

A pair of hands, one larger and one smaller, are shown holding a realistic globe of the Earth. The hands are positioned in the center of the frame, with the larger hand supporting the globe from below and the smaller hand reaching up towards it. The background is a soft, out-of-focus bokeh of yellow and green light spots, suggesting a natural, sunlit environment. The overall tone is hopeful and forward-looking.

# **A Living Revolution**

**20 Years of Genomics**

2019-2020 Annual Report



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A long-exposure photograph of the Aurora Borealis (Northern Lights) over a body of water at night. The aurora displays vibrant green and blue curtains of light against a dark, star-filled sky. The water below is calm, reflecting the colors of the lights. In the foreground, there are dark, mossy rocks. In the distance, a range of mountains is visible under a dark sky.

# 20 Years in Review

# A Message from the Honourable Ross Romano Minister of Colleges and Universities

Congratulations to Ontario Genomics for 20 years of revolutionizing genomics research and commercialization in Ontario. It is because of your commitment to excellence and leadership in the field, that Ontario continues to create strategic genomics resources and advances the development of globally competitive life sciences sectors.

Ontario Genomics continues to create successful public-private partnerships that capitalize on the very best Ontario has to offer. Ontario is well positioned to turn genomic discoveries into “made-in-Ontario” technologies and products that impact our communities and support job creation and economic growth. Our Government is committed to ensuring that Ontario sees the benefits of research discoveries, like those made at Ontario Genomics, through healthcare innovations, economic growth and employment opportunities.

The Government of Ontario recognizes the impact genomic research and technology has on our province and people, as the sector creates over 20,000 highly skilled jobs, generates over \$2.7 billion in investments and has contributed over \$1.8 billion to Ontario’s economy. Ontario Genomics presents unique value for Ontario’s graduates by providing critical experiential learning opportunities to develop the talent and skills necessary for the jobs of today and tomorrow.

As we reflect and celebrate Ontario Genomics’ successes over the past two decades, I look forward to seeing your organization grow and am confident that Ontario’s genomic technology sector will continue to make impactful breakthroughs in research across our province and beyond.



*The Government of Ontario recognizes the impact genomic research and technology has on our province and people, as the sector creates over 20,000 highly skilled jobs, generates over \$2.7 billion in investments and has contributed over \$1.8 billion to Ontario’s economy.*

# 20 Years of Leadership

## A Message from Our Board Chair, Dr. Deborah Stark



*There is a global bio-revolution underway. Ontario's unique expertise and tremendous networks can help transform life as we know it*

Year after year Ontario's genomics research community delivers practical solutions across sectors such as health, agriculture and agri-food, bioproducts, and natural resources and the environment. The result is enhanced economic growth and improved quality of life for people in Ontario, Canada and around the world.

Ontario Genomics 2020 annual report, "A Living Revolution," reflects on our 20-year contribution to this incredible research and commercialization eco-system.

For two decades, Ontario Genomics has been a catalyst for public-private partnerships between industry, start-up companies and research institutes, creating over 20,000 direct and indirect jobs across sectors and in every corner of the province. Our leadership and foresight have ensured that Ontario remains globally competitive in biotech and life science innovations.

The report also challenges us all to do more. As events this past year have shown us, there is a global bio-revolution underway. Ontario's unique genomics expertise and tremendous networks can help transform life as we know it by helping to:

- Diagnose diseases more quickly and less invasively;
- Improve agricultural yields and produce safer, more nutritious food more sustainably;
- Transform traditional manufacturing and processing technologies;
- Find solutions to environmental challenges; and
- Address COVID-19 and post-pandemic economic recovery challenges.

I extend my sincere thanks to OGs hard-working staff and management, our research community, our many stakeholders and partners, as well as my fellow board members for their unwavering efforts and commitment to bring the benefits of genomics innovations to life. It has been a privilege to serve on the Board of Directors over the past three years.

I know that the best is yet to come, and I can feel the energy and the excitement as we live this revolution together.

## A Message from Our President and CEO, Dr. Bettina Hamelin

This year has brought unprecedented challenges, for both our healthcare system and the economy, locally and globally. Now, more than ever, the promise of genomics and converging sciences, including engineering biology, is bringing tangible solutions and unparalleled hope. Fuelled by a global race to solve the world's most pressing challenges, genomics technologies and tools that impact our everyday lives are transforming and evolving at an exponential pace.

Over the course of this ongoing global health crisis, Ontario Genomics has stepped up to help fully utilize Ontario's genomics technologies and talent for local and global solutions. The ONCoV Genomics Coalition, led by Ontario Genomics is working to expedite viral and host sequencing to inform public health and public policy, help manage and overcome the ongoing COVID-19 crisis and ensure scalability for Ontario's future pandemics preparedness.

To say I am constantly inspired by the ingenuity and drive of Ontario's scientific community and our team right here at Ontario Genomics is an understatement. Working passionately to make our world a better place, our team is truly living this revolution by building a world-leading genomics ecosystem in Ontario with over \$2.7 billion in funding leveraged for genomics technology development, applied research, and commercialization since 2000.

As Ontario Genomics celebrates its 20th anniversary, we are so proud of our ongoing ability to re-imagine and develop new ideas that support Ontario' industry, researchers, and end-users across our economy. Our work takes the ground-breaking science out of the lab to give Ontario a critical competitive advantage.

As we look to the next 20 years, Ontario Genomics' legacy has readied us to continue to provide impactful leadership and drive made-in-Ontario solutions to accelerate the benefits of genomics and exponentially bolster Ontario's collective strengths. We have a real opportunity to work together to transform and reinvigorate Ontario's economy with the power of biotechnologies.

I look forward to continuing to work with all of you to continue to realize our vision of healthy people, a healthy economy, and a healthy planet for generations to come.



*Now, more than ever,  
the promise of genomics  
and converging sciences,  
including engineering  
biology, is bringing  
tangible solutions and  
unparalleled hope.*



# A Year in Review 2019-2020

*We bring the right researchers together with the right partners at the right time.*

We lead the application of genomics-based solutions across key sectors to drive economic growth, improve quality of life and foster global leadership in Ontario. Ontario Genomics connects scientists, ideas and partner organizations for collaborative investment opportunities in genomics technologies. Learn more about how we collaborate with multiple stakeholders to achieve our goals.

# 20 Years of Impact

Since 2000



**\$2.7B+**

Return on Innovation



**\$1.8B+**

GDP Growth Supported  
(Since 2013)



**\$345M+**

Active Portfolio (2019-  
2020)



**\$1.27B+**

Funds Raised



**20,000+**

Jobs Created



**230+**

Projects



**500+**

Partnerships



**\$1.34B**

Follow-On Investments

## Social Media Metrics During Fiscal 2019-2020

Our impact across social media platforms including Twitter & LinkedIn



**7,750**

Followers

**7,176**

Profile Visits

**2,257**

Engagements

**389k**

Impressions

# Success Across Sectors 2019-2020



*“Breeding animals resilient to heat stress and other environmental challenges exacerbated through climate change is a very important goal that will ensure a safe and sustainable food supply in a changing environment.”*

*Dr. Christine Baes, Assistant Professor at the University of Guelph & Canada Research Chair at Livestock Genomics*

