



GenomeCanada



2018

2019

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 issues include antimicrobial resistance, climate change, increasing energy demand, population growth and an aging population.

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 fuelled 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.



Figure 1: Genome Centres across Canada

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.

Underpinning our research funding programs are technology programs, designed to provide Canadian scientists with access to leading-edge 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 the broad societal implications of genomics research and its applications. Genome Canada programs address genomics and its ethical, environmental, economic, legal and social (GE³LS) aspects, as well as genomics in society. Through its programs, Genome Canada supports the exploration of issues. This includes investigating what advancements in science and technology mean for society, and how public confidence plays into the effective development of genomics applications in Canada.

Genome Canada also explores how public policy can adapt accordingly. The goal is to identify barriers to the uptake of genomics-derived applications in society early in the process.

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.

Governance

Genome Canada was established in February 2000 under the *Canada Corporations Act*. In 2012, it was issued new Articles of Continuance under the *Canada Not-for-Profit Corporations Act*.

Genome Canada is governed by a board of directors comprising up to 16 individuals drawn from the academic, private and public sectors. These individuals bring unique skills and experiences as well as strong interests and insights to successfully achieve Genome Canada's strategic priorities. Furthermore, the presidents of five federal research funding agencies are non-voting, ex officio advisers to the board. These are the presidents of the:

- Canada Foundation for Innovation,
- Canadian Institutes of Health Research (CIHR),
- National Research Council,
- Natural Sciences and Engineering Research Council, and
- Social Sciences and Humanities Research Council.

While the Genome Centres do not form part of the genomics enterprise governance structure, they are deeply involved at all levels of Genome Canada’s work, from strategy to program administration.

Genome Canada’s governance structure

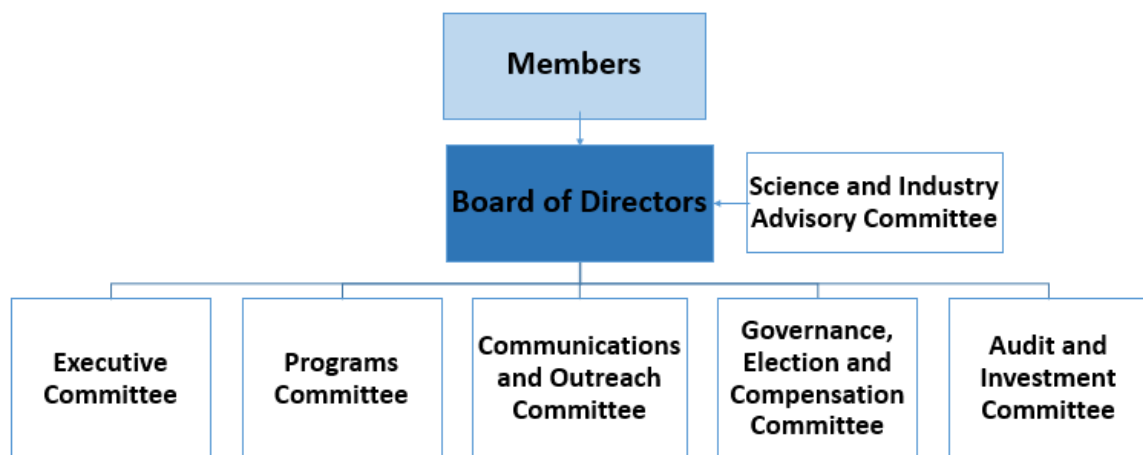


Figure 2: Genome Canada’s governance structure

The board of directors has overall responsibility for the stewardship of Genome Canada’s business and affairs. To help with the discharge of these duties, the board has five standing committees:

- an executive committee,
- a programs committee,
- a communications and outreach committee,
- a governance, election and compensation committee, and
- an audit and investment committee.

The science and industry advisory committee is comprised of external experts tasked with providing advice and recommendations to the board on:

- emerging scientific research opportunities, and challenges and potential areas for investment in genomics, including genomics in society and GE³LS research in Canada,
- international trends and developments, and potential national and international collaborations,
- areas of strategic social and economic importance to Canada, and
- the application of genomics research outcomes, including commercialization, knowledge transfer, policy development, and social and economic benefits.

Genome Canada's strategic directions

In 2012, Genome Canada launched *Genome Canada Strategic Plan 2012–2017*, a five-year strategic plan that included two new sectors: mining and energy. This strategic plan reflected an important added focus for Genome Canada. This focus was the growing influence of genomics as a transformative technology that will play a key role in addressing the most pressing challenges facing society in the 21st century.

Genome Canada is currently developing its next strategic plan in consultation with government and other stakeholders.



Figure 3: Genome Canada's mission

2.0 Results 2017-18

Genome Canada has placed more emphasis on innovation by supporting the application of knowledge gained from Canadian genomics research to real-world opportunities and challenges. Doing this grows the Canadian bioeconomy. At the same time, Genome Canada continues to support the fundamental science that fuels the innovation pipeline. Its programs and initiatives are purpose-driven, supporting projects with the greatest potential for social and economic benefits for Canadians.

