GenomeCanada

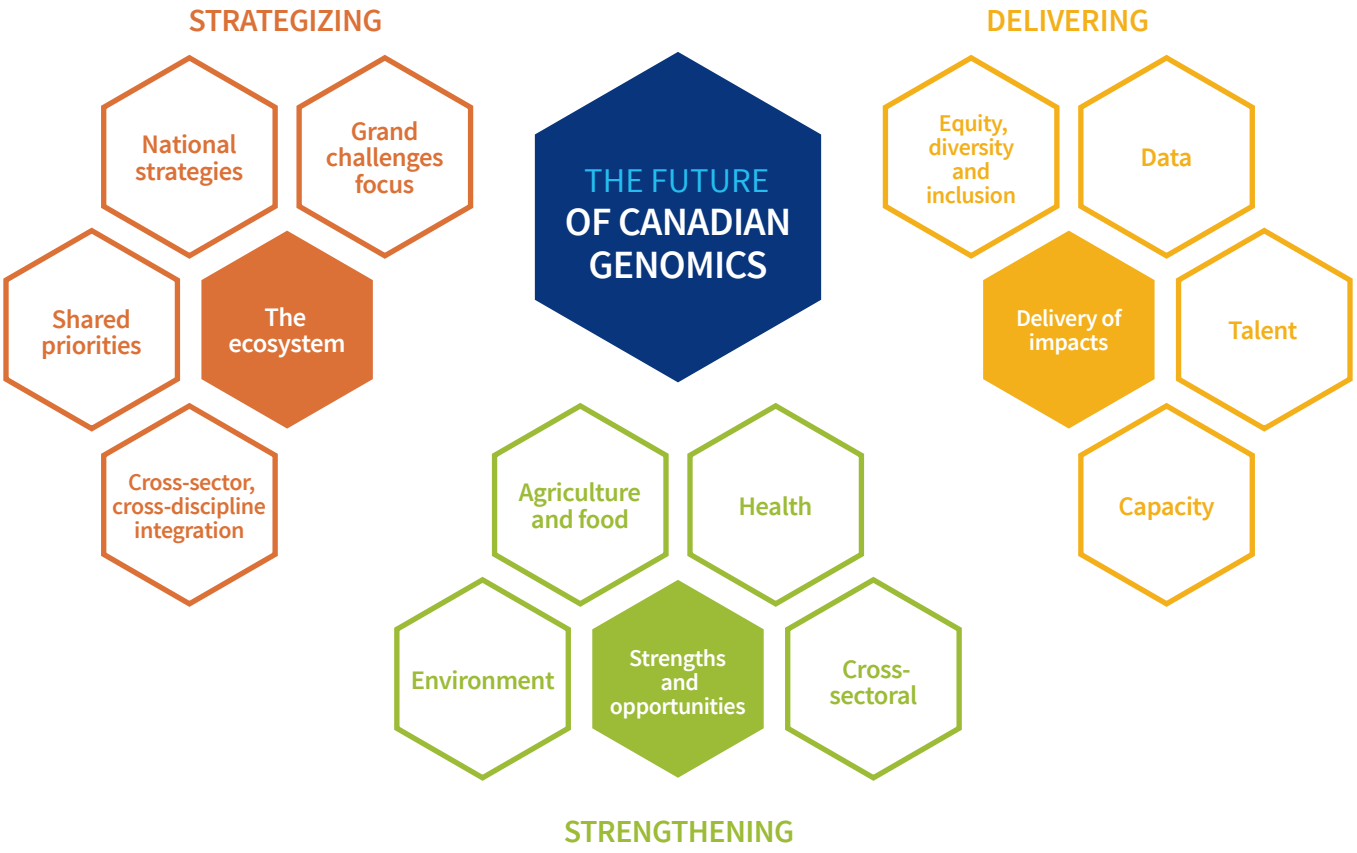
GENOME CANADA LEADERS' DIALOGUE ON THE FUTURE OF GENOMICS IN CANADA:

STRATEGIZING, STRENGTHENING AND DELIVERING IMPACT

November 30, 2021

SUMMARY

What will the future of Canadian genomics look like? How will we get there? These questions were the focus of three roundtables convened by Genome Canada. In them, we explored strategic directions for impact in genomics with global experts and researchers and partners in Canada's genomics ecosystem.