## Agriculture and Agri-Food: A Thriving and Resilient Dairy Cattle Industry

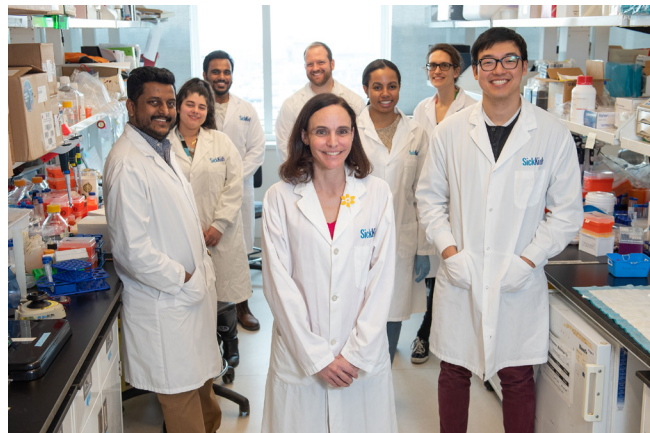
Canada is the world's fifth largest exporter of agricultural products. Canadian farmers are poised to play a decisive role in meeting the 70% increase in world food demand expected by 2050. Dairy cow growth, milk production, and reproduction, as well as their overall health and welfare, can be strongly influenced by changes in air temperature, humidity, and other environmental factors, including climate change. Genetic selection plays an essential role in breeding livestock to better cope with rapidly changing climate and environmental factors. In collaboration, Semex Alliance and the University of Guelph will provide innovative methods to select the right genetic traits to breed robust dairy cows that are resilient to environmental stressors, such as extreme hot or cold temperatures while maintaining health, production, and reproductive efficiency. This proof-of-concept project integrates phenotypic data collected using automated sensor technologies with high-throughput genotypes of dairy cows. By applying genomics-derived processes for identifying healthy, fertile, resilient animals for use in genomic selection programs, this project strengthens Ontario's dairy sector leadership and provides opportunities for large-scale application in Canada and around the world.



*Dr. Christine Baes, Assistant Professor at the University of Guelph & Canada Research Chair at Livestock Genomics*

# Health: Precision Medicine to Improve Diagnoses and Treatment of Pediatric Cancers

The past decade has seen many high-impact, genomics-driven discoveries that have ushered precision medicine as an emerging treatment for pediatric cancer. Pediatric tumours have a different genetic make-up and fewer actionable molecular targets than adult tumours, therefore precision oncology designed for children promises to greatly improve survival. There is currently a disconnect, with diagnostic analysis at the DNA level and oncology drugs targeting specific molecular targets at the protein level, leading to response rates of 15-20%. Therefore, there is a pressing need for novel diagnostic tests that examine all levels of cellular information - protein, RNA, and DNA — to accurately guide therapeutic decisions. The Hospital for Sick Children and US-based NanoString Technologies have collaborated to develop next-generation molecular tools for characterizing children’s cancer. This technology interrogates DNA, RNA, and protein simultaneously, providing better analysis of the patient’s cancer and the information needed to determine the personalized care and accurate assignment of the best class of drugs for each patient. By delivering essential information in a targeted, cost-effective, and timely manner, this diagnostics solution for pediatric cancers will benefit patients, the regional economy, and the healthcare system. This technology also has the potential in the future as a diagnostic tool for adult cancers. In a previous, successful GAPP project involving the same partners, their commercialized pediatric low-grade glioma (pLGG) and sarcoma tests were recently licensed by the Ontario Ministry of Health and the intellectual property (IP) has been licensed to Singapore and Hong Kong, with interest from Brazil as well. The work performed has created an evidence base for these tests and has resulted in over \$1M in instrument and consumable sales for NanoString.



*Dr. Cynthia Hawkins, Senior Scientist & Principal Investigator, The Hospital for Sick Children*

*“Our lab is dedicated to improving outcomes for children with cancer. This project will enable us to better predict which drugs will work best for each child’s cancer.”*

*Dr. Cynthia Hawkins, Senior Scientist & Principal Investigator, The Hospital for Sick Children*





*“At Ardra, we are harnessing the power of engineering biology to solve pressing problems in sustainable supply of natural ingredients.”*

*Pratish Gawand, CEO & Co-founder, Ardra Bio, Inc.*

## Bioproducts: Manufacturing Petroleum-Free, High Purity Sustainable Ingredients



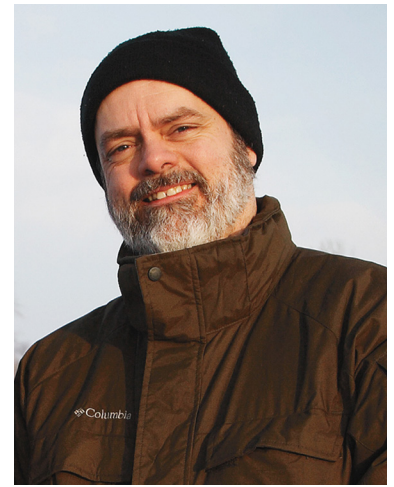
*Pratish Gawand, CEO & Co-founder, Ardra Bio, Inc.*

Products made from natural ingredients is the fastest-growing segment in the cosmetics and food industry. However, these industries are dominated by petrochemical-derived ingredients as opposed to natural ingredients. This is because the supply-chain of natural ingredients is highly unreliable. Natural ingredients are extracted from botanical raw materials, making their supply unpredictable, high-priced, and with undesirable attributes such as seasonal variation. Ardra is an engineering biology company producing natural ingredients using fermentation. Ardra's platform uses designer biochemical pathways to produce a portfolio of high-value natural ingredients using renewable raw

materials such as sugars. Ardra's ingredients have lower production cost, consistent quality, and are free of harmful residues that may be found in petroleum-derived synthetic ingredients. The investment from Ontario Genomics has helped Ardra advance its lead product - Natural Leaf Aldehyde: apple flavour ingredient used in the beverage industry. The investment enabled Ardra to scale-up its process from bench to pilot, thereby producing samples sold to and validated by potential customers. Ardra is currently engaged in the scale up of the process to demonstration trial and is in discussion for co-development partnerships to commercialize the process.

# Natural Resources and Environment: Environmental DNA Toolkit for Detection and Identification of Canadian Freshwater Fish

Freshwater fish contribute to Canada's economy both directly and indirectly and are critical for the preservation of freshwater resources and food security. Thriving freshwater fish resources are the lifeblood of many rural, northern, and Indigenous communities and are central to the social and cultural lives of millions of Canadians. Yet, over 25% of Canadian freshwater fish stocks are under threat. The logistical difficulties of monitoring fish in Canada's 2+ million lakes and countless rivers are compounded by the limitations of conventional sampling methods, which provide only a snapshot. This project will use genomic approaches to develop a Fish Survey Toolkit based on environmental DNA from water samples and a Fish Health Toolkit that will provide quantitative assessments of the health of fish and the stressors they face. Collectively, these toolkits will enable a complete and accurate assessment of the status of Canada's freshwater fish resources, save millions of dollars in fish survey costs, and result in additional indirect savings through more effective and directed management actions. Furthermore, and most importantly, the project will ensure the sustainability of Canada's freshwater fish resources for future generations.



*Dr. Daniel Heath, Professor,  
University of Windsor*

*"The GEN-FISH network consists of 24 committed and dedicated scientists who care passionately about the freshwater fishes of Canada and around the world. The GEN-FISH funding will ensure the development of novel, ground-breaking genomic technology to help conserve freshwater fish for generations to come."*