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 2017-18

In 2017-18, 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 2017-18, Genome Canada, in partnership with the CIHR, continued to invest in the 17 projects from the 2012 competition. A total of \$158.6 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 that 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.

- **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 \$94.6-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:
 - sustainable fisheries and honeybees,
 - stress and disease resistance of crops and livestock,
 - salmonellosis and ensuring the safety of fresh produce, and
 - enhanced feed efficiency in dairy cattle, which could result in reduced methane emissions.

Three projects, supported in partnership with the Western Grains Research Foundation, relate to 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: Sector Challenges – Genomic Solutions.** 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.

- **Launch of the 2017 LSARP Competition: Genomics and Precision Health.** This \$141-million competition, including co-funding, was launched in January 2017 in partnership with the CIHR. It supports projects that demonstrate how genomics-based research can contribute to a more evidence-based approach to health. These projects would improve health outcomes and/or enhance the cost-effectiveness of the health-care system.

Applicants demonstrated how their proposal could produce concrete deliverables by the end of the funding period. The deliverables would be translated into valuable clinical tools or improved health-care policies and practices. In July 2017, 139 pre-applications were reviewed, resulting in 35 project teams being asked to proceed to the full application stage. Funding decisions were made in December 2017.

- **Funding of more projects through GAPP.** Throughout 2017-18, Genome Canada continued to invest in GAPP. This included funding two new rounds of projects. A total of \$162.7 million, including co-funding, has been invested in 36 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. The most recent round included projects that:

- use genomic approaches to prevent deaths from bloodstream infections,
- develop novel immunotherapies to attack cancers,
- predict and mitigate preterm births,
- produce environmentally friendly bio-nylon, and
- develop natural feed additives to reduce the use of antibiotics in food animal production.

- **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 2017-18, this partnership supported nine Mitacs Accelerate internships in GAPP projects.

- **Continued investment in a GE³LS network in genomics and personalized health.** The GE³LS Network was introduced as a complement to the Genomics and Personalized Health 2012 LSARP competition. The network is a way to cross-fertilize and leverage the efforts of genomics research across the 2012 LSARP competition's 17 projects. A three-year investment of up to

\$2 million, including co-funding, began in 2016. Through this investment, the Precision Medicine Policy Network:

- facilitates the sharing of best practices,
 - primes and improves future research collaboration,
 - accelerates the progress of technologies toward application, and
 - maximizes the impact of investments in the 17 projects.
- **Ongoing investment in emerging issues.** Genome Canada is currently funding emerging issues projects that address important and timely needs. These issues include:
 - the porcine epidemic diarrhea virus,
 - tracking of the avian influenza in the wild bird population, and
 - maternal/fetal transmission of the Zika virus.
 - **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 2017-18, Genome Canada continued its investment in the SGC. Up to \$400 million in investments have been made in collaboration with partners.

The SGC, with the help of Genome Canada, developed a new partnership model. It gives disease-specific foundations, like Myeloma UK and the CHDI Foundation, access to relevant chemical probes as they emerge from the SGC pipeline. To date, the SGC's contributions include solving and depositing into the public domain more than 10,000 compounds used in more than 3,000 publications since 2010. As well, more than 40 clinical trials have been launched.

- **Launch of the Regional Priorities Partnership Program.** This new initiative was launched in August 2017. The Regional Priorities Partnership Program (RP3) was designed to support the Genome Centres in developing initiatives that advance genomics research and translation capacity in areas of strategic priority to their regions. This is an opportunity to strengthen relationships with provincial and regional partners (for example, local industries, government departments and agencies, or other stakeholders).

The RP3 also provides a chance to participate in initiatives that, in time, could feed into other Genome Canada programs and objectives. Each Genome Centre will engage in a consultation process with its regional partners. Consultations will determine the key priority areas to focus on and the type of research initiative that would best address the priority areas. Initiatives could range from targeted investments to a competitive process.

Genome Canada will review expressions of interest for eligibility to the program. Then, Genome Centre and/or its partner(s) will lead the subsequent application and peer review process. Genome Canada will make up to \$1 million available to each Genome Centre, provided partners contribute \$2 for each Genome Canada dollar invested. These initiatives are expected to start no later than April 1, 2019 and be completed on or before March 31, 2022.

- **Completion of the 2012 Bioinformatics and Computational Biology Competition projects.** Through this collaborative initiative with the CIHR, a total of \$11.3 million, including co-funding, was invested in 17 research projects addressing current challenges in bioinformatics and computational biology. Next-generation tools and methodologies have been developed to help the research community deal with the influx of large amounts of data produced by modern genomics technologies. The research community has received broad access to these new tools. The projects funded through this program:
 - produced 110 resources such as software programs, analysis tools, databases and data depositions,
 - resulted in 197 peer-reviewed publications, and
 - provided research experience for 189 full-time equivalent positions, including post-doctoral fellows, graduate students and undergraduate students.
- **Continued investment in the 2015 Bioinformatics and Computational Biology Competition.** Following on from the 2012 competition, the objectives of this competition, held in partnership with the CIHR, remained the same. The goals 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 funded will develop tools that empower public health agencies and the agri-food sector to more rapidly respond to threats. These could be threats posed by infectious disease outbreaks such as food-borne illnesses or the growing crisis of microbes resistant to antimicrobials. The projects will also 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.

