CANADIAN TECH AT THE LEADING EDGE

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What is CIN?

Canadian Innovation News reports on Canadian innovation and international collaboration opportunities.

Our mission is to provide actionable information, promote engaged communities and facilitate new linkages between the private sector, academia and government within Canada and internationally. We keep our readers up to date on the latest opportunities to collaborate and develop cutting-edge innovations in today's rapidly evolving, globally-connected world.

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Content

TEACHING COMPUTERS EMPATHY

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Lana Novikova, Founder, Heartbeat Ai

By CarolAnne Black

Lana Novikova is on a mission to teach computers to "read" your emotions.

Why is this important? Her Toronto start-up, Heartbeat Ai, is connecting the dots between artificial intelligence, cognitive sciences, consumer research and marketing to help organizations better know their customers, employees and patients – by understanding how they feel.

Heartbeat Ai's award-winning platform analyzes text – in near real-time – to extract emotional words and phrases

"We need to put humans at the centre of AI."

Lana Novikova, Heartbeat Ai

which are then grouped to recognize the writer's emotions. Text can be extracted from any source, including open-ended survey questions, call centre transcripts, customer feedback, product reviews and employee comments, and then turned into a user-friendly dashboard within minutes.

The software is designed to recognize 99 complex emotions, which are then clustered into nine primary feelings – Joy, Love, Trust, Anger, Fear, Disgust, Sadness, Surprise and Void (a lack of emotion). Novikova's goal is to get at the "deep why" underpinning our decisions.

A market researcher by trade, Novikova realized that asking open-ended questions gave deeper feedback than the commonly used closed-ended questions. She says that while the information she received was invaluable, what she lacked was a way to analyze this big data.

"I realized what I needed and what the industry needed was a tool that will take all this text, all the words and stories, and separate them into meaningful chunks. And for me, the meaningful chunks were emotions."

In 2017, Heartbeat Ai launched its full Enterprise SaaS (software as a service) and API (application programming interface) to help businesses integrate these new applications into their operations. Its first clients came on board after Heartbeat Ai's prototype won the 2016 Insight Innovation Competition for Market Research in Amsterdam.

All companies and organizations have a vested interest in knowing how people feel when they look at or consume a product. For example, an insurance company currently working with Heartbeat Ai is using empathetic questions and comments developed by Heartbeat Ai to improve its customer service.

As Novikova explains, technology typically has a high IQ and a low EQ (emotional quotient).

"We need to put humans at the centre of Ai," she says. Her focus is on a benevolent Ai – how applications can use empathy to support users.

When training their algorithm, (Novikova calls it "training the baby"), Heartbeat AI's method has been full supervision: psychologists and psycholinguists assigning meaning and emotional categories to over 20,000 words and phrases.

"AI absorbs what we put in it," she says. This technique ensures Heartbeat's analyses are unbiased.

The future for Heartbeat Ai is to test deep learning algorithms that will integrate contextual meanings of words and phrases, and to help the algorithm learn the connections between emotions and needs or motivations.

Novikova, who grew up in the then Soviet country of Kyrgyzstan before immigrating to the United States and then to Canada in 1999, hopes to one day see an eventual breakdown of barriers between people and cultures, and she sees empathy as the key.

"When you see how other people feel, you're more likely to build compassion rather than to judge."

CCAB aims to grow Toronto's biotech community

COMPANY SPOTLIGHT

"Toronto is home to a vibrant and prolific healthcare and life sciences community led by academic hospitals, world-class research institutions, top scientists, and a strong start-up ecosystem" (Jan 16, 2017; Melinda Richter, former Head of JLABS)

With a wealth of world-class researchers and continuing investment into its start-up ecosystem, Toronto has provided fertile ground for building the biotechnology sector in the province/nation. Since its start in 2014, the Centre for the Commercialization of Antibodies and Biologics (CCAB) has focused on helping academic researchers move their discoveries towards validated, marketable biotherapeutics. The company is now set to expand its role in this growing area.

