GenomeCanada

2019 2020

Corporate Plan

GLOBAL CHALLENGES GENOMIC SOLUTIONS

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GenomeCanada

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1.0 About Genome Canada

Organizational context

Genome Canada is a not-for-profit organization that acts as a catalyst for developing and applying genomics and genomics-based technologies to create economic and social benefits for Canadians. Genome Canada defines genomics as the comprehensive study – using high throughput technologies – of the genetic information of a cell or organism and its functions. This includes related disciplines such as proteomics, metabolomics and bioinformatics.

Genome Canada connects ideas and people across public and private sectors to find new uses for genomics. It also invests in large-scale science and technology to fuel innovation and translates discoveries into solutions across key sectors of national importance.

Genome Canada catalyzes multidisciplinary research and innovation across sectors where genomics can contribute solutions. This provides clear opportunities for Canada to play a leading international role in emerging global issues, such as antimicrobial resistance and climate change.

Since its inception in 2000, Genome Canada and six affiliated regional Genome Centres have been at the heart of Canada's genomics enterprise. This enterprise is a collaborative network of individuals and organizations who coordinate and conduct research, translate discoveries into applications and apply the results to the benefit of Canadians.

Genome Canada and the Genome Centres are dedicated to delivering on federal policy priorities for science and innovation. They have fueled the genomics enterprise and set a national agenda for genomics in Canada, driven by Government of Canada support. Genome Canada is the only agency in Canada with a singular focus on genomics – and its applications across multiple sectors of importance. It plays a unique and collaborative role in the broader science, technology and innovation ecosystem.

Through myriad partnerships and strategic program design, Genome Canada ensures its alignment with key federal players. These include granting councils, science-based departments and federally funded not-for-profit organizations. Working with such entities ensures a continuum of funding support across the entire life cycle of a research project – from discovery to application in the marketplace and public sector.

Genome Canada's business model provides national coordination while setting strategic direction that is responsive to regional needs and priorities. Upfront engagement with users of genomics ensures that the research is strategic and purpose-driven. This makes research more likely to be translated into applications that target opportunities and solve challenges in all sectors of the bioeconomy and across all regions of Canada.

This focus is important because only in Canada will research and development (R&D) be undertaken to address Canadian priorities such as:

- the sustainability and productivity of Canadian farms, forests and fisheries,
- the environmental footprint of Canadian oil and mining industries,
- the viability of Canadian health-care systems, and
- the improvement of health and economic opportunities in the Arctic and for Indigenous peoples.

Securing co-funding through partnerships is central to the Genome Canada business model. Bringing together diverse partners to co-invest in Canadian genomics research aligns efforts and benefits society.

In collaboration with the Genome Centres, Genome Canada has leveraged $1.5 billion in federal funding since 2000 for a total investment of $3.6 billion for genomics research in Canada.

Genomics is a maturing science, but we are only beginning to realize the enormous potential of this cutting-edge field of inquiry. As technological advances accelerate, early demonstrations of impact become clear. Thanks to sustained federal funding and the achievements of researchers supported by Genome Canada, the regional Genome Centres and other partners, Canada is now a powerhouse in genomics. Genome Canada is poised to build on this success and generate competitive advantages for Canadian sectors globally through genomics.

Genome Canada's range of programs

Genome Canada supports the advancement of genomics in Canada. The knowledge generated through its funding programs strengthens Canada's bioeconomy, supports evidence-based policy-making and improves the quality of life for Canadians.

Since its inception in 2000, Genome Canada has evolved its suite of programs. They now reflect both the rapidly changing state of genomics-based science and the opening up of opportunities across all sectors of the bioeconomy. These changes have been driven by users of genomics technology in the private and public sectors. Today, the Genome Canada portfolio of programs supports fundamental science through to translation and into application.

Large-Scale Applied Research Project (LSARP) competitions fuel the innovation pipeline. Through the LSARP program, Genome Canada supports discovery and applied research. It also encourages investigators to explore the potential uses of their discoveries by engaging with those who can help translate the research into applications that benefit Canadian society and the bioeconomy.

The Genomic Applications Partnership Program (GAPP) is an academic-receptor partnered program whose goal is to increase and accelerate the positive social and economic impact of Canada's genomics R&D capacity.
GAPP's objectives are to:

- accelerate the application of Canadian genomics-derived solutions to real-world opportunities and challenges defined by industry and the public sector,
- channel Canada's genomics capacity into sustainable innovations that benefit Canadians,
- enhance the value of Canadian genomics technologies and incentivize investment from industry and other partners, and
- foster mutually beneficial collaboration and knowledge exchange between Canadian academia and technology receptors.

Genome Canada's Emerging Issues and Regional Partnership Priority Programs respond to regional and national strategically identified need. Both programs allow for rapid, flexible response to issues in society, from the *Zika* virus epidemic, to the Polley Mountain mining disaster, to enhancing blight resistance in wheat.

Underpinning our research funding programs are technology programs, designed to provide Canadian scientists with access to leading-edge 'omics technologies. These technologies include bioinformatics and computational biology tools needed to manage, analyze and interpret the ever-growing amount of data produced through genomics inquiry.

Just as technology underpins the genomics scientific endeavour, so does understanding implications of genomics in society. Genome Canada programs address genomics and its ethical, environmental, economic, legal and social (GE^3LS) aspects, as well as genomics in society.

Commitment to accountability

In delivering its mandate, Genome Canada is committed to applying the highest standards of accountability and transparency to its operations. It provides a high level of assurance through mechanisms and instruments such as:

- corporate plans and annual reports,
- independent performance audit and evaluation studies,
- peer review and research oversight committee processes,
- annual attest audits,
- continuous risk management assessment, and
- effective oversight by the board of directors.

Genome Canada rigorously monitors its expenditures in order to manage operations in a fiscally prudent manner.

