

2018-2023 Strategic Plan

February 2018



Executive Summary

Génome Québec's 2018-2023 Strategic Plan was elaborated after a lengthy consultation process. The plan is an ambitious one, which capitalizes on existing strengths to stimulate the ecosystem and promote the expansion of industrial clusters derived from genomics knowledge. Many of the initiatives featured here involve leveraging our critical mass of researchers in order to make Québec one of the world's most innovative and creative societies.

Genomics, the only disruptive technology capable of both saving lives and creating wealth, generates opportunities and challenges. As industrialized nations continue to focus on the immense potential of this revolutionary technology, Québec has at its disposal the assets it needs to position itself as a global leader of change. This landscape is reflected in our 2018-2023 Strategic Plan.

If we look to the global environment, we can see that major countries are embracing genomics, particularly as it applies to human health, with many of them adopting national strategies on genomic medicine. We can also note the unique feature of the Canadian business model in terms of genomics funding.

End user appropriation and social acceptance are expected to be the main challenges faced by genomics, while its opportunities will stem primarily from the convergence of Big Data and artificial intelligence. Genomics is not a pipe dream; it now offers real deliverables and a growing number of solutions with major economic potential. Many countries have recognized this new reality and are leveraging genomics knowledge to stimulate their economies. In the last 18 years, Québec has invested over \$1 billion through Génome Québec, thus building a critical mass of competitive expertise now capable of serving as a pillar of economic development. Our Strategic Plan features initiatives to this effect.

It sets out four major strategic issues and three cross-cutting issues. Specific objectives have been determined for each of these. Our efforts reflect a commitment to creating value for Québec in keeping with the strategic priorities established by the Québec government in its major economic strategies: the research and innovation, life sciences, sustainable development, forest management, digital and maritime strategies. We have also taken into account emerging initiatives, such as the bio-food strategy.

Strategic Issues:

1. **Support for genomics research:** This involves ensuring the development of research excellence in genomics by funding large-scale projects relevant to Québec's priority sectors and by stimulating partnerships with end users.
2. **Integration and use of Big Data in genomics:** This involves making genomics a pillar of the Québec strategy on deep learning and artificial intelligence and ensuring access to quality data.
3. **Delivery of a world-class multi-sector offering of technological services:** This involves maximizing the scientific benefits of the technology platforms by ensuring their quality and accessibility.
4. **Education and social acceptance:** This involves making genomics work for citizens, industry and society.

Cross-cutting Issues:

1. **Governance and risk management:** This involves ensuring the achievement of Génome Québec's mission through proper funding and sound management.
2. **Attraction, retention and succession:** This involves creating a work environment able to attract and retain the best employees.
3. **National and international influence:** This involves positioning Québec as a global partner of choice.

Our Strategic Plan sets out many commitments. Here are some highlights:

- With a continued focus on scientific excellence as a key priority, we are maintaining our current activities in support of the scientific community, while proposing new initiatives to further enhance the competitiveness of our researchers. In light of the results of consultations, we are paying special attention to succession planning by attracting young researchers to carry the torch into the future. We have developed initiatives aiming to enrich and renew our critical mass of talent in genomics.
- Québec has proven capabilities in both data science and genomics. Moreover, the structure of our health system is a significant asset when it comes to bringing genomic data out of the lab and into the clinic. As such, we are proposing the creation of a Genomic Data Centre, which would provide a safe and robust infrastructure for the collection of data from clinical activities and research in genomics. Many such data centres are now emerging around the world.
- In terms of technological services, Génome Québec plans on becoming a reference in Québec for the development, validation and implementation of new technological tools and IT pipelines to be used for clinical sequencing as part of a Québec Centre in Clinical Genomics. This distinctive offer could be considerably enhanced if Québec were to be involved in a leading global initiative on the sequencing of a reference genome.
- Lastly, the genomics revolution is generating major transformations in many respects, leading to a lack of understanding, a fear of the unknown and resistance to change. The success of this revolution necessarily involves public education, social acceptance and improved scientific literacy. As such, public outreach has become the cornerstone of success for Génome Québec and one of its unprecedented priority. As experts in genomics, we consider it our duty to understand public perceptions, inform, reassure and train potential users, bring genomics into schools and promote researchers and their discoveries. We have proposed many initiatives that reflect this objective.

On a final note, with the necessary means to deliver on the commitments set out in this Strategic Plan, we undertake to double the leverage effect of the dollar in Québec by 2023.



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PARTNERS



Message from the President and CEO



Passion is often the driving force behind major transformations. It can serve as a powerful vehicle for some of the most stimulating, inspirational changes. It is passion that leads the great thinkers of the world to take risks, to convince others and to overcome the many obstacles in their path. Today's leading genomics researchers rank among these bold, forward-thinking individuals who have the courage to think beyond conventional boundaries. This is why their list of accomplishments just keeps on growing.

At Génome Québec, our mission is also to look ahead into the future and move beyond convention in order to help Québec take advantage of this boldness and courage.

As a powerful lever of wealth creation and generator of new knowledge, genomics is part of a broader vision for a modern, ambitious Québec.

Genomics is not a pipe dream; it is a disruptive technology now woven into the fabric of our society, where it raises

both opportunities and challenges. Whether in health care, the environment, agrifood or forestry, genomics has the potential to transform our way of doing things by improving productivity and enhancing quality of life for all. It is up to us to use this expertise to create new innovative and lucrative economic opportunities. Our 2018-2023 Strategic Plan reflects this very purpose. We have developed an ambitious plan, which capitalizes on existing strengths to stimulate the ecosystem and promote the expansion of industrial clusters derived from genomics knowledge. Québec has the potential to emerge as a strong leader and attract investments, entrepreneurs and new talent. The initiatives we are proposing are intended to make this vision a reality.

Since its inception in 2000, Génome Québec has supported the scientific and strategic development of genomics. Recognized as a catalyst for success, our organization has spared no effort to stimulate the excellence and integration of genomics. The next five years will be crucial on many

fronts, particularly in health care, as we prepare for the shift toward precision medicine. In the very near future, major changes will also be affecting other areas, where we will witness the rise of innovative solutions to issues of productivity, quality and sustainable development, to name just a few.

After initially defining its role as a research funding agency, Génome Québec now sees itself as a pillar of the Québec bioeconomy. Genomics technology has evolved significantly over the last eighteen years, so it stands to reason that our mandate should reflect this new reality. Over and above serving as a catalyst, Génome Québec has now become a strategic contributor to the economic development of one of the flagship sectors of the ecosystem and a niche of excellence that must continue to play a central role in the government's economic vision. Many countries around the world have invested significant energy in genomics as a way of creating wealth, with some even implementing national strategies on genomic medicine. The initiatives featured in our Strategic Plan involve leveraging our critical mass of researchers in order to make Québec one of the most innovative and creative societies in the world. All industrialized nations are now focused on the tremendous potential of this revolutionary technology.

Through collaboration among researchers, partners, users and governments, Québec has at its disposal the assets it needs to remain at the cutting edge in this rapidly evolving environment and the ability to position itself as a global leader of change. This is primarily due to existing infrastructure, expertise and strong political will.

Finally, genomics also raises a number of challenges, particularly in terms of social acceptance and regulations. The coming years will be pivotal ones and Génome Québec plans on leveraging the full extent of its expertise to promote public understanding in support of enlightened decision-making for the benefit of citizens, industry and society as a whole.





Mission

Génoque Québec's mission is to catalyze the development and excellence of genomics research and promote its integration and democratization. It is a pillar of the Québec bioeconomy and contributes to Québec's influence and its social and sustainable development.

Vision

Genomics-driven innovations improve health care service delivery, support agrifood, environmental and forest management practices and enhance public policies.