*Dr. Daniel Heath, Professor, University of Windsor*



# All Funded Projects 2019-2020

SECTOR	PROJECT TITLE	ORGANIZATION(S)	LEADER(S)	TOTAL FUNDING
<b>ONTARIO REGIONAL PRIORITIES PARTNERSHIP PROGRAM (ON-RP3)</b>				
Agriculture and Agri Food	A genomics-derived assay for rapid determination of Eimeria spp. oocyst viability: Improving coccidiosis management in the poultry industry	Ceva Animal Health, Inc.	John R. Barta, Jennifer Brisbin	\$366.628
Agriculture and Agri Food	Metabolomic-based strain selection of microbial bioinoculants which alleviate impacts of drought stress in crops	NutriAg	Neil Emery, Kelly Tanaka	\$ 358.250
Agriculture and Agri Food	Genomics tools to reduce sow stress and improve piglet survival and overall performance	Alliance Genetics Canada	Ray Lu, Dave Vandebroek	\$480.001
Agriculture and Agri Food	Using New Emerging Genomic Tools to Improve Soybean Yield and Seed Compositions in Ontario	SeCan	Mehrzad Eskandari, Jeff Reid	\$180.000
Agriculture and Agri Food	Development of an omics-driven beer yeast performance database to support the Ontario craft brewing industry	Escarpment Yeast Laboratories	George van der Merwe, Richard Preiss	\$366.165
Agriculture and Agri Food	Introducing cold tolerance in hazelnut	Ferrero Canada	Praveen Saxena, Barbara Yates	\$274.058
Agriculture and Agri Food	Application of genomic-based technologies to improve the rate of genetic gain in Ontario winter wheat breeding	Grain Farmers of Ontario	Elizabeth Lee, Joshua Cowan	\$400.000
Agriculture and Agri Food	Precision fertility and resiliency phenotyping in dairy cattle	Semex Alliance	Christine Baes, Michael Lohuis	\$499.899
				<b>\$2,925.001</b>
<b>GENOMICS IN SOCIETY INTERDISCIPLINARY RESEARCH TEAMS (GiSIRT)</b>				
Health	Canadian Network for Learning Healthcare Systems and Cost-Effective Omics Innovation (CLEO)	BC Cancer Agency	Dean Regier, Timothy Hanna, Tania Bubela	\$234.404
Environment	The Role of Genomics in Fostering and Supporting Arctic Biodiversity	University of Calgary	Maribeth Murray, Peter Pulsifer	\$109.962
Agriculture and Agri Food	Barriers and Opportunities for Commercialization of Gene-Edited Beef and Dairy Products	University of Guelph	Mike von Massow, Daniel Weary, Michael Lohuis	\$1,429.940
				<b>\$1,774.306</b>

SECTOR	PROJECT TITLE	ORGANIZATION(S)	LEADER(S)	TOTAL FUNDING
<b>GENOMICS APPLICATIONS PARTNERSHIP PROGRAM (GAPP)</b>				
Health	Validating and Improvement of in silico Proteome Screening and Drug Design Technologies by Experimental Drug Discovery	Cyclica, Inc.	Angus McQuibban, Zheng (Arthur) Li	\$2,303.527
Health	Beyond Genomics: Assessing the Improvement in Diagnosis of Rare Diseases using Clinical Epigenomics in Canada (EpiSign-CAN)	London Health Sciences Centre (LHSC)	Bekim Sadikovic, Marco Raposo, Peter Graf, Mike Kadour	\$4,785.831
Health	Targeting fungal stress responses to provide first-in-class treatment for drug-resistant fungal pathogens	Bright Angel Therapeutics	Leah Cowen, Luke Whitesell, Dominic Jaikaran	\$5,994.687
Agriculture and Agri Food	Strain development for butanol process addition to existing biodiesel plants	World Energy Hamilton (BIOX)	Lars Rehmann, Nak Paik	\$796.500
				<b>\$13,880.545</b>
<b>LARGE-SCALE APPLIED RESEARCH PROJECT COMPETITION (LSARP)</b>				
Agriculture and Agri Food	Integrating genomic approaches to improve dairy cattle resilience: A comprehensive goal to enhance Canadian dairy industry sustainability	University of Guelph	Christine Baes, Paul Stothard, Ronaldo Cerri, Marc-André Sirard	\$4,140.812
Agriculture and Agri Food	4DWheat: Diversity, Domestication, Discovery and Delivery	University of Saskatchewan	Curtis Pozniak, Sylvie Cloutier	\$1,652.019
Agriculture and Agri Food	BeeCSI: 'Omic tools for assessing bee health	York University	Amro Zayed, Leonard Foster	\$9,922.053
Agriculture and Agri Food	GEN-FISH: Genomic Network for Fish Identification, Stress and Health	University of Windsor	Daniel Heath, Margaret Docker, Stephan Cooke	\$9,077.272
Agriculture and Agri Food	FISHES: Fostering Indigenous Small-scale fisheries for Health, Economy, and food Security	Université Laval	Louis Bernatchez, Jean-Sébastien Moore, Dylan J. Fraser, Stephan Schott	\$2,111.728
				<b>\$26,903.884</b>
<b>Total Funding Received for 2019-2020</b>				<b>\$45,423.736</b>

# 20 Years of Community Engagement

## Genomics At The Tipping Point

### GENOMICS AT THE TIPPING POINT

#### Partnering to Accelerate Market Uptake & Impact



Ontario Genomics

December 5, 2019  
Toronto, ON

On December 5, 2019, Ontario Genomics hosted its second annual symposium: Genomics at the Tipping Point. This sold-out event connected and supported Ontario's policymakers, businesses, investors, and research communities working towards a common goal - to advance genomics technologies to solve real-world problems.

The symposium speakers and panellists showcased growing genomics talent and technologies across key sectors - agriculture and agri-food, health, engineering biology, and natural resources - in Ontario and beyond. Participants learned about the ground-breaking, world-leading genomics technologies cultivating in our own backyard and took part in our growing genomics community of practice.

Bettina Hamelin, President and CEO of Ontario Genomics, explained that the symposium was organized to cross-pollinate between sectors and disciplines, foster highly functioning collaborations, and open new partnership opportunities. "There is a lot of potential in Ontario – scientific expertise, stakeholders along the value chain – partnerships and networks are essential for success; academic institutions must partner with industry as neither side can do it alone. Innovation occurs through strategic partnerships by bringing together all elements necessary for success, but there must be support from all partners at the executive level."

In a keynote address, Steve Webb, CEO & Executive Director of Global Institute for Food Security, shared his insights on partnerships and innovation. He believes that Canada can lead in agricultural innovation, but our success needs to be better shared with the public. Steve Webb explained that Canada ranks ninth for flowing funds into agricultural innovation but is in 22nd place for outputs and 61st place for efficiency. He concluded by saying regulations and long product development timelines are slowing us down, "regulations need to support not hinder innovation."

The first session **Homegrown Success: Ontario's Genomics Industries Growing Our Economy**, began with four talks from industry representatives

- Sandra Dworatzek, Principal Scientist at SiREM, talked about providing homegrown innovative solutions for onsite remediation. Access to sustainable and low-cost remediation would decrease environmental liabilities, lower costs, allow for long-term environmental protection, and protect the ecosystem and human health.
- Michael Lohuis, VP Genetics R&D at Semex, explained the importance of bringing innovations through the regulatory pathway to ensure their safety and get them to market quickly.
- Sheila Singh, Co-founder of Empirica Therapeutics, stated, “The brilliance of the science is clear; the impact is getting those things translated and commercialized.”
- Martin Bloomberg, President of NutriAg, gave a broad perspective on how we need to usher in products and innovations that change how plants take up nutrients to get the most benefits.

The second session, **Attracting Foreign Investment: Ontario's Genomics Technologies for the Global Market**, reinforced and built off on the themes raised during the previous session.

- Pratish Gawand, CEO and Co-founder of Ardra Bio Inc., spoke about how patents are the currency for investors.
- Peter McCourt, Chief Scientist of Ascendant Laboratories, touched upon how Canadian markets should capitalize on opportunities to build evidence and revenue to attract foreign investment.
- Bekim Sadikovic, Head of Division at London Health Sciences Centre, spoke about healthcare – “Ontario has more capacity and expertise than any large genetic company in the world – if we could get organized, we would be unstoppable.”
- Julie-Anne Tanner, Medical Science Liaison at Myriad Neuroscience, explained that reducing red tape is key for innovation and market success.

The afternoon keynote address by Shiva Amiri, Director, Research Infrastructure at 23andMe, touched upon revolutionizing healthcare and drug discovery using genomics data. Shiva Amiri discussed the importance of genomic data storage for advancements in research and therapeutics. Additionally, she spoke about how genetic results can trigger behaviour change in consumers that were told that they are at risk for specific health issues, opening new avenues for timely precision health management.