2.0 Results 2018-19

Through early work on capability and capacity building, Genome Canada developed large-scale fundamental research projects and technology platforms. As the technology matured and the strength of the genomics enterprise in Canada increased, Genome Canada built up the expertise to drive innovation through its support of applied genomics, using genomics research to address challenges and opportunities in all sectors vital to Canada's growing bioeconomy.

The Genome Canada approach ensures alignment and complementarity with other key members of Canada's science, technology and innovation ecosystem. This mutually reinforces respective strategies and objectives and capitalizes on synergies that can be derived from working together.

Short- and medium-term outputs and outcomes from 2018-19

In 2018-19, Genome Canada achieved a broad and substantial range of short- and medium-term outputs and outcomes. They include the following:

- **Continued investment in the 2012 LSARP Competition – Genomics and Personalized Health**. Throughout 2018-19, Genome Canada, in partnership with the CIHR, continued to invest in the 17 projects from the 2012 competition. A total of $151.4 million, including co-funding, is being provided over the complete term of these projects. The projects aim to demonstrate how genomics can contribute to a more evidence-based approach to health, improve the cost-effectiveness of the health-care system, and ensure discoveries are translated into patient and population benefits. Areas of focus included tailoring patient treatments and therapies through the application of genomics. These are applied in fields as diverse as epilepsy, autism, HIV/AIDS, cancer, cardiovascular disease, rare neurological diseases and stroke, among others. These projects are nearly all completed.

- **Continued investment in the 2014 LSARP Competition – Genomics and Feeding the Future.** Genome Canada has continued to fund the 11 projects announced in 2015 via a $94.4 million investment, which includes co-funding. The projects use genomics approaches within the agriculture/agri-food and fisheries/aquaculture sectors to address challenges and opportunities related to global food safety, security and sustainable production. Funding flowed to projects focused on the application of genomics in multiple areas, including sustainable fisheries and honeybees, stress and disease resistance of crops and livestock and, in partnership with the Western Grains Research Foundation, utilizing genomics to expedite breeding for desirable traits in wheat, lentils and soybeans.

- **Continued investment in the 2015 LSARP Competition – Natural Resources and the Environment.** Genome Canada and co-funding partners are investing a total of $112.2 million in 13 projects. The scope of this competition includes genomics research in energy, mining, forestry, water stewardship, wildlife management and conservation. It also includes genomics research in bioproducts that will provide tools to help conserve natural resources and protect the environment. Outcomes have the potential to contribute to the Canadian bioeconomy and well-being of Canadians.

- **Funding of the 2017 LSARP Competition – Genomics and Precision Health.** This $163.8-million competition, including co-funding, was launched in January 2017 in partnership with the CIHR. Funds began to flow to these projects over the course of 2018-19. It supports projects that

demonstrate how genomics-based research can contribute to a more evidence-based approach to health. These projects are expected to improve health outcomes and/or enhance the cost-effectiveness of the health-care system. A broad range of projects were funded, including several focused on diagnosis and treatment for cancers, reducing health care disparities and improving diagnostic success for children with genetic diseases from Indigenous populations, diagnosis of rare diseases, and several chronic illnesses, including cystic fibrosis, inflammatory bowel disease, and childhood arthritis.

- **Launch of the 2018 LSARP Competition – Genomic Solutions for Agriculture, Agri-food, Fisheries and Aquaculture.** This $90M competition, including co-funding, was launched January 2018 in partnership with Agriculture and Agri-food Canada. It supports projects that demonstrate how genomics research can be translated into solutions advancing the sustainability, productive capacity and competitive position of the Canadian agriculture/agri-food and fisheries/aquaculture sectors. Research in these areas has the potential to provide new approaches that can improve disease and pest resistance in our crops, livestock, and fish, increase our understanding of soil and aquatic microbiomes, improve early disease detection in livestock, improve our ability to track, monitor and assess wild fish populations, and identify crops and livestock that are more resilient to temperature extremes due to climate change. 73 pre-applications were received in November 2018. These will be reviewed by January 2019 and the most competitive proposals will be asked to submit full applications by April 2019.

- **Funding of more projects through GAPP.** Throughout 2018-19, Genome Canada continued to invest in GAPP. A total of $207.4 million, including co-funding, has been invested in 54 receptor-led projects to date. Through GAPP, Genome Canada connects academic researchers with receptors in industry and the public sector. GAPP is designed to increase collaboration between genomics scientists and users of genomics research to advance projects that address real-world challenges and opportunities. GAPP is also intended to stimulate investment from private and public partners in Canadian genomics technologies. Recent rounds included projects that are working to develop diagnostic tests for pediatric cancers and tools to detect and identify surface microbial contamination.

- **Continued partnership with Mitacs through GAPP to provide training opportunities in the private sector.** Mitacs is a non-profit, national research organization. It manages and funds research and training programs for undergraduate and graduate students as well as post-doctoral fellows in partnership with universities, industry and government in Canada.

  A Genome Canada partnership with Mitacs provides placements and funding for graduate students and post-doctoral fellows to work on GAPP projects within industry partners' operations. The partnership prepares Canada's next generation of innovators to advance the field of genomics by allowing candidates to apply their knowledge and skills in a real-world setting. Companies, meanwhile, benefit from the high-quality research expertise. During 2018-19, this partnership supported eight Mitacs Accelerate internships in GAPP projects.

- **Continued investment in a GE^{3}LS network in genomics and personalized health.** The GE^{3}LS Network was introduced as a complement to the Genomics and Personalized Health 2012 LSARP competition. Genome Canada knows that there are challenges in implementing precision medicine technologies in practice. Many of these barriers are related to the GE^{3}LS aspects of genomics research. Recognizing that working across projects would generate synergies that

working in silos could not, Genome Canada invested $2 million, including co-funding, in the Precision Medicine Policy Network for three years, starting March 2016. The Network focuses on ethics, economics and health technology assessment, knowledge translation, intellectual property and commercialization.