Values

Excellence, which is reflected in our employees' dedication to upholding a firm reputation for quality. To that end, we carry out our duties in an exemplary manner at all times and all levels.

Openness, which is reflected in the accountability, responsiveness, flexibility and commitment of our employees, who work together as a team toward a common goal.

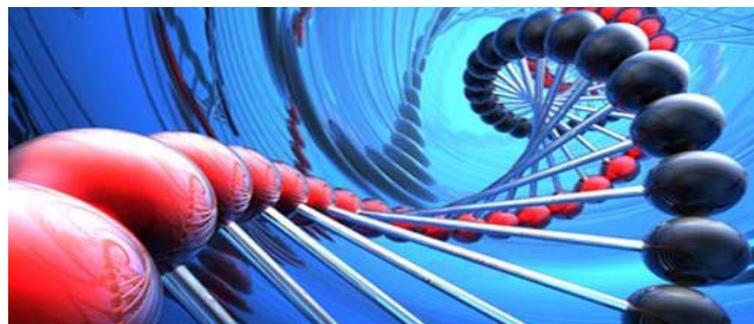
Creativity, which is reflected in each team member's capacity for innovative problem-solving and efficiency of action both individually and collectively.

Integrity, which is reflected in the commitment of our employees to acting in a fair and honest manner in keeping with their personal values and those of the organization.

Ethics, which is reflected in the assurance that research will be conducted within ethical guidelines acceptable to society at large. This is also reflected in good governance and sound risk management.

Emergence of a Sector of Excellence

Québec has at its disposal a sector of excellence in genomics. Embracing this technology is a sound decision that holds great promise for the future of our economy. Genomics is the only disruptive technology capable of both saving lives and creating economic wealth.



Choices That Pay Off

Genomics

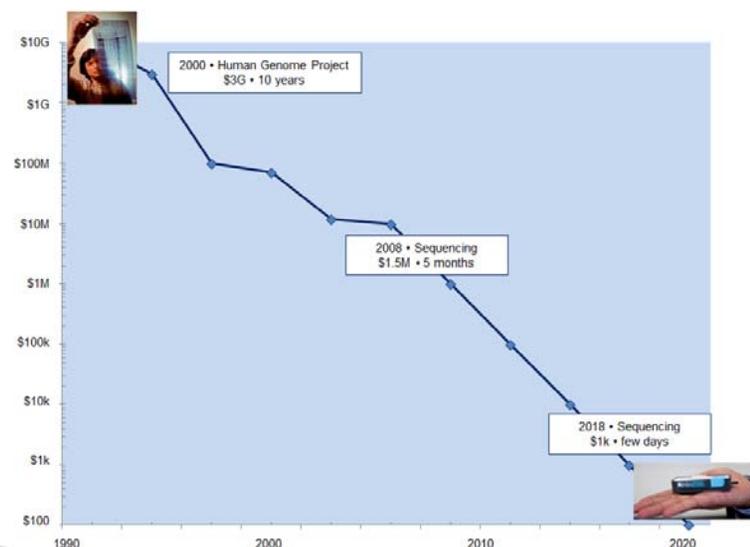
Genomics is a disruptive technology that involves the study of the entire genetic information of living beings, including humans, plants, animals and microorganisms. It is capable of transforming the way things are done in many areas and providing solutions that stimulate Québec's economic growth. For instance, genomics will have a major impact on industrial competitiveness. It will help to significantly improve human and animal health, public health, food production and the environment; in other words, it will enhance the quality of life and wellness of Québec society as a whole. Its ability to deliver solutions for many of the challenges facing our modern society represents a real revolution.

This revolution was brought about by the dramatic decrease in the cost of sequencing over the past ten years, a phenomenon that has led to a surge in the production of Big Data. As sequencing costs continue to decrease by approximately 30 percent every year, it is becoming easier and cheaper to access genomic data, which is generating many high-level jobs and the emergence of genomics-derived industrial clusters.

In the last eighteen years, Génome Québec has contributed to the establishment of an enviable critical mass of expertise in genomics. Since 2001, more than \$1 billion has been invested in genomics in Québec, with \$318 million coming from the Québec government. The province now has access to world-class expertise and infrastructure giving it the competitive advantage it needs to rank among the world's best. If used to its full capacity, this niche of excellence has the

potential to become one of the top ten leaders of the Organisation for Economic Co-operation and Development (OECD) in research and innovation.

The spin-offs from genomics will benefit the government, industry and citizens and contribute to society in Québec, Canada and around the world. Indeed, genomics can help better prevent and treat disease and even save lives. It also supports the development of new industrial products and processes that can contribute to the health of citizens, mitigate the impact of climate change, find alternatives to oil, enhance food security and improve the sustainability of our environment and natural resources.



A Strong Multiplier Effect

For every dollar invested by the Québec government, more than two additional dollars from outside sources are injected into the development of genomics here in Québec. Our Strategic Plan seeks to arrive at a 1:4 multiplier effect by 2023.

Génome Québec: A Vector of Economic Development

Established in 2000, Génome Québec is a non-profit organization with a unique business model founded on leveraging the effect of the dollar in Québec. By supporting the scientific and strategic development of genomics, Génome Québec has, over time, become a multidisciplinary expert, an ambassador of excellence and a catalyst for competitiveness.

Since 2001, over \$1 billion has been invested in genomics through our organization. This includes \$318 million from the MESI (ministère de l'Économie, de la Science et de l'Innovation), \$276 million from Genome Canada and \$432 million from other partners. Initially, 50 percent of the money we invested came from the Québec government. Today, the government's contribution is 31 percent.

Off all the research and innovation organizations in Québec, ours is probably the best positioned to play a leading role in a Québec which has opted to focus on innovation as a driver of its economic development. The structure of our business model and our operational flexibility make it possible for us to optimize the contribution of the private sector and other partners.

Genomic applications in all sectors are a major asset with significant potential for the Québec economy. Many industries that stand to benefit



from these applications are firmly rooted in the industrial landscape of the province. In this regard, for the next five years, we will be prioritizing four strategic sectors: health, agri-food, forestry and the environment.

We have the knowledge, infrastructure and determination to build a healthy society, create wealth and rank among the best. To maintain our assets and take advantage of the massive investments made in recent years, it is now time to develop an optimal environment that will facilitate the integration of genomics and its benefits.

All of these efforts will align with the main strategies of the Québec government, including the Research and Innovation Strategy, Life Sciences Strategy, Sustainable Development Strategy, Forest Management Strategy and the Bio-food Strategy expected to be tabled shortly.

At last, we have reached a crossroads, but to move forward, we will need to overcome three major challenges: the implementation of genomics, its appropriation by users and citizens and, last but not least, the convergence between genomics and the processing and analysis of Big Data through artificial intelligence. So it is with this in mind that we have developed our Strategic Plan for 2018-2023.



Key Issues

The issues we will be facing in the next five to ten years will be very different from those of the last eighteen years. The future of genomics is no longer based on technological challenges related to sequencing and other types of services from technology platform. The new challenges will involve three areas, including data management, social acceptance and financial sustainability.

First, the future of genomics depends on our ability to organize, analyze and interpret data. In addition, it will only be possible to leverage benefits from genomics if we are capable of harmonizing genomics data and clinical data within a single system. This is a tremendous challenge at the moment, not to mention that the issue of access to the medical records of patients has yet to be solved.

Second, change is frightening. Genomics raises a number of major challenges with regard to social acceptance, such as genetic discrimination, human genome editing (e.g., CRISPR) and genetic modification (GMO). To address these questions, legal and ethical expertise is required in addition to in-depth knowledge of public policy, education and communication. The successful implementation of genomics requires its appropriation and acceptance by the public. To this end, it will be crucial to develop suitable training and education tools and to manage public expectations regarding the promise of genomics.