The ensuing panel discussion was an insightful conversation about **Transforming Our Healthcare System Through Ontario's**





### Precision Medicine Expertise.

- Christian Marshall, Co-Director of the Centre for Genetic Medicine at SickKids, shed light on the silos in the rare disease sphere and how data obtained from genome-wide testing could help reduce time and costs for diagnosis.
- Felix Ratjen, Head and Senior Scientist of Translational Medicine at SickKids, reinforced the importance of research translation and precision medicine, “A paradigm shift can be ushered in where instead of prescribing the same treatment to everyone, only the patients that will respond to the treatment based on prediction models will be prescribed, increasing effectiveness.”



### The final series of talks and panel discussions focused on **Leading Momentum to Advance Biomanufacturing in Ontario.**

- Bettina Hamelin shed light on the capacity of engineering biology tools to transform global markets. “ Now is the time for Ontario and Canada to leverage its tremendous advantage and capacity to collaborate across sectors to participate in the Fourth Industrial Revolution and the global bio-economy market. To further this vision, we launched CanDESyNe - the gateway to Ontario and Canada's industry-led engineering biology-enabled bio-manufacturing and biotechnology ecosystem.”
- Adrien Côté, Executive Director at Velocity, affirmed the need for Canada to fund emerging biomanufacturing areas to keep pace with other jurisdictions.
- Robert Deans, Chief Technology Officer at BlueRock Therapeutics, emphasized the importance of infrastructure and partnerships to move engineering biology innovations forward.
- Sheena Holt, Operations Manager, IGPC Ethanol Inc., reinforced the need for collaboration and increased venture capital funding to help grow companies and move technology forward.



The symposium brought many sectors together – linked by the power of genomics and shared learning that success comes from strong partnerships fueled by relationships between people with the right expertise and the best skill sets to leverage each other’s strengths.

Ontario Genomics prioritizes its role in facilitating these critical partnerships. By connecting people, ideas, and organizations, we can strengthen our collective networks and realize the ground-breaking potential of genomics technologies in Ontario and worldwide.



# Can-DESyNe

## *Canadian DNA Engineering Systems Network: The gateway to Canada's industry-led engineering biology-enabled bio-manufacturing and biotechnology ecosystem.*

By building the Can-DESyNe ecosystem, we can leverage and connect existing and new regional and sector-specific resources, multinationals, established SMEs, innovative start-ups and academic expertise to establish Canada as a global leader in novel, industrial scale advanced bio-manufacturing technologies and biotechnologies that will benefit numerous end users.

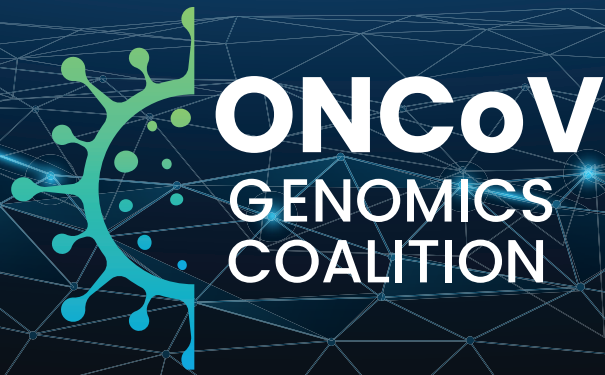
The ecosystem will focus on three sectors, namely industrial biotechnology, agriculture and agri-food, and health and biosciences, selected for, 1) industry/market pull; 2) existing pan-Canadian initiatives spanning research to commercialization TRL levels, 3) urgent requirement and imminent opportunities for sustainable alternatives to traditional manufacturing technologies, 4) economic and societal importance to Canada and Canadians. Fundamental elements required to establish Canada as a leader through the National Engineering Biology steering committee-enabled, sustainable bio-manufacturing and biotechnology ecosystem are:

1. **Strengthening Canadian Advantage:** a technology adoption & infrastructure network will link existing engineering biology technology facilities to expedite access to expertise, tools, technologies, resources and training.

2. **Driving Innovation:** driven by industry, Can-DESyNe partners will co-develop a suite of flexible programs to feed the technology pipeline.
3. **Translation to Commercialization:** products and/or processes will be moved forward via Can-DESyNe collaborations and consortia, for technology implementation and industrial scale up. Start-ups will benefit from international accelerator programs and a dedicated landing pad.
4. **Regulation and Outreach:** establishing global leadership for regulatory frameworks and pathways to adoption.
5. **Training and Mentorship:** integral to all activities and enriched by 16 Canadian undergraduate iGEM teams.

### **GOVERNANCE**

Can-DESyNe will operate distinctly from Genome Canada by administration through a newly created engineering biology Centre of Innovation and Entrepreneurship (CIE). The CIE, National Engineering Biology Steering Committee, Genome Canada Enterprise and key Partners will define the governance necessary for transparent and fair decision-making for project selection and intellectual property (IP) ownership.



Genomic technologies are foundational to combat the ongoing COVID-19 pandemic. Ontario Genomics has brought together Ontario's world-leading experts in genomics to form the ONCoV Genomics Rapid Response Coalition, leveraging the power of sequencing, bioinformatics, genomics epidemiology, and artificial intelligence to expedite Ontario's response to COVID-19. The ONCoV Genomics Coalition enables all partners to engage and leverage expertise, networks and funding.

## **MISSION**

The Coalition's mission is to accelerate the genomic characterization and surveillance of SARS-CoV-2 in Ontario and to expedite patient genome sequencing. Through a coordinated approach, we gather all of Ontario's genomics resources and capacity to enable real-time and comprehensive genomic analysis and reporting to inform public health policy. This work will oversee the development and implementation of processes and tools to link host and viral sequence data with patient data, help manage and overcome the ongoing COVID-19 crisis and ensure scalability and preparedness for Ontario's future pandemics. It will also lay the groundwork to understand COVID-19 disease processes and to develop treatments and vaccines in collaboration with national and international COVID-19 initiatives.

## **BACKGROUND**

### **HARNESSING ONTARIO'S WORLD LEADERSHIP IN GENOMICS**

There is incredible genomics, data and artificial intelligence strength and capacity in Ontario that, if mobilized in a strategic and coordinated way, can expedite Ontario's response to COVID-19 to keep people safe at home, work and school. Ontario Genomics recognizes that these capabilities need to be aligned to respond quickly, integrate sharing and inform decision-making, leverage resources and avoid duplication, redundancy, and siloes. To fully mobilize all of Ontario's genomics community and resources, Ontario Genomics has facilitated the ONCoV Rapid Response Coalition (the "Coalition"). The Coalition brings together over 30 academic, industry and government partners. It serves

as a nucleus to expedite immediate access to existing and new bioinformatics and genomics infrastructure, tools and reagents within the province, enable data access and sharing as well as a coordination and standardization framework for the entire viral sequencing workflow including patient sample collection, viral RNA extraction, genome sequencing, bioinformatics analysis, and data quality standards, while providing a knowledge transfer mechanism to ensure key outcomes are communicated to public health officials and clinicians. It also ensures Canada-wide alignment and coordination and allows us to leverage and deduce Ontario-specific learnings from the combined strengths of national (including CanCOGeN) and international sequencing efforts.

## APPROACH AND OBJECTIVES

The Coalition works under a governance structure which includes a Steering Committee and subcommittees for method standardization and coordination of:



Patient samples and metadata



Viral and host sequencing



Data curation and management



Epidemiological studies  
(Including tracking transmission and evolution of the virus.)

To achieve the above objectives, the work of the Coalition is directed to the following activities:

### 1. STANDARDIZED AND COORDINATED COLLECTION AND DOCUMENTATION OF PATIENT SAMPLES

Patient samples will be collected in a standardized and coordinated way to include inpatients and assessment centre ambulatory patients across Ontario. Sample collections will include respiratory viral RNA with paired host DNA, where possible. Appropriate consent protocols will be followed. Collection sites across the province will be supported to obtain basic and targeted deeper patient metadata collection. The latter will be obtained through chart review and/or consented recontact of patients.