In late 2017, Robert Verhagen took the helm of CCAB as CEO, bringing more than 20 years of business and leadership experience in the pharmaceutical and diagnostics fields to the organization.

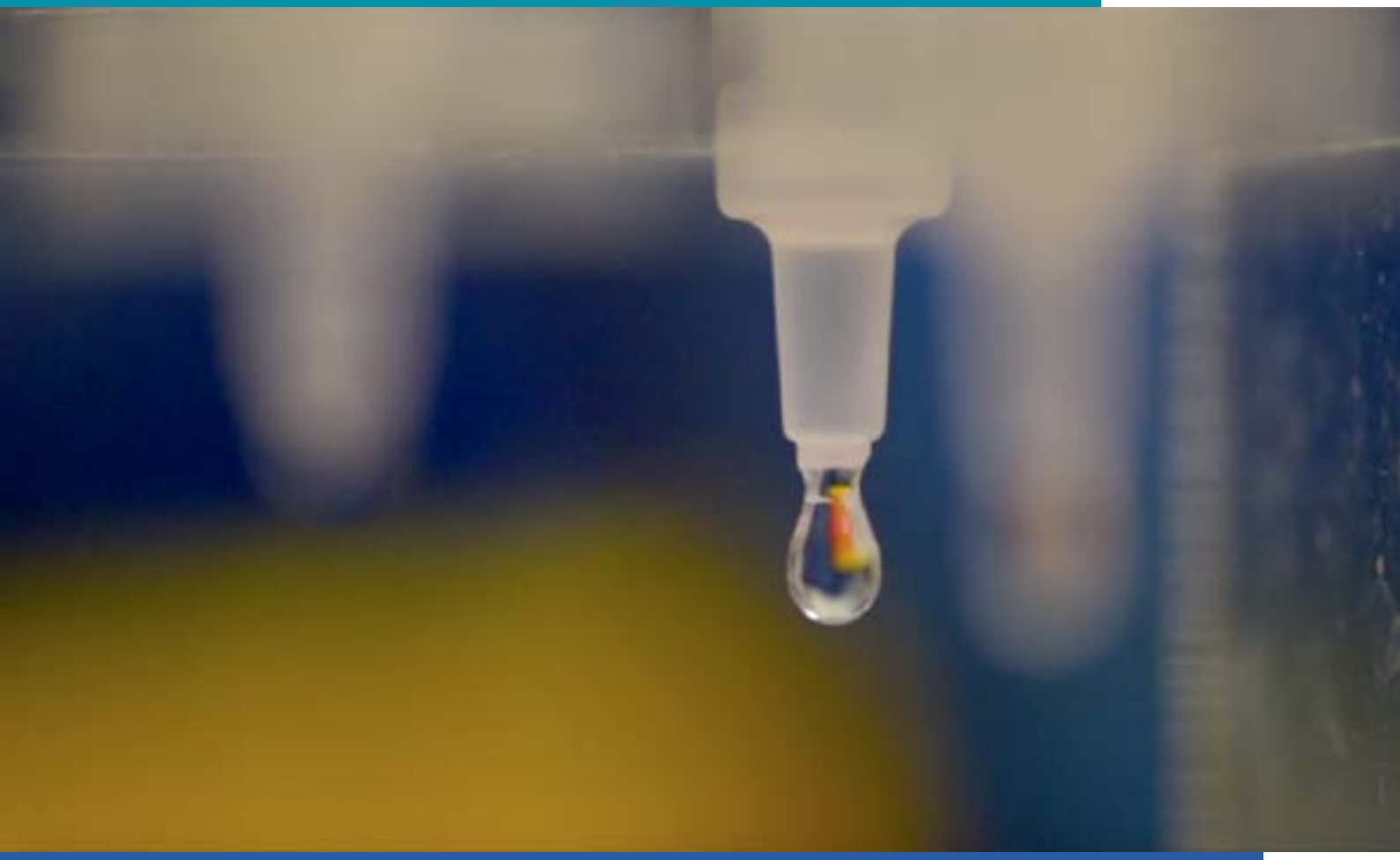
When describing his vision for CCAB, Verhagen said, "I'm looking forward to building on CCAB's accomplishments and strengths. It has had success in commercializing antibody technology from the University of Toronto and the organization will now look at assisting in the creation of companies around that technology and in new areas."