Third, in the medium to long-term, sustained financing depends upon our ability to measure the impact of genomics and quantify and maximize its benefits. The financial future of genomics will also involve the ability to integrate industrial partners.

A Few Words on Genetic Discrimination in Québec

As genetic testing becomes increasingly accessible and reliable, the possibility of genetic discrimination is raising a number of issues. The use of genetic information to diagnose genetic diseases or predict the risk of developing such diseases in the future (breast cancer, Alzheimer, rare diseases, etc.) is likely to interest third parties other than physicians and genetic researchers.

At the moment, no major empirical study evaluating the extent of genetic discrimination in Québec has been conducted. There is very little data available in Canada as well.

Until recently, there was a legislative void in this area, but in April 2017, the House of Common adopted its *Genetic Non-Discrimination Act* (S-201). The Act makes it a criminal offence to require individuals to undergo a genetic test or disclose the results of a genetic test as a condition of providing them with goods or services, entering into or continuing a contract or agreement with them, or offering them special conditions in the contract or agreement. Exceptions are provided for the use of genetic test results by health practitioners and researchers. It was modelled on European laws (e.g., France, Belgium, Germany) developed some fifteen years ago primarily to prevent genetic discrimination in life insurance and employment. For the most part, it focuses on federal employers and insurance companies. Support for this piece of federal legislation was not unanimous. The Québec government has called into question the constitutionality of the Act and is awaiting a ruling from the Court of Appeal of Québec in this regard.

Around the world, many countries have enacted laws and measures to protect citizens from genetic discrimination. In a study commissioned by Génome Québec¹, the authors have mapped out the different normative and legal approaches developed around the world and provided an assessment of their effectiveness. Genetic discrimination being such a complex issue means that any type of measures adopted must be accompanied by a well-defined information campaign.

¹ *Genetic Discrimination in Québec: A Reasoned Proactive Approach in Response to a Complex Social Issue* Y. Joly, C. Dupras, I. Ngueng Feze et L. Song (CGP), Montréal, August 2017



A Few Words on Human Genome Editing²

The advent of CRISPR-Cas9, the 2015 scientific breakthrough, gave rise to hope of new therapies and to the possibility of preventing genetic diseases, along with concerns regarding its potential use for purposes of eugenics or genetic improvement.

Genome editing is a way of making specific changes to the DNA of an organism. These changes can be made to somatic cells or germline cells. Somatic modification is currently used in gene therapy. Germline modification, however, is still prohibited given its controversial hereditary nature (i.e. the fact that genetic alterations can be passed down to the next generation).

The potential clinical applications of genome editing fall under three categories: a) treatment of diseases; b) prevention of the inheritance of diseases; and c) genetic improvement. In Canada, there is currently no regulation or guidelines specifically pertaining to somatic modification for therapeutic purposes. However, products of genetic therapies, generally considered biologics,² are governed by Health Canada's *Food and Drug Regulations*.

In contrast, there is a criminal ban on germline modification across Canada without regard to the differences between a clinical and research context. Québec has not yet adopted legislation or established standards on human genome editing (either somatic or germline) even though it is the only province to have passed legislation on medically assisted procreation. It has, however, set up the Commission de l'éthique en science et en technologie du Québec (CEST), which was tasked with preparing an opinion on issues raised by human germline modification.

The main concern regarding the efficacy and safety of human genome editing involves CRISPR-Cas9. Issues of social justice related to the use of the technology (fair access) and resulting prejudice (discrimination, inequality, etc.) also need to be considered. Experts agree that including the public in the conversation is a must.

Since the CRISPR-Cas 9 breakthrough, national and international policymakers have been busy developing policy statements and guidelines on the genetic modification of germline cells. In hindsight, most of these declarations are similar to the extent that they are all generally favourable to human genome editing for research purposes, as long as the research is justified and subjected to an ethical review and monitoring to ensure both the progress of the technologies and a better understanding of related safety and ethical issues.

The majority of the declarations also favoured a moratorium or the continued ban on the use of germline modification for clinical applications as recommended by the International Summit on Human Gene Editing in 2015. In the United States, though there is currently no nationwide ban, the National Institutes of Health (NIH) has declared that it will not be funding research involving the use of genome editing technologies on human embryos.

Last, the number of studies using human genome editing is on the rise with China leading the way in terms of the number of studies conducted and the United States at the helm in terms of conclusive results.

² This text is an excerpt from the policy brief prepared by Centre of Genomics and Policy of the McGill University and Génome Québec Innovation Centre as commissioned by Génome Québec: *Human Genome Editing: Ethical and Political Consideration*, B.M. Knoppers, M. T. Nguyen, F. Noohi et E. Kleiderman, Montréal, September 2017



The great leaders of the world have implemented national strategies on genomic medicine

These major initiatives are conducted in close collaboration with top-level policymakers, including those of the health system.



International Landscape

Countries that have adopted major national strategies in the area of genomics have done so with a focus on human health. At the moment, the global trend consists in integrating genomic medicine into health systems. Countries under study have all invested heavily in the implementation of national strategies aiming to address public health, scientific, technological, economic and environmental challenges. Contrary to Québec's approach, countries such as the United Kingdom, France, the United States, Denmark and Estonia have integrated their national strategy on genomics directly into their health systems, rather than making it a component of a life sciences or research and innovation strategy. In most cases, these initiatives reflect political will at the highest levels and are generally spearheaded by the department of health. Human genomics is about more than just medicine and the interpretation and processing of massive amounts of medical data; it represents a sector of strategic, economic and industrial importance.

Canada has a unique multi-sector business model, having opted to create a diversified genomics sector with an integrated strategy that can be adapted to the various priority sectors. In Québec, this has translated into the creation Génome Québec, a non-profit organization tasked with supporting the development of genomics in health, agrifood, forestry and the environment.

As for genomics applied to areas other than human health, some countries have built a critical mass of expertise through specific funding programs and competitions. There are no national strategies on genomics in areas outside human health. However, countries such as the United States, France, the United Kingdom, Sweden and Brazil, have developed expertise of the highest order. In coming years, non-health genomics sectors are destined to grow much stronger given existing challenges associated demographics and climate change for which genomics has a number of answers.



Examples of Major National Strategies

United Kingdom

The United Kingdom is recognized for its leadership in genomics research. Thanks to massive investments, more specifically from the Medical Research Council, National Institute for Health Research (NIHR), Wellcome Trust, Cancer Research UK, universities and other partners, the United Kingdom has been successful in implementing the strategy and infrastructure needed to make the shift toward genomic medicine.

In December 2012, Prime Minister David Cameron gave the scientific community a major challenge: to sequence 100,000 whole genomes. Against this backdrop, the UK Department of Health created Genomics England, a company whose one and only shareholder is the National Health System (NHS). Genomics England is operated by the Department of Health on behalf of the public and funded by the NIHR. Public Health England and Health Education England are also part of the equation and play a key role in carrying out all components of the program.

In support of this great vision, the British government announced in 2014 a £300 million investment in a project to sequence 100,000 genomes. The endeavour, which aimed to improve the care of patients based on their genomic profile, attracted many health companies and generated a number of corporate partnerships.

To this end, Genomics England established a major partnership with Illumina, a world-leading company in sequencing technology. To date, over 31,000 genomes have been collected by NHS and sequenced by Genomics England, primarily those of patients with rare diseases or cancer. An important milestone has been reached, but many implementation challenges remain.

In her 2017 Annual Report, Sally C Davies, Chief Medical Officer, stated that the time had come for the United Kingdom to take the next step in terms of implementing genomic medicine. Until now, the process has remained somewhat “piecemeal” in keeping with regional fields of interest. Historically, this approach has been responsive to the needs of many patients and has improved, and even save many human lives.

