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August 7, 2020

Genomics on a Mission: Mobilizing the Bioeconomy for Canada's Recovery

Genome's Canada Pre-Budget Submission to the
House of Commons Standing Committee on Finance



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List of Recommendations:

- **Recommendation 1:** That the government invest in mission-driven research — with line-of-sight to application — to mobilize genomics to drive Canada’s recovery in key sectors.
- **Recommendation 2:** That the government invest in a national genomics data strategy to drive data generation, analysis, standards, tools, access and usage to derive maximum value and impact from Canada’s genomics data assets.
- **Recommendation 3:** That the government invest in training of the next generation of genomics researchers, innovators and entrepreneurs to support the development of a genomics-enabled Canadian bioeconomy.
- **Recommendation 4:** That the government invest in long-term and predictable research and research infrastructure through the federal granting agencies and the Canada Foundation for Innovation to ensure a strong and vibrant knowledge base for recovery.



Introduction

A confluence of advances in biological science with the accelerating development of computing, automation, and artificial intelligence is fueling a new wave of innovation. The Bio Revolution could have a significant impact on economies and our lives, from health and agriculture, to consumer goods, energy and materials.... These new capabilities and applications are already improving our response to global challenges from climate change to pandemics.

— McKinsey Global Institute, [The Bio Revolution: Innovations transforming economies, societies, and our lives](#), May 2020

2020 has forced us to confront the power — and the peril — of the biological world. Genomics, the science of life, has been front and centre in combatting COVID-19. Canada’s exceptional genomics research community has stepped up with strong responses for short-term containment and long-term management. Doctors, public health authorities, policymakers and Canadian companies working on testing and tracing, drug therapies and vaccines are all leaning on genomics to protect Canadians.

The year ahead holds big challenges for Canada: the ongoing health crisis, massive economic upheaval and deepening social inequities. Canada’s universities and colleges have been hard hit [while private-sector spending on R & D and training has dropped](#).

Supply chain vulnerabilities have exposed historic gaps in developing “made-in-Canada” value-added products that drive competitiveness, putting a premium on national self-sufficiency. Policy responses require new thinking and ingenious data-driven bets amid shifting global economic dynamics and the looming climate crisis.

A genome is a living organism's complete set of DNA, including all of its genes. [Genomics is an interdisciplinary field](#) of science focusing on the structure, function, evolution, mapping and editing of genomes. As a big data science, genomics is also the toolkit for biological innovation.

Biological innovation has the power to transform our world for the better, driving economic growth and reducing global carbon emissions. [McKinsey Global Institute](#) estimates that as much as **60% of the physical inputs to the global economy could be produced biologically**, meaning that we can build more parts and products through sustainable, renewable processes. This could be worth US\$2-4 trillion¹ in direct economic impact by 2040; by 2040-50, **the direct applications of genomics across sectors could reduce annual average man-made greenhouse gas (GHG) emissions by 7-9% from 2018 emissions levels.**

¹ Where the impact lands in that range will depend on how and when innovations are adopted.



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As Canada continues to deal with COVID-19 and charts a course for a resilient recovery, harnessing the game-changing potential of biological innovation can deliver homegrown solutions, position Canada for global market leadership and, fundamentally, protect and improve Canadians' lives.

Genome Canada is on a mission to do just that. We have dynamic leadership with a bold vision, a strong pan-Canadian network of Genome Centres and a proven track record of demand-driven innovation in the bioeconomy. We have leveraged \$1.6 billion in federal investment into \$3.9 billion in R&D, supported over 5,000 talented trainees and spun-out more than 80 new Canadian companies.

With support in Budget 2021 — just as we led when COVID-19 first hit — we can help Canada not only recover, but also build back *better*.

COVID-19: Genomics on a Mission

When the pandemic struck, Genome Canada activated its community immediately, with rapid time to impact. Funded by the federal government, the Canadian COVID Genomics Network (CanCOGeN) is generating accessible and usable genomics data to track transmission, inform policy decisions and guide testing and tracing strategies, vaccine development and drug treatments. The national network will sequence the genomes of up to 10,000 Canadians and of 150,000 viral samples. By bringing genomics capacity to our provincial public health labs, this project is laying a foundation for Canada to deal with future COVID-19 waves and other disease outbreaks. CanCOGeN has downstream potential for partnerships with biotechnology companies to accelerate and scale made-in-Canada drug development.

Case Study: AbCellera - Genomics Solutions that Remove the Bottlenecks in Drug Discovery

AbCellera focuses on the discovery of therapeutic antibodies using innovative technologies that scan, decode and analyze antibodies from natural immune systems. Founded in 2012, the company is a spin-off from the University of British Columbia. Genome Canada and Genome BC supported a project in 2017-18 for developing antibody-based therapeutics for Duchenne Muscular Dystrophy fibrosis that led to COVID-19 solutions with [new federal support for a manufacturing facility](#). AbCellera's rapid pandemic response platform has contributed to the world's first COVID-19 clinical trial for a Potential Monoclonal Antibody Treatment.



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Economic Recovery: Genomics on a Mission

Canada’s recovery from “[the first modern pandemic](#)” demands fresh solutions grounded in science-based, data-driven missions that problem-solve for major cross-sectoral challenges. To build back better, we cannot return to business-as-usual siloes.

Other G7 countries recognize this. The [UK’s Roadmap for Research and Development](#) puts mission-driven research front and centre while [Germany’s future-oriented recovery package](#) includes big bets on the role of emerging platform technologies.

Canada must make similar strategic choices. A [major new report](#) calls for a challenge-driven industrial strategy that focuses on the entire innovation continuum, leverages Canada’s strength in human capital and implements a multi-faceted R&D and commercialization strategy for a data-driven economy.