- **Continued investment in the Joint Initiative with the Social Sciences and Humanities Research Council (SSHRC) on Societal Implications of Genomics.** This $2 million initiative jointly supports social sciences and humanities research and related activities that will enrich the understanding of the societal implications of genomic research. By reaching a community of social sciences and humanities scholars who may still be unfamiliar with Genome Canada's programs, the initiative is also intended to help build the cadre of social sciences and humanities scholars interested in pursuing genomics-related research collaborations and facilitate their becoming part of multidisciplinary teams applying to Genome Canada applied research competitions. SSHRC has the lead on the peer review as applicants apply through SSHRC's regular programs. A total of 10 projects have now been approved for funding.

- **Ongoing investment in Emerging Issues**. Genome Canada is currently funding emerging issues projects that address important and timely needs. Since 2000, Genome Canada has invested $6.8 million (including co-funding) into Emerging Issues projects. This includes most recently a project to accelerate breeding of sunflower, flax, and lentils by leveraging the diversity in gene banks. Access to these data will enable researchers and breeders to mobilize data to enhance crop improvements and increase productivity, sustainability, and resilience of crop varieties.

- **Continued investment in the 2015 E-Rare-3 Joint Transnational Call – Translational Research Projects on Rare Diseases, Structural Genomics Consortium.** Nine projects with Canadian participants are ongoing through this joint international funding mechanism. The opportunity was created in collaboration with five Canadian partners and various organizations from European Union countries. The Canadian partners are the CIHR, Fonds de recherche du Québec – Santé, the Ataxia Charlevoix-Saguenay Foundation, Cystic Fibrosis Canada and Muscular Dystrophy Canada.

  The total investment from all partners for the nine projects is $13.4 million over three years. Genome Canada directly funds three of the projects. These projects focus on harmonizing phenomics information and improving the diagnosis and treatment of a cardiac arrhythmia syndrome. They also focus on studying a life-threatening autosomal skin disease to understand its pathophysiology, facilitating the development of targeted therapies. E-Rare-3 is enabling scientists in different countries to build effective collaboration around a common interdisciplinary research project based on the sharing of expertise.

- **Continued support for the Structural Genomics Consortium.** The Structural Genomics Consortium (SGC), established in 2004, is a not-for-profit public–private partnership that supports the discovery of new medicines through open access research. Throughout 2018-19, Genome Canada continued its investment in the SGC. Up to $400 million in investments have been made in collaboration with partners.

- **Investment in the Regional Priorities Partnership Program**. This $18 million initiative (including co-funding) supports the Genome Centres in developing initiatives that advance

genomics research and translation capacity in areas of strategic priority to their regions. Six projects have been approved thus far on various topics, including:

- early detection and treatment of bipolar disorder
- implementation of a modern and sustainable mussel breeding program
- improving cannabis productivity and strain identification
- a provincial platform to meet clinical genomics needs
- development of genomic tools for the vaccination and breeding of cleaner fish (lumpfish and cunner) in support of the aquaculture industry
- enhancing Fusarium head blight resistance in durum wheat

- **Continued investment in the 2015 Bioinformatics and Computational Biology Competitions.** The objectives of this competition, held in partnership with the CIHR, are to support the development of next-generation tools and methodologies and to provide the research community broad and timely access to these tools.

  Sixteen projects were funded for two-year terms for a total of $4 million. The projects will bolster federal action on antimicrobial resistance through stronger surveillance, stewardship and innovation. Other projects will enhance diagnosis and treatment for patients, improve crops of importance to Canada, and strengthen environmental monitoring.

- **Continued investment in the 2017 Bioinformatics and Computational Biology Competitions.** Launched in December 2017, the major objectives of this $24-million competition are similar to those of previous competitions. The 2017 competition supported proposals under two streams: proposals mainly impacting the human health sector, and proposals mainly impacting one or more of the other sectors that Genome Canada focuses on. The 25 projects funded included ones using machine learning to predict drug resistance in pathogenic bacteria, toolkits for rapid characterization of bacterial genomes, tackling environmental and agri-food context of antimicrobial resistance, among many others.

- **Continued investment in the Genomics Technology Platforms.** Ten technology platforms are being supported for a total of up to $150 million, including co-funding, over five years, beginning in April 2017. The technology platforms provide the research community with the highest-quality ‘omics technologies and advice. Each of the platforms provides researchers access to high throughput ‘omics technologies such as DNA sequencing, proteomics and metabolomics. The platforms also provide researchers with new method and protocol development, data analysis and bioinformatics.

- **Continued investment in the 2015 Disruptive Innovation in Genomics Competition.** Genome Canada and co-funders are investing in projects that deliver innovations in the field of genomics. These projects have the potential to displace an existing technology, disrupt an existing market or create a new market. It is anticipated that disruptive innovations will enable the rapid acceleration of genomics research, marking a significant leap forward for the genomics revolution. Twenty projects were selected for funding under the first round of Phase 1 of this competition and five projects were selected for funding in the first round of Phase 2 for a total investment of $18.5 million.

- **Funding the 2017 Disruptive Innovation in Genomics Competition.** Genome Canada and co-funding partners are investing $19.1 million in seven phase 1 projects that are advancing to

phase 2. These projects focus on a range of areas, for example, the development of techniques to rapidly isolate and analyze fetal cells for prenatal diagnosis of genetic abnormalities using non-invasive procedures and diagnostic testing to increase the success rate of genetic testing in children with rare genetic diseases and cancer.

- **Advancing a precision health strategy.** Genome Canada has been building on one of the key recommendations from the Genomics and Precision Health Forum held in late 2016 in Toronto - working to advance the implementation of genomics in the health-care system through the creation of a rare disease pilot project.