Now, however, to maintain its leadership and offer its citizens the best possible health care in the world, the United Kingdom must review the

manner in which it has integrated genomics into its health system in order to deliver a first-rate national service which is flexible, responsive and profitable, not to mention consistent with principles of fairness, accessibility and cost competitiveness. Reaching these objectives requires national standards and centralized genomic laboratories with related services. Under this model, the sequenced data produced in centralized laboratories will be returned to genomic medicine centres for interpretation.

The vision of the United Kingdom also recognizes the importance of patient and public trust, which is a strategic priority at the core of their process. The ultimate goal is to make sure everyone feel included in the endeavour. Health Education England was created for one reason only: to support the delivery of excellent care and health improvement to the patients and public of England. With close ties to the NHS and to Genomics England, the organization must ensure that the workforce of today and tomorrow has the right numbers, skills, values and behaviours at the right time and in the right place.

United States

In his 2015 State of the Union Address, President Obama announced a bold research initiative to improve disease prevention and treatment. Backed by an investment of US\$215 million and confirmed in the 2016 budget, the Precision Medicine Initiative paved the way to a new research model focused on real patient needs. With the launch of the initiative, Americans were aspiring to accelerate biomedical discoveries and provide clinicians with new tools, knowledge and therapies to generate more effective, better targeted treatments for patients.

The investment, which was shared among the National Institutes of Health (NIH), the National Cancer Institute (NCI) and the Food and Drug Administration (FDA), will be used as follows:

- to create a national research cohort of one million American volunteers. The goal of this cohort is to propel the understanding of both disease and health. It proposes an approach that consists in doing research through engaged participants and responsible, open data sharing (US\$130M);



- › to increase efforts to identify genomic drivers in cancer and apply this knowledge in the development of more effective approaches to treatment (US\$70M);
- › to acquire additional expertise and advance the development of high quality, curated databases to support the regulatory structure needed to advance innovation in precision medicine and protect public health (US\$10M);
- › to support the development of interoperability standards and requirements that address privacy and enable the secure sharing of data across systems (US\$5M).

In order to develop the infrastructure needed to propel cancer genomics knowledge and launch a volunteer million-person cohort, the Obama Administration had pledged to forge strong partnerships with existing research cohorts, patient groups and private corporations. To lay the groundwork for this effort, the Administration had planned on calling upon academic medical centres, researchers, foundation, privacy experts, medical ethicists and medical product innovators. The plan also involved developing new approaches to promote patient participation and empowerment.

Now, we need to wait and see what will happen to this major initiative under the new Republican administration. At the federal level, we can expect a drop in research investments, but states such as California, Massachusetts, Minnesota, Texas and others, will continue supporting the effort, as will the many well-established American foundations.

The American model is very different given the private, decentralized nature of their health system. However, the massive investments made in genomic medicine since the celebrated completion of the whole human genome demonstrate the tremendous promise and economic potential of this disruptive technology. In California, entire economies have been built almost exclusively on genomics-driven technological sectors. The same is true in the United Kingdom, where the growth of cities such as Oxford and Cambridge is due directly to academic and industrial activity generated by genomics knowledge.

France

When it comes to genomic medicine, France is lagging behind other European countries. In April 2015, Prime Minister Manuel Valls asked the National Alliance for Life Sciences and Health (Aviesan) to develop a strategy aiming to make up for lost time. With an investment of €650 million, the 10-year French Plan for Genomic Medicine 2025 features the establishment of sequencing platforms covering the whole territory, a national data analysis centre and a national centre of reference, innovation, expertise and technology transfer. The goal of the plan is to capitalize on the specific features of the French health system and fully integrate care, research, training and innovation in a way that enhances health and quality of life.

Following in the footsteps of the United Kingdom, the United States and China, France has launched a program to build a medical and industrial cluster to integrate precision medicine into the care continuum and to develop a national genomic medicine sector. The ethical dimension is a central aspect of the plan.

The plan has three broad objectives:

1. To position France among the leading nations in the area of genomic medicine.
2. To lay the groundwork for the integration of genomic medicine into the care continuum and the management of disease (cancer, rare or common diseases). By 2020, France hopes to be sequencing some 235,000 genomes per year.
3. To establish a national genomic medicine sector, which can serve as a lever for scientific and technological innovation, the transfer of technology and economic growth.



Spearheaded by the French government, the plan is designed to meet the various needs along the care continuum, from the prescription of genomic tests to the establishment of diagnoses by physicians. It includes a series of measures:

- › the launch of twelve sequencing platforms covering the whole territory;
- › the implementation of a national supercomputing centre, the Data Collector and Analyser (DCA), capable of processing and using the considerable volume of data and offering health professional first-line services;
- › the creation of a national centre of reference, innovation, expertise and technology transfer (CRefIX) built around the high throughput sequencing platforms and the DCA. The CRefIX will be developed by academic centres in partnership with industry. It will include two locations: the first at the Genopole in Évry will handle sequencing and the other in Paris will focus on the digital component;
- › the implementation of standardized, interoperable electronic patient records to enable the integration and use of genomic and clinical data;
- › the launch of four pilot projects on cancer, rare diseases and common diseases and a study among the general population aiming to test the technological, clinical and regulatory barriers found along the various stages of the care continuum;
- › the roll-out of training programs in universities and schools to establish a multidisciplinary genomic medicine cluster and to build the skills and train the personnel needed to meet the challenge of using and interpreting data.

As is the case with the United Kingdom, France believes that any national plan on genomic medicine necessarily requires the engagement, understanding and acceptance of the public and other stakeholders involved. In addition to measures on the ethical and regulatory aspects, some of the countries currently involved in genomic medicine have made a firm commitment to public communication, consultation and dialogue (e.g., Estonia and the United Kingdom). France, too, plans on taking

significant measures in this respect by using various media tools and methods to dialogue and consult with actors in the academic sector and the general public across the nation.

Denmark

In May 2017, Denmark announced major investments in a national precision medicine strategy, known as Per Med. The new program involved two key components: the integration of genomic data into electronic medical records and the implementation of a national genomics centre. The new strategy will be spearheaded jointly by the Ministry of Health and Danish Regions, an organization that represents the country's five regions. It should be mentioned that in Denmark health is a regional responsibility.

Per Med will be required to set up an organization tasked with improving the efficiency of the health system and rendering it more responsive to patient needs. The action plan involves introducing new technologies, strengthening the legal and ethical safeguards on the use of genetic data by the health system, launching research and development projects, creating common technology platforms and implementing a national governance mechanism for both health and research.

The approach selected will focus on consolidating efforts rather than launching multiple initiatives and investments. Denmark is hoping to sequence genomes and store the data in a single location, where they will be accessible for therapeutic, diagnostic and research purposes. The entire initiative will be conducted by the public sector.

Per Med also includes the creation of a national genomics centre. Contrary to other existing genomics centres, however, this one will not be dedicated solely to research. Instead, it will serve as a central platform for the integration of genetic data into electronic medical records in order to build a resource capable of offering the people of Denmark more effective, better tailored health care. The centre will also develop processes for the analysis and sharing of data, which will be accessible through a centralized database. Genetic and phenotypic data will also be made available to researchers in keeping with ethical regulations.



Given the uniform nature of its infrastructure, Denmark is considered to have a competitive advantage for the nationwide implementation of a culture focused on precision medicine.

Estonia

In 2000, the Estonian government launched the Estonian Genome Project Foundation whose mission is to create a major population-based database dedicated to research and development in genetics and genomics. The large-scale project also involves collecting genetic and health data for the purpose of using the results of genetic studies to enhance public health. In 2007, the project became the Estonian Genome Center of the University of Tartu.

