligence algorithms to be developed. In turn, these algorithms make it possible to bring to light relationships which, until then, had remained obscured in the data, as well as to help utilities make decisions to optimize water management. In fact, a growing number of private and public organizations are already working on this issue.

Since 2017, CANN Forecast has used machine learning to help municipalities better manage their water resources. Our first solution, InteliSwim, was born out of a collaboration with the Wastewater department of the City of Montreal. Indeed, in cities with combined sewer systems, untreated sewage is discharged into the environment during heavy storms, which is a major water pollution concern. InteliSwim uses data regarding phenomena such as precipitation, sewer overflows, and streamflow to estimate water quality in rivers up to 72 hours in advance. Two years later, we teamed up with nine Canadian communities to develop InteliPipes – an AI-based model that identifies at-risk pipes before they break.

Using technology to preserve water more efficiently is a key strategy to mitigate the effects of increasingly frequent dry spells, considering that drinking water losses already average 13 percent in Canada [9] and 16 percent in the United States. [10] This situation is exacerbated by the fact that water infrastructure is aging, as well as by the domino effect of climate change. In 2010, for example, severe droughts in the Midwestern United States caused the ground to shrink, which in turn increased the occurrence of water main breaks. [11]

In this context, California State University partnered with the City of Sacramento to reduce water usage after the government mandated a 25 percent reduction in consumption across the state. [12] Using a leak-detection algorithm on data collected by more than 85,000 smart water meters, they achieved a 50 percent decrease in the likelihood of a leak for households that participated in the program.

DESIGNING FOR PEOPLE

If technological tools to adapt to climate change are becoming more and more numerous around the world, we should not forget that for these innovations to stick, they must be directed in the service of people. As the researchers from California State University comment: "[S]mart meters by themselves do not produce changes in consumption patterns," but, rather, there is a "critical need to engage customers'' [13] throughout the process. Another mistake to avoid is to believe that all effective solutions should be "smart." By implementing blue-green infrastructure, for instance – such as green roofs and rain gardens – municipalities can reduce the risk of flooding while simultaneously improving the urban landscape for their citizens.

REFERENCES

1. Kate Whiting, "3 charts that show how attitudes to climate science vary around the world," World Economic Forum, https://www.weforum.org/agenda/2020/01/climate-science-global-warming-most-sceptics-country
2. For a more detailed overview of the process: "How Climate Change Impacts Our Water", by Sarah Fecht, Columbia Climate School https://news.climate.columbia.edu/2019/09/23/climate-change-impacts-water
3. "Overview of Climate Change in Canada," Government of Canada,, https://www.nrcan.gc.ca/changements-climatiques/impacts-adaptation/overview-climate-change-canada/10321
4. Council of Canadian Academies. Canada's Top Climate Change Risks: The Expert Panel on Climate Change Risks and Adaptation Potential, [Ottawa, ON: 2019].
5. Ibid.
6. Ibid.
7. Luke Muehlhauser and Lila Rieber, Exponential and non-exponential trends in information technology, 2014, December 5, https://intelligence.org/2014/05/12/exponential-and-non-exponential/
8. "Industrial IoT Connections to Reach 37 Billion Globally by 2025, as 'Smart Factory' Concept Realised," Juniper Research, November 2, 2020, https://www.juniperresearch.com/press/industrial-iot-iiot-connections-smart-factories
9. Grand River Municipal Water Demand Management, Grand River Watershed: Water Management Plan, https://www.grandriver.ca/en/our-watershed/resources/Documents/Water_Supplies_Primer7.pdf.
10. United States Environmental Protection Agency, Office of Water, Water Audits and Water Loss Control for Public Water Systems, 2013, https://www.epa.gov/sites/default/files/2015-04/documents/epa816f13002.pdf
11. Mark W. LeChevallier, "The impact of climate change on water infrastructure," Journal - American Water Works Association, 106, no. 4 [2014]
12. 1Wesley P. Schultz et al. "Smart Water Meters and Data Analytics Decrease Wasted Water Due to Leaks," Journal - American Water Works Association 110, no. 11 [2018]
13. Ibid.

SCIENCE POLICY IN CANADA

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CSPC Trailblazer Award Winner 2020

Some might say the COVID-19 pandemic showcased science at its best. We ushered in a new era in vaccinology by developing mRNA vaccines and distributing them in record time. We rolled out PCR and rapid antigen tests in airports, schools, hospitals and drive-through centers. Science literacy amidst policy-makers and the general public skyrocketed. Scientists featured prominently in the media and had a greater role in decision-making. COVID-related data were shared across borders. Our government invested billions of dollars to help Canada's academic research community strengthen biomanufacturing, vaccine development and therapeutics, reinforcing the importance of a strong, vibrant science and research ecosystem.

However, it wasn't all a bed of roses. Labs shuttered. Misinformation, a lack of trust, and conspiracy theories corrupted hopes that science would get us safely through and beyond the pandemic. High impact journals retracted studies and statements. The uncertainty that spurs scientists to engage in further investigation and research was cited as evidence of ulterior motives or as supporting fringe beliefs. Science became politicized, dividing mask wearers and non-mask wearers within and across families, communities and provinces. Racism reared its ugly head, exposing fatal cracks in our social structures, our data collection processes and the need for transformative action.

Building back better is a recovery framework that we as Canadians have embraced for the economy. We similarly aspire to a spirit of building back better within our science policy world. The Clerk of the Privy Council appointed Dr. Harpreet Kochhar as Deputy Minister Champion of the Science and Technology Community. The Deputy Minister Champion guides from a strategic level, builds awareness of and advances science issues. The DM Science and Technology community, under Dr. Kochhar's champion role, is focused on three science priorities for immediate attention: anti-racist science, science security, and the added value of government science.

Likewise, the Office of the Chief Science Advisor continues to be meaningfully consulted by our elected government officials, as well as by the heads of the public service on a host of science-policy issues. Dr. Mona Nemer's role as a potent change agent within government is having an impact. Expert committees, task forces, and external science advisory committees have multiplied, giving space to greater science leadership in decision-making. CanCOVID [1] set precedent for rapid, real-time open science-policy interactions. Research granting councils like CIHR [2] are working more closely with Assistant Deputy Ministers on priority policy files, and integrating sex, gender and diversity considerations across programs.

The Departmental Science Advisor Network [3]

now boasts members representing the Departments of Fisheries and Oceans, Transport, Environment and Climate Change, Natural Resources, Health, the Canadian Space Agency, Polar Knowledge Canada, the National Research Council, and the Public Health Agency of Canada. Departmental Science Advisors provide high level science advice on complex files, champion science and research within their agency or department, and enhance interdepartmental science collaboration. At Health Canada we have worked hard to implement a new Framework for Science and Research Excellence. [4] We have also launched a Science and Researcher Integration Network to ensure that scientists' voices are heard across the organization. We host Departmental Science Townhalls to enhance science literacy, present monthly 'Science Matters' to the Executive Committee, support the establishment of plain language mentorship programs for scientists to better brief policy makers, and are aiming to consolidate science input into regulatory modernization processes.

Is there more to be done? Sure. But as we approach 2022 are we trending in the right direction? Absolutely. We must therefore guide this momentum, however hard-earned, to change our future. By shaking up the status quo the pandemic has created opportunities to redefine what science excellence in decision-making looks like. Let's put our best foot forward so that science optimally drives better policy and impact for all Canadians.

REFERENCES

1. https://cancovid.ca/
2. https://cihr-irsc.gc.ca/e/51917.html
3. https://science.gc.ca/eic/site/063.nsf/eng/h_98245.html
4. https://drive.google.com/file/d/14xb_c0xmUW_ZkMbglMOHRiAm_dooEvb2/view

CONFLICT RESOLUTION: Policy Vs Science

Norma Domey
National Vice President,
Professional Institute of the
Public Service of Canada

Having spent more than 30 years as a Federal Government scientist who made science-based recommendations for policy makers at Health Canada and Environment and Climate Change Canada, I have found there are several inherent difficulties in applying scientific information to management decisions that likely contribute to disputes between parties over how and what information is used to inform policy decision-making. In my opinion, these difficulties stem from important differences between the way that science is conducted and the way that decision-makers use and weigh scientific information. Scientific information is often difficult to utilize in management decisions because scientific norms, processes, and limitations can result in scientific information that does not clearly support any alternative over any other. Further, as more scientific information is obtained, the weight of support may shift from one alternative to another. These shifts result more from science having different priorities and practices than management decision-making processes. However, it has been my experience that all parties involved in science and policy try their best to resolve conflicts.

STEPS IN CONFLICT RESOLUTION

As in any other conflict resolution process, science and policy share common ground, but that can only be achieved if you follow all of the usual steps in conflict resolution: A) Prepare the discussion so that all parties have equal footing, B) Ask the question: Where or when did things diverge? And then each side needs to listen carefully to the other. C) Have each side explain the main issues (outcomes, not concerns) caused by the divergence, and respond with how they perceive those outcomes (for example, side A says 'Your fracking is wrecking the environment', side B responds 'I hear you saying that our efforts to increase oil production, including fracking, are worrying to you'. Note this is not about agreement per se, it's about agreement on where the points of disagreement are). D) Have each side express their honest concerns about dealing with the issue (we worry you'll destroy the environment, we worry that the industry will collapse, etc.). E) Having agreement on all of that, it's possible to proceed to agreeing common ground and actions (we both want a thriving Canada, here's a plan to achieve that). There's always an attempt to leap to judgement on that part E (don't bother us with the concerns, etc. we already know all the other stuff), and usually that fails to find any common ground.

TURF PROTECTION

Many times in science/policy conflicts, each side regards the other as infringing on its 'turf.' The reality is that some of that turf is shared property. Rachel Carson's 1962 book 'Silent Spring' was a clarion call for academics to wake up, get out of their ivory towers, and become more relevant to a society dealing with emerging threats to the environment. But as academia has responded and become more activist and relevant in many ways, there has been friction. Policy makers suspect that scientists want to write policy, scientists suspect that policy makers want to unravel science. In truth, there is some justification to those fears, in that the ordinary perspective of each side is very different. Science deals with the 'correct' world, where facts are stubborn things that must be dealt with. Policy deals with a political context where answers are mutable and subject to the philosophy of those that govern. When policy tries to make facts mutable, or when scientists try to make political solutions rigid, the resulting clash will be inevitable.