- **Continued outreach**. Genome Canada engaged in several outreach activities in 2018-19:
    - Co-hosted a Science Symposium (February 2018) in Montreal featuring presentations by leading regional scientists on a number of topics, including cancer, synthetic biology, GE^{3}LS, bioinformatics, the microbiome, and so forth.
    - Hosted a reception at the Plant and Animal Genome XXVI Conference (January 2018) facilitating networking between Canadian researchers and foreign scientists, collaborators, and other stakeholders to discuss their research and exchange ideas.
    - Hosted a kiosk at the 2018 BIO International Convention to highlight Canadian genomics and the opportunity it provides to boost the economy and improve quality of life. It also enabled networking with researchers, government officials, and industry.
    - Genome Canada sponsored the visit to Science North of a traveling Smithsonian exhibit Genome: Unlocking Life's Code culminating in a BioLab permanent exhibit.
    - Supported the development of educational videos to demystify genomics and demonstrate their applicability to industry, for example, a video on microbial genomics being used for de-risking offshore oil and gas exploration in Nova Scotia and one on a rare disease patient in Ontario.
    - Sponsored genomics-related outreach at the Canada Science and Technology Museum and the Canada Agriculture and Food Museum, as well as a public lecture on genomics: Genomics and You.
    - Numerous smaller-scale outreach events, including public talks on genomics in mining, keynote addresses, scientific cafes, and lab tours for students.

- **Finalizing and implementing new strategic vision for Genome Canada**. As a prelude to the launch of a new strategic vision, Genome Canada consulted with more than 300 stakeholders from coast to coast, including researchers, industry, academic leaders and federal and provincial policymakers. Based on these consultations and on discussions among the Board and senior leadership, a new vision is being developed and will be launched in early 2019. This vision allows for the flexibility required of a fast-moving science, while also giving a clear direction forward for the organization to continue to drive genomics research in Canada. Its implementation will continue through 2019 as Genome Canada updates its logic model, performance and evaluation metrics, and performance, evaluation, risk and audit framework.

Remaining challenges from 2018-19

The principal challenge remaining from 2018-19 is **co-funding.** The current model of short-term funding agreements with the Government of Canada inhibits strategic investment planning. It also negatively impacts the ability of Genome Canada and the Genome Centres to secure co-funding through medium- to long-term partnerships. A longer-term federal funding commitment would position Genome Canada as a stable and credible partner with industry and the provinces and territories. Funding should also be at a

level that allows for the full implementation of Genome Canada's strategic plan. Genome Canada's essential co-funding partners require a multi-year planning horizon for the kind of large-scale and long-term investments that genomics research and innovation entails.

High requirements for co-funding can also affect equitable access to Genome Canada funding, favouring more experience researchers with larger networks and those with a long track record of funding to attract co-funding partners.

3.0 Planned activities 2019-20

As the leading voice for Canadian genomics researchers, Genome Canada will continue to support the genomics research ecosystem and genomics researchers through its provision of large-scale funding for big genomics research projects while also enabling timely responses to social needs through rapid-response funding for emerging and strategic issues. Genome Canada will maintain its support of researchers that seek to push the limits of their methodologies and tools and who want to disrupt current ways of thinking and doing with funding in bioinformatics and disruptive technologies. Genome Canada hopes to challenge researchers to continue to push the boundaries of innovation, to think outside the box and disrupt technologies, tools, and industries through the application of genomics research and tools in practice. And finally, Genome Canada seeks to nurture the understanding and application of genomics in all sectors through its support of the study of genomics in society.

For the 2019-20 fiscal year, Genome Canada will continue to manage ongoing programs and initiatives funded by the various agreements noted in Table 1 at the end of this report. Table 2 (also at the end of this report) additionally includes a list of all programs funded by Genome Canada that will be active in 2019-20.

Putting genomics into the hands of those who will use it

Support large-scale, interdisciplinary research with line-of-sight to application

Genome Canada continues to support research and innovation that address real-world challenges and that have the greatest potential to generate social and economic benefits for Canadians. Growing and sustaining Canada's dynamic bioeconomy involves maintaining a balanced portfolio of funding for discovery and applied research to fuel innovation. The move towards adoption and application means that today's genomics projects are inherently interdisciplinary, crossing the boundaries between biology, biochemistry, bioinformatics, the social sciences, humanities, engineering, and so forth. Genome Canada maintains its commitment to large-scale, interdisciplinary research through its inclusion of GE^{3}LS in the LSARP programs, both as standalone projects and as an integrated component, in addition to other smaller programs, including partnerships with SSHRC to build capacity in research on genomics in society.

The 2018 *Large-Scale Applied Research Project Competition: Genomics Solutions for Agriculture, Agri-food, Fisheries and Aquaculture,* a $90 million competition launched in partnership with Agriculture and Agri-Food Canada (AAFC) supports projects that demonstrate how genomics research can be translated into solutions advancing the sustainability, productive capacity and competitive position of the Canadian agriculture/agri-food and fisheries/aquaculture sectors. Funding decisions are anticipated in June 2019.

Stemming from the 2012 *Large-Scale Applied Research Project Competition: Genomics and Personalized Health*, the Precision Medicine Policy Network will be funded for $0.4 million in 2019-20. The Network brings together the GE^{3}LS researchers working across the 17 2012 LSARP projects to generate synergies and collaboration.

Upfront engagement with potential users of genomics research ensures that the research funded is purpose-driven, with line-of-sight to application. Industry's commitment to, and interest in, genomics is palpable, as many organizations not only collaborate with researchers on their projects but provide important co-funding in support of that research. In 2019-20, Genome Canada will invest $24 million (excluding co-funding) into LSARP projects engaging with industry users, in addition to the $13 million that is intended to be invested in GAPP. Canadian sectors are clearly primed to integrate genomics to drive innovation, foster sustainable practices and power the growth of their businesses. Further, through a

partnership with Mitacs, GAPP projects are helping train the next generation of entrepreneurs. They will advance genomics in Canadian industries of the future. In 2019-20, the Mitacs partnered Accelerate scholarship program anticipates supporting at least six fellows.