Under Verhagen's leadership, CCAB's technical expertise will also expand to help these young companies and the research community as it launches C-Lab, its custom antibody and protein production service, and begins distribution of reagent antibodies from its portfolio.

Robert Verhagen

Beyond CCAB, Verhagen's vision is also intended to impact the larger Canadian biotechnology community.

"Previously, Canada has focused on bringing in large pharma companies to support the biotech ecosystem in Toronto. We'd like to help bridge the gap that start-ups face in attracting interest from large pharma while growing the business skills of the



Antibody production and purification at C-Lab

people involved. If we have talented, smart people who are successful in building a company, Toronto gains the much needed expertise and talent needed to repeat this".

Even when companies relocate, Verhagen said the people that work there often remain."In this light, if CCAB can help train C-level executives, they will have the skills and drive to each build more companies and, in 20-30 years, Toronto will have the research and business talent to drive the industry. This, in turn, will attract money and the big players in industry".

With this outlook, CCAB aims to help enrich the talent pool and shift traditional thinking away from attracting pharma from elsewhere, towards supporting Canadian-built pharma success.

New Brunswick turns fish and forests into high tech opportunities

Atlantic Canada's increasing success on the biotech and life sciences front in the last decade is a true story of finding the sweet spot of where old meets new.

Take New Brunswick for example: "We've seen consistent growth over the last five years," says Meaghan Seagrave, CEO of BioNB. We've begun to understand just how hugely important it is to find ways to take advantage of the opportunities to innovate in our traditional industries in a manner that increases output but addresses the global move towards greenhouse gas reduction and minimizing climate change." Seagrave credits much of this growth to the familiar theme of collaboration. "Finding ways to work better together as opposed to institution against institution or province against province is beginning to give us real competitive advantage."

For Seagrave this shift requires looking at both the region and its opportunities differently. "You take a look at Atlantic Canada and we've got all these hidden gems with so much opportunity to do things bigger and better—like fish processing. We've got a 115 fish processing plants in New Brunswick alone. Why are we not working more with the entire industry (both big and small players) to look at the collective opportunities through technology and data analytics to innovate?"

Seagrave points to Maritime Innovation, JD Irving Limited's new lab in Sussex, NB, as a perfect example of how biotechnology is transforming legacy industries in New Brunswick.

"We think of them as a traditional forest company, but people would be shocked to understand the analytics and the science around the genomics of the trees, the opportunities of taking the data and using it to grow trees bigger, faster, stronger, and then implementing even robotics and AI into the sector."

While New Brunswick is well known for traditional industries like forestry and fishing, Seagrave says it has much more to offer.

"We've got the oldest computer science department in North America at the University of New Brunswick. We have

"We've got the oldest computer science department in North America at the University of New Brunswick. We have the largest percentage of engineers per capita in all of Canada in New Brunswick and we have the largest number of water technology companies in North America just in and around the Fredericton area. If you look at little pieces like these and link them together we have a huge opportunity."

Meaghan Seagrave, BioNB

Sugarbeet. *Photo: BioNB*

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It makes Atlantic Canada and New Brunswick in particular, a really interesting place to bring business, do business and grow business in North America. There are few places in the world that have access to the plethora of natural resources or diversity of research capacity necessary to support these opportunities.

What makes Atlantic Canada a hotbed for bio and life sciences?

Over the past decade Canada has become a global leader in life sciences and biotechnology innovation and commercialization. The sector's steady growth is largely due to its solid base of expertise and continued investment in world-leading research. And while biotechnology innovation can be found across the country, Atlantic Canada has become a hotbed of activity and is leading the country in key bio and life-sciences areas.