SERVING THE GOVERNMENT OF THE DAY

The hierarchy of power makes resolution of science/policy conflicts more troublesome. Policy is in the captain's chair, as it is closer to the seat of legislative power and legal authority. Moreover, policy usually involves an army of people serving the government of the day, while academics many times are operating as leaders of small teams, etc. In that context, it is relatively easy to characterize the academic side as being 'biased,' or the policy side as being 'dismissive.' This violates step 1 of conflict resolution above: ensuring equal footing for the discussion. This is where group action on the science side can be important, to bring things to a less personal, more equal footing. It's one area where I think there needs to be more improvement – globally and especially in Canada. Traditionally, bodies such as national academies and larger scientific societies have taken on the role of policy critique and science advocacy. However, it appears that some of these institutions have been ineffectual (at best) or AWOL (at worst) during recent times. For example, did the Royal Society step up when muzzling of science became an election issue in Canada several years ago? No. They were invisible. Did the National Academy of Science or any Health Science professional society in the United States raise an uproar when we learned that the Biden Administration abandoned Scientific Integrity policy to control the communications of their researchers regarding COVID? Silence!

SCIENCE ADVOCACY

Some groups have emerged to try to tackle the lack of activity by the traditional science advocates, for example the Union of Concerned Scientists in the United States, and Evidence for Democracy (E4D) in Canada. However, their resources are limited, and they cannot possibly cover all the important bases that need to be covered for specific critique. They must focus on the big picture. While it is true that the Professional Institute of the Public Service of Canada (PIPSC) helped to foster the establishment of E4D in Canada, and successfully defended against the muzzling of Science during the Harper Administration, it also has limits to resources and mandate – it cannot be all things to all people. So, while unions like PIPSC can be involved in urgent defensive actions, establishing constructive critique on multiple fronts becomes a bit more challenging. Perhaps the establishment of an open access journal where research by public service scientists, with a volunteer editorial staff, could provide critical evidence for the policy side to consider. Continued research and hypotheses development and testing (particularly comparative case studies and large sample size (n), empirical studies) are needed to understand the real strengths, limitations, and applicability of each dispute resolution approach to effectively assist managers to appropriately cope with disputes over science.

Government research, by its very nature, is focused on the big, long-term picture and the public good – as Chair PIPSC National Science Advisory Committee, in my humble opinion, it's a good place to start.

THE BRIDGE FROM BOTH ENDS

Rob Slater

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Environmental Policy at Carleton University, Executive Director for the Regulatory Governance Initiative (RGI)

CSPC Lifetime Achievement Award Winner 2020

Last year, the CSPC recognised me with a lifetime achievement award. That was a delightful surprise and prompted me to think about what I had learned in over 50 years of trying to bridge the worlds of experts with the worlds of policy and politics. And make no mistake, these are different worlds that have their own vocabulary and values which are different in important ways. Neither world is 'absolutely right', they are just different and at the core mutually dependent thus the role of the bridge.

Also, I didn't want to just look backwards but also to incorporate some of the lessons we are learning from two dominant issues of our times: the pandemic and climate change. I have obviously been highly selective and will suggest just three points.

DISCERNMENT

There is no shortage of expert opinion. As an example, it has been said that there are more scientists currently employed in scientific endeavours than have lived in the entirety of human history and the amount of new information is increasing proportionately. The trick is to make sure you, as an expert, know who needs information and for what purpose and the format which will be most useful. The capacity to scan a large field and synthesise the key information into an understandable story is a highly prized talent. We've all seen firsthand our public health colleagues doing this daily for almost two years. When they have the time, it would be helpful if they could share with us how they were equipped to play these roles and how they would advise others to prepare themselves.

The management of information is at least familiar territory for most of us. The management of misinformation is not and one we cannot ignore. Misinformation has been revealed as a significant factor in shaping policy choices and necessitates developing the ability to detect and scan malicious misinformation with the intent of neutralising it.

AUTONOMY

As an expert scientist you want to pursue your search for knowledge as you define it. Leaders want unencumbered use of the expert's advice to advance files or shape advice when informing others. At a strategic level, the Minister or senior leader wants to be free to make choices based upon expert advice, that will also satisfy legislative obligations or advance political priorities. These are complex and interdependent activities where the stakes are high and the relationships challenging. Questions around who controls what and whom can be difficult as the different players may not have the same views on the discretion available to them. This can pose a threat to credibility. Managing this through joint problem solving and coordination can be effective.

The last two years have also given us an object lesson in the distinctions between the science experts and the policy/political decision makers. Canadian scientists, from a lay perspective, have been operating in a coherent and mutually supportive manner regardless of which government or university or health authority they worked for. There were of course differences in what they did but it appeared that they had autonomy over their operations. They also were the main gateways for disseminating and interpreting information and answering questions. They could not be held accountable for how their information was used.

At the political level the policy choices were examined and decided upon. Clearly, despite extraordinary governance attempts to create a coordinated and consistent response there has been a good deal of diversity which has been attributed to the different social and economic dynamics inherent in a large federation. The contrasting coherence in the scientific community may be attributed to the universal acceptance of the scientific method and its attendant values.

CONSENSUS

A former White House advisor, harboured in an Administration opposed to action on climate change, confessed that his aim was to produce doubt. This was part of a campaign heavily supported by certain interests which felt threatened. Doubt implies that you are not sure and that translates into inaction until people make up their minds. This is in the same category as misinformation.

Conviction leading to consensus is the antidote to doubt. The world has become very sophisticated and adept at generating a consensus and maintaining them. Their language has evolved and uses concepts such as 'certainty and risk'. These are topics that are familiar to political decision makers, and they are accustomed to dealing with them.

It is worth noting that a consensus should not be taken to suggest unanimity. The nature of science is that there are always outliers who hold opinions distinct from the majority view. Paradoxically, one generation's outlier can produce the next generation's breakthrough. The names of Charles Darwin and Tuzo Wilson spring to mind.

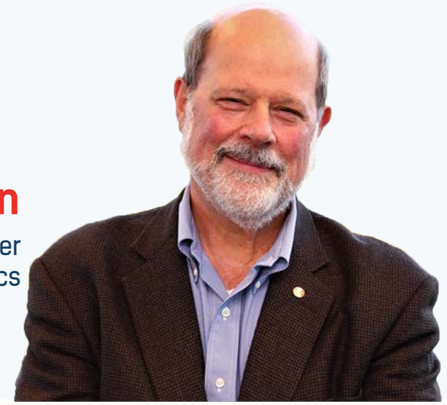
These days more and more issues seem to find themselves on a global agenda. The presence of Canada on the consensus forming bodies is essential if Canadian generated information is to be considered and Canadian interests to be understood. Our influence in these fora demands experienced, credible individuals with the right credentials and support from their institutions.

I have directed this towards those of you who want to make a difference through your work, and I have suggested some characteristics that have been particularly effective in leading change. One final observation to public servants who have been described as the permanent custodians of permanent problems–never underestimate the virtue of stamina for subjects that can demand your attention for 25 years and more.

Acknowledgements. *I would like to extend thanks to my colleagues William Pullen at the University of Ottawa and Dr. David Miller at Carleton University for their unfailing collaboration and advice over the years.*

INCLUSIVE INNOVATION KEY TO UNLOCKING FULL POTENTIAL OF CANADA'S INNOVATION ECOSYSTEM

John Hepburn
Chief Executive Officer
Mitacs



Today, more than ever before, Canada needs to draw on the ingenuity and creativity of our greatest strength – our people – to drive innovation and economic growth. The importance of inclusive innovation can be simply but powerfully stated: diverse teams are more likely to outperform teams lacking diversity, even if members of the less diverse group are individually more highly skilled. Inclusivity helps broaden the impact of innovation – we want our input to be more diverse to improve our innovations, but we also want the output of innovation to be more diverse to better serve more people.

It goes even further: when compared to their counterparts, diverse and inclusive organizations are 87% more likely to make better decisions (Korn Ferry Research, 2021) and 75% faster at bringing products to market (Center for Talent Innovation, 2021). Additionally, a 2017 study by the Boston Consulting Group (BCG) found that companies with more diverse management teams experienced higher revenue from new products and services. Diversity brings different perspectives, creativity, and thinking to a challenge and, ultimately, this translates into greater innovation and the creation of a larger talent pool for the innovation economy. The innovation economy is driven by talent; we can't afford to exclude people from this economy.

What, then, can companies do to unlock the full potential of inclusive innovation in their organizations?

REMOVE BARRIERS TO ACCESS

A key first step is recognizing that barriers to access across the innovation ecosystem result in significant systemic marginalization of underrepresented groups. Removing barriers, which are often unintentional and hard to recognize, will allow organizations to unleash the extraordinary creativity, ingenuity, and capacity of those whose lived experience offers diverse ways of knowing and being in the world. Indeed, mobilizing inclusivity is vital to ensuring that innovation not only addresses economic impact but, crucially, addresses inequities across Canadian society.

Barriers to access include gaps in educational attainment, where under-represented groups tend to have lower rates of higher education, difficulty accessing funding from traditional financial institutions, and experience the effects of unconscious bias and discrimination – including hiring bias, systemic and stereotypical attitudes, physical inaccessibility, and prejudice and discrimination in both education and the workforce. These inequalities undermine innovation by preventing the development and effective use of skills, knowledge, and creativity.

Science, Innovation and Economic Development

IMPLEMENT AN EQUITY, DIVERSITY AND INCLUSION (EDI) STRATEGY

Inclusive innovation cannot truly be achieved until an organization makes a conscious effort to prioritize equity, diversity, and inclusion in everything they do. This means acknowledging the existence of systemic barriers and power imbalances related to privilege, continually seeking to learn, reflect, and act to meet the needs of all employees and stakeholders, recognizing the complexities of the relationship between Indigenous and non-Indigenous peoples and striving to engage with Indigenous peoples in a non-colonial, respectful manner, and working to ensure equitable access to opportunities while building meaningful relationships with Indigenous partners.

At Mitacs, we have taken important steps towards inclusive innovation through our commitment to an ambitious EDI strategy and policy as a core value of our organization, and most recently, through the creation and hiring of a new senior role, VP Equity, Diversity, and Inclusion.