Supporting bold, inspirational missions

Genome Canada believes it is important to tackle key challenges facing society that can be effectively addressed through genomics. The *Clinical Implementation of Precision Health Initiative*, a national pilot, will develop a coordinated, national strategy for applying precision health to rare disease. The initiative will work on clinical implementation through the GAPP program, focusing on genome sequencing being offered as a clinical genetic test. The goal will be for the tests to be used within established diagnostic and clinical pathways for those patients with rare diseases. Addressing issues around ethics and governance will be tackled through the Emerging Issues program, which will support the development of a governance framework, privacy, data access, and data sharing policies, in addition to informed consent and other ethical and legal frameworks. Finally, strategic funds will be employed to create an integrated data commons to collect, harmonize, and provide access to clinical and multi-omics datasets. Should federal funding be received in Budget 2019, this endeavour will be expanded to include the assembly of a national rare disease cohort through the collection and sequencing of 30,000 samples from rare-disease patients and their families. This initiative will lay the foundation for the eventual application of genomics in the clinic more broadly for all Canadians.

Supporting big data and providing access to ‘omics technologies

Genome Canada will continue to support leading-edge technologies that enable Canadian genomics research. These include technology platforms, technology development, and bioinformatics and computational biology. In 2019-20, Genome Canada is slated to invest $14 million in its 10 technology platforms. The goal of these platforms is to provide researchers with access to high throughput ’omics technologies and advice on appropriate technologies, study design, data analysis and bioinformatics that enable and improve the quality of the research. The platforms are also supported to develop new and improved genomics technologies, ensuring that the services they provide support cutting-edge genomics research.

Genome Canada is investing $4.1 million in its big data program, Bioinformatics and Computational Biology (B/CB), in 2019-20 to ensure scientists have the tools needed to interpret, manage, govern, store and share genomics data in a secure and equitable manner. These tools are essential for analyzing and integrating complex data sets and to better understand the associated biology. More efficient tools and methodologies will relieve major bottlenecks in the genomics research community.

Getting to the heart of what we do

Supporting an equitable, diverse, and inclusive research program

Genome Canada recognizes that equity, diversity and inclusion (EDI) strengthen the research ecosystem, enhance research quality, and increase the social relevance and impact of research and innovation. Genome Canada recognizes that challenges remain in achieving the full participation of underrepresented groups (including women, racialized and ethnic minorities, Indigenous peoples, people with disabilities and LGBTQ2+ people) in scientific careers and is committed to identifying and overcoming barriers that may exist within its own hiring process, programs, peer-review system, and governing bodies.

Genome Canada has implemented an EDI policy and framework and is working to implement EDI principles throughout its calls for applications and funding guidelines. Additional work is being undertaken to encourage applications that follow EDI principles, to ensure our reviewers are unbiased and increase diversity in Genome Canada's governing bodies. To ensure that Genome Canada is aware of any EDI issues in its programming, the ability to capture EDI data is being built into the information management system that is currently under development within the organization. This will allow for competition and project level analysis on EDI components. Genome Canada also supports events that focus on underrepresented groups, including the Advancing Women in Agriculture Conference and the international Gender Summit.

Designing and delivering relevant, effective, and responsive programs

Genome Canada works to remain in touch with the research ecosystem and industry needs by regularly undertaking and updating its sector strategies. All of its programs are informed by the research community, its stakeholders, relevant industry, and the Genome Centres. Genome Canada regularly works with the six Genome Centres, who have regional expertise and capabilities, to ensure that all programs remain relevant and responsive. In addition to its large-scale science and big data programs, Genome Canada currently offers two smaller national programs tackling a variety of issues. The Emerging Issues program addresses important and timely needs, while the Regional Priorities Partnership Program focuses on supporting the Genome Centres in developing initiatives that advance genomics research and translation capacity in areas of strategic priority to their region. In 2019-20, Genome Canada plans to have approximately $300,000 available for its Emerging Issues program and $2 million for the Regional Priorities Partnership Program, respectively.

Genome Canada believes that part of what we must do to generate innovation is to challenge the norm. The Disruptive Innovation in Genomics competition (DIG) supports the development of new genomics-based technology (or the application of existing technology from another field applied to genomics) that is transformative and has the potential to displace an existing technology or disrupt an existing market or create a new one. In 2019-20, Genome Canada will continue its investment in existing disruptive innovation projects with $3.5million.

Engage in international initiatives to ensure Canadians benefit from multinational efforts

Genome Canada believes in the multiplying effect of collaboration. While Canada has a strong national genomics program, Genome Canada believes that it is important to ensure that Canadians participate in the resulting benefits of international research. Genome Canada serves as an effective representative for Canada, bringing Canadian researches to the table and coordinating participation.

Genome Canada has been a member and supporter of the Global Alliance for Genomics and Health (GA4GH) since 2014. The GA4GH has over 500-member organizations from 71 countries focused on improving human health through global genomics and clinical data sharing. It is intended that Genome Canada's Precision Health Initiative will be the next Driver Project of focus. Genome Canada is planning to provide approximately $100,000 in 2019-20 to support the convening activities to advance the research efforts of the alliance.

Genome Canada will also continue to support the international DivSeek initiative. The main goal of DivSeek is to enable researchers and breeders to mobilize the genetic variation found in the world's gene banks to accelerate the rate of crop breeding and to enhance the productivity, sustainability, and resilience of crop varieties. While crop-based genomic data is rapidly growing in quantity, the ability of crop breeders to easily use these data for the benefit of developing new crop varieties is lacking. Genome

Canada believes in facilitating access to user-friendly bioinformatics tools and cyberinfrastructures to handle the datasets and complex analysis will facilitate innovation in crops and is investing $200,000 in a project entitled DivSeek Canada led by several Canadian researchers. This type of innovation in crops is of importance to Canada's agriculture sector in meeting the challenge of global food security in the face of population growth, changing climate, and increasing constraints on land, water, and fertilizer. Genome Canada will also provide approximately $250,000 over three years in support the DivSeek International Network (DIN) secretariat based at, and co-funded by, the Global Institute for Food Security in Saskatoon. The secretariat will act as an organizational hub to DIN activities, including working groups, partner meetings, publications, and educational outreach.