- **Launch of the 2017 Competition in Bioinformatics and Computational Biology.** Launched in December 2017, the major objectives of this \$24-million competition are similar to those of the 2012 and 2015 competitions. The 2017 competition will support 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 – namely, agriculture and agri-food, fisheries and aquaculture, forestry, energy, mining and the environment.

- **2016 Competition for Genomics Technology Platforms.** This competition resulted in the support of operations and technology development in Genome Canada's 10 technology platforms (previously named the Genomics Innovation Network). The support was 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 genomics technologies and advice. Each of the platforms provides researchers access to high throughput genomics 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 and launch of the 2017 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. In July 2017, the request for applications for the 2017 Disruptive Innovation in Genomics Competition for Phase 1 Projects Advancing to Phase 2 was released. This second round is intended solely for those Phase 1 projects that were funded in the first round and interested in applying for Phase 2 funding. Decisions on this round will be made in June 2018. Up to \$5.7 million (excluding co-funding) has been allocated for this competition.

- **Showcasing Canada's genomics enterprise on the world stage.** At the BIO International Convention in San Diego in June 2017, Genome Canada and the Genome Centres combined efforts to highlight Canada's unique national and regional genomics model. This model is delivering innovative solutions to the issues facing Canadians in a globally competitive environment.

The convention annually attracts over 15,000 biotechnology and pharmaceutical leaders from around the globe. They come together for one week of intensive networking to discover new opportunities and promising partnerships. This combined effort helps Genome Canada ensure visibility in front of influential decision-makers, form valuable partnerships and access high-level stakeholders.

- **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. It has been working to advance the implementation of genomics in the health-care system through the creation of a rare disease pilot project.

In September 2017, Genome Canada brought together key stakeholders with expertise in this sector. They were asked to review a proposal ahead of its inclusion in Genome Canada's five year federal funding submission for Budget 2018. These stakeholders included academic researchers, clinicians, ethicists and bioinformaticians as well as key partners such as the CIHR and the Global Alliance for Genomics & Health (GA4GH).

Another key part of our plan involves learning from international precision health initiatives through our continued participation in broad initiatives. These include the GA4GH and the Global Genomic Medicine Collaborative, as well as engagement with national initiatives in England, the United States, France and Australia, among others.

Remaining challenges from 2017-18

Genome Canada demonstrated considerable success in meeting its core mandate to lead the Canadian genomics enterprise. As articulated in the objectives of *Genome Canada Strategic Plan 2012–2017*, the organization continues to connect ideas and people across public and private sectors.

It also continues to invest in large-scale science and technology to fuel innovation and support the translation of discoveries into application to maximize the positive impact of genomics across sectors. Through funding and program activities, genomics research in Canada has continued to set a world standard. And its global influence has been enhanced through the funding of several international partnerships.

The principal challenge remaining from 2017-18 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.

3.0 Planned activities 2018-19

Genome Canada's funds and initiatives

Delivering ongoing programs

For the 2018-19 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 2018-19.

Genome Canada continues to support research and innovation that address real-world challenges and 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.

It also means ensuring funding for research that has advanced to the translational phase. This approach ensures alignment and complementarity with other key members of Canada's science, technology and innovation ecosystem. This allows all involved to mutually reinforce strategies and objectives and capitalize on synergies that can be derived from working together.

Positive impacts of genomics research on sectors important to Canada are beginning to be realized. The following section highlights some of the outcomes arising from Genome Canada funding decisions.

HUMAN HEALTH

Improving health care through precision health

Genomics is driving a paradigm shift from a disease-oriented health-care system to one that is more precise, personalized, predictive, preventive and cost-effective. Canadian genomics research has already led to earlier and more accurate diagnoses. It has also led to more effective treatments and improved health outcomes for patients touched by cancer, heart disease, autism, epilepsy, rare genetic disorders and other debilitating diseases.

Outcome examples

- Research has estimated that the cost of caring for rare disease patients is 10 to 20 times more expensive than for healthy patients. That same cost is estimated to be five times more expensive than for patients with chronic conditions. This justifies the use of exome sequencing to diagnose rare diseases. Mutations in known genes have been identified for 162 rare disease, and 83 novel or potentially novel genes implicated in rare diseases have been discovered.
- In November 2014, the Children's Hospital of Eastern Ontario (CHEO) launched a public interest litigation. This was done to establish the freedom of Canadian public health-care providers to offer genetic testing unhindered by gene patents. The University of Alberta and McGill University-led PACEOMICS project played a key role in bringing this case forward. (PACEOMICS stands for Personalized, Accessible, Cost-Effective applications of 'Omics technologies. This project's research experts are developing processes and tools to help realize the potential of personalized medicine in Canada and around the world.) Professor Richard Gold of PACEOMICS provided policy advice to CHEO's litigation team, leading to the case's successful resolution."