As a result, Estonia now has its own population-based cohort. It includes 52,000 genetic samples from randomly selected participants, 18 years of age and older, all of whom have signed an informed consent form. The cohort is representative of the population in terms of geographic distribution, age and gender (83% Estonians, 14% Russians, 3% others). Participants are recruited in hospitals by general practitioners and specialists.

With a population of only 1.3 million, Estonia has managed to successfully position itself in the area of precision medicine. In fact, this small nation might just be the first in the world to actually make the shift toward a national system focused on personalized medicine. Interestingly, mechanisms are already in place to coordinate the merger of genetic data into the automated decision-support system (e-Health), which will significantly help doctors and have a major impact on disease prediction, prevention and treatment. And contrary to Iceland and the United States, Estonia has set up a biobank which legally protects the privacy and rights of donors. Even Broad Institute President Eric Lander cites the Estonian model as an example to follow.

The Canadian Context

Génomique Québec is part of a network of six regional genomics centres defined as “Canada’s genomics enterprise.” All receive funding from Genome Canada. The niches of excellence of each of the centres vary from one province to the next. They work together on many fronts, especially when it comes to promoting genomics at the national level.

However, during Genome Canada competitions, each province attempts to obtain the maximum amount of funding available nationwide, generating a climate of competition. To date, Génomique Québec has always ranked among the highest performing provinces.

Génomique Québec boasts the highest level of activity in Canada. It also stands out for using a very small percentage of its budget for administrative expenses. Among the three leading centres in Canada – Génomique Québec, Genome British Columbia and Ontario Genomics – Québec is the province that receives the smallest share of provincial funding earmarked for general and administrative expenses.

To maintain its leadership position in Canada, Génomique Québec must diversify – even increase – its funding for activities related to sector development, business development and public outreach.



Genomics in Non-Health Sectors

Looking at the international trend in genomics applied to the agrifood, forestry and environmental sectors, it quickly becomes apparent that human health continues to be a priority in terms of funding. However, with the surge in the number of global issues, such as climate change, the global demographic growth, the availability of natural resources and food production and safety, there is an increasing need for specific expertise to help us make sense of these phenomena and their impact on biodiversity. More and more, countries are banding together in an effort to find solutions and take global action. It goes without saying that science is at the core of these reflections, with genomics as one of the most promising technologies when it comes to establishing the right diagnoses.

In addition, in sectors other than human health, the expertise developed differs significantly from one country to the next. This reflects the variations in climate and species in territories around the world. This is also the case for genomes. Generally speaking, while issues may be similar at the international level, the solutions generated by genomics must constantly be reexamined from scratch. All of this can sometimes make international co-operation more difficult, yet certainly not impossible. In Germany, the Federal Minister of Education and Research recently launched a call for proposals as part of a National Research Strategy Bioeconomy 2030. This call for proposals, which is open to collaborations with Canadian researchers, focuses on projects on global food security, health, safety and sustainable food production, the use of renewable resources by industry and the development of biomass-based energy. Major funding opportunities are rare and return on a cyclical basis only. One example is Horizon 2020, one of the largest programs available in Europe.

Agrifood

According to the latest projections by the United Nations, the global population is expected to reach nine billion inhabitants by 2043, up from the seven billion attained in October 2011³.

Given the population growth, climate change, dwindling resources, global competitiveness, government policies and regulatory processes, global issues such as human health, nutrition and sustainability are putting increasing pressure on available resources. Producing larger quantities of safe, high-quality food using less space, while reducing the impact on the environment, constitutes one of the major challenges of the 21st century. By continuing to invest in the advances generated by genomics, the agrifood sector will be well positioned to meet this challenge. Québec is capable of playing a leading role by providing solutions.

In Canada, the agrifood sector has placed significant emphasis on research, development and the implementation of genomics at a level comparable to another cutting edge sector: human health⁴. Ultimately, using genomics and its related technologies to their optimal capacity will help to create a better world for future generations by improving health, increasing food security and promoting sustainable production practices. Québec, with its well-developed research infrastructure (McGill Institute for Global Food Security, Institute of Nutrition and Functional Foods (INAF) of Université Laval, etc.) and robust agrifood sector, could play a leadership role on the international stage by contributing to enhance food security. Many countries have built a critical mass of expertise in agriculture or agronomy. One of the most interesting models in this area is the Institut national de recherche agronomique (INRA), a public research institute dedicated to agricultural science in France and the first of its kind in Europe. Governed by the Ministries of Research and of Agriculture, the INRA is unique in that it brings together three key areas of expertise: food, agriculture and the environment. The INRA conducts a number of genomics research projects in plant genomics, plant pathogens and beef, wheat and aquaculture genomics, etc. According to several researchers working in the sector here in Québec, the

³ <https://esa.un.org/unpd/wpp/#q1>

⁴ [The Opportunity for Agri-Food Genomics in Canada: Ours for the Making](#), Sector Strategy, Genome Canada, May 2013



organizational structure of the INRA is a source of inspiration, since it unites under one roof agrifood and the protection of natural resources, making it easier to consider the issues from different angles.

The United Kingdom, too, has developed a national strategy on agriculture⁵ (but it dates back to 2013), which takes into account new technologies and their development, including biotechnology and Big Data.

In addition, there are agriculture research centres in Australia and Catalonia, illustrating the political will of these governments to promote the advancement of knowledge in this field.

Asked about collaborative efforts to explore at the international level, Québec researchers mentioned the United States (California, Iowa, etc.), the United Kingdom, France, Denmark, Germany and Sweden. As is the case with forestry, however, differences in climate and species variations from one country to the other make international co-operation rather difficult.

Forestry

In the area of forest genomics, Canada is the only country in the world to have set up substantial funding specifically for genomics. As a result, it is recognized for its leadership, with two poles of excellence based in Québec and in British Columbia.

The forest industry is critical to Canada, both as an economic pillar and a cultural symbol. Forests are one of our country's most important renewable natural resources. The majority of forest lands are owned by the provinces, but harvested by the private sector.

Around the world, the forest industry is starting to recover from the impact of financial crises and recessions, but the major challenges involved in accessing a guaranteed, competitive timber supply remain and include global changes in supply and demand, increased international competition and the threat of insect pests and environmental changes.

⁵ <https://www.gov.uk/government/publications/uk-agricultural-technologies-strategy/uk-agricultural-technologies-strategy-executive-summary>

From a research perspective, major international topics under study include the sustainability of forests and the connection among forest diversity, its functioning and its resistance to climate change. Other areas of interest include the genetic basis of complex tree traits and phenotype prediction.

Progress achieved through genomics research to date is generating new tools and new ways of thinking about forest management to guarantee its sustainability and ensure that Canada remains a world leader with the largest forest resource managed to last well into the future.

The big players in the field are primarily based in Europe, specifically in the United Kingdom, France, and Scandinavia and in Brazil. As previously mentioned, differences in terms of climate and forest species variations among these countries make international collaborations more complex. Lastly, it is worth noting that the largest plantation programs in the world can be found in China, where a moratorium is currently in place. China, in fact, plants not for production purposes, but rather for preservation, which is different from what the other countries discussed here are doing.

The Environment

In terms of the environment, the potential of genomics remains little known and practically untapped. However, given the major impact of climate change and the signing of worldwide agreements on reducing carbon emissions and other harmful effects on the environment, world leaders will have no choice but to look to science for answers. In its Strategic Plan, Genome Canada has made genomics a top priority in the fight against climate change. In fact, it proposes a program designed to foster the development of a vibrant Canadian economy with low-carbon emission levels and the capacity to adapt to climate change. To do so, it relies on cutting edge technologies and innovation. If Genome Canada manages to obtain the necessary funds, Canada could take the helm in the area of environmental protection, and Québec already has in place an enviable critical mass of expertise in this sector.