ENCOURAGE WORK-INTEGRATED LEARNING FOR ALL

One of the ways an organization can attract diverse talent is by creating awareness of the opportunities and support that are available to all post-secondary students and recent graduates. It will be crucial for companies to make these connections if they are going to solve their most pressing innovation and business challenges. This is where an organization like Mitacs plays an important role. As a national not-for-profit that designs and delivers innovation partnerships and training programs focused on innovation, Mitacs works directly with organizations, connecting them with post-secondary research across all disciplines in order to fill the gap between business innovation and skilled talent.

Through the innovation partnerships created by Mitacs, students can apply what they've learned in a variety of settings to real-world business or community organizations. Students like Lia Fabre-Dimsdale, who, through an internship at Atomic Cartoons, gained experience as an animator. Fabre-Dimsdale, a member of the Liidlii Kue First Nation, was offered the opportunity to participate in Mitacs's Business Strategy Internship program by one of her professors. She is now working on the animated children's series, Molly of Denali. Her internship was facilitated by Mitacs's Indigenous call, which offers additional benefits for Indigenous-owned companies to hire interns or for companies that hire Indigenous interns.

Mitacs recognizes that barriers to access across the innovation ecosystem result in significant systemic marginalization of under-represented groups. By investing in talent within under-represented communities and removing systemic barriers that prevent these groups from taking an active role in driving innovation, all of Canada will benefit.

DEVELOPING TALENT AND GROWING BIOMANUFACTURING IN CANADA

Kate Winchester

Head of Sanofi Pasteur Toronto's Flu and Pandemic Readiness Program

WHY DID YOU CHOOSE TO WORK IN BIOMANUFACTURING AND WHAT WERE YOUR CAREER AMBITIONS?

I grew up in Ontario and studied chemical engineering at the University of Waterloo. I was really interested in pursuing a career in industrial biotechnology. Living in Canada in the early 2000's when I graduated, I had the chance to work in either the petroleum or pulp and paper industries, but I felt strongly that I wanted to help people and make patients' lives better. This was my calling.

When I graduated from university, I wanted to work in an environment that was producing new therapies. I was willing to move away from home and leave Canada to find the right opportunity and the biomanufacturing industry in the United States was thriving. At that time, there was a lot of opportunity in California to gain large-scale biomanufacturing experience working on innovative products. So, I moved there right out of school for an opportunity to work at a new facility that was producing monoclonal antibodies to treat cancer.

WHAT WERE YOU HOPING TO ACHIEVE BY COMING BACK TO ONTARIO?

When I had a family of my own, I wanted to come back to Canada. I had been casually keeping an eye on the status of the biotechnology industry at home and happened to see the announcement that Sanofi would be investing in a new large vaccine manufacturing facility (Building 100) in Toronto. It piqued my curiosity that perhaps a shift had started to happen with additional investment in biomanufacturing going on now in Canada.

At the time Building 100 was announced (2018), it was the largest ever bulk manufacturing investment by Sanofi worldwide. On top of the 100+ year history of Sanofi's Connaught Campus and existing strong life science foundation, this investment allowed for opportunities for many in our industry, for those just starting out and for those with deep experience, to develop their careers while working to build a manufacturing facility for pediatric booster vaccines with the latest technology and processes. Building 100 was a spark – the first initiative to begin the revitalization of Sanofi's operations in Toronto. It brought talent back to Canada, built knowledge and capacity locally, created jobs, and increased opportunities for university co-op students to get hands-on experience here. I moved home to Ontario in 2019 to join Sanofi in Toronto. I hoped that I would see future investments at the Toronto site and more broadly in biomanufacturing in Canada.

Sanofi's recently announced $925M influenza vaccine and pandemic readiness manufacturing facility is a great outcome. Since the beginning of the COVID-19 pandemic, a renewed commitment and financial support from the Federal Government, Province of Ontario and the City of Toronto is building momentum. More companies are investing in Canada and creating considerable opportunities to grow the industry, improve healthcare outcomes and increase local talent. It is a good challenge to have for companies to now face competition for talent attraction and retention. This enhances our overall life sciences sector.

HOW IS THE GOVERNMENT SUPPORTING CANADA'S BIOMANUFACTURING INDUSTRY TO DEVELOP AND ATTRACT TALENT?

The Federal Government and Ontario's biomanufacturing and life science strategies prove that developing and protecting this sector is of national interest. And, strategically investing to promote, cultivate and capitalize on Canadian innovation is needed. More funding directed towards academic institutions and researchers is one way to build the talent pipeline for the future and investing in partnership with industry is another.

I left Canada for California because the skills I needed to achieve my career objectives are highly specialized. I gained this experience working in large-scale industrial biomanufacturing facilities as did many of my colleagues now working at Sanofi. California is one example where government made a conscious effort to develop a biotechnology hub and has realized the benefits of this strategy from the resulting scientific contributions to human health as well as the local economy.

Right now, large-scale industrial vaccine manufacturing in Canada is limited. The planned Moderna mRNA facility is

another step in the right direction, but the Federal and provincial governments still have work to do to continue attracting private sector investment. This is needed for Canada to play a more prominent role internationally while protecting Canadians during public health crises. Policy makers must ensure connections exist between adapting innovation into our healthcare systems at globally competitive valuation, along with our economic development initiatives. Canada is a small market competing with other countries with more established biomanufacturing hubs and policy environments that are attractive for investment from an industry perspective.

CAN YOU TELL US WHAT IS GOING ON AT SANOFI'S TORONTO SITE NOW AND MORE ABOUT YOUR ROLE?

I am currently the head of a new program where my team is responsible for building a large-scale industrial influenza vaccine manufacturing facility with capabilities for pandemic preparedness. This includes new drug substance production capacity and technologically advanced formulation, filling, visual inspection, and packaging capabilities (FFIP). These FFIP capabilities will be a key pandemic readiness asset that could support the production and distribution of critical vaccines during a public health emergency.

This is so exciting because the facility is being designed with the future in mind: leading-edge technology including robotics, digital tools designed to increase knowledge capture during production processes, advanced manufacturing principles, and flexibility with the capacity for high throughput commercial production and small volume for research and development needs.

It is a great time to be working at the Sanofi Toronto campus because it has so much to offer people at different stages of their careers – research and development facilities, massive commercial manufacturing, combination pediatric vaccines, our new influenza manufacturing facility and the pandemic readiness program. Our commercial manufacturing operations are expanding. It is rewarding working with a great team dedicated to advancing public health through a focus on science, advanced technology, and innovating every day. I'm thrilled to be part of it and for the opportunities it is creating for people to build their careers and be part of the growth of biomanufacturing in Canada.

BIOMANUFACTURING INNOVATION SCIENCE

A key for future resilience

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The COVID-19 pandemic imposed unprecedented health and societal challenges and notably highlighted the global lack of pandemic preparedness and weaknesses in supply chains across diverse industrial sectors. Nevertheless, this same threat inspired a rapid and global response, coordinated across sectors and sometimes among nations, culminating in the expedient arrival of life-saving vaccines and therapeutics.

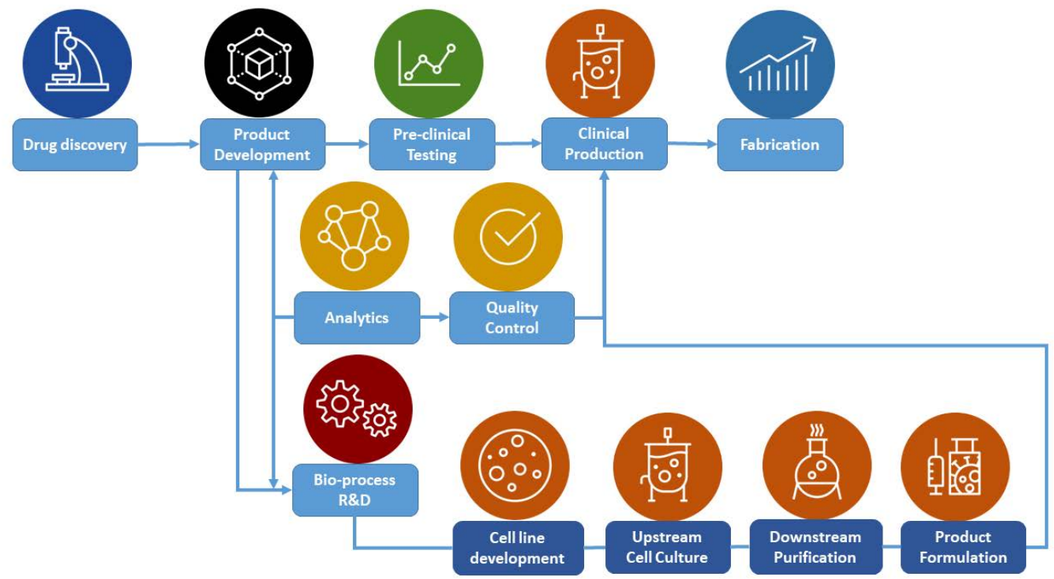
The speed at which COVID-19 vaccines were developed, evaluated, and authorized is due to numerous important underlying factors: decades of investment in prior research in platform technologies such as the mRNA delivery system; global coalitions/partnerships and unprecedented government incentives to engage in multi-sectoral collaboration to rapidly re-orient vaccine platforms and enable manufacturing; rolling regulatory review of candidate vaccine dossiers to accelerate their emergency authorization.

In Canada, like in many other countries, the federal government recognizing the national technology and innovation gap prioritized procurement of life-saving vaccines from the global supply chain. At the same time, national spending was triggered towards supporting early-stage SMEs to de-risk and accelerate their vaccine candidates to enter clinical trials and secondly, investing rapidly to build out biomanufacturing facilities, including publicly owned ones. While these investments have not yet translated into a made-in-Canada authorized vaccine, the return on investment will lie in having strengthened Canada's future resilience. Preparing for the next pandemic, we opine that besides investment in infrastructure, Canada needs a coordinated investment in the continuum of Biomanufacturing innovation science (Fig. 1). This is needed to bolster multi-disciplinary innovation for various design elements that can de-risk the manufacturing process, and ensure robust population scale manufacturing for multiple product types. Below we identify the key themes that should be addressed under such a science policy.