- The Québec Ministry of Health and Social Services' Committee on Prenatal Screening has recommended introducing non-invasive prenatal testing into the public health-care system. Results from the PEGASUS project played a key role in this. PEGASUS – funded through the 2012 LSARP competition – utilized the discovery that fetal DNA present in a mother's blood can be used to test for genetic abnormalities. It created a simple blood test to do so. This voids the need for pregnant women to undergo amniocentesis.
- A rapid diagnostic device in the evolving world of point-of-care diagnosis of tuberculosis and malaria was developed and implemented.
- A rapid, low-cost, instrument-free diagnostic for all subtypes of hepatitis C virus was developed to address an important health-care need in developing countries and underserved areas.
- A novel biomarker test was developed at the University of Ottawa Heart Institute to predict outcomes for heart failure patients and support decisions on treatment and hospital discharge. The test has entered clinical trials in Canada and the United States.
- New, highly sensitive mass spectrometry assays to detect and quantify vast arrays of proteins in mouse plasma were developed and validated. The assays have now been commercialized for use in drug development programs.
- Next-generation sequencing panels to detect and analyze genetic mutations in patients with hereditary cancer risk and in cancerous tumours were optimized and validated. The panels have now been introduced into standard of care in one of Canada's largest health networks.
- A new prognostic test was developed that enables clinicians to predict responses to current acute myeloid leukemia treatments for a subset of patients. These patients previously lacked any recognizable molecular marker to direct treatment. The test has been validated by the U.K.'s National Cancer Research Institute Haematological Oncology Clinical Studies Group. It will be implemented in clinical laboratories in Canada, the U.K. and Australia.
- Led by Dr. Jabado, the 2012 LSARP Biomarkers for Pediatric Glioblastoma through Genomics and Epigenomics project have shown that epigenetic deregulation during brain development is at the core of many deadly pediatric brain tumours. These discoveries have provided the foundation of the 2016 World Health Organization classification for pediatric brain tumours. This is the worldwide standard for establishing, diagnosing and orienting therapy and clinical trials.

AGRICULTURE AND AGRI-FOOD

Generating competitive production systems and innovative products

Canada's agri-food sector employs some 2.2 million Canadians and Canada is among the world's leading exporters of food products. The agriculture and agri-food sector is well positioned to use genomics to grow Canada's share of the global market as demand increases. Canadian genomics research is improving food quality, safety and security, and boosting production in crops and livestock. It is helping Canadian producers create high-value products, increase global market share, diversify exports, and preserve and create jobs here in Canada.

Outcome examples

- The CTAG2 project is led by the University of Saskatchewan, working with the National Research Council of Canada, Agriculture and Agri-Food Canada, the University of Guelph and the University of Regina. CTAG2 strives to ensure the long-term sustainability of wheat. A growing global population will increase the demand for wheat. The CTAG2 project has completed sequencing of two Canadian wheat cultivars as part of the 10 Wheat Genome Project. This international program was designed to characterize DNA variation in commercially relevant wheat cultivars and develop global genetic resources. This will support a vibrant wheat research and breeding community.
- A new generation of biocomposite material is using genomics to revolutionize the automotive industry. Biocomposites developed from agricultural crops such as flax have a multi-billion-dollar market potential. Optimizing the properties for both natural fibres and compatible renewable resins required to manufacture this revolutionary material are key. Steps are underway to produce and test the first prototype of biocomposite parts.
- Advanced genomics tools are being used to improve the quality of canola, both oil for human consumption and meal for animal feed. The tools also reduce fibre and saturated fatty acid content. This has resulted in pioneering work in developing canola hybrids for healthy oil production.
- In 2017, the sunflower genome was published in *Nature*. (See “The sunflower genome illuminates the evolutionary history of the Asterids and provides new insights into oil metabolism and flowering time,” *Nature* 546:148-152.) To boost domestic sunflower production, scientists are working to identify what allows wild sunflowers to better withstand drought, flooding, salt and low nutrition levels. Sunflowers are a \$20-billion crop and the only oilseed in the Global Crop Diversity Trust’s list of 25 priority food security crops.
- Tomatoes and peppers with 25 per cent to 30 per cent improved resistance to bacterial and fungal pathogens are now being incorporated into Canadian breeding programs. Tomato hybrids with improved disease resistance will be ready for commercial release by 2022.
- Researchers have determined that genetically modified camelina – a plant with high oil content – can be used as a partial replacement for fish oil and fish meal in aquaculture feeds. This helps in cases where traditional methods cannot meet current demand. The Canadian Food Inspection Agency has approved the use of mechanically extracted camelina oil as a feed ingredient for farmed salmon and trout.
- A major dairy products manufacturer has established genomic testing and databases to precisely characterize its starter cultures for producing high-value cheeses. The tools will also help monitor the effects of production problems on the cultures.

FORESTRY

Making the sector more profitable and sustainable

Canada has one of the best conifer genomics platforms in the world and is well positioned to apply genomics-based tools to support the development of productive and healthy forests. Canadian research is helping to offset the impacts of pests (such as mountain pine beetle) and pathogens, and boost forest productivity. Research is also helping to monitor biodiversity and track invasive species for trees of

economic importance, such as the white spruce and balsam fir. Lastly, research is seen as a powerful enabler in diversifying the forest industry from pulp, paper and lumber into a high-margin bioproducts-based industry.