### 2. VIRAL SEQUENCING CORES

Using the expertise and capacities of the OICR/CDIC, McMaster University and the Ontario Health Sciences SARS-CoV-2 Sequencing Network (ONS2) and Public Health Ontario, the Coalition will optimize workflows and enhance frontline capacity to ensure rapid turnaround times, essential to inform decisions for immediate impact. This strategy will build frontline genomics capacity for the duration of the COVID-19 outbreak.

### 3. VIRAL GENOME DATA COORDINATION CENTRE

The CDIC, OICR and McMaster University teams will create central data coordination centres for viral genome sequencing data. This will establish and enforce metadata standards, enable best-practice analysis workflows and harmonize the data and results. The group will also provide data portals for users and coordinate sharing of the Ontario dataset with national and international data-sharing initiatives. The Coalition works under a governance structure which includes a Steering Committee and subcommittees for method.

### 4. CORE DATA ANALYSIS FOR REAL-TIME FEEDBACK LOOPS TO PUBLIC HEALTH

Real-time viral sequencing is instrumental to answer key questions that inform public health and public policy decisions. Coalition epidemiological studies will include the characterization of viral evolution, transmissibility, virulence, reinfection potential and local spread, regionally and provincially and will have a particular focus on the prediction of outbreaks including in specific populations such as those at higher risk.

### 5. LINKING GENOME AND PATIENT DATA THROUGH A COORDINATED APPROACH

The group will develop and implement processes and tools that link viral and host sequencing data with Ontario's rich patient data housed at frontline institutions, Public Health Ontario, IC/ES and the newly established Ontario Health Data Platform.

### 6. ENABLING TECHNOLOGY DEVELOPMENT

The coalition will function as a nucleus for technology development in Ontario's universities and start-up community. This work will include:

- a) Rapid and cost-effective genomic detection capabilities and diagnostics
- b) Therapeutic and preventative treatment paradigms enabled by genomics

This will be achieved by providing expert advice and clinical samples for technology testing and validation, as well as funding opportunities.

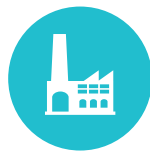
## COLLABORATIVE ADVANTAGE

The Coalition will offer numerous benefits to its members and partners that support the fight against COVID-19. These include large-scale access to research and innovation potential, funding leverage and connectivity beyond Ontario into the Canadian COVID-19 Genomics Network and international initiatives. Specific benefits include:



### GOVERNMENT

- Increased testing capacity through Ontario's collective organizational and institutional research and innovation power
- Comprehensive genomics data to inform public health countermeasures to control the pandemic and safely reopen the economy
- Enriched Ontario Health Data Platform through linkage to genomics data for COVID-19 and other diseases
- Development of medical treatments and preventive vaccines for COVID-19 and future pandemics
- Preparedness for future pandemics by a network of Ontario's foremost genomics and data experts
- Facilitation of commercialization and job growth by creating a nucleus for clinical validation for made-in-Ontario technologies



### INDUSTRY

- Access to Ontario's COVID-19 and infectious disease research leaders
- Enriched pipeline opportunities through access and collaboration with research projects to de-risk investments
- Access to members that can validate COVID-19 technologies
- Access to coalition members with patient stratification data/cohorts
- Access to clinical trial entry points for vaccines or treatments in Ontario
- Access to a network of Ontario healthcare influencers and thought leaders
- Engagement with Ontario's legislators through participation in Coalition initiatives
- Access to exclusive seminars on new COVID-19 discoveries



### COALITION MEMBERSHIP

- Become part of a network of Ontario's COVID-19 and infectious diseases research leaders
- Inform the Coalition's direction to ensure validity and usefulness for Ontario's patients and public health decision-makers
- Collaborate, co-create and publish ground-breaking research
- Promote research impact through a variety of digital media platforms
- Access to expertise for study and/or technology design and validation
- Enhance data access through collaborative data sharing
- Access to shared genomics and surveillance resources

# Board of Directors



The primary mandate of Ontario Genomics' Board of Directors is to provide strategic insight and operational governance. The Board comprises leaders from Canada's life science sector, including not-for-profit research and education institutions, agriculture, food, bio-economy, pharmaceutical and biotechnology enterprises, financial entities, public policy centres, and government. Through quarterly meetings, the Board

aims to fulfill Ontario Genomics' guiding principle promoting world-class research, creating strategic genomics resources and advocating the development of a globally competitive life sciences sector. The Board members' time and expertise are essential to our ongoing success and future direction, and we are grateful for their contributions.

## **BOARD MEMBERS:**

- Deborah Stark (Chair)
- Tom Corr (Vice-Chair)
- Stephen Cummings
- Jack Gauldie
- Diane Gosselin
- Colin Kelleher
- John Kelly
- Mark Lundie
- Alex MacKenzie
- P. Alison Paprica
- Benjamin Rovinski
- Alan Winter

## **OBSERVERS:**

- Rob Annan – President & CEO, Genome Canada
- Katherine Kelly Gatten – Director, Science & Research Branch, Ministry of Colleges & Universities
- Mark Lehman - Regional Director General (Ontario), Innovation, Science and Economic Development Canada

# Timeline

**2000**

## Ontario Genomics

### 2000: Ontario Genomics Established

Ontario Genomics was created to stimulate, enable and nurture genomics innovation in Ontario. We are a catalyst for developing and applying genomic technologies across key sectors to drive economic growth, improved quality of life and global leadership for Ontario. Our first year of operations yielded 14 successfully funded projects, totaling \$118 million in investment.

## Global Event

### 2000: Revolutionizing the Understanding of Human Genomics

While the first draft of the Human Genome Project is unveiled, the entire genome sequence of one of the first model organisms of genetics, the fruit fly is released. Both these ground-breaking discoveries revolutionize our understanding of human genomics.

**2001**

## Ontario Genomics

### 2001: Annotation of Human Chromosome 7

Chromosome 7 contains many genes crucial to development, carries the cystic fibrosis gene, and is often found damaged in some types of leukemia and other cancers. This project resulted in the publication of a seminal manuscript, describing an accurate DNA sequence and annotation of the entire human chromosome 7.

Related Developments (link to 2003).

## Global Event

### 2001: Canada's Chromosome: Uncovered

An Ontario research team annotates and sequences Chromosome 7, now known as "Canada's chromosome" in tribute to the related disease findings by Canadian scientists. This leads to uncovering structural features such as imprinted genes, fragile sites, and segmental duplications enabling the discovery of candidate genes for developmental diseases including autism.

Related Developments (Link to 2004)

**2002**

## Ontario Genomics

### 2002: Cystic Fibrosis: Mapping the Genes

The more we know about the genes that underlie disease, the more skillfully we can devise treatments. This cystic fibrosis project utilized sophisticated genetic techniques to identify ~100 genes that could affect the progression of the diseases and resulted in the creation of the world's largest repository of family-based cell lines for clinical-genetic studies.

## Global Event

### 2002: Creation of First Ever Virus with a Synthesized Genome

Virologists at the State University of New York create the first lab-made virus - Poliovirus, through widespread high-throughput sequencing and computationally driven interpretation. With its entire genome synthesized from scratch, this helps researchers understand viral disease progression which is a critical step to effective vaccine development.

# 2003

## Ontario Genomics

### 2003: Decoding Neurological and Behavioural Disorders

There is individual variability in the structure and copy number of genes located at specific genomic regions which have been connected to numerous disorders. This first of its kind study, accurately characterized these segmental duplications and helped gain further understanding on their role in neurodevelopmental, neurological, and behavioral disorders.

Related Developments ([link to 2008](#))

## Global Event

### 2003: Structural Genomics Consortium Established

The completion of the Human Genome Project inspires the founding of the Structural Genomics Consortium for the advancement of Canadian genomics by studying proteins to decode the functions and disease relevance of all proteins encoded by the human genome.