The Structural Genomics Consortium (SGC), is a unique Canadian-led public-private partnership established in 2004 to support the discovery of new medicines through open science research. Genome Canada's funding has allowed the SGC to remain in Canada and facilitated its open access programming through new partnerships. Genome Canada will invest $3.2 million in 2019-20.

Established in 2007, the Canadian Stem Cells Consortium (CSCC) is formed of the Canada Foundation for Innovation, the Canadian Institutes of Health Research, Genome Canada, the Ontario Institute for Cancer Research and the Stem Cell Network. The goal of the CSCC is to develop and implement a strategy to support research in cancer stem cells. Genome Canada is investing $1.6 million in its CSCC initiatives in 2019-20.

Using our heads

Demonstrating thought-leadership through a genomics lens

Genome Canada believes that investments in bettering the lives of Canadians can take multiple forms. In addition to funding world-class science, Genome Canada also takes a leadership role in important collaborative initiatives. While Genome-Canada funded scientists work to increase the productivity, resilience, and quality of Canadian-grown crops, Genome Canada is working to complement this by coordinating the creation of an information management platform that would house important genetic information to accelerate plant breeding by leveraging the genetic diversity of the world's live collections and seed banks. Genome Canada's support brought the secretariat to Canada. This information will assist in developing high-yield, climate-tolerant, earth-friendly crops to begin to address food security issues now and in the future. The path to solving some of our greatest social challenges is forged collaboratively, one step at a time.

Genome Canada is also forging ahead with its continued work on rare diseases. In addition to supporting several ground-breaking projects on rare diseases, Genome Canada has seen the need for more and taken the lead on establishing a national Precision Health Initiative pilot to develop a coordinated, national strategy for applying genomic research to rare diseases. This complements the ongoing work Genome Canada has been doing with the Global Alliance for Genomics and Health, where it is anticipated that the next area for intense international focus will be rare diseases, spearheaded by the Genome Canada Precision Health Initiative.

Genome Canada-funded scientists are among the forefront of genomics-related thought leadership nationally and internationally. They have been invited to speak before Parliamentary committees, been admitted to the Royal Society of Canada, and have been the recipient of the Kyoto Prize and the Killam Prize, among others. Genome Canada is seeking to tap into this excellence to better share their knowledge with all our stakeholders. In 2019-20, Genome Canada is launching a policy brief series that focuses on the intersection of genomics, social interests, and policy, for example, a focus on genomics and cannabis.

Genome Canada, in collaboration with the Genome Centres, is launching a new National Series on Genomics and Society. This initiative will highlight thought leadership, amplify the communications impact and reach of regional public engagement events taking place nationally, and help to connect researchers outside of their regional networks. Topics for these events may include, but not be limited to, gene editing, genetic discrimination, big data and artificial intelligence, precision health, synthetic biology, the microbiome, cannabis, biomaterials and bioproducts, and agriculture and agri-foods.

Promote discussion and a Canadian perspective on genomics issues

Genome Canada supports and encourages outreach and engagement in the community. Genome Canada-funded scientists open their labs to tours by school students of all levels every year. They take on co-op and summer students to generate capacity and interest in science. They support the interest of undergraduate, masters, PhD students, and postdoctoral fellows by finding places for them on their research projects. They support the work of these students and fellows by supplying data for theses and research papers, training in new skills, and relevant job experience. They speak at local schools and universities, are invited to speak at other universities globally, are visiting professors in other departments, and hold public workshops to share their knowledge.

In addition to our support of scientists and their outreach, in 2019-20, Genome Canada will continue to sponsor and participate in outreach events, both nationally and internationally. Genome Canada represents Canadian genomics in national and international conferences and meetings and engages with broad sets of stakeholders through Genome Centre programs like GeneSkool and through partnerships with organizations like Let's Talk Science, the Summer Internship for Indigenous Peoples in Genomics, and others. A renewed outreach and engagement strategy will be launched in 2019-20 to ensure Genome Canada fulfills its mission to engage stakeholders effectively.

Continuing discussions about key issues in genomics with stakeholders

Genome Canada believes that the only way to truly generate innovation and solve social problems through genomics is to listen to its stakeholders - researchers, industry users, and those Canadians we hope to help, from crop growers and patients with genetic diseases to beekeepers and salmon farmers. Genome Canada regularly consults with its stakeholders to revise its sector strategies. These sector strategies are led by a steering committee and serve to define the role of genomics in agriculture/agri-food, the environment, energy and mining, fisheries and aquaculture, forestry, and health. Currently, Genome Canada is revising its health, agriculture/agri-foods and fisheries/aquaculture sector strategies in its ongoing efforts to keep up with the speed of innovation in genomics.

Genome Canada is a world leader in genomics and its ethical, environmental, economic, legal, and social aspects (GE^3LS). To ensure it stays that way, Genome Canada recently undertook a review of its integrated GE^3LS program and in 2019-20, will be implementing the recommendations of the expert panel.

Genome Canada also continues to showcase Canadian genomics on the international stage. For example, Genome Canada plans to attend the 2019 BIO International Convention in Philadelphia in June 2019. BIO allows Genome Canada and the Genome Centres a week of intensive promotion and networking to discover new opportunities and promising partnerships. This is in addition to participation at other national and international events and conferences planned for the year ahead.