Outcome examples

- Genomic tools and strategies have been developed for breeding Douglas fir and lodgepole pine that can thrive in new climates and resist pathogens, advancing forest management adaptation.
- Assays for the rapid detection of invasive insect and fungal pathogens have been developed, validated and implemented in the Canadian Food Inspection Agency's plant pathology laboratory.
- Genomic screening has helped forest managers in Quebec select white spruce seedlings with increased growth characteristics and higher-quality wood. This will lead to greater productivity in the forest sector, both locally and globally.
- Blister rust resistance genes in western white pine have been identified and pollen from resistant trees used to create clean seedlings for coastal reforestation in British Columbia.
- Microbial communities developed for pulp and paper mills have reduced harmful bioproducts and produced power for operations. This makes mills more efficient while increasing their social license to operate.
- "Enzyme cocktails" that degrade and convert biomass more efficiently have been produced, improving biofuel economics.
- New tools have been created to genetically improve poplar trees as a Canadian bioenergy feedstock.
- Genomics and climate mapping information have been drafted that is helping provincial forestry agencies in British Columbia and Alberta structure policy for tree planting. With this information, the agencies can match the best tree seed to the environment, taking into account climate change.

FISHERIES AND AQUACULTURE

Enhancing production, protecting fish and ecosystems

Genomics is driving growth in the sector by helping to improve fish production, decrease loss from disease and pests, increase traceability and optimize feed formula for healthy, profitable and sustainable fish farms. Further, genomics offers powerful tools to monitor wild fish stocks for biodiversity, genetic origins and population health. It is providing critical information for the regulation of fisheries, leading to healthy and sustainable ecosystems.

Outcome examples

- Producers are enjoying a 20 per cent reduction in grow-out time for halibut because of genomic research results. This has led to a quicker time to market and greater profitability.
- A multi-year international collaboration involving Canadian researchers sequenced the Atlantic salmon genome. This has provided the foundation for the industry's use of marker-selected breeding.

- The discovery and application of molecular biomarkers will help develop novel diets for salmon.
- Researchers have identified the genomic signature associated with increased mortality in migrating Fraser River sockeye salmon. This signals that more research is needed on infectious diseases among wild stocks.
- Producers can now reduce losses in Atlantic salmon, armed with research that uses marker-assisted selection to develop strains of Atlantic salmon resistant to infectious pancreatic necrosis.
- Researchers have developed health assessment tools for marine mussels. These can also be used to indicate environmental stressors such as climate change and pollution.

ENVIRONMENT

Maintaining a clean, safe and sustainable environment

Genomics is equipping Canada to preserve a clean, safe and sustainable environment. Technologies are being developed to monitor and manage the effects of human and climate impact as well as invasive species. Canada is recognized for its global leadership in biodiversity science. It is also recognized for breakthroughs that further understanding of economically and ecologically important trees, and development of new tools to de-contaminate polluted sites.

Outcome examples

- KB-1®, a microbial culture used to enhance the clean-up of contaminated groundwater, was refined through Canadian genomics research. It is the first product of its kind licensed in Canada and is used at hundreds of sites worldwide.
- Bioaugmentation has been demonstrated as an effective approach to remediate benzene contamination.
- Genomics is being employed to assess and mitigate the environmental impacts of the Mount Polley Mine tailings spill. This demonstrates the utility of genomics within the mining industry and establishes a potential long-term research platform with the mine.
- Genomics tools have been used in Alberta's Wood Buffalo National Park to assess biodiversity around the oil sands. The tools have also helped produce a baseline upon which to measure the effects of the oil sands. Environment and Climate Change Canada is now using these tools in the Canadian Aquatic Biomonitoring Network.
- Tools to identify how organisms respond at a genetic level to toxic substances in the environment are being explored.

ENERGY

Providing tools to increase productivity in an environmentally sustainable way

Canada is the world's fifth largest oil producer. Oil is an important part of our economy, and economic forces are challenging the sector to be more efficient and environmentally friendly. The sector can be advanced by integrating new genomics-based technologies into existing processes. For example, one of the greatest challenges is the amount of hot water used to extract bitumen from oil sands (the average ratio is 3:1). This is straining water and energy resources and generating considerable waste for storage in tailings ponds. Genomics knowledge of microbial processes involved in hydrocarbon extraction and waste remediation is helping to improve the management of water use, recycling and treatment in the energy industry.

Outcome examples

- An energy company changed its plan of action on risks caused by microbes in its tailings ponds as a result of knowledge that emerged through the use of genomics tools.
- Microbes that are important in the processing of material extracted from the oil sands have been identified. Understanding the biological activity will allow for the development of more efficient processes.
- Microbes that accelerate the corrosion of pipelines have been identified. This will enable the development of methods to control these microbes, making pipelines safer.
- Understanding the role of microbes during liquid natural gas extraction provides information to develop sustainable processes and reduce impact on the environment.