PRODUCT DEVELOPMENT BRIDGE FOR A PIPELINE OF INNOVATIVE BIOLOGICS FOR COVID-19 AND BEYOND

Biologics are the fastest growing class of newly approved drugs and include products such as vaccines, antibodies, cell and gene therapy to treat a plethora of rare or chronic diseases and emerging infections. [1] A recent scan revealed that Canada has an impressive pipeline of innovative Biologics in development; nearly 133 groups in Canada are developing over 328 biologics. [2] This number has doubled within 4 years and represents a rich pipeline of early-stage products from academia to SME developers that require next-stage de-risking including biomanufacturing. While investment in the Clinical Trial Fund to move such candidates to first-in human trials is much needed and identified in the 2021 federal budget, equally important will be ensuring feasibility of manufacturing scale-up. This will require an early partnership between R&D and manufacturing facilities to design and optimize the production process and product characterization. Furthermore, pandemic preparedness will require technology readiness for rapid production at population scale (preferably within weeks rather than years to move from concept to production and testing). Lastly different types of products such as vaccines, antibody therapies or cell and gene therapy will require different models; distributed and/or central manufacturing. Therefore, investment in de-risking manufacturability will need to go hand-in-hand with early stage product

Figure 1



development.

FOUNDATIONAL SCIENCE SUPPORTING TURN-KEY OR PLUG-AND-PLAY PLATFORMS:

A second crucial pillar of innovation is the area of turn-key plug-and-play production and delivery platforms. Safe and effective COVID-19 vaccines arrived so quickly because they were rapidly built upon decades of research on the mechanism of action and safety, for novel platform technologies (e.g., Adenovirus vaccine vectors, encapsulated mRNA delivery systems) developed for other applications. The ability to have an inventory of such platforms, qualified and de-risked, with companion manufacturing already ironed out, ready to deploy for target vaccine of interest will be key to future pandemic preparedness. Today, Canada has limited capacity for large-scale manufacturing of mRNA-based candidates, such as Pfizer and Moderna COVID vaccines, despite the fact that the early-stage innovation for lipid nanoparticle delivery system for mRNA originated here. Furthermore, other innovative delivery and production technologies such as virus-like particles, customized viral vectors and even cell-free production platforms are emerging. Ideally these platforms will be developed alongside optimization of the manufacturing process with predictability by integrating AI modelling for improved yield and advanced analytics for end-product characterization. Canada also has a breadth of expertise in cross-disciplinary areas such as quantum science, synthetic biology, [3] quantum science, [4] microfluidic devices and advanced materials and robotics which could be positioned for next generation manufacturing to digitalize and automate precision manufacturing. Overall, a coordinated investment in next generation technologies that links together teams of developers to include platform-specific manufacturing process design will position Canada for rapidly unlocking domestic capacity to bring forth solutions for emerging and/or complex diseases.

FLEXIBLE INFRASTRUCTURE – FLEXIBLE PLATFORMS – MYRIAD OUTPUTS:

In considering what types of vaccines or other biopharmaceutical development could be supported with Canada's new Biomanufacturing infrastructure, it is important to realize that not all products use

the same production process. There are then two ways of approaching this issue from strategic investment; creating centres for excellence for specific platform types across different sites (e.g., those that focus on mRNA production versus viral vectors versus protein vaccines), or an integrated facility that is designed with dedicated sections for different types of products. This latter approach may be feasible in certain cases where the know-how for producing most biological products is leveraged as conserved requirements for multiple product types. Such flexibility allows us to not only think about rapidly responding to emerging infections in urgent situations, but also to re-orient this infrastructure and platforms at other times to accelerate product development for other diseases (cancer, autoimmunity, rare diseases etc). Pivoting from product to product as need arises is most feasible with a publicly-funded investment strategy that can and should respond to policy directives. The advantage is that public policy could be geared towards manufacturing for societal needs for areas such as rare diseases or anti-microbial resistance that are often not supported by a free market economic growth lucrative to the industry.

COORDINATING THE VALUE CHAIN: THE TRINITY OF PARTNERSHIPS

The collective power of academia, industry and intramural government R&D units working together to rise to a challenge of forging effective solutions for a crisis situation cannot be overstated. The global COVID-19 vaccine development response has been rapid, effective, and scalable because of the incentive and support available to unite contributors of basic science, established vaccine platform technologies, experienced bioprocess engineering and manufacturing processes, and expertise in bringing products through regulatory approval and to the commercial market. These same principles can be leveraged to address other health imperatives nationally and globally. Whether addressing vaccines for emerging infections, gene therapies for rare and ultra-rare diseases, cell or antibody

Figure 2

Biomanufacturing Innovation; Call to Action

- Funding instruments that promote multi-sectoral collaboration; academia-OGD-industry partnerships
- Biomanufacturing R&D Innovation; platforms, emerging technologies, biomaterials, analytics, digitization and automation
- Funding instruments to de-risk and accelerate manufacturing for a pipeline of Canadian products
- Flexible access to appropriate scale of domestic Biomanufacturing (clinical material to commercial products)
- Public-private partnerships where value creation is driven by societal/health/national benefit
- Policy directive for regulatory flexibility; for rare diseases, personalized medicine or pandemic preparedness
- Biomanufacturing readiness and ability to pivot during crisis

therapies for cancer, personalized cell products to treat chronic disease, or novel agents to combat antimicrobial resistance, a coordinated investment and governance to coordinate clusters of excellence to accelerate product development and streamline the value chain is bound to accelerate the arrival of effective solutions.

BUILDING FOR THE FUTURE:

Canada has deep fundamental science capabilities in many disciplines including a vibrant research community in life sciences. To create value of our discoveries and advance novel vaccines and biologic therapies to benefit the society, investment in enabling manufacturing infrastructure and delivery platforms is imperative. Our burgeoning biomanufacturing sector will benefit from an integrated science policy that address key elements (Fig 2).

An underpinning need to achieve this action plan will be the availability of highly qualified personnel. Various estimates have suggested that Canada needs >3000 highly qualified personnel over the next 3–5 years to support the burgeoning Biomanufacturing sector. [4] This requires directed integration of academic training centres with manufacturing facilities and regulators to provide a comprehensive skills training, as well as re-skilling and up-skilling to bridge work-force gaps from early stage R&D to commercialization. Additionally, Canada will need to foster C-suite talent in this highly competitive space where global demand will influence brain-drain and/or -gain. Canada is poised to achieve its vision of an integrated Life Sciences strategy [5] that can drive bioeconomy; [6] biomanufacturing innovation science needs to be an integral theme of its implementation.

REFERENCES:

1. Rapid growth in biopharma: Challenges and opportunities | McKinsey https://www.mckinsey.com/industries/life-sciences/our-insights/rapid-growth-in-biopharma
2. Mathew Starek and Raymond Eileen; National Research Council of Canada; compiled from MedTrack and GlobalData and company web-sites.
3. White Paper: Engineering Biology | CAN-DESyNe https://www.candesyne.ca/white-paper-engineering-biology
4. Can we afford not to participate in the quantum race? – CSPC https://sciencepolicy.ca/posts/can-we-afford-not-to-participate-in-the-quantum-race/
5. Biomanufacturing_Strategy_EN_WEB.pdf https://www.ic.gc.ca/eic/site/151.nsf/vwapj/Biomanufacturing_Strategy_EN_WEB.pdf/$file/Biomanufacturing_Strategy_EN_WEB.pdf
6. The Bio Revolution: Innovations transforming economies, societies, and our lives | McKinsey https://www.mckinsey.com/industries/life-sciences/our-insights/the-bio-revolution-innovations-transforming-economies-societies-and-our-lives

SCIENCE AND INNOVATION IN A POST-PANDEMIC FUTURE

Karimah es Sabar

Chair, Health and Biosciences Economic Strategy Recovery

The COVID 19 pandemic has negatively impacted most industry sectors in Canada; and the effects of the last 18 months will have knock-on impacts for decades. Yet, one sector has continued to excel through the challenges – biosciences. Just as power-driven machines defined the Industrial Revolution, biosciences will frame the 21st century, a world that will be shaped in part by our ability to respond quickly and nimbly to future global crises.

Encompassing everything from medical device manufacturing to biopharmaceutical development and the latest diagnostic tools, the biosciences industry is the engine that will propel successful nations forward. Canada can, and must, be one of those nations. While the pandemic showcased Canada's biosciences talent and boosted the growth of several high-quality companies, we need to do more in order to thrive post-pandemic, and we need to do it now. At the outset, governments at all levels must foster ingenuity and embrace innovative policy decisions to nurture and grow a robust, sustainable biotechnology ecosystem in Canada. We need to cut red tape, power through the noise, and get serious about maximizing, nurturing and retaining our talent, resources and companies.

VACCINE EQUITY: NO ONE IS SAFE UNTIL WE ALL ARE

There is a reason Canadian backpackers stick maple leaves onto their bags—we are a nation that people are proud to belong to. We have a global reputation as peacekeepers and humanitarians. Lately we have slacked off, it is time to re-earn that reputation: we cannot rest on our successes while most of the world remains vulnerable and unvaccinated. Most African nations currently have less than a 20% immunization rate. [1] The time for hoarding vaccines and ensuring only our own supply is over—viruses have no respect for borders, and only when everyone in the world is vaccinated will this pandemic be truly contained.

Investing in global health just makes good sense when we build and share our technology, we make a better world for everyone. However, we can only do good for others when our own house is in order: science and innovation must be made the cornerstone of our economic and societal recovery. To be ready for the next time we are hit by a (health) crisis, to mitigate it and respond quickly and nimbly, we will need to be prepared. Early action is needed to invest in Canadian-based vaccine manufacturing: no longer should we depend on others. Only once we are self-sufficient can we truly support others globally and fulfill Canada's humanitarian promise to the world.

Prevention, primary intervention and early response is a much sounder medical and financial approach than having to deal with the sequalae of the problems. Preparation is a cost-effective strategy that ensures quality of life and healthy societies. As a nation, we rank fourth globally for scientific publications [2] and our academic system is enviable. But it's not enough. We must build on Canadian science and innovation in all stages of the research and development continuum by maintaining momentum, retaining talent and creating anchor companies. We must think scope and scale—yes, we're a small nation, but we have the potential to build and anchor world leading companies. All our players—academia, research, philanthropic organizations, industry, government— need to be rowing together.

INTERNATIONAL LEADERSHIP

In a global context, Canada has the opportunity to take leadership. With 4.8 million Canadians having tertiary education in STEM [3], biosciences and cleantech are areas where Canada's companies can produce for the world building on our existing strengths. Our investment in industry must be taken to a new level by re-examining our life sciences and biomanufacturing sectors and building them up to a higher capacity. The Canadian Biomanufacturing and Life Sciences Strategy, [4] announced in July of 2021, outlines how we become

a self-sufficient nation, while orchestrating international cooperation in health crises.