Finally, as it has always done, Genome Canada will continue to maintain and develop national and international partnerships in areas of pressing importance to Canadians and it will continue to reach out to all types of industries and potential users to inform them of the many ways in which genomics research and tools could be applicable to their sector.

4.0 Financial management

The federal government, through Innovation, Science and Economic Development Canada, has committed $1.5 billion in funding to Genome Canada since 2000-01. This includes the most recent support of $237.2 million in Budget 2016. All funding is provided through funding agreements between Genome Canada and Innovation, Science and Economic Development Canada. Genome Canada and the Genome Centres raise co-funding from others, including the public, not-for-profit and private sectors.

Investment and management of funds

The Audit and Investment Committee supports Genome Canada's board of directors in fulfilling its fiduciary responsibilities with respect to the management of funds. The committee meets quarterly and reports to the board on the outcome of its deliberations.

The committee is responsible for:

- overseeing the investment and management of funds received from the Government of Canada as per a board-approved investment policy
  - the policy outlines guidelines, standards and procedures for the prudent investment and management of funds, and
- overseeing Genome Canada's policies, processes and activities in the areas of accounting and internal controls, risk management, auditing and financial reporting.

The board's programs committee brings further oversight to the management of funds by ensuring research funding and activities are aligned with Genome Canada's strategic priorities. The committee provides advice to the board of directors on research programs and projects, research partnerships and collaborations, competitions and program evaluation.

Source and use of funds

Genome Canada currently manages funds arising from the following funding agreements.

TABLE 1: GENOME CANADA FUNDING AGREEMENTS WITH INNOVATION, SCIENCE AND ECONOMIC DEVELOPMENT CANADA

Federal budget	Competitions and projects funded
Budget 2008 ($140 million)	Competition in applied genomics research in bioproducts and crops Two research projects through the Cancer Stem Cell Consortium and the International Barcode of Life project Support for the science and technology innovation centres The operations of six regional Genome Centres and Genome Canada through to 2012-13
Budget 2010 ($75 million)	Competition in forestry and the environment Multi-sector competition Competition for operations support for the Genomics Innovation Network
Budget 2011 ($65 million)	Competition in applied genomics research in personalized health Funding of Phase III of the Structural Genomics Consortium (SGC) and continued funding for the International Barcode of Life project Funding for the Public Population Project in Genomics Competition in bioinformatics and computational biology Contribution to the operations of six regional Genome Centres and Genome Canada for 2013-14

Federal budget	Competitions and projects funded
Budget 2012 ($60 million)	Funding for the Genomic Applications Partnership Program Funding for renewal of the Genomics Innovation Network for two years Funding of the SGC and the International Barcode of Life project
Budget 2013 ($165 million)	Two competitions in large-scale applied genomics research Funding for Genomics Innovation Network operations in 2015-16 and 2016-17, as well as related technology development Funding for disruptive innovation in genomics and in bioinformatics and computational biology Funding for national and international partnerships, including the SGC and the International Barcode of Life project Contribution to the operations of six regional Genome Centres and Genome Canada through to 2016-17
Budget 2016 ($237.2 million)	Two competitions in large-scale applied genomics research Support for genomics technology platforms and for bioinformatics and computational biology competitions Funding for the Genomic Applications Partnership Program Funding for national and international partnerships and strategic initiatives Contribution to the operations of six regional Genome Centres and Genome Canada through to 2019-20

Cash management

Genome Canada disburses funds on a quarterly basis through the six regional Genome Centres (for approved research projects) and the technology platforms. On a quarterly basis, each Genome Centre is required to review the expenditures to date. Each Centre is also required to estimate cash requirements for Centre operations and for each project and technology platform that it manages. It then submits a "draw request" to Genome Canada, indicating the cash needs for the subsequent quarter.

The Genome Centres assess the project / technology platform needs against the approved budget, actual expenditures, scientific progress to date and co-funding received from other sources. Genome Canada then conducts its own thorough review of the draw request submission before releasing funds.

Receipts and disbursements

Table 2 on the following page provides an estimate of the receipts and disbursements for the funding agreements.