MINING

Boosting Canada's outputs and advancing international leadership

Genomics research is underway in Canada that aims to improve industrial mineral extraction and processing. Further, genomics tools are providing new strategies to help manage and clean up contaminants and control acid rock drainage and the unwanted leaching of metals. The applications of and opportunities for genomics in the sector are just starting to be recognized. This is a tremendous growth area for both research and industry.

Outcome examples

- Acid mine drainage is a common problem in mining sites. Genomics is being used to identify microbes that are involved in remediation, providing sustainable solutions to a huge liability for the industry.
- DNA barcoding is being used by British Columbia mining company New Gold to evaluate the impact of its operations on the environment and develop sustainable processes. DNA barcoding is a genomics tool for assessing biodiversity.
- Microbes to leach metals from mine waste are being identified. A one per cent increase in the amount of metal retrieved before the waste is discarded would lead to millions of dollars in profitability for Canadian mining companies.
- Tools are being developed to monitor and improve mine drainage treatment.

- There is better understanding of the biological processes involved in the breakdown of pollutants at contaminated mining sites.

Project and program planning 2018-19

In its 2016 federal budget, the Government of Canada provided Genome Canada with a contribution of \$237.2 million over three years. This contribution allows Genome Canada to pursue new endeavours and continue to support its current programs, as agreed to in prior agreements with Innovation, Science and Economic Development Canada.

Large-scale science

Large-Scale Applied Research Projects

Genome Canada has allocated \$74 million to the design and launch of two upcoming LSARP competitions. Genome Canada's strategy to support large-scale research projects organizes sectors into three groups: human health, agriculture/agri-food and fisheries/aquaculture, and natural resources and the environment. Competitions for each group are launched approximately 18 months apart.

The timing proposed for the current funding aligns with the end date of the projects funded in the corresponding LSARP competition in the previous five-year cycle (2012-17). This gives the large research teams the opportunity to compete for new funding, and, if successful, prevent the dissolution of teams that have been built – maximizing previous investments. The level of funding proposed for each competition is similar to the amount invested in the previous cycle and reflects the relative level of maturity and capacity for each sector.

2017 LSARP Competition – Genomics and Precision Health

As described in section 2, "Results 2017-18," funding decisions for this competition were made in December 2017. Approved projects will start April 1, 2018, with terms of up to four years. Genome Canada has allocated up to \$46 million of the \$144 million competition.

2018 LSARP Competition – Genomics and Agriculture, Agri-Food, Fisheries and Aquaculture

The 2018 LSARP Competition will support projects using genomics to address challenges and opportunities in the agriculture and agri-food sector, and the fisheries and aquaculture sector. Genome Canada is investing \$30 million in this competition, whose design will be finalized in early 2018. The competition will then be launched in June 2018, with project approval decisions planned for June 2019. The 2018-19 corporate plan includes only the forecast costs for the consultation, design and pre-application review phase of this LSARP competition.

Genome Canada is developing updated strategies for the agriculture and agri-food, and fisheries and aquaculture, sectors. It is doing this by consulting key stakeholders, including relevant government departments and agencies, the private sector and leading researchers. These strategies will inform Genome Canada and the Genome Centres as requests for applications are developed. This will also lead to a decision by Genome Canada's board of directors on the competition's objectives and parameters.

Strategic initiatives

Up to \$24 million has been allocated to strategic research priorities determined by the Genome Canada board of directors. Genome Canada remains committed to supporting national and international initiatives and emerging and regional issues. As such, funds have been set aside to support the following.

- **National and international strategic initiatives on topics of strategic importance to Canada.** The successful development of strategic national and international partnerships is ongoing. These partnerships demonstrate that the value and strength of the Canadian genomics research community and Genome Canada are recognized around the world.
- **An emerging issue or opportunity requiring immediate attention and timely resolution.** This situation requires, in turn, a funding program that is flexible, responsive and nimble. Applications for emerging issues are accepted on an ad hoc basis. Decisions can be taken within a few weeks, depending on the nature and complexity of the issue. Genome Canada's emerging issues program provides up to \$250,000 from Genome Canada plus co-funding from other sources for up to two years.

Projects funded to date are usually in response to issues brought to Genome Canada's attention or initiated by a Genome Centre. Additional opportunities will be evaluated on an ad hoc basis to determine their strategic importance to Canada and urgency of response needed.

- **The RP3.** As described in section 2, "Results 2017-18," this new initiative was launched in 2017. Genome Canada is investing up to \$6 million in the resulting regionally determined priorities. Through 2018-19, the Genome Centres will have completed their review processes of the initiatives. As a result, projects will start at different times during the year.
- **Research Catalyst Network on Rare Diseases II.** This program builds on the foundation of a successful ongoing partnered initiative led by the CIHR. Genome Canada's investment will be up to \$1 million. With co-funding from the CIHR and other partners, total investment will equal up to \$3 million. Genome Canada is working with the CIHR to finalize the funding opportunity for launch in early 2018. This renewal opportunity for the existing network is intended to allow the network to continue to catalyze connections between:
 - clinical geneticists discovering new genes in patients with rare diseases, and
 - scientists analyzing equivalent genes and pathways in model organisms.