Discussed time and again, climate change is creating major environmental and economic challenges for Canada, whose rate of warming is estimated to be twice the global rate. This situation comes with consequences, including longer, warmer growing seasons, weather events causing more droughts, forest fires and floods, fluctuations affecting biodiversity and ecosystems and a rise in the number and frequency of insect-borne diseases.

This explains in large part the commitment of the Canadian and Québec governments to the 2015 Paris Accord (COP21) and its goal of limiting global warming to 2 degrees Celsius. It is an ambitious project requiring a Canada-wide strategy on managing the challenges of global warming and promoting the growth of our bioeconomy. In this respect, we can look to genomics for innovative solutions.

As we know, the impact of climate change on the geographic distribution and productivity of various species is difficult to predict. Genomics is a tool of choice used by researchers to evaluate and better understand the genetic specificities of living organisms and to identify problems, such as contamination and pollution, in a rapid and effective manner.

Moreover, genomics is capable of quickly identifying the plants that are better adapted to weather events by improving crossing and selection methods, which have been used since the domestication of plants and animals. These methods, now completely transformed by knowledge in genomics, can help identify ways to adapt to climate change.

Whether it comes to reducing carbon emissions, providing sustainable, cost-effective solutions to complex environmental problems or improving the technological arsenal of key industries, genomic-based applications are already available to help us respond to the challenges of climate change and stimulate the bioeconomy in Canada and Québec.

From a Québec perspective, collaborations under the Québec-Ontario-California agreement could be explored and leveraged to fight climate change.



Strategic Issue 1

Support for genomics research

Orientation

Ensure the development of research excellence in genomics by funding major projects in Québec's priority sectors

Québec's strength in genomics is recognized in the sectors of precision medicine and forestry. Increasingly, Québec researchers are also making a name for themselves in agrifood and the environment. Yet while the potential of genomics technology is huge, our portfolio still rests on the expertise of a limited number of researchers. Ranked among the best in the world, these researchers are important pillars on which a diversified and competitive talent pool can be developed. In coming years, the shift to precision medicine and the strengthening of other sectors will be major challenges. To attain unparalleled levels of performance, we will need to overcome many obstacles, such as ensuring the optimal integration of genomics, strengthening and mobilizing skills, stimulating new investments, maintaining our infrastructure at the leading edge of technology and encouraging scientific entrepreneurship.

In the field of health, genomics will transform the way we prevent, diagnose, treat and predict the evolution of disease. It will also facilitate decision-making when managing disease.

This is why both Genome Canada and the Québec government, through its 2017-2027 Life Sciences Strategy, have identified precision medicine as a cross-cutting priority sector. These choices have led to considerable investments intended to advance research and ensure the optimal integration of genomics into the health system.

Sectors other than human health – agrifood, forestry and the environment – offer tremendous potential for solutions, and the capacity of genomics in this respect remains only modestly explored. There are now great opportunities for building research partnerships between academia and industry. Given the critical importance of these sectors for Québec in terms of economic competitiveness and the well-being of the population, significant effort must be devoted to their expansion, particularly since they have the potential to become promising strategic niches for Québec's industrial landscape.



Objectives

1. Promote genomics as a tool for economic development in Québec
2. Support the development of genomics in strategic sectors for Québec
3. Optimize the success rate of Québec in Genome Canada competitions
4. Ensure the emergence of new research teams in genomics
5. Ensure the uptake of research results by end users
6. Increase the contribution of external partners (private and international)
7. Develop emerging sectors with high potential



Strategic Issue 2

Integration and use of Big Data in genomics

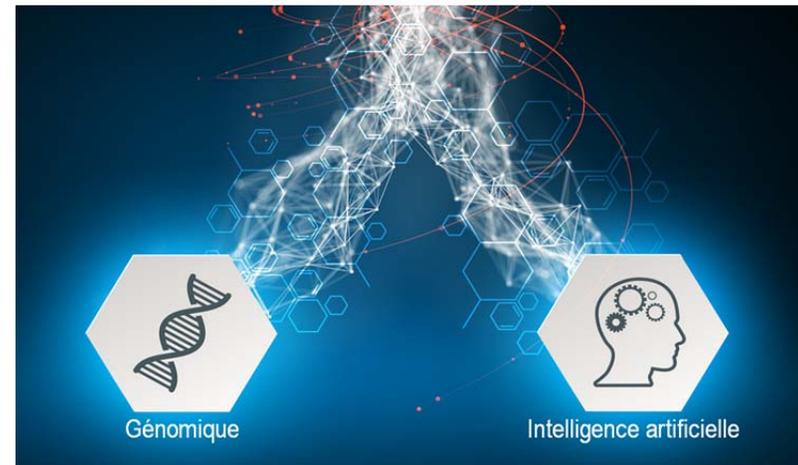
Orientation

Make genomics a pillar of the Québec strategy on deep learning and artificial intelligence

The development of pioneering approaches to problem solving and decision-making, along with the main drivers of innovation, rely on scientific research that requires the use of massive amounts of data. In recent decades, major technological breakthroughs have increased, more than ever before, our ability to generate larger and more complex data, which in turn has led to the emergence of new technologies and infrastructure needed to collect, store, manage, use and integrate all this information. This new reality raises its own set of challenges regarding our ability to control the processing of Big Data from genomics.

To this end, we will need to leverage the billions of dollars invested globally in these sectors, and more importantly, to maximize benefits for the good of Québec society. Québec has major assets in this area, with industry professionals and academics working together on developing leading expertise in data science, optimization (operational research) and artificial intelligence. In this respect, Québec, and more specifically Montréal, is uniquely positioned to harness digital data using artificial intelligence in university and private sector settings.

Genomics is generating some of the most important Big Data of the human health sector. Rapid advances in next generation sequencing technology are revolutionizing health care and driving the development of precision medicine. Whole genome sequencing is playing a growing role



in the investigation of genetic and orphan diseases and in cancer management. Québec is considering integrating these technologies into its health system through the launch of a Québec Centre and Network on Clinical Genomics. At the same time, the province has developed solid research expertise in genomic applications in health. The decreasing cost of sequencing and ongoing technological progress will only accelerate the evolution toward an even more effective model of precision medicine, where a growing number of Quebecers can have their genomes mapped in order to detect and prevent diseases and guide treatment.

The development of genomics, however, comes with a major challenge: how to manage all this sequenced data?

- Genome sequencing generates tremendous amounts of sensitive data, whose analysis and storage require a secure, dedicated infrastructure.
- Making the most genome-related data for clinical or research purposes requires access to huge databases, which raises issues on the standardization, harmonization and integration of data from a variety of different sources.
- Harnessing genomic data in an optimal manner also involves their convergence with clinical information.



To respond to this challenge, Québec will need to establish a genomic data centre for clinical and research use. Without such a centralized structure, we run the risk of conducting genomics research in silo mode. Computer infrastructure dedicated to genomics would be divided among many hospitals and research centre, which would have an impact on cost, sustainability and on data access, its quality and its complexity.

As such, Québec will need to establish a Québec Genomic Data Centre (QGDC), which would provide a safe and robust infrastructure for the collection of data from clinical activities and research in genomics. Québec would then be capable of the data generated at its future QGDC and could work toward developing ways to integrate genomic data into the clinical setting. The QGDC would facilitate co-operation among clinicians, researchers and industrial partners, while strengthening the synergistic development of Québec expertise in artificial intelligence.