Health and biosciences, in addition to clean tech and digitization are the three-legged stool of an innovation-driven economy. For Canada to maintain its quality-of-life standards and leadership position in the global scientific arena, we must foster and nurture a robust innovation-driven economy. Emerging markets are proving to be aggressive competitors in these areas. Vietnam, for instance, has gradually been increasing public health expenditure at an average of 9% since 2003 when the SARS pandemic struck. A relatively small Asian nation of 95 million people, Vietnam, quickly mobilized digital technology with the Ministry of Public Health relying on transparency and communicating with third-party agencies as it tracked, traced and published all confirmed cases on a publicly accessible online tracker. These strategies clearly paid off: today, Vietnam has had one of the lowest death tolls from COVID-19. [5]

THE FUTURE: SCIENCE & INNOVATION AS DIPLOMACY

The pandemic has clearly shown us how intertwined and interdependent our small world really is, despite geographic boundaries. It has also thrust to the forefront the opportunities presented to Canada's scientific capacity on a global scale. Our success as a nation allows us to deploy science and innovation diplomacy to benefit all of humanity. It may be a bold goal, but it is one worth aspiring to.

There are many areas of science where we can collaborate globally even with the most challenging of countries: the language of science is international. Through collaboration, there is a human connection and the ability to enable a betterment in quality of life amongst countries that need it the most. "Scientific diplomacy" also provides us an opportunity to exercise soft power and influence human rights and other social and environmental standards which Canada holds dear.

There are many reasons for prioritizing and powering Canadian biosciences and cleantech ecosystems as a cornerstone to building a healthy and sustainable economy, not the least being to improve the lives of all Canadians as well as of other fellow human beings who need our help, and with whom we share this planet.

REFERENCES

1. https://www.afro.who.int/news/africa-faces-470-million-covid-19-vaccine-shortfall-2021
2. https://www.investcanada.ca/industries/life-sciences
3. https://www.investcanada.ca/industries/life-sciences
4. https://c212.net/c/link/?t=0&l=en&o=3242289-1&h=2980216217&u=https%3A%2F%2Fwww.ic.gc.ca%2Feic%2Fsite%2F151.nsf%2Feng%2F00018.html&a=Biomanufacturing+and+Life+Sciences+Strategy
5. https://theconversation.com/what-developing-countries-can-teach-rich-countries-about-how-to-respond-to-a-pandemic-146784

SUSTAINING THE BLUE BELT:

Suggestions for Forward Thinking Policy to Protect Great Lakes Food Fisheries

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Compared to Ontario agriculture, Ontario's seafood industry enjoys comparatively few protections. Whereas Ontario's famed Green Belt protects agricultural and environmentally sensitive lands from urban sprawl and development, no such protections exist for the many ports and sensitive habitats that support Great Lakes fisheries and their contribution to Canadian diets. This is a serious gap in Canadian food policy, and underscores the lack of cultural awareness in Canada's society of the role of the Great Lakes "Blue Belt" and the many fisheries it supports.

The Great Lakes Fishery Commission reports that commercial, recreational and tribal fisheries on the Great Lakes are collectively valued at more than $7 billion annually and support more than 75,000 jobs. While many people enjoy eating recreationally or traditionally harvested fish, only commercially caught fish may be legally bought and sold in restaurants or at grocery stores. Yellow perch, yellow pickerel (walleye), rainbow smelt, and whitefish make up the bulk of the commercial catch, the vast majority of which is eaten in the Great Lakes region (primarily the U.S.), or in major cities around the United States and Canada. The comparatively "local" consumption of Great Lakes fish is remarkable, as many seafood species are eaten great distances from where they are caught, creating substantial carbon footprints and becoming unavailable to people in the localities where they are harvested.

Provincial and federal policy, as well as a turn toward societal recognition of fish as local food, is essential to supporting the Blue Belt and its fisheries. Here, I propose several policy directions that could better protect fishing infrastructure and access, ranging from the provincial to the local level.

A RIGHT-TO-FISH ACT

At the provincial level, policy-makers could strengthen existing right-to-farm legislation, such as Ontario's Farm and Food Production Protection Act [1] or British Columbia's Farm Practices Protection Act [2] by including wild-caught fisheries. In Ontario, this legislation states that, "It is desirable to conserve, protect and encourage the development and improvement of agricultural lands for the production of food, fibre and other agricultural or horticultural products." Wild-caught fisheries are an important and regionally local means of food production, yet they are not explicitly mentioned within the act (though, notably, cultured fisheries are).

The act goes on to acknowledge that farming operations may cause "discomfort and inconveniences" to those on adjacent properties, but that agriculture also suffers from increasing societal pressures that complicate their efforts to produce important agricultural products. The act argues that agricultural areas, uses and normal farm practices should be promoted and protected in a way that balances the needs of farmers with public health, safety and environmental concerns. Fisheries too need these protections, as the very pressures from which this act protects Ontario's agricultural industry thus impact wild-caught fisheries, fishing fleets and their places of work (e.g., working waterfronts), and by extension, the food systems they support.

Given the intent expressed in the act to conserve, protect, and encourage the development and improvement of agricultural production, amending this act to include wild-caught fisheries and their normal practices is an essential policy step to better incorporate all aspects of Ontario's food production under its protections.

PUBLIC TRUST DOCTRINES

Alternatively, a localized movement could focus protective measures to benefit a broader community of marine trades by using zoning laws to safeguard waterfront access and infrastructure for those businesses dependent on the water. Local ordinances that establish a tiered system of waterfront zoning, such as those used in Michigan and elsewhere, can provide municipal or city planners with tools to prioritize public and trade access to waterfronts. [3] This approach to zones prevents other types of development, such as residences, from encroaching on waterfront space.

Another option might be to place public commercial fishing space that borders water under public trust doctrines. In Canada, public trust doctrines [4] say that the Canadian government holds certain resources, (e.g., navigable waters, shoreline, groundwater) on trust, or in a fiduciary capacity for the public. [5] This approach could be extended to preserve public access and use of waterfront space over private interests, which would effectively protect use of these spaces for fishermen and others who need consistent, reliable access to water.

HERITAGE CONSERVATION DISTRICTS

Finally, another option for Great Lakes fishing communities may be to seek heritage status for long-standing fishery areas, such as working waterfronts, harbours and other infrastructure. Heritage Conservation Districts [6] are areas designated under the Ontario Heritage Act [7] and are intended to

"contribute to an understanding and appreciation of the cultural identity of the local community, region, province or nation." [8] One advantage of this approach could be that designating fishing areas would raise their profile as important centers of cultural heritage for Great Lakes coastal communities. As public awareness of these fisheries across the province is limited and as fleets shrink in size, this sort of visible recognition may build public knowledge around food fisheries and their role in Canadian society. However, this approach would not come without possible limitations. Development in and around heritage-designated sites must go through additional layers of review and approval, which some communities may find too arduous.

In summary, Great Lakes fisheries are the Blue Belt of Ontario food systems and are in need of the same protections afforded to terrestrial agriculture. Fishing livelihoods contribute to local economies, culture and food systems, and a multipronged policy approach to protecting their access and infrastructure can ensure Ontarians enjoy local seafood for generations to come.

REFERENCES

1. https://www.ontario.ca/laws/statute/98f01
2. https://www.bclaws.ca/civix/document/id/complete/statreg/96131_01
3. https://www.michiganseagrant.org/topics/resilient-coastal-communities/waterfront-planning-and-zoning/
4. https://www.legalaid.mb.ca/wp-content/uploads/2017/03/Consumers-Association-of-Canada-Lake-Winnipeg-Regulation-Appendix-7-Public-Trust-Doctrine_-April-14.15-1.pdf
5. Smallwood, K. P. (1993). Coming out of hibernation: The Canadian public trust doctrine [University of British Columbia]. https://doi.org/10.14288/1.0086301
6. http://www.mtc.gov.on.ca/en/publications/Heritage_Tool_Kit_HCD_English.pdf
7. http://www.mtc.gov.on.ca/en/heritage/heritage_act.shtml
8. Ontario & Ministère de la culture. (2006). Les districts de conservation du patrimoine: Guide de désignation des districts aux termes de la Loi sur le patrimoine de l'Ontario. Ministère de la culture.

CSPC: MY GATEWAY INTO A SCIENCE POLICY CAREER

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In reflecting about my foray into the field of science policy, two trends in the global context stand out to me. First, the shifting employment landscape for PhDs in the sciences (chemistry, in my case), towards "alternative career paths" beyond academia and R&D in the private sector (elaborated in several reports, including the 2021 Degrees of Success report by the Council of Canadian Academies; [1] and second the growing recognition of the value of bringing scientists into policy making in the public and not-for-profit sectors. In the last decade alone, several governments and international organizations have launched science policy fellowships to engage early career researchers to drive evidence-based decision making, many inspired by the AAAS Science and Technology Policy Fellowships (1973) [2]. Some recent examples include the Association of Southeast Asian Nations (ASEAN) Science and Technology Fellowship (2014) [3], the Mitacs Canadian Science Policy Fellowship (CSPF, 2016) [4], the DST Science, Technology, and Innovation Policy Fellowships in India (DST-STIP, 2016) [5], the Parliamentary Academic Fellowship Scheme of the United Kingdom Parliamentary Office of Science and Technology (POST, 2016) [6], the Australian Science Policy Fellowship Program (2018) [7], the Africa Science Policy Fellowship (2019) [8], and the Science, Technology, Policy Fellowship Program of the Inter-American Institute for Global Change Research (STeP-IAI, 2020) [9].

In the context of this external push and pull, my own interest in science policy developed during my PhD years at the University of Maryland, College Park. As a student leader in the Chemistry Department, I collaborated with fellow classmates to convince our administration to provide greater support to PhD students for job transitions to diverse career paths. This early attempt at driving policy change [10] within the university ecosystem helped me recognize where my own values, interests, and skills lay. As I began pursuing career options in this field, I was also simultaneously planning to move to Toronto, Canada. A former volunteer told me about the Canadian Science Policy Conference, and a few minutes on their website told me I had to be a part of it! I joined my first virtual meeting as a volunteer for the CSPC 2019 Editorial Committee, during my lunch break in the lab of a biotech startup company in Maryland, USA.