Canada’s expertise in world-leading genomics can be a “[big science deployed to meet big problems](#)”. Multidisciplinary and multisectoral, genomics-driven research and innovation missions can mobilize Canada’s private and public sectors, researchers and entrepreneurs around a shared national recovery challenge. Genome Canada – in collaboration with the regional Genome Centres – is uniquely positioned to play a national leadership role.

We recommend that the federal government invest in:

- **Mission-driven research — with line-of-sight to application — to mobilize genomics to drive Canada’s recovery in key sectors. Missions can include:**
 - **Public health and healthcare innovation** (e.g., future pandemic preparedness; national strategy for infectious diseases and anti-microbial resistance; precision health with clinical genomics as standard of care);
 - **Sustainable agriculture** (e.g., world leader in climate-adapted export crops; reducing GHG emissions from livestock and fertilizers; enhancing food security/food diversity, especially in remote communities; leveraging the microbiome for animal/crop health and production; increasing exports through value-add aquaculture); and
 - **Resources of the future** (e.g., greening Canada’s energy and extractive sectors; monitoring, preserving and benefitting from Arctic biodiversity; global leadership in building products made with biomaterials).



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Genomics on a Mission: Capitalizing on the Global Plant Protein Opportunity

COVID-19 has exposed vulnerabilities and opportunities in Canada’s agri-food sector. A mission-driven approach to agricultural genomics will help fill supply chain gaps, create resilience in food production and strengthen Canada’s export leadership. This includes using genomics to adapt agricultural production to climate change, address food and nutritional insecurity, increase value-added food processing, improve crop and livestock health, sustainably produce rare or novel ingredients, and enhance food’s nutritional value and shelf life. [McKinsey estimates](#) the direct annual impact from all genomics applications in agriculture at up to US\$1.2 trillion over the next 20 years. Canada produces 30% of the world’s peas and is the largest lentil exporter in the world. With the explosion in plant-based protein alternatives triggered by the collapse of meat processing chains around the world, Canada is strategically positioned to lead this developing market and create significant value for farmers, processors and consumers here and around the world.

A National Genomics Data Strategy for Canada

We increasingly live in a data-driven “intangibles” economy. Today’s large data assets can be sources of economic growth and prosperity, when properly structured and managed to create opportunities for innovation and commercialization. While international cooperation and open science continue to be essential, there is a growing drive to extract value from rapidly expanding Canadian data assets *for the benefit of Canadians*.

Since 2000, Genome Canada has funded breakthroughs and innovations in health, mining, forestry and agriculture. Each of these efforts has yielded important datasets. Canada faces big challenges in organizing existing data and establishing standards for the collection of new data. A national genomics data strategy will allow us to harness these data sets and maximize their value-add for Canadians.

Genomics is a Big Data science. A person’s genome contains billions of data points that can be mined for actionable insights in the same way that our online presence drives the engine of online commerce. Canada can take a leadership position in developing and deploying cutting-edge processes and technologies to address key challenges when attempting to harness Big Data from biological sources: data security, insight extraction and data commercialization.

Canada has an unprecedented opportunity to create genomics data resources and assets to support made-in-Canada successes in industry, health and the public sector. At the same time, given the rapid developments in gene editing and artificial intelligence, we must address regulatory, privacy, intellectual property and data sovereignty concerns.



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Genome Canada is well-positioned to play a national leadership role in driving this strategy, in collaboration with the Genome Centres and other key stakeholders.

We recommend that the federal government invest in:

- **A national genomics data strategy to drive data generation, analysis, standards, tools, access and usage to derive maximum value and impact from Canada’s genomics data assets.**

Building and Diversifying the Genomics Talent Pipeline

Canada’s youth employment rate [dropped to 49%](#) at the outset of the pandemic, the lowest rate since comparable data-gathering began in 1976. Changing geopolitical conditions and COVID-19 are disrupting the foreign talent pipeline. Talent attraction and development will be a key element of our economic recovery. Creation of both knowledge- and skills-based jobs will be needed. Genomics and the industries it enables can create jobs in research, engineering, construction, manufacturing, regulatory, policy and other sectors.

Building a training component into new challenge-driven research and innovation missions will prime the genomics talent pipeline and support entrepreneurship and job creation. At the same time, we must advance equity and inclusion within the genomics field and increase training opportunities for talented young researchers from a range of diverse backgrounds. Genome Canada is committed to playing a national leadership role to make this a reality.

We recommend that the federal government invest in:

- **Training of the next generation of genomics researchers, innovators and entrepreneurs to support the development of a genomics-enabled Canadian bioeconomy.**

Finally, and fundamentally, as Canada’s response to COVID-19 has shown, **when crisis hits, science leads**. Canada’s post-COVID recovery can only happen if the foundation of Canada’s research ecosystem — its researchers and institutions — remains vibrant and strong.

We recommend that the federal government invest in:

- **Long-term and predictable research and research infrastructure through the federal granting agencies and the Canada Foundation for Innovation.**



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Conclusion

As Canada and the world look towards resilient recovery and green growth, harnessing the power and potential of bio-innovation will be a game-changer for first-mover countries.

Genome Canada, in collaboration with the network of regional Genome Centres, can work with the Government of Canada to design and deliver genomics research, innovation and data-driven missions that bring together the right players to align with solutions to the cross-sectoral challenges facing the country.

We proved with CanCOGeN that we could step up and deliver for Canada. With new investment, we can do it again, so Canada builds back better.

Thank you for the opportunity to provide a submission. We would be pleased to appear before the Committee to discuss these recommendations.

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See our [2019-20 Annual Report](#).