"The region has seen over $1 billion dollars in exits and follow-on investment over the past few years in this sector," said Scott Moffitt, managing director of BioNova, Nova Scotia's Life Science Association. "Being responsive, nimble and knowledgeable has helped us to get to this point."

Today, Atlantic Canada is home to over 150 bioscience companies and 25 research organizations that are at the forefront of global research in human health, medical technologies and diagnostics, marine biology, vaccine diagnostics, pharmaceutical and therapeutics, animal and fish health products, and agricultural technology, including a strong potato research cluster.

Despite all the innovative work coming out of the region, one of the most frequently asked questions to biotech and life-sciences organizations is "Why are you located in Atlantic Canada?"

And while there's not just one answer, the reasoning does stem from a regional uniqueness and an inherent entrepreneurial spirit that drives collaboration, partnership and a belief that our tiny little region on the East Coast of Canada can compete and win on the global stage.

Supported by federal and provincial organizations including Springboard Atlantic, BioNova, BioNB, the PEI BioAlliance and NATI, the region's continued growth in bio and life sciences doesn't show signs of slowing down.

"The demand for these technologies and new solutions is accelerating, says Rory Francis, CEO of the PEI BioAlliance. "And we are well positioned to be part of that."

Atlantic Canada is home to many innovative companies driving innovative research and

Photo: PEI BioAlliance

development in key areas of bio and life sciences. Despite representing just 5% of the Canadian population, the region has continued to punch above its weight in attracting new opportunities, including Natural Products Canada – one of just two bio Centres of Excellence for Commercialization and Research (CECR) in Canada.

This is in no small part due the world-class research talent and expertise from the region's 20+ universities and colleges, the two dozen research institutes dedicated to supporting the region's bio-based industries and a regional understanding that moving ideas to commercializable opportunities is key to growing the sector and region.

"It's not enough just to do the research," says Francis. "There's a lot of discipline and a lot of understanding required to make this economically impactful."

And, he adds, that starts with our ability to work together as a sector. This evolution of the Atlantic bio and life science sector leverages a history of scientific ingenuity and an entrepreneurial and self-reliant spirit – it has created a dynamic environment for innovation.

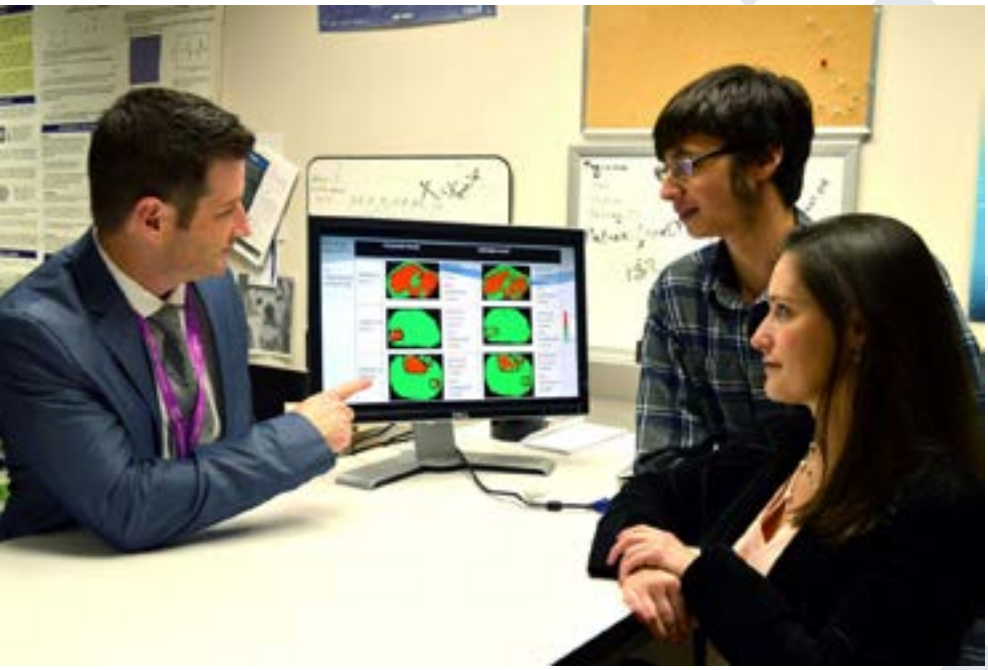
"We are not creating a sector from scratch here; we are building on 150 years of research and innovation in traditional industries that we know very well. That's a base that not many regions have or understand," says Meaghan Seagrave, executive director of BioNB.