Many such data centres are now emerging around the world. Under the auspices of the Global Alliance for Genomics and Health, these centres participate in the creation of international standards on genomic data sharing. The QGDC, too, could take part in developing and adopting these standards and build interoperability with other major centres worldwide, which would lead to the development of synergistic bonds and to the increased impact of Québec data.

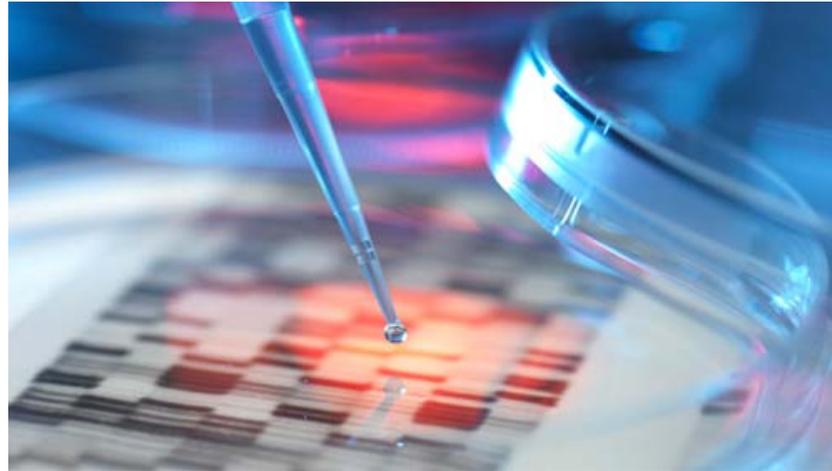
Québec has developed strengths in genomics and artificial intelligence. Moreover, the structure of our health system is a significant asset when it comes to bringing genomic data out of the lab and into the clinic. The QGDC could serve as a catalyst that would stimulate synergy among these poles of expertise. This environment could give Québec researchers a competitive edge, attract investments from the private sector and improve patient care in Québec. If harnessed to its full capacity, the coming together of these two major clusters of excellence – artificial intelligence and genomics – will help Québec secure a unique position on the world stage, attract foreign investments and contribute to the development of a new industrial sector.

Challenges remain, however, as do many silos, which prevent publicly funded data from being shared and accessed by others. Génome Québec is looking to join the collective conversation on finding solutions to this problem.



Objectives

1. Establish a Québec Genomic Data Centre (QGDC)
2. Support the process of integrating genomic data on deep learning and artificial intelligence
3. Contribute to Québec's position as a world-class centre of excellence in the area of Big Data, deep learning and artificial intelligence



Strategic Issue 3

Delivery of a world-class multi-sector offering of technological services

Orientation

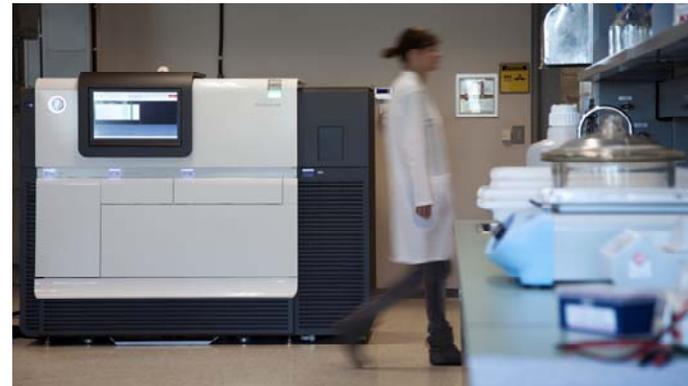
Maximize the scientific benefits of the technology platforms by ensuring their quality and accessibility

Over the years, we have developed major strategic infrastructure and research platforms, which are made available to the Québec, Canadian and international scientific community working in academia and industry.

In this regard, we plan on leveraging the expertise acquired over the last eighteen years to expand and refine our service offering and ensure that our state-of-the-art infrastructure generates international contracts and attracts and retains in Québec top-notch researchers. In addition to our standard activities offered with a constant commitment to competitiveness (access, quality and cost of services), we will be emphasizing the harmonized nature of our processes and our expertise in biobanking, cohorts and bioinformatics. Ultimately, this accumulated knowledge will enable the development of new world-class platforms in support of Québec's distinctive offering in Canada and abroad.

In connection with the activities of our genomic and bioinformatic platforms, we plan on becoming a reference in Québec for the development, validation and implementation of new technological tools and IT pipelines to be used for clinical sequencing as part of a Québec Centre in Clinical Genomics (QCCG). This plan reflects a commitment to ensuring the effective integration of all the latest genomics technologies in keeping with exemplary practices and existing international regulatory requirements, all by way of leveraging maximum benefits for patients.

This unique offer could be considerably enhanced if Québec were to be involved in a leading global initiative on the sequencing of a reference genome. With this in mind, we are proposing the development of a "reference genome" for Québec. Conducted with scientific and financial partners, the project would help to expand the statistical power of existing cohorts, here and abroad, for more accurate imputation of genetic variations. Contrary to other similar initiatives announced elsewhere in the world, the Québec project has the enviable advantage of speed and performance considering the expertise acquired in recent years. It is an asset that could help position Québec at the helm in this area. Once completed, the reference genome will help us better understand the genetic diversity of Quebecers and improve the therapeutic and preventive approach by integrating phenotypic and environmental data. From the standpoint of public health, population aging, sustainable development and economic growth, this tool should be given serious consideration.



Objectives

1. Adapt the Génome Québec service offering to user needs

2. Make optimal use of the services and equipment operated by Génome Québec

3. Optimize the partnership on the development and implementation of new technologies for the benefit of the research community and other end users

4. Establish a Centre of Reference, Innovation and Technological Innovation in Clinical Genomics

5. Establish a Québec reference genome (RefGeno-Q)



Strategic Issue 4

Education and social acceptance

Orientation

Make genomics work for citizens, industry and society

The genomics revolution leads to major transformations on many fronts. As a result, we face misunderstanding, fear of the unknown and resistance to change. Other countries such as Great Britain, the United States, France, Denmark and Estonia, have understood this and have responded with strategies and mechanisms capable of supporting this societal shift. In Canada, some provinces, including British Columbia, have taken a proactive approach. Québec, which has been investing considerable sums in genomics for the last eighteen years, now stands at a crossroads. To make the most of the benefits from our efforts, education, scientific literacy and social acceptance are the cornerstone of success.

Since its inception, Génome Québec, in co-operation with the scientific community, has acquired solid expertise through its corporate communication platforms and from the ethical, economic, environmental, social and legal knowledge it has developed over the years. We would like to leverage this accumulated know-how in order to make genomics work for citizens, industry and society.

For Génome Québec, the democratization of knowledge, training of young talent and integration of genomics are important driving forces behind the economic development and influence of Québec. Against this backdrop, education, regulation and social acceptance will be central to our strategy for the next five years.

We wish to build bridges in order to harness this knowledge for the benefit of the community.

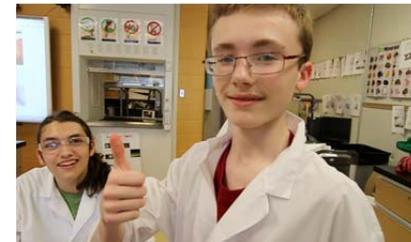
Genomics holds great promise. Its influence is already being felt in critical fields, such as health, agrifood, forestry and the environment. In the public arena, however, genomics inspires passionate sentiments, but not always for the right reasons. People formulate opinions without really understanding its potential or the rules that regulate it. This is why we feel it is urgent and critical to provide users, policymakers and citizens with the training tools and accurate information they need to make sound choices and enlightened decisions.

As such, public outreach has become an unprecedented priority for Génome Québec. As experts in genomics in Québec, we consider it our duty to understand public perceptions, inform, reassure and train potential users, bring genomics into schools, mobilize stakeholders and promote researchers and their discoveries.