TABLE 2: SUMMARY OF RECEIPTS AND DISBURSEMENTS

Details *(in millions of dollars)*	Actual 2000-18	Forecast 2018-19	Forecast 2019-20	Forecast other years	Total	Estimated co-funding	Genome Canada and co-funding	%
RECEIPTS								
Government of Canada								
Previous budgets	840.0				840.0		840.0	*22.9%*
Budget 2010	75.0				75.0		75.0	*2.1%*
Budget 2011	65.0				65.0		65.0	*1.8%*
Budget 2012	60.0				60.0		60.0	*1.6%*
Budget 2013	133.3	20.3	11.4		165.0		165.0	*4.5%*
Budget 2016	35.4	48.4	60.4	93.0	237.2		237.2	*6.5%*
Investment income	90.5	0.5			91.0		91.0	*2.5%*
Co-funding						2,122.5	2,122.5	*58.1%*
	1,299.2	**69.2**	**71.8**	**93.0**	**1,533.2**	**2,122.5**	**3,655.7**	*100.0%*
DISBURSEMENTS								
Research projects and Genome Centres funding								
Projects and programs completed in previous years	864.3	0.0	0.0	0.0	864.3	1,088.1	1,952.4	*53.3%*
2012 LSARP*: Genomics and Personalized Health	45.7	0.3	0.6	0.0	46.6	103.6	150.2	*4.2%*
2014 LSARP*: Genomics and Feeding the Future	19.3	5.5	4.8	3.0	32.6	61.8	94.4	*2.6%*
2015 LSARP*: Natural Resources and the Environment	9.9	7.4	7.5	9.6	34.4	77.7	112.1	*3.1%*
2017 LSARP*: Genomics and Precision Health	0.0	8.2	10.0	26.6	44.8	119.1	163.9	*4.5%*
2018 LSARP*: Genomics and Agriculture, Agri-Food, Fisheries and Aquaculture	0.0	0.0	3.0	27.0	30.0	60.0	90.0	*2.5%*
Genomic Applications Partnership Program	31.3	11.9	13.8	25.8	82.8	184.9	267.7	*7.3%*
Translational Networks	0.0	0.0	0.4	2.6	3.0	3.0	6.0	*0.2%*
GE^{3}LS Third Modality	0.7	0.1	0.2	0.0	1.0	1.0	2.0	*0.1%*
Bioinformatics and Computational Biology	6.7	2.2	4.1	5.8	18.8	20.5	39.3	*1.1%*
Strategic Initiatives	1.9	0.7	1.8	5.0	9.4	32.1	41.5	*1.1%*
Regional Priorities	0.0	0.3	1.5	4.2	6.0	12.0	18.0	*0.5%*
Advancing Big Data Science	1.9	0.0	0.1	0.0	2.0	4.0	6.0	*0.1%*
Emerging issues	1.2	0.0	0.5	0.9	2.6	8.7	11.3	*0.3%*
Global Alliance for Genomics and Health	0.8	0.2	0.0	0.0	1.0	2.3	3.3	*0.1%*
Structural Genomics Consortium IV	5.4	3.0	3.3	0.8	12.5	27.1	39.6	*1.0%*
Cancer Stem Cells Consortium	19.4	2.1	1.3	0.0	22.8	67.8	90.8	*2.5%*
Genomics technology platforms	36.8	13.0	13.0	5.9	68.7	72.8	141.5	*3.9%*
Disruptive Innovation in Genomics	7.2	2.0	2.9	3.4	15.5	22.1	37.6	*1.0%*
Canadian Epigenetics Environment	0.9	0.1	0.0	0.0	1.0	1.0	2.0	*0.1%*
Genome Centre operations	92.3	4.8	4.7	0.0	101.8	152.9	254.7	*7.0%*
	1,145.7	**61.8**	**73.5**	**120.6**	**1,401.6**	**2,122.5**	**3,524.1**	*96.5%*
Genome Canada operations	**114.5**	**6.4**	**7.2**	**0.0**	**128.1**	**0.0**	**128.1**	*3.5%*
Total disbursements	**1,260.2**	**68.2**	**80.7**	**120.6**	**1,529.7**	**2,122.5**	**3,652.2**	*100.0%*
Excess receipts over disbursements	**39.0**	**1.0**	**-8.9**	**-27.6**	**3.5**			
Opening cash balance	**0.0**	**39.0**	**40.0**	**31.1**				
Closing cash balance	**39.0**	**40.0**	**31.1**	**3.5**	**3.5**			

5.0 Risk assessment, mitigation measures and Performance Monitoring

Genome Canada has a wide array of policies, systems and processes that have been developed over time to address issues of risk assessment and mitigation strategies. They also address ongoing performance and evaluation monitoring. The *Performance, Evaluation, Risk, Audit Framework* was approved by the board of directors in December 2015.

Risk management

Risk management is integrated into all of Genome Canada's operational, managerial and governance activities. A formal risk management framework is in place and is annually updated and approved by the board of directors. Strategic risks arising from the external operating environment as well as the internal operating environment are assessed on an ongoing basis.

- At the project selection level, risk is managed and mitigated through a process that restricts funding to certain projects. Namely, these are projects judged to have the greatest probability of success from both a scientific and managerial point of view. The viability of each project's success is further mitigated through ongoing monitoring and reviews.

- At the operational level, officers of Genome Canada identify risks and propose strategies for mitigating and reporting. Examples include due diligence routines for reviews of draw requests and for reviews of funded projects.

- At the managerial level, policies, systems, processes and procedures (administrative, financial, human resource management) are developed, implemented and monitored.

- At the governance level, the board of directors and its committees are aware of their risk management responsibilities. They exercise modern governance practices with respect to policy approval and oversight.

- The Audit and Investment Committee is responsible for the monitoring of risk and mitigation strategies and regularly reviews the organization's corporate risk profile.

- The Genome Canada internal working environment culture is one that values honesty, integrity and ethical conduct.

Annual audit

The annual audit of Genome Canada's financial statements is conducted in accordance with generally accepted Canadian auditing standards. The statements are filed with Innovation, Science and Economic Development Canada by July 31 of each fiscal year. The objective is to express an opinion on whether Genome Canada's financial statements present fairly – in all material respects – the financial position, results of operations and cash flow of the corporation.

Upon completion of the audit, the financial statements and a summary of audit findings are presented to the audit and investment committee. They are then presented to the board of directors for approval. The financial statements can be found on the Genome Canada website: www.genomecanada.ca.

Recipient audit

Genome Canada has developed and implemented a recipient audit framework in consultation with the Genome Centres. As part of this exercise, a risk assessment tool was developed to enable the Genome Centres to identify projects that would undergo a detailed compliance audit. This includes the technology platforms. This framework was introduced to bring a common approach to recipient audits across Canada and to improve the management control framework within which genomics research is administered.

Compliance audit

In fiscal year 2011-12, then-named Industry Canada, as a routine practice, initiated a compliance audit of Genome Canada. It was conducted by an independent accounting firm. The stated objective of the audit was to assess Genome Canada's compliance with the requirements of the funding agreement that was in effect in fiscal year 2010-11. The resulting audit report concluded that "…we are of the opinion that GC (Genome Canada) did comply with the requirements of its funding agreement with Industry Canada."

Performance measurement and evaluation

Genome Canada's funding agreement with Innovation, Science and Economic Development Canada specifies that Genome Canada will provide reporting on data collected in the past fiscal year. This is described in the *Performance Information Strategy*.

Performance monitoring

Genome Canada has adopted a corporate scorecard to monitor the organizations performance. This scorecard monitors performance in four key areas, People, Finance, Programs and Thought Leadership. The scorecard is reviewed by the Board Quarterly.

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