"The sky's the limit," says Doris Grant, director for Industry Liaison and Innovation at Dalhousie University. "Collaboration is at the core of everything we do and having the whole ecosystem working together and recognizing this sector for the opportunity that it is only motivates us further."

Industry partnerships at core of unique BIOTIC model

INNOVATOR SPOTLIGHT

When the National Research Council (NRC) announced a restructuring in 2012, the potential for the loss of key research capabilities in Atlantic Canada was a real possibility. But in true Atlantic Canadian fashion, the industry came together to look at the opportunity and, through that process, BIOTIC was born.

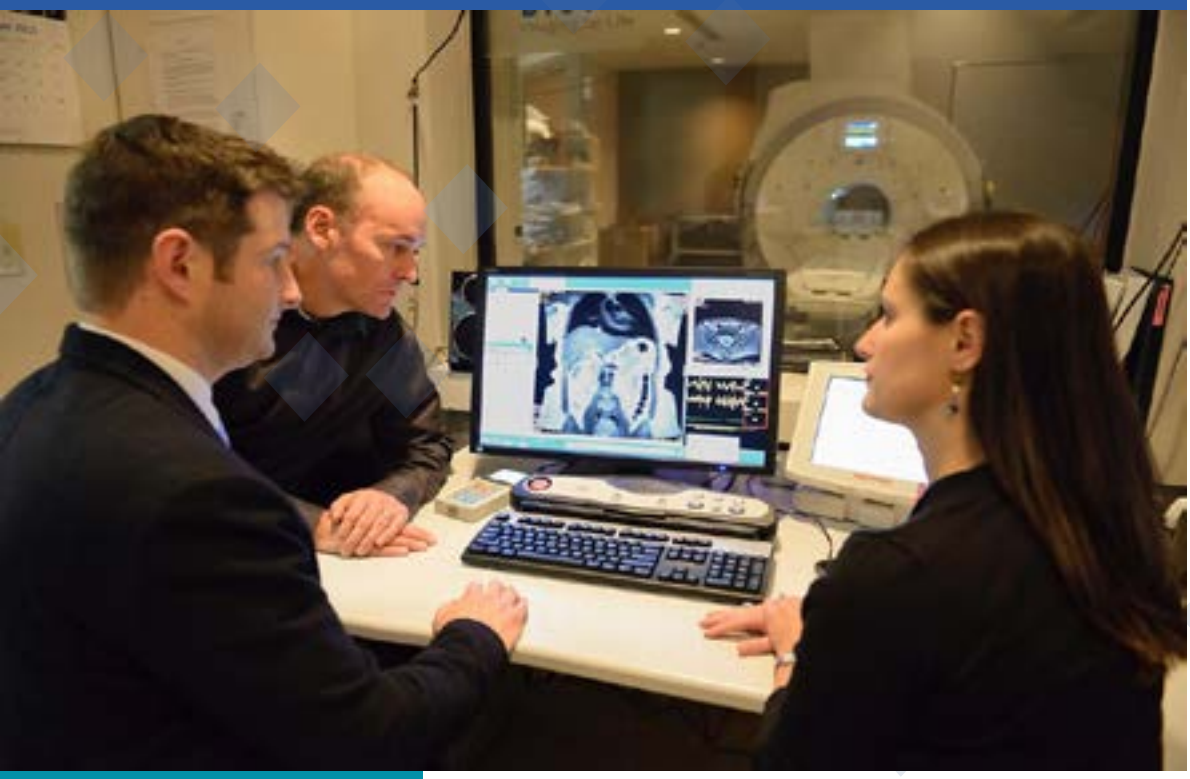


BIOTIC (**BIO**medical **T**ranslational **I**maging **C**entre) is a multi-site imaging centre that is embedded in the two leading research and teaching hospitals in Nova Scotia.

A core research facility of the health centres, BIOTIC provides expertise in all facets of imaging R&D and collaborates on commercial development projects with industry partners as well as R&D projects with a number of institutions.

Another shining example of the growing success coming out of Atlantic Canada's bio and life-sciences sector is BIOTIC's unique partnership model to research. It's a model that just doesn't exist in other markets.

"For us it's not all about the equipment and experts," says Denise LaLanne, Biotic Director of Innovation Services. "We marry together the cutting-edge technology with a project management philosophy that allows companies to



move ideas forward. A key part of our difference is that industry partnership is at the core of how we are structured."

This entrepreneurial and collaborative spirit allows BIOTIC to work with some of the leading bio and life-science companies in the world.

Heather Chalmers, General Manager for GE Healthcare Canada says their collaboration with BIOTIC is able to draw on the considerable expertise in Nova Scotia to improve patient care for the province and potentially the world.

"GE Healthcare is keen to invest in collaborations that draw on the best capabilities from Canada's leading healthcare providers and research organizations to help commercialize products with the potential to advance our understanding and treatment of disease." For BIOTIC, the key is continuing to use its research to apply the technology and translate that into changes that benefit healthcare.

"The long-term opportunities are very broad," says BIOTIC's Science Lead, Dr. Steven Beyea. "From more accurate diagnosis to improved economics through a reduction in healthcare costs, these new technologies show signs of helping to change the way we deliver healthcare."