Objectives

1. Assess public perceptions
2. Inform and train potential users
3. Bring genomics into schools
4. Mobilize stakeholders
5. Promote researchers and their discoveries



Cross-Cutting Issue 1

Governance and risk management

Orientation

Ensure the achievement of Génome Québec's mission through proper funding, sound governance and efficient risk management

Since its inception, Génome Québec has earned a reputation as an expert in the financial and scientific management of large-scale projects and in the oversight of technology platforms. Génome Québec has also instituted a credible and efficient model of governance.

Activity volumes are on the rise, reaching \$100 million annually. When it comes to good governance, our organization is meeting its responsibilities, while maintaining an operating cost ratio below 4% for its activities.

By consolidating its leadership role in research and innovation, Génome Québec has positioned itself as a partner of choice.

Partnerships and networks are critical to the development and integration of genomics. In order to forge new bonds with other actors and partners, Génome Québec relies on collaborations that can leverage the most impact. In addition, given our goal of facilitating the integration of genomics solutions into Québec economic activity, we are focusing on bringing together the know-how from both academia and industry. To this end, securing funding for strategic development activities is essential.



Objectives

Finances

1. Increase the overall funding for Génome Québec activities
-

Governance and risk management

2. Ensure proper risk management
 3. Optimize sound governance practices
-



Cross-Cutting Issue 2

Attraction, retention and succession

ORIENTATION

Create a work environment able to attract and retain the best employees

In the midst of one of the revolutions of the 21st century, employees working for an organization like Génome Québec are highly coveted by many professionals. Yet even as they work in a cutting edge sector with tremendous potential for the coming years, access to ongoing research and innovation funding remains a constant challenge. As a result, working in this field is risky. As an employer, it then becomes extremely important for us to motivate our employees and create for them a climate of confidence, thus making it easier to attract top talent. Another factor important to us as an employer is the sense of pride of our employees, which is derived from the knowledge that going to work each day means making a difference in the world. This is what Génome Québec has to offer.

However, maintaining this level of motivation and well-being in a constantly changing environment is a daily challenge. It is a challenge that our employees have had to face several times in recent years. So for the period covered by this Strategic Plan, we will be focusing on building this climate of confidence, recognizing talent, optimizing strengths and creating competitive, attractive working conditions. In addition, we would like to establish a climate where feedback and continuous improvement are welcome, because we firmly believe that these factors all play an essential role in improving the performance of our organization and enhancing the engagement of our people.

Finally, to ensure the proper planning and management of human resources, we will develop a plan and process to address the impact on the smooth flow of our operations that can occur when a key employee resigns.



Objectives

1. Implement measures to help attract the best employees

 2. Implement measures to help retain the best employees

 3. Develop a succession plan to maintain the level of expertise and ensure the continuity of services
-



Cross-Cutting Issue 3

National and international influence

Orientation

Position Québec as an international partner of choice

Genomics knows no boundaries. Its success necessarily involves the sharing of knowledge. National and international scientific collaboration is essential, since it accelerates the discovery process and, in turn, the delivery of benefits to society. It is critical, therefore, that research support programs be sustained in order to promote the leadership of Québec research in genomics.

Most Québec researchers are already involved in Canadian and international networks. Many of them are even spearheading these efforts. This just goes to show that over the years Québec has developed world-class expertise. The same is true for our infrastructure, which enjoys a solid reputation globally. In other words, Québec has at its disposal the assets it needs to attract talent, partners and foreign investors. Yet while our local ecosystem may be solid and competitive, its growth and sustainability rely largely on our ability to shine the spotlight on our distinctive value by promoting Québec talent and assets and by stimulating collaborations. Consequently, if we want to stay in the game, in Canada and internationally, we must give ourselves the means to succeed. We need to be present, visible, dynamic and engaged. To do so, we plan on taking proactive action and aligning our efforts with other Québec, Canadian and foreign organizations.



Objectives

1. Develop strategic research partnerships
2. Develop a network of international partners of major technology platforms
3. Develop a network of international partners in education and social acceptance
4. Promote Québec expertise in the areas of genomics and bioinformatics



Conclusion

We have presented here the issues and objectives of Génome Québec for 2018-2023. Our Strategic Plan ultimately focuses on creating the optimal environment for the development of genomics; but it is also meant to give citizens, industry and society the chance to take advantage of the results generated by the many investments made in genomics in recent years. The approach we propose aims to make Génome Québec one of the pillars of economic development in Québec. All efforts will be made to honour the commitments set out in our plan.

The genomics sector has been part of the Québec ecosystem for eighteen years now. To date, more than \$1 billion has been invested, with \$318 million by the Québec government. At this point, we are able to say with assurance that Québec can now rely on genomics and its benefits to plan its economic performance and competitiveness, create wealth, save lives and, more broadly, to improve the well-being of the community as a whole. Québec has secured for itself an enviable position in Canada and internationally and brought together the key success factors it needs to take it to the next level on the world stage.

Our 2018-2020 Strategic Plan was drafted to respond to four strategic issues supported by three cross-cutting issues. Specific objectives have been determined for each of these. Our efforts reflect a commitment to creating value for Québec in keeping with the strategic priorities established by the Québec government.

To hit the mark, we need to focus on scientific excellence, ensure the use of Big Data in genomics, offer state-of-the-art technological services and, last but not least, foster social engagement and acceptance.

With the necessary means to deliver on the commitments set out in this Strategic Plan, we undertake to double the leverage effect of the dollar in Québec by 2023.

As set out in the Québec Strategy on Research and Innovation, “to ensure its prosperity and the quality of life of its citizens, Québec must place greater emphasis on its capacity for innovation, on its hothouse of talent and on the new ideas that emerge.” (Translation)



Methodology

Our 2018-2023 Strategic Plan is the result of a rigorous process of reflection, analysis and consultation. The groundwork for the document was laid by the Génome Québec management committee. This early reflection was quickly adjusted when the Québec government tabled its strategies on research and innovation, life sciences, sustainable development, forest management as well as its digital and maritime strategies. We also took into account coming strategies, including the one on bio-food. In addition, we scanned the international environment to clearly identify the main orientations in genomics. On the national front, we made sure to present a plan that aligned with the major Canadian priorities.

Upon completion of a first draft, we launched a consultation process, which lasted four months. Over thirty interviews were conducted among members of the scientific community and our partners. We also met with all the vice-presidents of research in Québec universities.

This involved personal interviews with representatives of our management committee. The interviews lasted an average of two hours and were recorded. A few days before the meeting, respondents were given a summary of the strategic plan and a list of general and specific questions. It is important to point out that everyone surveyed took the exercise very seriously, which enabled us to collect invaluable information, suggestions and critiques.

Given our objective of ensuring motivation and a sense of belonging, we also consulted with our employees. Many of them actively participated in the process by making highly relevant suggestions, some of which have been included in the plan.

After this lengthy consultation process, we reviewed our original document, so that we could present to our board members a Strategic Plan that reflected our issues, needs and propositions discussed during our meetings. The new version of the plan was the subject of a working session with members of the Génome Québec board, held on December 12, 2017. The 2018-2023 Strategic Plan was subsequently adopted. It will be officially tabled to the ministère de l'Économie, de la Science et de l'Innovation, as stipulated in the Génome Québec funding agreement.

This five-year plan, which will be used to build annual action plans, will be kept up to date on an ongoing basis. It will be available on the Génome Québec Website.



ÉDITION

Génome Québec

The 2018-2023 Strategic Plan is available in electronic format at: www.genomequebec.com, Under **About Us/ Our Publications / Corporate Publications**

Legal deposit Bibliothèque et Archives nationales du Québec, 2018

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