The future of Canadian genomics is reliant on the interaction of strategies, strengths and delivery. Each component has areas of focus, but all connect together to create an impactful Canadian genomics ecosystem.

MAIN MESSAGES

In convening key stakeholders from across the Canadian genomics ecosystem, Genome Canada collated important messages on building the future of Canadian genomics.

The ecosystem

- Developing an effective national research and innovation (R&I) strategy requires Canada to learn from other countries' experiences: for example, Norway's transition to R&I funding societal challenges and the U.K.'s ambitious vision combined with a 10-year action plan to put genomics at the centre of national health care.

- Canada has significant strengths, opportunities and collaborations in genomics. But we must:
  - better align and coordinate the ecosystem around shared national priorities, and
  - make strategic choices on what to pursue and how to realize its impact.

Strengths and opportunities

- Canada's diversity is a key strength in genomics. But we must promote and increase equitable access, delivery and impact.

- Indigenous genomics data, communities, ways of knowing and researchers must be part of Canada's genomics future.

- Well-coordinated cross-agency, cross-sectoral and cross-disciplinary approaches must be cornerstone features that define the future of Canadian genomics.

Delivery of impacts

- Building talent and training pathways, from school-age and to end-user receptors, must be a key component of impact-driven Canadian genomics.

- Canada must use a "point of use" lens to build capacity in the genomics ecosystem through multiple pathways to impact.

- Unlocking the capabilities of data-driven genomics R&I requires leveraging genomics data—health and non-health—and associated meta-data across Canada through better data mapping, standards, integration, access and analysis, including artificial intelligence.

INTRODUCTION

We are in the early days of a **Bio Revolution**: advanced biosciences and biotechnology will fundamentally transform our lives. The confluence of genomics, big data, artificial intelligence (AI), gene editing and synthetic biology offers an unparalleled opportunity to deliver homegrown biological solutions to complex problems, drive economic growth and position Canada for global market leadership in key areas of strength, and—most importantly—protect and improve Canadians' lives.

Strengthening Canada's innovation ecosystem for greater impact on value creation, economic growth and jobs has been a major focus of federal innovation policy and investments over the last few years. **Budget 2021** doubled down on this goal with support for key innovative sectors to drive pandemic resilience and economic growth. It also announced major investments in **biosciences and biomanufacturing** as well as in AI, quantum and genomics. A new **$400 million Pan-Canadian Genomics Strategy** over six years includes $136.7 million for Genome Canada's mission-driven programming.

For 20 years, Genome Canada has invested in building Canada's genomics capacity across sectors through applied R&I partnerships. Now, we're looking to the next 20 years. We recently convened three virtual roundtables with Canada's genomics research community, global experts and key partners in the national genomics ecosystem.

We designed the roundtables to help identify future opportunities and challenges for Canadian genomics overall, and to inform our strategic direction and new mission-driven approach to delivering greater impact. The roundtables covered three different themes. The first one was hosted by Dr. Rob Annan, President and CEO, Genome Canada, and focused on the genomics ecosystem and **strategies to support innovation and impact**. Dr. Catalina Lopez-Correa, Chief Scientific Officer, Genome Canada, hosted the next two roundtables, the first of which looked at Canada's genomics **strengths and areas of future focus**, whereas the second focused on the **mechanisms required to deliver** on potential impacts for Canada and globally. Elder Claudette Commanda, Professor, University of Ottawa, and Executive Director, First Nations Confederacy of Cultural Education Centres, was invited to offer words of wisdom at the outset of each event, where she spoke about sharing knowledge as a community being a sacred responsibility.