Mobilizing Canada's Bioeconomy to Fight Climate Change

INNOVATOR SPOTLIGHT

One of the key challenges faced by the bioeconomy is the provision of competitively-priced, high-quality biomass. BioFuelNet Canada (BFN) is building on this insight and on its past accomplishments to develop and grow the bioeconomy.

One exciting project has opened up the prospect of growing a "super-crop" with multiple value streams. By growing willow trees tilted at 45 degrees, BFN researchers made scientific advances in the biology behind the cellulose-rich "tension wood" that contributes high quality biomass for enhanced biofuel yield. Under the supervision of Université de Montréal adjunct professor Michel Labrecque, the scientists identified willow varieties and growth techniques that increased the trees' capacity to clean up polluted soil. They also exploited the biochemistry behind this high-tolerance capacity for substantially increased green chemicals production (bioproducts).

In another BFN project, a team led by University of British Columbia engineering professor Dr. Shahab Sokhansanj developed a novel, energy-efficient process for steam-treating wood pellets. The process yields unusually strong and durable pellets tailor-made for conversion into usable bioproducts such as biochar and biocoal. Global Bio-Coal Energy Inc. is partnering with this BFN research team to commercialize the breakthrough process. Transforming raw biomass into a standardized form, such as the pellet, significantly facilitates transportation and use, whether within Canada or overseas.

As these examples show, BFN's strength lies in building bridges between researchers and entrepreneurs from across Canada who share similar objectives that strengthen the bioeconomy. That is why BFN took one step further earlier this year to create a cluster focused on commoditizing agricultural biomass to fight climate change. Read more about BioMass Canada on our website. Policy-makers, industry representatives and the academic community need to better

understand the bioeconomy and advanced biofuels in particular. That is why BFN created its online Advanced Biofuels Course. Consisting of 17 lectures by Canada's top biofuels experts, this course provides decision makers with the necessary information to better understand the challenges and opportunities that our bioeconomy offers. This month alone, 25 federal government representatives benefited from this unique collection of know-how in an on-site course.