Even before physically moving to Toronto, I felt welcomed into a community of highly motivated graduate students and professionals from a variety of cultural backgrounds, pursuing diverse career paths in science, who came together from all over Canada (and USA) to build the Canadian Science Policy Conference each year! In a period of five months, I found myself working enthusiastically on three different committees. On the Editorial Committee, we were preparing to launch the first ever Canadian Science Policy Magazine, the third edition of which I now have the pleasure of contributing to! On the Grants Committee, we were applying our grant-writing skills from academia to make a case for funding a platform for scientists, policymakers, students, and science policy enthusiasts from a variety of disciplines to come together and debate, discuss and distill ideas to benefit Canada. On the Conference Program Committee, I had the opportunity to shape the conference agenda and work with esteemed panelists to deliver a symposium on "Acting for Equity, Diversity, and Inclusion in Canadian Science and Research." I was therefore delighted when CSPC invited me to work full-time for them as Program Manager, with the opportunity to engage with all nine volunteer committees and pilot new programs for the Centre! CSPC 2019 was a memorable experience, and I couldn't decide if I was more excited to meet my friends, who I had been meeting (virtually) weekly for the past several months, or to watch the biggest names in Canadian science policy; politicians, leaders, Nobel laureates present their ideas. It was at this conference that I first met the Mitacs Canadian Science Policy Fellows (CSPFs) and felt inspired to apply to this program. In 2020, I joined the Natural Sciences and Engineering Research Council of Canada as a CSPF and have since been working on international and policy priorities for supporting Canadian researchers. It brings me immense satisfaction to apply my scientific training and international experience to my work each day, working alongside talented and motivated colleagues in the public service! I continue to remain engaged with CSPC as the co-chair of the CSPC 2020 and 2021 Evaluation & Reports Committee and

am helping build science policy capacity in the Americas as a STeP-IAI fellow. At CSPC 2021 STeP-IAI fellows including myself and our mentors, will present an interactive session titled "Beyond boundaries: Building science diplomacy capacities and a transdisciplinary network of early career researchers across the Americas" [11].

In a world scarred by the pandemic and various slow burning issues rooted in science, the importance of science policy and evidence-based decision making cannot be overstated. CSPC has been my gateway into Canadian science policy, finding a community of like-minded people with diverse experiences, and a place to do meaningful work to push the boundaries in the field of science policy in Canada. My experience is just one of many that shows that this Centre attracts and brings together much more than the expert speakers at its annual conference; it assembles Canada's next generation of leaders in science policy.

REFERENCES

1. Council of Canadian Academies, "Degrees of Success." Published 26 January 2021 at https://cca-reports.ca/reports/the-labour-market-transition-of-phd-graduates/
2. American Association for the Advancement of Science, "Science Technology Policy Fellowships." Published at https://www.aaas.org/programs/science-technology-policy-fellowships/overview
3. Association of Southeast Asian Nations, "ASEAN Science and Technology Fellowship." Published at https://www.aseanfoundation.org/asean_science_and_technology_fellowship
4. Mitacs, "Canadian Science Policy Fellowship." Published at https://www.mitacs.ca/en/programs/policy-fellowship/program-details
5. DST Centre for Policy Research, "DST Science, Technology, and Innovation Policy Fellowship Programme." Published at https://dstcpriisc.org/about-us-2/dst-sti-policy-fellowship/
6. United Kingdom Parliamentary Office of Science and Technology, "Parliamentary Academy Fellowship Scheme." Published at https://www.parliament.uk/get-involved/research-impact-at-the-uk-parliament/academic-fellowships/
7. Australian Office of the Chief Scientist "Australian Science Policy Fellowship Program." Published at https://www.chiefscientist.gov.au/australian-science-policy-fellowship-program
8. InterAcademy Partnership, "Africa Science Policy Fellowship." Published at https://www.interacademies.org/node/53388
9. Inter-American Institute for Global Change Research, "Science, Technology, Policy Fellowship Program." Published at https://www.iai.int/en/step
10. Ritchie, T. S.; Perez Cardenas, M. T.; Ganapati, S. Establishment and Implementation of a Peer-Supported Professional-Development Initiative by Doctoral Students, for Doctoral Students. J. Chem. Educ. 2018, 95(11), 1947-1953. https://doi.org/10.1021/acs.jchemed.8b00337
11. Canadian Science Policy Conference 2021, "Beyond boundaries: Building science diplomacy capacities and a transdisciplinary network of early career researchers across the Americas." Published at https://csps2021.sched.com/event/mPN3

A VOLUNTEER'S PERSPECTIVE ON CSPC

Angela Zhou

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I never really grasped the full impact of science during my PhD training. Granted, I was very much a basic scientist, and my program was heavily biomedical research-focused where, at least at the time, the only exposure to what you can do with science was either academia or the pharmaceutical and biotech industry. We all understand that the decisions made by various stakeholders in society should be based on data and evidence, but the general concept of how that happens seemed rather abstract. In trying to understand it, I stumbled on CSPC.

Actually, CSPC makes itself easy to find by being the first result on Google when you search "science policy in Canada." This was an early clue to the extensive reach and impact of this organization. Over more than three years of volunteering with CSPC, I have learned a lot about the Canadian research and policy ecosystem, its many networks and players, and the importance of creating a forum to bring them together towards solutions.

My first conference was in 2018, when I was a very green, eager-eyed volunteer on the Grant Writing and Program Committees (both of which I later co-chaired). The sheer diversity of thought represented at the event, something I realized later as my involvement with the Program Committee grew, was very much by active effort and design. In coordinating the call for panels and panel review processes for the conference, I had the opportunity to see all the remarkable submissions and the extensive discussions to ensure that not only the whole conference, but each individual panel, reflected the Canadian landscape on a given issue. The result is the immense representation of different sectors and topics at the conference, and the ensuing conversations and discussions allowed an early-career individual like me to learn, interact, and network with current and upcoming leaders in the country.

Volunteering with CSPC has also allowed me to build various skills and competencies. The amount of coordination, management, and leadership that comes with co-chairing the Program Committee has been a valuable learning experience, and the unpredictability of conference planning has taught me to work effectively under pressure. Along with my time on the Grant Writing committee, CPSC has helped improve my communication and team-building skills. Mehrdad and the Office have always been immensely supportive, providing an open space for new ideas on how to continuously improve the event.

I would be remiss to not mention the exceptional team of volunteers. Unsurprisingly, CSPC attracts passionate and driven colleagues from all walks of life and career paths. I have learned so much from them and am always grateful for the time and mentorship they have given me.

The most disappointing thing about having to go online is not being able to hang out with these wonderful people every year. I look forward to when we can all grab a drink together in Ottawa and celebrate another successful conference.

ENHANCING CAPACITY BUILDING FOR THE NEXT GENERATION OF SCIENCE POLICY LEADERS

Adriana Bankston

CEO & Managing Publisher for the Journal of Science Policy & Governance (JSPG)

The COVID-19 pandemic has fundamentally changed our society, requiring innovative adaptations to a new reality. While the pandemic has highlighted many inequities, it provides the opportunity to build forward in ways that ensure diversity, equity and inclusion as central to a better future for all.

Science and technology policy plays a critical role in building forward better, as we re-imagine the future of our society in the post-pandemic era. In this time of global change, it is imperative to equip the next generation of leaders in science and technology policy with the skills, tools and resources needed to drive the future of the field forward.

Capacity building for the next generation of science policy leaders requires multiple stakeholders to participate. This includes universities, funding agencies, scientific societies, nonprofits and other organizations that can help create an ecosystem for developing the leaders of tomorrow in science and technology policy.

Building such an ecosystem will require multiple aspects to be fulfilled, which can take the field into the 21st century. The first aspect is significant institutional reforms needed to incorporate science and technology policy training into classroom offerings. This may take the form of courses, certificate programs or degree programs in science and technology policy that can help broaden the horizon and expand the outlook of young scholars on important societal issues, and enable them to design ways in which they can make an impact.

The second aspect is offering rewards in the form of supplements on grants to faculty who provide

mentoring to support trainees towards successful science policy careers. This may also occur through fellowships awarded directly to trainees. Both avenues would integrate policy aspects of research performed by young scholars into their dissertations, and encourage mentors to emphasize broader impacts of their work. Finally, the third aspect is developing tools and resources to enhance communication skills for the next generation in science and technology policy, which is critical to their career success. This often occurs through nonprofits and other organizations that can supplement already existing training within universities.

As such, strong skills in policy research and writing are a critical part of professional development for the next generation in science and technology policy, enabling young scholars to translate their innovative ideas into reality. The Journal of Science Policy & Governance (JSPG) provides students, post-docs, policy fellows and early career professionals with a platform for making their innovative science policy ideas more widely known, conveying them in a compelling manner to broad audiences, and elevating them across international platforms that are both influential and relevant. For many rising stars in science policy, publishing in JSPG is a significant stepping stone into the field and a pivotal opportunity to kick-start or further develop their careers. JSPG staff elevate published work in high level forums where early career voices from all backgrounds are represented and can significantly impact the future of science policy. Among the spaces where JSPG published authors have discussed their work include presentations on climate change solutions at the British Embassy Washington, and participation in inter-generational policy debates around emerging technologies with experts in the United Nations.

It is critical that diversity, equity and inclusion are central to our future vision for the landscape of science and technology policy, and to ensure that the next rising stars come from all backgrounds and have the opportunity to drive the field forward with their innovative ideas.

This is particularly important post-pandemic, where the policy landscape will have fundamentally changed from what it is today, and where young voices need to be at the table now more than ever to pave the way towards innovation in science and technology policy on a global scale.

TRANSFORMING RESEARCH EDUCATION FOR POSTNORMAL TIMES

Susan Porter

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We live in 'postnormal' times, [1] a transitional era when the conventions of science, understanding, institutions, and society that brought civilization to this juncture have proven inadequate, and different ways of being and thinking are in flux. As we careen into an uncertain and surely momentous future for our planet and its people, it may not be overblown to suggest, as Open Philanthropy's Holden Karnofsky has, that we live in the most important century of all time for humanity.

Global warming, rising inequality, and the COVID-19 pandemic have all painfully illustrated the extraordinary interconnectedness and complexity of all facets of our existence, to an extent and with a speed of change never before experienced. Along with this complex interdependence are other postnormal characteristics of uncertainty, chaos, and deeply conflicting values.