The network will fund small focused projects that allow for rapid confirmation of potential disease-causing genes. These projects would also fuel pilot studies to improve understanding of how specific gene mutations cause disease. Collaborations across the Canadian biomedical community are intended to expedite the understanding of disorders and enable the design of new therapies. Both goals will ultimately benefit those affected by rare diseases.

Technology

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.

Technology platforms operations and technology development

The goal of Genome Canada's 10 technology platforms is to provide researchers with access to high throughput genomics technologies. DNA sequencing, RNA gene expression, protein identification and quantitation, and metabolomics are among such technologies. Access to new method and protocol development, data analysis and bioinformatics is provided as well. Each technology platform also assists researchers in the development of research proposals.

The platforms provide advice on appropriate technologies, study design, data analysis and bioinformatics that enable and improve the quality of the research. The platforms also develop new and improved genomics technologies, ensuring that the services they provide support cutting-edge genomics research.

Operations and technology development at the 10 genomics technology platforms will receive a \$45-million investment over three years, ending in March 31, 2020. (See section 2, “Results 2017-18,” for details.) This reflects the desire to meet the needs, and ensure the continued success, of genomics research projects funded by Genome Canada and other organizations.

An additional two years of funding (April 1, 2020, to March 31, 2022) could be made available. This, however, is subject to the successful outcome of an interim review of each platform and Genome Canada securing additional funds. The latter will enable technology platforms to develop new and improved technologies. This will ensure that the platforms remain at the forefront in providing Canadian researchers with access to leading-edge genomics technologies.

Bioinformatics and computational biology

Bioinformatics and computational biology competitions support the development of next-generation tools and methodologies required by the research community. Researchers need these tools and methodologies to:

- deal with the large amounts of data produced by modern genomics technologies,
- analyze and integrate complex data sets, and
- better understand the associated biology.

The competitions also strive to ensure that the research community has broad access to these new tools.

2017 Competition in Bioinformatics and Computational Biology

As described in section 2, “Results 2017-18,” this competition was launched in December 2017. The review meeting will take place in May 2018, with funding decisions set for June 2018. Genome Canada will provide this competition a total of \$12 million.

Translation

Genomic Application Partnership Programs

This Genome Canada program was designed to increase collaboration between genomics scientists and users of genomics research. It is also intended to stimulate investment from private and public partners in Canadian solutions that address real-world challenges and opportunities in the field of genomics. Since its launch in 2013, GAPP has demonstrated phenomenal levels of participation across sectors. Thirty-six projects are currently underway, with users focusing on applications as diverse as:

- novel therapeutics,
- green automobile manufacturing,
- improved feed for fish, poultry and swine,
- enhanced cheese quality, and
- personalized diagnostic tools for lung transplantation and other diseases.

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 2018-19, Genome Canada will offer two rounds of GAPP funding. Genome Canada is looking into increasing the flexibility of the program for applicants. It would do this by providing two additional opportunities for funding decisions each year.

Translational networks

The uptake of genomics-based innovations can be affected by various social, economic and environmental factors, including legal and regulatory requirements. This is especially true when such innovations represent significant changes to current practices. Already, GE³LS research conducted through LSARP competitions helps us better understand these factors – primarily in the context of individual projects but also in relation to sectors.

The Translational Networks Program is intended to strengthen the connections between researchers, users and other stakeholders on issues that could impact the uptake and application of genomics technologies. This includes commercialization. Connections will be strengthened through networks that:

- add support to, and enhance, the GE³LS research undertaken by funded Genome Canada projects,
- accelerate the synthesis and dissemination of research pertinent to users, including policy-makers and opinion leaders,
- tackle challenges common to funded research projects, and/or
- address new opportunities or challenges not currently addressed by other Genome Canada funded projects.

The first such network is underway. It supports LSARP projects funded through the 2012 LSARP Competition – Genomics and Personalized Health. The program is being further developed for launch in early 2018-19, providing an opportunity for the support of additional networks. Genome Canada plans to invest \$3 million in these networks.

Building external relations and communicating Genome Canada's activities

Genome Canada continues to work closely with the regional Genome Centres to promote the power and promise of genomics. It helps convey diverse stories about genomics' impacts across multiple sectors of importance to Canada.

In May 2017, the Government of Canada released its framework on Lyme disease. Since then, Genome Canada has explored the possibility of funding research on Lyme disease with the Centres, through Genome Canada's emerging issues program.

This program is designed to address emerging issues or opportunities that require immediate attention and timely resolution. To be eligible for funding as an emerging issue, the research must be of high importance, both nationally and internationally. The research must be such that it can be addressed through genomics and related approaches, and completed within one to two years, as a rule. The maximum funding from Genome Canada is \$250,000 per project and the co-funding ratio is 1:2.

The Lyme disease initiative is intended to focus on research that helps develop novel diagnostic tests and/or treatment of the disease. Research would also help develop better surveillance tools. The Centres are working with researchers in their regions to develop potential relevant proposals for review and funding in 2018-19.