Looking ahead, BFN is ready to catalyze more partnerships that will play an active role in addressing the climate and energy challenges that we face. We cannot do this in isolated silos!

About us

BioFuelNet Canada (BFN) is a federally-incorporated, not-for-profit organization and former Network of Centres of Excellence with a proven record of accomplishment in bioeconomy research and innovation. Since 2012, BFN integrated the efforts of over 230 researchers from across Canada, working with 29 post-secondary institutions and 127 industry partners. Our vision is the emergence of a Canadian bioeconomy based on advanced biofuels and bioproducts that are socially, economically and environmentally sustainable and globally competitive.

Fredericton NB's ecosystem is driving the city forward

Lurie Guthrie, Economic Development and Marketing Specialist, Ignite Fredericton

As the entrepreneurial spirit flourishes across Atlantic Canada, the city of Fredericton continues to work hard at cultivating a start-up ecosystem that builds on the city's early successes in key areas like biosciences, ICT and data security.

Most communities that want to grow their start-up ecosystems rely on regional and provincial services to help. By contrast, the city of Fredericton's economic development agency Ignite Fredericton has invested significantly in its Planet Hatch accelerator to provide a high level of infrastructure to its business start-up community.

Ignite and Planet Hatch have worked with the other key resources in Fredericton to create a true start-up ecosystem that is paying big dividends.

Laurie Guthrie, economic development and marketing specialist at Ignite Fredericton, says that while this investment is paying off for Fredericton, they continue to get asked why they focus on small start up companies.

"Thanks to our tracking we're able to substantively say that these investments resulted in 17 new homes, and 48,000 movies and 120 new vehicles purchased

in our community. That's when people get it and have that aha moment that this is important for everyone."

And while the focus on the start-up ecosystem is helping to drive Fredericton's economy, Guthrie says the real intent of their programs is to propel the provincial and regional economy forward.

"Our programs are open to anyone who wants to use them," says Guthrie. "I think we need to build on that – growing the strength of what we have rather than spending money trying to duplicate it in every community."

As a result, many companies and individuals from across the province (including new Canadian immigrants) continue to learn and grow thanks to Planet Hatch's programs and services.

It's for all these reasons Fredericton was named Canada's Startup Community in 2016. Despite this success Guthrie says they won't be resting on their laurels.

"We're going to work hard to improve our services with what we're calling Planet Hatch 2.0," says Guthrie. "We'll bring in new partners, continue to focus on international student retention and we'll continue to focus on creating a culture of entrepreneurship with our students."

Government selects supercluster winners

The Canadian government has selected five supercluster proposals that will share $950 million in funding for the next five years under the Innovation Superclusters Initiative. The five winning bids bested four other superclusters in an open competition that took some nine months to complete. Nine shortlisted superclusters were invited to submit full proposals in fall 2017, after the original call to participate attracted 50 Letters of Intent last summer.

Karina Gould, Minister of Democratic Institutions, announced one of the successful proposals under the $950-million Innovation Superclusters Initiative at the McMaster Innovation Park in February.

The five winners are:

- Atlantic Canada's Oceans Supercluster will focus on investing in digital ocean technologies for aquaculture, capture fishery, offshore oil and gas, and clean energy in order to maximize the sustainable development of the ocean economy.

- Quebec's SCALE AI or artificial intelligence-powered Supply Chains supercluster will focus on the use of artificial intelligence and data science in supply chains, particularly in the retail, manufacturing and infrastructure sectors.

- Ontario's Next Generation Manufacturing (NGM) or advanced manufacturing supercluster, with members mostly located in southern Ontario, will work on innovative solutions for a wide range of industry sectors, using big data, intelligent machines and the Internet of Things to scale and improve production efficiency.

- British Columbia's Digital Technology supercluster will work on projects designed to boost Canada's precision health, manufacturing and resource and environment technologies by advancing data collection, analysis and visualization.