We are in an era of epistemological rupturing. Slowly fading are 'normal' ways of thinking that include the belief that we can control and manage life through technology and science, that reductive scientific reasoning leads to truth and thence to optimal policies and interventions, that constant economic growth is desirable and inevitable, that science is inherently value-neutral.

As first described in the 1990s by Sylvio Funtowicz and Jerome Ravetz, the science needed for this postnormal age must be grounded in assumptions of uncertainty and incomplete control, and integration of multiple perspectives and ways of knowing. We are seeing this in many areas, with the rise of interdisciplinarity, the incorporation of Indigenous and other ways of knowing in scientific thought and mobilization, and the democratization of the scientific enterprise.

What if we took seriously these necessary ways of doing science when we shape the education of our future scholars? The scientists of today and our future – whether their ultimate scholarly activities encompass research, analysis, teaching, policy, engagement, management, or any other realm – will need to be fundamentally different from 20th century scientists. Through the work they do, they will need to be humble, empathic, and motivated to integrate diverse perspectives and ways of knowing; they will need to be imaginative and skilled in lateral, abductive, and systems thinking; they will need to be attuned to both the big picture, specific contexts, and the ethical dimensions of all they do; they will need to be resolved and able to elicit change. These are holistic qualities, closely aligning with concepts of wisdom and 'postformal' thinking (in reference to Jean Piaget's 'formal operational' thinking which describes reasoning within a formal, structured system). As such, they are nurtured through truly transformative learning most akin to the German concept of 'bildung', or 'formation', rather than simply 'skills training'.

Change to graduate education in recent decades have mostly been the addition of experiences and modules tacked on to 'normal' modes of graduate education. While some have the potential to be transformative, they are typically unintegrated with students' deepest intellectual formation. I would argue that for students to become the types of scholars needed in the 21st century, they need to do, and be assessed in, at least some aspects of these scholarly practices, and that objective needs to be explicit in the goals of a graduate degree.

In 2018, the Canadian Association for Graduate Studies (CAGS) completed a two-year, national consultation of faculty and students on this question; that is, are broadened forms of doctoral research and dissertations necessary, acceptable, and feasible in the current academy? We found a nervous but excited 'yes' to this question, with acknowledgment of potential problems and of barriers to achieving this in a very slow-moving, 'normal', academic and larger research ecosystem. The final report of the task force included ten recommendations for students, faculty, and universities to enable such changes, including the need for a parallel legitimization and assessment of broadened forms of faculty research.

At the University of British Columbia, we have been devoted to reimagining doctoral education along these lines for almost a decade, and in 2015, launched a program open to doctoral students across all disciplines (the Public Scholars Initiative) to financially and academically support students in broadening their research and dissertation in ways relevant to their own and society's needs. Successful applicants engage diverse perspectives and partners towards a tangible societal benefit, generally breaching disciplinary and academic norms in scholarly approaches and products. Over 90 of the 262 students so far have completed their dissertation and graduated. For fields in which these broadened forms of research are increasingly common, the program provided needed resources or enabled students to expand their interactions with partners or mobilize their research. For others, the

research and dissertation were a radical departure from the norms of their fields. Among these were social scientists incorporating creative approaches and products in their dissertation (e.g., art, film, creative writing); natural scientists and engineers incorporating pedagogical, qualitative, or engaged research, or knowledge mobilization products; applied scientists incorporating Indigenous ways of knowing, policy papers, or participatory action research.

We have learned much from this 'experiment'. Perhaps most importantly, we confirmed that at least parts of the academy are prepared to embrace these expanded forms of scholarship and communication as integral to the doctoral degree. We were delighted to discover that students often understood their topic more profoundly through applying the findings or using alternative ways of addressing them. Most surprisingly, we heard how deeply meaningful it was for students to have their identities as change agents and their approaches to scholarship legitimized. This has given us confidence for continued reform, including the development of a transdisciplinary collaborative PhD model, expanded notions of supervision, and concurrent credentials on the types of subjects and competencies needed for these postformal research approaches (e.g., design and systems thinking).

Continued institutional and broader national change is needed to make this more accessible. Funding needs to further expand beyond disciplinary and traditional academic boundaries; the changing nature of scholarly work needs to be valued in all assessments; students should be able to expand their research and mobilization efforts beyond the limitations of the supervisors' funding. The sole 'master–apprentice' model of graduate mentorship needs to continue to evolve. There remains a need for discipline-based, fundamental research, but there should also be ways to ensure students in those fields have some exposure to thinking outside those boundaries. There is no time to lose.

REFERENCES

1. Sardar, Z. (2010). Welcome to postnormal times. Futures 67:26.

LOOKING AHEAD:
EYES ON SCIENCE, POLICY AND TRANSPARENCY AMID CHANGING TIDES

What a year it's been since the last Canadian Science Policy Conference.

Since then, we've continued to navigate a global pandemic, received the first federal budget in two years, and most recently, braved a fast-paced 36-day long federal election.

And at Evidence for Democracy, we've been through some changes too. We bid farewell to the former leadership team, and welcomed an entirely new cast of faces, with a new Executive Director at the helm.

So, what new waters are we about to brave together?

To put these times into perspective, we're closing in on the ten year anniversary of the 'Death of Evidence' rallies next year. It was a dramatic turning point for the science community in Canada and, as chance would have it, spurred the birth of Evidence for Democracy. There have been some good signals from the federal government in this past decade, such as the introduction of a Minister of Science, the appointment of a Chief Science Advisor, and the 2017 Fundamental Science Review.

But each of these signals has a caveat. The Minister of Science role no longer exists, leaving the science portfolio under the mandate of the Minister of Innovation, Science and Industry. The Office of the Chief Science Advisor continues to not be protected to withstand changes in government, and several recommendations from the Fundamental Science Review are unresolved. And on top of all this, transparency remains a persistently missing link when it comes to the role of evidence and how governments make decisions. How can we assess progress on evidence-informed decision-making, without understanding what information goes into complex policy decisions?

Rachael Maxwell
Executive Director at Evidence for Democracy

Farah Qaiser
Director of Research and Policy at Evidence for Democracy

To add to this, there are indications of growing distrust across key societal institutions, such as healthcare and government. Very quickly, the bigger picture starts to feel very messy. There are several root causes to consider here, including levels of political cohesiveness, social trust, income equality, mis/disinformation, and collectivism – and importantly, science isn't immune to any of these factors.

To continue to build trust in science and move forward, it will take coordinated action across the Canadian federation. From elected representatives to scientists, to academic institutions and every level of government, all stakeholders need to step up and play their part.

As a starting point, we can turn to the recent federal election, and what this new, yet familiar, government composition might mean for science and evidence in Canada.

Given the limited shelf life of minority governments, it's hard to imagine a scenario where deep advances are made on critical science issues, such as improving Canada's investments in fundamental science or developing a national science strategy. One of the proposals from the Liberal Party's election platform was a plan to mobilize a Canadian version of one of the global north's biggest research success stories, the Defense Advanced Research Projects Agency. Again, given the size and scope of such an endeavour, it feels aggressively optimistic to imagine the Canadian riff (cutely named CARPA) will grow legs to stand on in the next 18-24 months.

One area where science and evidence might be able to make some in-roads is the new Standing Committee on Science and Research, a motion which received unanimous approval in the last session of Parliament. While the mandate of the new committee remains up in the air, this will be a key opportunity for all parties to weigh in and work together, all under the keen eyes of a science community that continues to demonstrate a growing desire to make policy-relevant contributions.

At Evidence for Democracy, we're continuing to keep our eyes on evidence. In 2021, we adapted a framework from Sense About Science in the United

Kingdom to evaluate the transparency of evidence underlying policy decisions. Simply put: can the evidence behind policies be found by the lay public? Now, we're applying this framework to evaluate policies from science-based federal departments and agencies, including bills, regulations, and funding announcements. We'll be releasing our findings shortly, and potentially, bringing this important work to the provincial level next.

And of course, we're also keeping our eyes on what happens next for the Office of the Chief Science Advisor. While the office was renewed for a second two-year term in September 2020, it is still not protected by any official measure to withstand changes in government. Given the extraordinary strain on the relationship between science and government over the course of the pandemic, this should be of concern for advancing an evidence agenda.

But all of this will only be possible if there is sustained and deliberate engagement from the Canadian science community. This means staying engaged, and in some cases, taking a dive into unknown waters. From running for office, to developing skills in empathetic science communication, or appearing before Parliamentary Committees, every action matters when it comes to getting evidence into the hands of those who need it most.

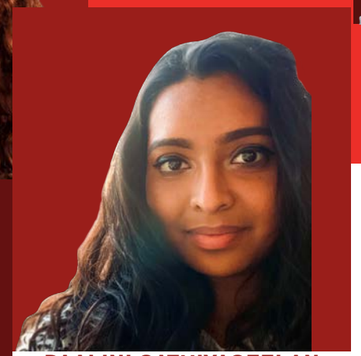
While we hope it goes without saying, Evidence for Democracy is here to help you mobilize science to policy, through targeted research, training, campaigns and the many opportunities that surely lay in wait. Because, we all benefit when governments make decisions informed by the best available evidence.

Intersections Between NEXT GENERATION RESEARCHERS and SCIENCE POLICY in Canada – Past, Present and Future

SIVANI BASKARAN

MADISON RILLING

JINA KUM



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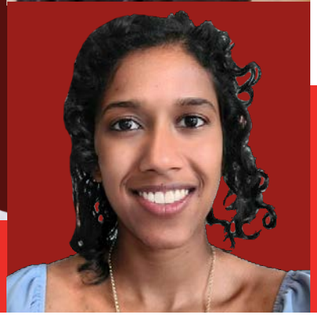

DHANYASRI MADDIBOINA

Sivani Baskaran[1], Dhanyasri Maddiboina[1], Jina Kum[1], Sarah Laframboise[2,9], Paalini Sathiyaseelan[3,6], Madison Rilling[4], Farah Qaiser[1,4,5], Anh-Khoi Trinh[6], Shawn McGuirk[6,7,8]

1. Toronto Science Policy Network
2. Ottawa Science Policy Network
3. Science Policy in Health Environment Research and Ethics
4. Canada's Chief Science Advisor's Youth Council
5. Evidence for Democracy
6. Science & Policy Exchange
7. Natural Sciences and Engineering Research Council of Canada
8. Association Francophone Pour le Savoir
9. Canadian Science Policy Centre

Over the past year, we have seen firsthand how science can inform policy. Although often less visible, the impact of policy on science is just as important. As the dialogue between science and policy is critical to both evidence- and stakeholder-informed decisions, scientists and researchers are becoming increasingly engaged with the science-policy interface. In particular, grassroots organizations led by next generation researchers (NGRs) – including, but not limited to, graduate students, postdoctoral fellows, and research professionals – are continuing to build opportunities for the next generation of scientists to engage in science policy. Many are active participants of the 2021 Canadian Science Policy Conference, as volunteers, panel organizers, or speakers.