Looking forward, Genome Canada will continue to maintain and develop national and international partnerships in areas of pressing importance to Canadians. Genome Canada is discussing holding a public forum on the applications of gene editing with Health Canada, Agriculture and Agri-Food Canada, and the CIHR. In particular, the forum would examine the use of gene drives to control the transmission of infectious disease. This is tentatively planned for fall 2018.

Genome Canada will also continue working with various partners that were involved in a 2017 workshop on antimicrobial resistance. Together, they are working to implement recommendations and maintain ongoing engagement with key federal partners. This is being done to ensure that the role of genomics is highlighted in federal actions and activities.

Genome Canada also continues to showcase Canadian genomics on the international stage. For example, Genome Canada plans to attend the 2018 BIO International Convention in Boston in June 2018. 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.

As part of its strategic planning process, Genome Canada is reviewing current communications and outreach activities. It continues to be committed to promoting Canadian genomics to support innovation-based growth, evidence-informed policy development and public engagement.

4.0 Finance 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 <i>(in millions of dollars)</i>	Genome Canada						Total	Genome Canada and co-funding	%
	Actual 2000-17	Forecast 2017-18	Forecast 2018-19	Forecast other years	Total	Estimated co-funding			
RECEIPTS									
Government of Canada									
Previous budgets	700.0				700.0		700.0	19.2%	
Budget 2008	138.3	1.7			140.0		140.0	3.8%	
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	111.3	22.0	20.3	11.4	165.0		165.0	4.5%	
Budget 2016	0.0	35.4	48.4	153.4	237.2		237.2	6.5%	
Investment income	89.9	0.2			90.1		90.1	2.5%	
Co-funding						2,121.2	2,121.2	58.0%	
	1,239.5	59.3	68.7	164.8	1,532.3	2,121.2	3,653.5	100.0%	
DISBURSEMENTS									
Research projects and Genome Centres funding									
Projects and programs completed in previous years	864.9	0.0	0.0	0.0	864.9	1,100.8	1,965.7	53.8%	
2012 LSARP*: Genomics and Personalized Health	42.3	4.6	0.0	0.0	46.9	120.8	167.7	4.6%	
2014 LSARP*: Genomics and Feeding the Future	11.9	8.0	8.0	4.7	32.6	61.8	94.4	2.6%	
2015 LSARP*: Natural Resources and the Environment	2.7	8.5	8.5	14.8	34.5	77.7	112.2	3.1%	
2017 LSARP*: Genomics and Precision Health	0.0	0.0	7.5	36.5	44.0	97.0	141.0	3.9%	
2018 LSARP*: Genomics and Agriculture, Agri-Food, Fisheries and Aquaculture	0.0	0.0	0.0	30.0	30.0	60.0	90.0	2.5%	
Genomic Applications Partnership Program	20.4	13.0	12.7	36.7	82.8	177.2	260.0	7.1%	
Translational Networks	0.0	0.0	0.3	2.7	3.0	3.0	6.0	0.2%	
GE ³ LS Third Modality	0.3	0.7	0.0	0.0	1.0	1.0	2.0	0.1%	
Bioinformatics and Computational Biology	5.9	1.2	3.0	9.0	19.1	20.3	39.4	1.1%	
Strategic Initiatives	0.9	1.7	2.7	6.1	11.4	36.6	48.0	1.3%	
Regional Priorities	0.0	0.0	2.0	4.0	6.0	12.0	18.0	0.5%	
Advancing Big Data Science	1.5	0.5	0.0	0.0	2.0	4.0	6.0	0.2%	
Emerging issues	0.6	0.1	0.0	0.0	0.7	4.5	5.2	0.1%	
Global Alliance for Genomics and Health	0.6	0.4	0.0	0.0	1.0	2.3	3.3	0.1%	
Structural Genomics Consortium IV	2.3	3.1	3.1	4.0	12.5	27.1	39.6	1.1%	
Cancer Stem Cells Consortium	17.7	2.2	2.2	0.9	23.0	68.0	91.0	2.5%	
Genomics technology platforms	19.0	20.4	15.0	15.0	69.4	70.4	139.8	3.8%	
Disruptive Innovation in Genomics	3.5	3.5	3.0	5.0	15.0	20.5	35.5	1.0%	
Canadian Epigenetics Environment	0.4	0.6	0.0	0.0	1.0	1.0	2.0	0.1%	
Genome Centre operations	87.4	4.8	4.8	4.8	101.8	155.2	257.0	7.0%	
	1,082.3	73.3	72.8	174.2	1,402.6	2,121.2	3,523.8	96.5%	
Genome Canada operations	108.1	6.8	6.6	6.6	128.1	0.0	128.1	3.5%	
Total disbursements	1,190.4	80.1	79.4	180.8	1,530.7	2,121.2	3,651.9	100.0%	
Excess receipts over disbursements	49.1	-20.8	-10.7	-16.0	1.6				
Opening cash balance	0.0	49.1	28.3	17.6					
Closing cash balance	49.1	28.3	17.6	1.6	1.6				

* LSARP = Large-Scale Applied Research Project

5.0 Risk assessment and mitigation measures

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*.

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