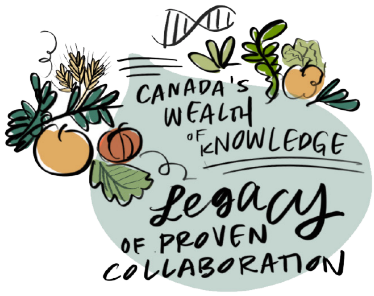
GENOMICS ECOSYSTEM AND STRATEGIES TO SUPPORT INNOVATION AND IMPACT

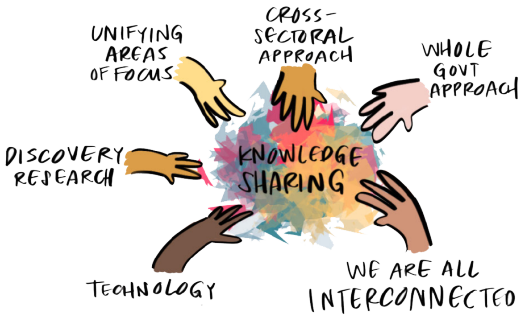
Stakeholders from across Canada's genomics ecosystem—research, innovation, business, policy and other relevant actors—brought their expertise and insight to Genome Canada's mission strategy and a shared platform for the country's genomics future.

We were all inspired by a Keynote on Norway's experience transforming its national research and innovation ecosystem to one that supports societal change. Roundtable participants pinpointed key components of a future Canadian genomics ecosystem:

- Building on Canada's research strengths in genomics where we "punch above our weight", including on societal implications of genomics
- Ensuring meaningful inclusion of Canada's diversity, including Indigenous researchers and knowledge holders
- Developing a coherent genomics R&I ecosystem that brings multiple partners together around shared priorities
- Coordinating national genomics initiatives across funders, participants and users to generate local solutions to global challenges
- Being ready to adapt and adjust R&I to changing global priorities and challenges
- Creating a clear focus on grand challenges, such as the UN Sustainable Development Goals, should drive investment decisions that ensure large-scale impact from our genomics investment
- Maintaining a cross-sectoral and cross-disciplinary approach to genomics that can deliver on grand challenges, rather than simply aligning with single-sector priorities

Keynote: Ms. Anne Kjersti Fahlvik, Executive Director of Business Development and Innovation at the Research Council of Norway.





CANADA'S GENOMICS STRENGTHS AND AREAS OF FUTURE FOCUS

Keynote: Professor Dame Sue Hill, Chief Scientific Officer for England and Senior Responsible Officer for Genomics in NHS England.

Where does Canada have significant global strengths and opportunities in genomics? What are the areas in which we can lead?

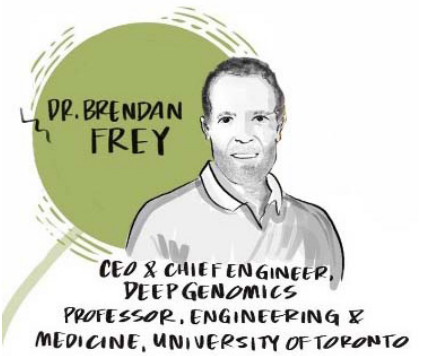
We brought Canada's genomics research community together to answer these questions. First, Keynote Professor Dame Sue Hill outlined lessons learned from NHS England's National Genomic Healthcare Strategy, Genome UK: the future of healthcare. Then, roundtable participants explored Canada's genomics strengths in health, the environment and agriculture with a strong focus on intersections and cross-disciplinary opportunities. We identified some major strengths and opportunities for Canada:

- Leveraging our diversity through more clearly articulated equity-driven genomics research to lead the world in health genomics
- Advancing all sectors of genomics research and innovation through greater genomic data and associated meta-data creation, sharing and analysis
- Driving equitable clinical implementation of genomics technologies in health through bold investments, inclusive genomics data and equitable approaches to data use and stewardship
- Successfully linking genomics science to commercial agricultural systems to provide significant opportunities for domestic and international food security for Canada
- Using novel genomics approaches to climate change monitoring, mitigation and adaptation including guarding against future environmental shocks and building on Canadian world leadership in areas such as forestry genomics and industrial environmental repair
- Combining genomic knowledge and learnings with other disciplines (e.g., ecology, climate science, health care) to realize societal impacts more quickly and efficiently than trying to simply drive genomics on its own to potential impacts
- Building on Canada's unique strengths in GE^{3}LS and Genomics in Society research and analysis to link genomics science with its potential impacts
- Making the delivery of equitable genomics impacts a priority through use of inclusive and reconciliation-based approaches to share and mobilize genomics knowledge broadly across Canadian stakeholders, communities and all parts of society

MECHANISMS REQUIRED TO DELIVER ON POTENTIAL IMPACTS FOR CANADA AND GLOBALLY

R&I systems rely on bridging research and innovation, supporting translation and uptake, and driving towards benefits. Canada's genomics R&I stakeholders convened to discuss the foundational ecosystem elements required to deliver on potential impacts for Canada and the world. This included putting the capacity, talent and data systems in place to support a highly impactful genomics ecosystem—one that can leverage unique multi- and interdisciplinary genomics across R&I areas.