# 2004

## Ontario Genomics

### 2004: Molecular Test to Predict Colon Cancer Susceptibility

In Canada, there are an average of over 26,900 new cases of colon cancer each year: 9,700 of those result in deaths. To improve early detection and clinical intervention, the ARCTIC project team developed a molecular test to predict peoples' genetic susceptibility to colon cancer.

## Global Event

### 2004: Discovery of Genomic Copy Number Variants

Dr. Stephen Scherer's pioneering discovery of genomic copy number variants and his work on chromosome 7 opens a new window for studies of natural genetic variation, evolution, and disease.

Related Developments ([Link to 2008](#))

## Industry Spotlight

### 2004: Investing in DVS - Gamechangers in Life Science Innovation and Technology

DVS provides multi-omics solutions to deliver new insights in health and disease. Ontario Genomics was one of the first to invest in this spin-out company which was recently acquired by Fluidigm for \$207.5 million. DVS' Ontario site, now Fluidigm Canada, is a provider of industry-leading biotechnology tools, collaborating with researchers around the world to mount an aggressive and sustainable response against the COVID-19 pandemic by enabling research for SARS-CoV-2 virus detection and the monitoring.

# 2005

## Ontario Genomics

### 2005: Canadian Barcode of Life

DNA barcodes use a small fragment of an organism's DNA to identify the species to which an organism belongs. This project developed comprehensive DNA barcode libraries for all the world's birds and fishes, and this DNA-based identification system is now used globally to catalogue and decode the world's biodiversity.

Related Developments ([Link to 2008](#))

## Global Event

### 2005: Canadian Stem Cell Scientists Take the Prize

Toronto scientists, Ernest A. McCulloch and James E. Till receive the Lasker Award for Basic Medical Research for their landmark discovery of transplantable bone marrow that forever changes the face of cancer therapy.

### Ontario Genomics

#### 2006: Alzheimer's Disease: Developing a Diagnostic

Alzheimer's is a progressive disorder that causes brain cells to degenerate and die that results in dementia and disrupts a person's ability to function independently. This project developed a diagnostic assay using molecular and proteomic techniques to detect amyloid protein plaques which are known to cause Alzheimer's and help slow its progression.

## 2006

### Global Event

#### 2006: Illumina's Breakthrough with Next-Gen Sequencing

Illumina, a leading developer, manufacturer, and marketer of life science and genomics tools, launches its first genome analyzer giving scientists the power to sequence 1 gigabase (Gb) of data in a single run — this pioneering technology has since been used to sequence numerous microbe, plant, human, and animal genomes.

### Ontario Genomics

#### 2007: Accurately Predicting Gene Function

A key challenge in disease research is integrating massive amounts of 'omics data to better understand disease mechanisms and their effects on individual patients. This project developed a first of its kind software tool, GeneMANIA to integrate multi-omic data and use machine learning to accurately predict gene function. To this day, this software serves thousands of users in accurately predicting gene function.

## 2007

### Global Event

#### 2007: ChIP-Seq Implemented

Chromatin immunoprecipitation sequencing, ChIP-Seq, one of the early applications of Next-Gen Sequencing, creates the first comprehensive genome-wide map. This establishes the importance of ChIP-Seq in gene regulation and epigenetic studies.

### Ontario Genomics

#### 2008: TCAG: Genomics Powerhouse

The Centre for Applied Genomics provides world-leading infrastructure, technical expertise, and experimental and informatics support for innovative genomics research. Our funding provided TCAG support for their projects across a wide variety of disciplines: human biomedical research, agriculture, fisheries, biopharma research, translational diagnostics, public health, bioinformatics, and many other disciplines.

Related Developments (Link to 2019)

## 2008

### Global Event

#### 2008: International Barcode of Life

The International Barcode of Life is founded in Canada with the vision of developing an accurate, rapid, cost-effective, and universally accessible DNA-based system for species identifications.

Related Developments (Link to 2018)

# 2009

## Ontario Genomics

### 2009: Microbial Bioremediation against Industrial and Agricultural Waste

Today's global economy is based upon the production and use of fossil fuels. However, considering climate change, we are searching for sustainable alternatives. This project developed microbial-based processes to transform, reuse, recycle and remediate contaminants and by-products from common industrial and agricultural processes. They continue to contribute to the sustainability of the biorefineries of the future.

## Global Event

### 2009: Identification of a New Tumour Suppressor Gene

Researchers at the National Institute of Health uncover a novel tumour suppressor gene in melanoma, the deadliest form of skin cancer — furthering potential therapeutic discoveries.

# 2010

## Ontario Genomics

### 2010: Finding Rare Genes in Canada

Rare genetic disorders affect approximately 500,000 children in Canada. Most genes that cause these conditions are undiscovered. Using revolutionary next-generation technology, this Ontario-based consortium allows for rapid gene discovery of rare childhood-onset disorders, with immediate and long-term health benefits for Canadian families. Additionally, it ensures that Canada becomes a world leader in this field.

## Global Event

### 2010: Understanding Human Disease

While the Canadian Structural Genomics Consortium solves its 1,000th protein structure, the J. Craig Venter Institute synthesizes the world's first bacteria with a lab-made genome from scratch. Both these discoveries further our understanding of human disease and management.

# 2011

## Ontario Genomics

### 2011: Exploring Splicing Mis-regulation in Human Disease

In 2003, the complete sequence of the human genome was decoded, however, deciphering the genetic code hidden within the genome has been difficult. This project helped develop a method to identify the instructions comprising a 'splicing code' within the genome. This opened the door to a new major direction of research in the Canadian genomics community.

## Global Event

### 2011: Ancient DNA reveals secrets of human history

International team of genomic scientists who produced the first Neanderthal whole genome sequence are recognized for providing clarity about the extinct relative of modern humans.

### Ontario Genomics

#### 2012: Developing Therapeutics Using Protein Interaction Networks

Integral membrane proteins play a role in many human diseases but are notoriously difficult to study. This research developed a powerful new technology, the Mammalian Membrane Two-Hybrid (MaMTH) assay, which can map protein-to-protein interactions of integral membrane proteins directly in the natural context of the cell. This will advance biomedical research and therapeutic discovery while benefiting Canadian social and economic infrastructure.

### Ontario Genomics

#### 2013: Inflammatory Bowel Diseases (IBDs): Improving Detection and Treatment

IBDs are incurable, debilitating diseases and early detection is critical to avoiding complications. However, there are no tests to determine the presence or type of IBD. This project used cutting-edge technology to develop a simple, non-invasive approach to detect IBD. These diagnostic tests have improved IBD patient outcomes by shortening the time to diagnosis, allowing for treatment to commence sooner and thus reduce complications from untreated disease.

### Ontario Genomics

#### 2014: Cardiovascular Biomarker Testing

Heart failure is the costliest chronic disease in the world. This research developed a better way to identify and classify heart failure by testing novel biomarkers for the disease. This panel assists physicians in earlier identification and classification of heart failure and supports personalized treatment for more effective therapies and better outcomes.

# 2012

### Global Event

#### 2012: Whole Fetal Genome Sequenced Before Birth

Genetic scientists develop the first ever non-invasive prenatal genetic diagnostic technique using cell-free fetal DNA from maternal blood and confirming it with parental genomic sequence information.

# 2013

### Global Event

#### 2013: U.S. Supreme Court Strikes Down Human Gene Patents

In a landmark ruling, the U.S. Supreme Court rules that naturally occurring human genes cannot be patented making the genes accessible for research and commercial genetic testing.

# 2014

### Global Event

#### 2014: Giving Life a Bigger Genetic Alphabet

Microbiologists expand the E. coli genetic code by engineering the bacteria to incorporate two additional letters into their genetic alphabet opening new avenues to create designer proteins which will help solve some of the world's biggest challenges across sectors.