In fact, the founding of the Canadian Science Policy Centre (CSPC) in 2009 by Mehrdad Hariri, then a postdoctoral fellow at the McLaughlin-Rotman Centre for Global Health, was a landmark moment, and this has since provided a platform for professionals at all levels to participate in science policy discussions. Over the years, CSPC has become a hub for leading science and innovation policy discussions, while promoting diverse partnerships and interconnection of stakeholders. CSPC is now a significant capacity builder for science policy and has opened a door for NGR to get into science policy fields.

As a result, many young scientists were inspired to engage in science policy. Soon after, the NGR-led non-profit Science & Policy Exchange (SPE) was established in 2010, [1] by students at McGill University, to bring the student voice into science policy discussions. Frustrations at the time also sparked a watershed movement in the history of Canadian science policy: in 2012, scientists came together to advocate for science through the Death of Evidence rallies [2] which later marked the beginnings of the non-profit Evidence for Democracy (E4D), co-founded by Katie Gibbs, during her final year of graduate school, and Scott Findlay.

For a decade, organizations like CSPC, SPE, and E4D served as a support network for individuals and groups within the Canadian science policy world. The mobilization and transfer of knowledge of these groups through workshops and mentorship programs were key in the blossoming of the science policy community in Canada. In particular, graduate students and other NGRs felt more compelled to explore these spaces and get involved. Inspired by these organizations, the Toronto Science Policy Network (TSPN) was founded in 2018 by a group of graduate students at the University of Toronto as a space for researchers and members of the community to learn about and engage in science policy. [3] This further paved the way for NGR-run policy groups across Canada. In this past year alone, we have seen immense interest in science policy amongst graduate students, with the formation of science policy student groups at the University of Ottawa (Ottawa Science Policy Network) and Ryerson University (Ryerson Science Policy Network), as well as a new NGR-led non-profit in Vancouver, called the Science Policy in Health Environment Research and Ethics (SP.HERE) Society.

These science policy groups serve an understated purpose – to provide access to knowledge and training related to science policy, politics, and diplomacy for the next generation of scientists in Canada. In particular, these groups have become a major avenue for introducing the field and bringing attention to careers at the interface of science and policy. They host events and science policy networking opportunities, which are a key resource for NGRs to become acquainted with this sphere of diverse career pathways and to obtain training resources for such a transition from their academic training.
Despite there being only a few NGR-led science policy groups in Canada, they have punched above their weight and had a tremendous impact on the science policy landscape. For example, SPE led the Students4theReport campaign in 2017 and went on to conduct a nation-wide survey on the perspectives of next generation researchers on federal research funding, [4] producing multiple reports with the results. [5] In a similar vein, during the early days of the pandemic, TSPN conducted a survey of graduate students in Canada to understand the early impacts of COVID-19 on graduate students. Both groups have also participated in multiple federal budget consultations. [6]

NGR-led science policy groups are also common collaborators; by pooling their talents and resources, they have successfully co-hosted panels, co-written numerous op-eds, and delivered campaigns, including Vote Science which informed Canadians and advocated for the importance of science during the 2019 and 2021 federal elections. [7]

Unfortunately, since the majority of these groups are run entirely by the will and passion of their volunteer members, the consistency of their activities and outreach efforts can vary, and their long-term sustainability is not assured. The development of a robust Canadian science policy ecosystem, with multiple entry points for young scientists, requires concerted and dedicated governmental funding and support. This in turn can help build a robust and collaborative ecosystem, allowing university-based science policy groups to flourish too. It is also important for research institutions and organizations to value the contributions and impacts NGRs are making in the Canadian science policy landscape. Most NGRs join these movements and groups because they have a passion for science and the positive impacts it can have, and has had, on society. They also take initiative because of their curiosity and desire to understand the intersections of the science policy interface. In many cases, they create opportunities for themselves, where there are otherwise very few.

That said, there are a handful of valuable programs that provide opportunities for NGRs to bridge from research to working within the science policy machinery of Canada. Examples include the Government of Canada Recruitment of Policy Leaders program, Natural Resources Canada's Policy Analyst Recruitment and Development program, and Mitacs' Canadian Science Policy Fellowship. Unfortunately, these programs are limited in their eligibility and capacity and, therefore, can only provide bridges for a small fraction of those who seek careers at the intersection of science and policy. These programs are also limited in scope, as most focus on the integration of PhD graduates into the federal government – more opportunities are needed for graduates with master's degrees and within provincial and municipal governments, as well as in the non-profit and private sectors.

Additionally, in recent years, some institutions have started introducing youth councils and advisory bodies into their ranks. In 2014, Québec's Chief Scientist, Dr. Rémi Quirion, established a student researcher and postdoctoral advisory committee, the Comité intersectoriel étudiant (CIE) des Fonds de recherche du Québec (FRQ, the provincial research funding agencies). [8] As a statutory committee of the FRQ, the CIÉ plays an advisory role to both the Chief Scientist and the FRQ's three board of directors. Intrinsically involved with research funding, the CIÉ has been a model of success of student involvement in governance on the policy for science front. More recently, Dr. Mona Nemer established an inaugural Chief Science Advisor's Youth Council (CSA-YC) [9], consisting of 20 youth from across the country, spanning different disciplines and career stages. Remarkably, at the time of applications, over 1,000

youth applied to join the CSA-YC, demonstrating the strong interest among the next generation of scientists to explore the field of science policy. [10] Other examples of youth councils and advisory bodies include the CIHR Institute of Human Development Child and Youth Health's youth advisory council, [11] the Environment and Climate Change Youth Council, [12],and the Comité interordres de la relève étudiante of Québec's Conseil supérieur de l'éducation. [13]

Collectively, the rise of new science policy and advisory groups is a testament to the increasing traction of the science policy community in Canada. At the intersection of all these groups, there is a richness of experience and expertise in the different approaches for integrating new talent and perspectives into the science policy world. This momentum must be sustained and supported, if capacity building for science policy is to continue in Canada.

To do so, we are establishing a new collective support network, named SciPolCanada, which will be a Slack-based platform aiming to serve as an open, inclusive, and centralized channel for any individual or group in Canada to get connected with the broader science policy community. The platform is supported by a large number of NGR-led science policy groups, societies and non-profits nationwide. Importantly, this platform can provide support and resources to the increasing number of engaged researchers and science policy groups across Canada.

By creating a virtual platform for NGRs to engage in science policy, we are seeking to make joining, forming, and participating in NGR-led Canadian science policy groups more accessible. We want to continue the momentum of NGR groups by fostering collaborations between the different groups, sharing resources and experiences, and connecting individuals who may be interested in starting their own group. Notably, to the best of our knowledge, there are no active science policy groups in the maritime provinces and in northern and central Canada.

The importance and impacts of science to society is far-reaching. We are now face-to-face with the realities of a pandemic, climate change, and widespread misinformation. NGRs are taking note and are becoming increasingly interested in the intersections of science and policy, going so far as to start their own organizations and lead campaigns. Our society looks towards science and the use of evidence-informed policies, to help guide us out of these crises. Therefore, we also need to ensure that we have trained scientists working with policy makers, and working as policy makers, to develop evidence-informed decisions for Canada. It is our hope that SciPolCanada can be a bridge towards this goal, for everyone living in Canada.

REFERENCES

1. https://issuu.com/magazine-sciencepolicy/docs/cspc_magazine_2019/50
2. https://doi.org/10.1038/487271b
3. https://researchmoneyinc.com/articles/a-paulicyworks-milestone-2020-students-and-science-policy/
4. https://www.sp-exchange.ca/students4thereport
5. https://www.sp-exchange.ca/rethinking-federal-research-funding
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9. https://www.ic.gc.ca/eic/site/063.nsf/eng/h_97990.html
10. https://www.universityaffairs.ca/news/news-article/canadas-chief-science-advisor-is-looking-for-some-youthful-insight/
11. https://cihr-irsc.gc.ca/e/51876.html
12. https://www.canada.ca/en/environment-climate-change/news/2021/07/new-environment-and-climate-change-youth-council-to-engage-on-key-environmental-challenges.html
13. https://www.cse.gouv.qc.ca/cire/

CSPC AWARDS

EXCEPTIONAL CONTRIBUTION TO SCIENCE POLICY AWARD

As an enabler in science policy, CSPC has always strived to recognize the contributions of individuals to this field, at different stages of their lives and professional careers and in various fields.
With that in mind, in 2019, CSPC established a new category of awards for Exceptional Contribution to Science Policy. This award recognizes the work of individuals who have worked in science policy over a period of many years and made a deep impact in Canadian science policy.

2020 – Lifetime Achievement Award Winner: Robert Slater

2020 – Trailblazer Award Winner: Dr. Cara Tannenbaum

2019 – Winner: Paul Dufour

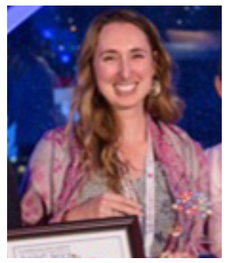
SCIENCE POLICY AWARD OF EXCELLENCE – YOUTH CATEGORY

This award recognizes a young individual (student, postdoctoral fellow, researcher, entrepreneur, etc.) under the age of 35 who proposes an innovative and compelling evidence-based policy that will make a positive difference to Canadians. This award is designed not only to highlight innovative, evidence-driven policy ideas by policy students and young professionals, but also to encourage young people not currently studying, or working on, public policy to share their policy ideas.

2020 Winner: Hannah Harrison

2019 Winner: Emily De Sousa

2018 Winner: Jessica Kolopenuk



2017 Winner: Sierra Clark

2016 Winner: Amani Saini

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