- Saskatchewan's Protein Innovations Canada (PIC) supercluster will work to position Canada as a top supplier of plant-based proteins and related products.

Australia and Canadian firm sign cannabis R&D deal

Canopy Growth Corp., Smith Falls, Ont., has signed a deal with the Victorian State Government to further develop research and technical capabilities in the production of medical cannabis in Australia. The research agreement between

Canopy Growth and Australia's department of agriculture will focus on medical applications for cannabis genetics, strain development, cultivation, and processing.

Stabilized cannabis genetics from Canopy Growth's Canadian operations have already been successfully imported into the country and are growing in the state of Victoria.

"This agreement allows us to combine our expertise in medical cannabis with the world-leading bioscience research capabilities of Agriculture Victoria," said Mark Zekulin, president, Canopy Growth.

"With this important MOU, we hope to increase innovation and institutional understanding in the Australian medical cannabis market to ensure that our globally recognized genetics are available in Australia for research and commercial purposes."

Victoria was the first state in Australia to legalize access to medical cannabis for patients in the region, and the state will use its bioscience research capabilities to work with Canopy Growth to identify and develop optimal plant strains for a range of therapeutic uses. Specific capabilities include genome sequencing, comprehensive metabolome analysis and chemo-typing, as well as technologies for accelerated precision breeding.

Canopy Growth has emerged as the world's largest cannabis company.

First NEOMED spin off takes aim at cancer

The NEOMED Institute, a Montreal-based R&D institute, has spun off its first company in advance of clinical trials to test a new therapy for several cancers, including brain, breast, lung and leukemia. NEOMED Therapeutics 1 Inc. is seeking to raise funds to advance its lead molecule – NEO2734 – through human clinical trials beginning early 2019 and to progress its clinical biomarker program.

NEOMED licensed the original technology in 2014 from privately-held Epigenetix Inc. which was founded on research developed by Dr. Claes Wahlestedt, associate dean and centre director for Therapeutic Innovation at University of Miami Miller School of Medicine.

NEOMED has also appointed Christine Lennon as its president and CEO to lead the firm's transition from an epigenetic inhibitor program to a clinical stage company. Lennon has held a number of leadership roles in large pharma, biotech and in venture capital, most recently at Novartis Oncology in Canada and in Europe, Shire and Neurochem (now Bellus Health).

Both privately-held Miami, Florida-based Epigenetix Inc and NEOMED Institute will be founding shareholders in NEOMED Therapeutics 1.

$5.9 million will help grow big data businesses in Atlantic Canada

The Government of Canada is investing nearly $6 million in an $18-million project that brings together universities, industry and government in a research partnership to grow the regional ocean economy.

Led by Dalhousie University, the project will establish a shared computer analytics platform known as DeepSense that will help Atlantic Canadian companies to develop and commercialize big data analytics products and services.

Businesses will collaborate with scientists to develop their products and services using high performance computing infrastructure and personnel support provided by IBM Canada, an in-kind contribution valued at $9,838,000. Dalhousie University and the Ocean Frontier Institute (OFI) are also investing a total of $2,133,151 in the project.

RBC opening cybersecurity lab in Waterloo

The Royal Bank of Canada (RBC) is opening a cybersecurity lab and investing $1.78 million into research at the University of Waterloo to develop advanced cybersecurity and privacy tools.

The funding will support research in the following areas:

- Data-driven software defined security, led by Raouf Boutaba, will focus on detecting and mitigating security threats using machine learning and AI.
- Privacy enhancing technologies, led by Ian Goldberg, will focus on the safety and security of consumer metadata, including identity and location.
- Post-quantum cryptography, led by David Jao, will focus on a unique blend of pure mathematics and computer science that produces a data encryption so strong that quantum computers cannot crack it.

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CCAB
Centre for the Commercialization of Antibodies and Biologics

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RÉSEAU BIOFUELNET CANADA