# 2015

## Ontario Genomics

### 2015: Sustainable Fishery in Nunavut

Affordable access to safe, nutritious, and culturally relevant food is one of the biggest challenges facing Nunavummiut, the people of Nunavut. This project integrated traditional and local knowledge with leading-edge genomic science and bioinformatics to gain an understanding of the genomes of these fish populations - allowing for monitoring of their migration and characteristics, to inform strategies and maintain genetically diverse and healthy stocks

## Global Event

### 2015: New Ways to Study Stem Cells in Blood

Canadian scientist, Dr. John Dick discovers new ways to study single cells allowing researchers to explore how abnormal stem cells lead to leukemia and other blood disorders.

## Industry Spotlight

### 2015: Investing in SiREM - Leader in Bioaugmentation and Remediation

SiREM provides the tools environmental professionals need to optimize remediation of chlorinated solvents and other recalcitrant chemicals. As an industry leader, SiREM provides unparalleled technical support, combined with a unique range of products and testing services, that save money and increase the remediation effectiveness of carcinogenic solvents.

# 2016

## Ontario Genomics

### 2016: Increasing Canola Crop Yield

The Canadian canola industry generates \$19.3 billion and nearly 250,000 jobs across the country. This project identified the genetic links of traits that would significantly enhance crop productivity without negatively impacting seed quality. This will enable commercialization of improved plants, with enhanced yields of canola, growing industry revenues by an estimated \$3-4 billion per year.

## Global Event

### 2016: First Human CRISPR Gene-Editing Trial Gets Early Approval

The first ever human genome editing trial receives FDA's green signal to augment immune cells as a potential novel cancer therapeutic avenue.

## Industry Spotlight

### 2016: Investing in Nicoya - Changing the Realm of Biotechnology, Life Sciences, and Healthcare

Nicoya is a leading provider of analytical instruments for the biotechnology and pharmaceutical industries. They're developing breakthrough nanotechnology, biochemistry, and optical sensor technology. Ontario Genomics funded their benchtop instrumentation research that helps study protein and molecular interactions, a critical step for effective drug discovery. They recently raised \$10M in funding to expedite drug discovery and expand to international markets. Nicoya is also developing a portable COVID-19 diagnostic test that will expand testing capabilities in centralized and point-of-care settings.



# 2017

## Ontario Genomics

### 2017: Childhood Arthritis: Precision Therapy

Over 24,000 Canadian children have arthritis that can cause permanent destruction of joints, leading to a life of disability. Evidence shows that early short-term precision treatment can help control the disease, with the possibility to curing it. This project will develop the first genomics-based, low-cost biomarker blood test to rapidly identify the best treatment for each child, thus completely transforming the treatment of childhood arthritis.

## Global Event

### 2017: Wheat Genome Sequenced

A University of Saskatchewan team led by Dr. Curtis Pozniak plays a key role in the completion of the entire genomic sequence of wheat - a complex crop with repetitive sequences and a size of 15 billion base pairs.

## Industry Spotlight

### 2017: Investing in Rapid Novor – World Leader in Antibody Protein Sequencing Technology

Ontario Genomics supports Rapid Novor early in their journey to advance life-science for better human health using next-generation sequencing. Rapid Novor is supporting COVID-19 research with complimentary antibody sequencing for researchers and they recently moved into a new purpose-built, state-of-the-art facility tripling their lab space.

# 2018

## Ontario Genomics

### 2018: Drug Development by Targeting Protein Interactions

Protein-to-protein interactions (PPI) impact many human diseases. This project developed a new, transformative method for studying PPI interactions, called Split Intein-Mediated Protein Ligation (SIMPL), which will accelerate our understanding of cell physiology and disease development and identify new therapies. SIMPL will be commercialized to provide economic and health benefits for Canadians.

## Global Event

### 2018: Ontarian DNA Barcode Centre Catalogues Earth's Biodiversity

The University of Guelph's International Barcode of Life led by Dr. Paul Hebert continues identifying and cataloging DNA barcodes from 600,000 unique species from around the world.

# 2019

## Ontario Genomics

### 2019: BeeCSI: Tools for Assessing Bee Health

Honeybees are crucial to Canada's agriculture and contribute up to \$5.5 billion a year to our economy. However, their health has been declining over the past decade. This project uses genomic tools to develop a new health assessment and diagnosis platform powered by stressor-specific markers. The tools will be made accessible to the beekeeping industry to improve bee health and reduce bee loss contributing positively to our economy.

## Global Event

### 2019: Autism Speaks releases newest MSSNG database

Canada-based MSSNG, the world's largest open-source whole-genome database specific to autism, goes live and offers more tools for researchers to better understand the genetics of autism.

## Industry Spotlight

### 2019: Empirica Therapeutics – Pioneers in Innovative Immunotherapies for Cancers

Ontario Genomics partners with Empirica, a University of Toronto spin-out that uses a powerful functional genomics platform to enable the discovery of precision therapeutics options against the most aggressive and treatment-resistant forms of cancers, including glioblastoma and brain metastasis. The company was recently acquired by Century Therapeutics.

# 2020

## Ontario Genomics

### 2020: ONCoV Genomics Coalition

To accelerate the genomic characterization and surveillance of SARS-CoV-2 in Ontario and expedite patient genome sequencing, Ontario Genomics is bringing together the province's genomics resources and capacity to enable timely and comprehensive analysis of the virus. This will expedite real-time testing and reporting to inform public health and policy, help manage and overcome the ongoing COVID-19 crisis and ensure scalability for Ontario's future pandemics preparedness.