Building on a Keynote from Dr. Brendan Frey on the success factors for Deep Genomics, roundtable participants addressed how capacity, talent and data should work together to provide the framework for translating genomics knowledge into impact:



Keynote: Dr. Brendan Frey, Founder and CEO of Deep Genomics

- Equity must drive efforts to build capacity, develop talent, and create and analyze genomics data. Canada has a real opportunity to leverage our diversity to strengthen the impacts within our ecosystem.
- The interaction of different support elements will determine the impact of genomics. Discovery research is one critical element of the ecosystem. Building strategic partnerships and effective synergies across all stakeholders—from universities to industry to regulators to communities—is also essential to realizing promised impacts.
- Building capacity for genomics goes beyond the lab. It also includes supporting tool and infrastructure development, facilitating cross-sectoral collaborations, and developing end-user and receptor capacity. We must invest in "point-of-use" capacity to smooth the pathways to genomics impact.
- With a growing genomics and broad -omics small and medium-sized enterprise community, Canada has a developing capacity that can be leveraged through private-sector investments and public-sector supports.
- Canada's genomics data ecosystem needs to be fully mapped and integrated to allow us to make appropriate connections, focused on realizing impacts, for data nationally and internationally. This requires health and non-human health data repositories, data standards to facilitate better sharing across the federated ecosystem, researcher and industry access to shared data, and better use of AI to accelerate analysis and create more value.
- Given the multidisciplinary nature of genomics and imperatives of the fast-growing bioeconomy, the ecosystem needs to develop a strategic education-training-talent pathway from STEM K-12, through student research internships, to cross-training that creates researcher-entrepreneurs, and to upskilling genomics highly qualified personnel to meet evolving industry needs.

OVERARCHING LESSONS

Across all three roundtables, a clear picture emerged of the need to build Canada's genomics future in such a way that it can effectively address society's most challenging problems. This means a coherent genomics R&I ecosystem that mobilizes the scientific, human resource, infrastructure and data capacity already present in Canada around shared national priorities. It also means supporting coordinated efforts that drive cross-sectoral, diverse and dynamic collaborations that deliver equitable impacts and inclusive genomics. Participants repeatedly stressed that Canada's diversity is its strength—from Indigenous ways of knowing, to community-partnered research, to addressing genomics' historic inequities. Using the value generated across our diverse ecosystem will be a mark of success for any future genomics strategy.

NEXT STEPS

The roundtables are part of a broader dialogue on the future of genomics in Canada. On November, 30, 2021, the launch date for this report, Genome Canada is hosting a public townhall.

We are employing a mission-driven approach to supporting genomics across Canada. The Government of Canada is launching consultations for the proposed Pan-Canadian Genomics Strategy in early 2022.

FURTHER READING

For those interested in further information on the future of genomics for Canada, the following provide useful primers:

- Bonham, V. & Green, E., 2021, The genomics workforce must become more diverse: a strategic imperative, *The American Journal of Human Genetics*, **108**, 3–7.
- Business Council of Canada, 2020, Powering a strong recovery: an economic growth plan for Canada
- McGuire, A.L., Gabriel, S., Tishkoff, S.A., et al., 2020, The road ahead in genetics and genomics. Nat Rev Genet 21, 581–596.
- McKinsey Global Institute, 2020, The Bio Revolution: Innovations transforming economies, societies, and our lives
- Navarro, F.C.P., Mohsen, H., Yan, C. et al., 2019, Genomics and data science: an application within an umbrella, *Genome Biol* **20**, 109
- OECD, 2020, Optimizing the Operation and Use of National Research Infrastructures, OECD Science, Technology and Industry Papers, No. 91
- RAND Europe, 2021, Tackling societal challenges and guiding the future of research and innovation in Norway
- U.K. Government, 2020, Genome UK: the future of healthcare

For further information

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genomecanada.ca/future

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