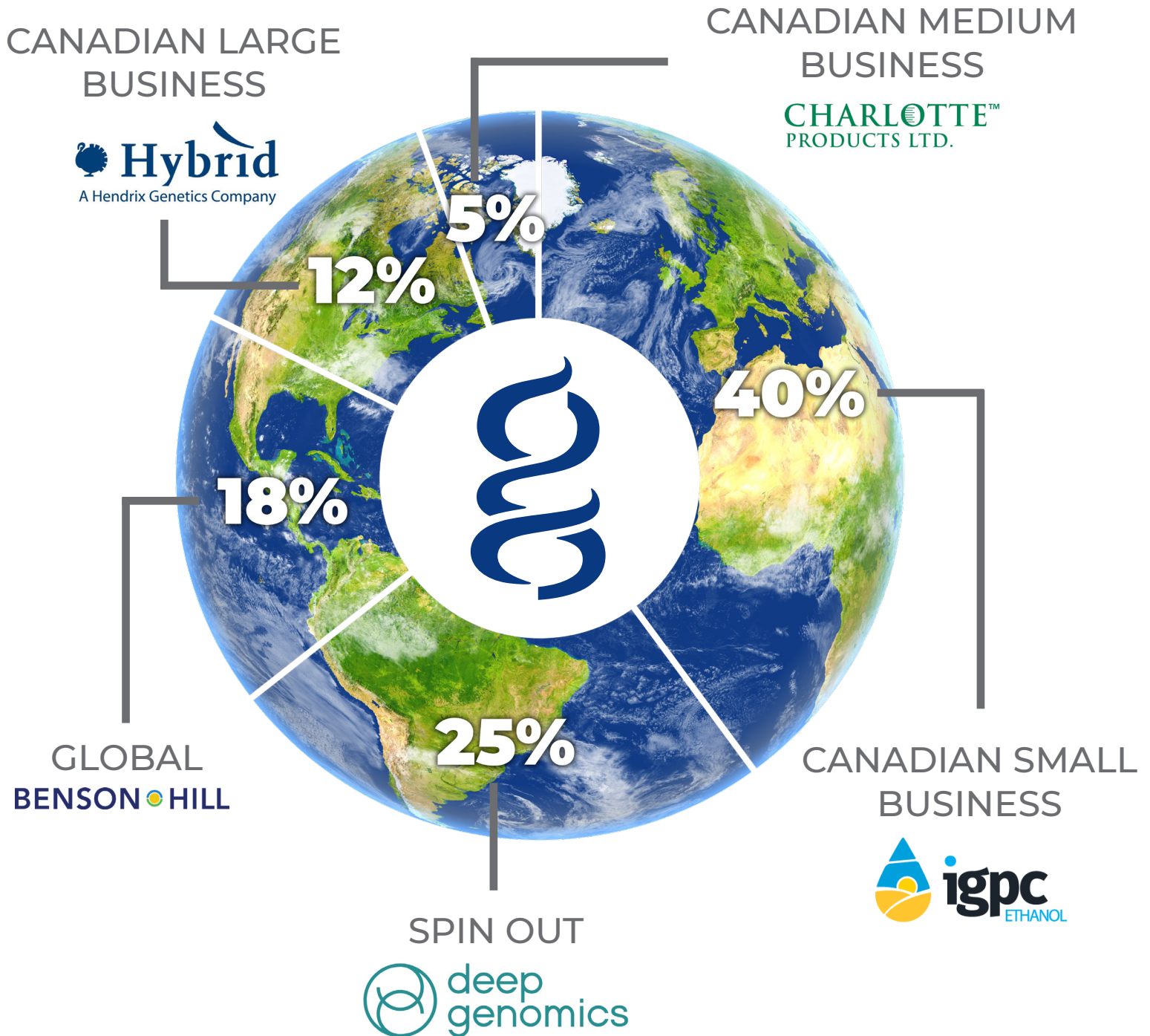
## Global Event

### 2020: A Living Revolution - 2020 and Beyond

Over the last two decades, genomics has witnessed profound transformations as theoretical research finds meaningful multi-sector applications. Single cell analyses and liquid biopsies are changing the face of medical diagnostics, while CRISPR technologies are preparing for an industrial prime-time debut to cure diseases. Researchers and industries now have many of the tools needed to explore the massive systemic complexity of biology that has previously stalled progress to address some of the world's most challenging problems. Furthermore, a landmark judgement by the Supreme Court of Canada, upheld the genetic non-discrimination act, overcoming barriers and opening avenues for widespread participation in genomic studies.

# 20 Years of Supporting Diverse Industries

Over the past 20 years, Ontario Genomics has supported 130 trailblazing companies across multiple sectors. Our network of innovative industries continues to grow and diversify.



## Global: Benson Hill Unlocking Natural Plant Genetic Diversity

The world's population is growing and so is the demand for crops to feed it. Traditional breeding techniques are not sufficient to meet this goal; new technologies are needed. USA-based Benson



Hill empowers innovators to develop healthier, more flavorful, and sustainable food by unlocking the natural genetic diversity of plants. Ontario Genomics' vision aligns with Benson Hill's goal of biodiversity and sustainability for a better food system to empower breeders, farmers, food manufacturers, and consumers, leading to the start of our partnership in 2017. An Ontario Genomics project led by Dr. Peter Pauls at the University of Guelph works with Benson Hill to produce more efficient varieties of canola for Canadian producers. This project would directly impact the canola industry which generates \$19.3 billion and nearly 250,000 jobs across Canada. The results of this project will enable commercialization of the improved plants through licensing and collaborative development agreements. Increasing the yield of the canola crop benefits growers and others across the value chain, growing industry revenues by \$3 to \$4 billion per year. Benson Hill has also established a Canadian subsidiary, Saturn Agrosiences, for this project that will result in newly created jobs for Canadians.

## Canadian Spin Out: Deep Genomics Creating a New Universe of Genetic Medicines

Toronto-based Deep Genomics, a University of Toronto spin-out, was founded by Dr. Brendan Frey in 2015 to address the need for an AI-driven approach to developing genetic medicines. Deep Genomics creates AI technology, processes, and culture that enable the advancement of drug programs rapidly and with a high success rate, for the discovery,



development, partnering, and commercialization of drug programs. Ontario Genomics has been an early supporter of Dr. Frey's research and our long-standing collaboration began in 2005 when we supported a project that undertook the structural and functional annotation of the human genome. Our continued partnership has grown over the years. Deep Genomics raised \$3.7M in a seed round in 2015, followed by a series A funding of USD \$13M in 2017, and a series B funding of \$40M in 2020 bringing the company's total funding to-date to \$61 million. This financing is being put toward the development of treatments for rare genetic diseases, in addition to the expansion of Deep Genomics' AI-based drug discovery platform. Their advanced machine learning and AI technology is developing a universe of precision genetic medicines, enabling drug discovery for rare diseases with high unmet need.

## Canadian Small Business: IGPC Ethanol, Inc. Clean Environment through Sustainable Renewable Fuel Production

Renewable energy minimizes carbon pollution and has a much lower impact on our environment. Established in 2007, IGPC Ethanol Inc. contributes significantly to the Renewable Fuels Industry and Ontario's agricultural sector. By producing 380 million litres of denatured fuel grade ethanol and 340,000 tonnes of distillers' grains, IGPC Ethanol Inc., has become a leader in Southwestern Ontario's business community by creating environmentally sustainable economic growth. Additionally, they support local farmers by offering a distribution solution for their corn crops while producing high protein feed supplement for their livestock. Ontario Genomics supported IGPC Ethanol in 2015 for a project that directly aligns with Ontario's Strategic Opportunity to establish a flourishing bioeconomy through the advanced processing of existing crops, creating valuable new products that mitigate impacts of climate change. Additionally, this project helped expand Ontario's portfolio of bioproducts from renewable biomass.



## Canadian Medium Business: Charlotte Products Limited Spearheading Detection and Cleaning Innovations

Three decades ago, Charlotte Products Limited was founded with a vision to bring sustainable, effective, healthy, and environmentally responsible cleaning solutions to the market. This made-in-Ontario company has grown into a global leader for sustainable cleaning innovation. Charlotte Products partnered with Ontario Genomics for a project that is creating a device for the detection and identification of surface microbial contamination in high-risk facilities. Led by Dr. Shana Kelley, this project combines DNA-templated quantum dot technology with a genomics-based approach to generate pathogen recognition elements that allow for precise detection of bacteria and viruses that are causative agents of hospital associated infections. This high-performance monitoring system, Optisolve Insight, will allow hospitals and long-term care facilities to rapidly detect and identify infectious agents onsite and in situ. Key targets for this project will be highly contagious, drug-resistant hospital bacteria and highly infectious viruses. This technology is particularly relevant in the current pandemic. This eco-friendly, easy to use, bio-monitoring system could enable accurate, real-time detection of SARS-CoV-2 on surfaces in high-risk facilities thereby informing public health policy measures and helping prevent the rapid spread of COVID-19.

**CHARLOTTE™  
PRODUCTS LTD.**

## Canadian Large Business: Hendrix Genetics – Hybrid Turkeys Better Breeding Today for a Brighter Life Tomorrow

Hendrix Genetics is at the forefront of multi-species animal breeding, genetics, and technology. They look for innovative and sustainable solutions to produce animals that thrive under diverse conditions. At present, they have global breeding programs in turkeys, poultry birds, guinea fowl, swine, salmon, and trout. In 2017, Ontario Genomics collaborated with Kitchener-based Hybrid Turkeys, a Hendrix Genetics company, in a University of Guelph collaborative project. This project adapts and applies genomic tools developed in other livestock species to improve the health, welfare, and productivity of Canadian turkeys. This will lead to a \$39 million estimated economic gain for the Canadian turkey industry over five years. This project will also have environmental benefits due to improved feed efficiency and reduced manure and greenhouse gas production. By applying advanced genomic selection, Canada's role as a supplier of turkey genetics to the world will be secured. By estimates, the rate of genetic gain can be increased from 15% to 60%, depending on the trait chosen. These improvements will provide value across the production chain, from breeders and farmers to turkey processors and, ultimately, to consumers.



## Thank You to Our Funders



