

BUILDING THE BIOECONOMY

Biomass Canada — Fuelling the Canadian Bioeconomy

The Biomass Cluster (BMC) is Canada's first research cluster focused on commoditizing biomass, including farm-to-market supply chains and enhancing sustainability.

Dr. Donald Smith and Dr. Xiaomin Zhou



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CEO,
BioFuelNet Canada
& Professor,
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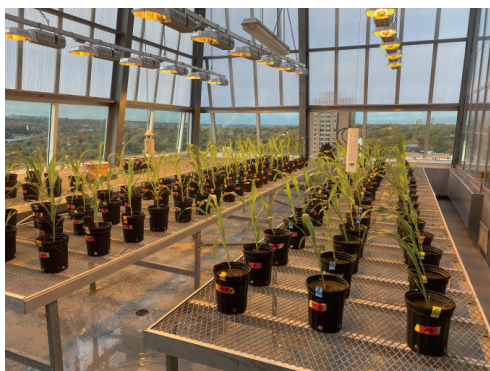


Dr. Xiaomin Zhou
Director of
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BioFuelNet Canada

Climate change poses an increasing challenge to the production of both food and biomass crops. In addition to food security, these crops are necessary as they'll play a key role in underpinning the developing Canadian bioeconomy through allowing for the reliable production of biomass (sustainable proportion of crop residues in the case of food crops) bio-energy, including biofuels, and associated high-value bioproducts, such as bio-plastics and pharmaceuticals. The agricultural sector has a key role to play in Canada's drive to develop its bioeconomy and decrease the carbon footprint of the energy and materials that we consume and export. The potential payback, a thriving agro-bioeconomy, to Canada is enormous. The agricultural sector could reduce Canadian greenhouse gas emissions by up to the equivalent of 79 metric tonnes of carbon dioxide per year and generate up to \$3.8 billion in additional farm revenues.

What we can do?

BMC was developed by BioFuelNet, which was established through earlier Networks of Centres of Excellence funding. The BMC spans 5 years (2018 to 2023), with support from the Canadian Agricultural Partnership and other partners. The BMC includes 22 industry partners, as well as 7 universities, 15 lead researchers and co-leaders (five from Agriculture and Agri-Food Canada), plus 51 graduate students



TESTING OF PLANT-GROWTH PROMOTING BACTERIA ON DIFFERENT GENOTYPES OF SORGHUM UNDER GREENHOUSE CONDITIONS IN HALIFAX, NOVA SCOTIA. THIS PICTURE IS PROVIDED BY DR. KEVIN VESSEY.

and post-doctoral fellows being trained. The BMC work will improve technologies and market opportunities for biomass, bioenergy, and associated high-value bioproducts, benefitting agricultural producers across Canada, including in the northern regions.

BMC seeks to mobilize Canada's agricultural sector to commoditize biomass for bioenergy and bioproducts, to benefit agricultural producers across Canada, while mitigating and adapting to climate change. In doing so it will improve agricultural producers' incomes through biomass production on marginal lands (where food material is generally not produced) and adding value to agricultural wastes. This will serve to improve the overall sustainability of Canadian agriculture by reducing greenhouse gas emissions (production of biofuels and incorporation of organic matter into soils) and making Canadian crop production systems more climate change resilient (enhanced stress resistance through plant-microbe interactions). BMC's work will enable Canadian farmers to earn additional revenues from crop residues, biomass crops grown on marginal lands and from the emerging carbon credit markets. BMC is divided into three themes: 1) Biomass and bioenergy for northern latitudes, 2) Optimization of biomass production, and 3) Biomass pre-processing, supply-chain logistics and economics. BMC also conducts a considerable level of knowledge transfer, ensuring that producers and industry are fully informed regarding research outcomes.



DR. HAMID REZAEI IS MEASURING THE ANGLE OF REPOSE OF WHEAT STRAW. THIS PICTURE IS PROVIDED REALWORLD MEDIA INC.



To learn more more about the BMC, visit biomass.biofuelnet.ca

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BioMass Canada



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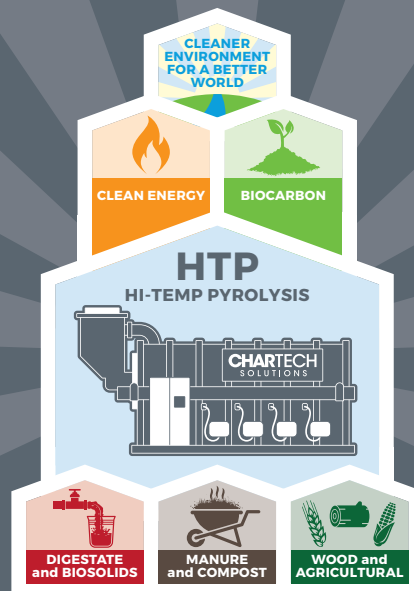


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Decarbonizing for a Circular Economy

CHAR Technologies Ltd. (CHAR) is a leading cleantech development and environmental services company specializing in organic waste pyrolysis and biocarbon development, custom equipment for industrial air and water treatment, and providing services in environmental management, site investigation and remediation, engineering, environmental compliance and resource efficiency.

Our proprietary high temperature pyrolysis (HTP) technology converts woody materials and organic waste into renewable natural gas (RNG), green hydrogen and biocarbon.





Biogas Is Heating Your Home and Charging Your Phone

Sarah Stadnyk



Jennifer Green
Executive Director,
Canadian Biogas
Association

You know that funky smell coming from your green bin? That’s the primary ingredient of biogas. If you capture enough of it, and purify it, it becomes a powerful and reliable source of renewable energy.

Wherever you live in Canada, there’s a good chance that climate-friendly biogas is working for you at this very moment: it’s helping to charge your phone, to power your fridge, to heat your home, or to fuel your transit system. And if it isn’t yet, it will be soon.

That’s because biogas is one of Canada’s fastest-growing renewable energy sources. It’s clean, it’s reliable, it’s cost-effective, and it comes from something we have a lot of in Canada: organic waste.

Canada’s 6 million tonnes of food waste, 16 million tonnes of farm manure, 1,500 active landfills, and sludge from 1,200 wastewater treatment plants are all readily-available sources of biogas energy.

Canada’s biogas producers capture the waste methane emitted by these organic wastes, before it gets released into the atmosphere as climate pollution, and instead get value out of it by turning it into a clean source of electricity and renewable natural gas (RNG).

Biogas is Canada’s quiet achiever

There are currently more than 270 biogas projects operating across Canada, producing reliable and clean energy for communities, farms, homes, and businesses. How much exactly? In 2020, the sector produced the equivalent of roughly 400 million square metres of solar panels, or more than 13 large hydro dams.

These projects are being led by farmers, who are converting one million tonnes of manure and agricultural waste into biogas; by industries, which can tap into wastewater sludge; and by municipalities. For instance, the City of Surrey is capturing the biogas from its Green Bin program and converting it into the fuel being used for its waste collection fleet. And in 2021, the City of Hamilton unveiled Ontario’s first “carbon-negative” bus, which is fuelled completely by RNG made with biogas from a nearby biogas facility.

There’s opportunity for much more

The good news is that there’s opportunity for much more made-in-Canada biogas. Research shows that Canada could efficiently tap at least eight times more energy from biogas and RNG, with untapped resources in every part of the country. Having the right market signals and policies in place can shape a bright future in

which biogas supports greenhouse gas emission reductions, organic waste diversion, and clean energy production in a profound way.

The Canadian Biogas Association (CBA) is dedicated to growing the biogas industry to its fullest potential and maximizing the benefits from biogas. Jennifer Green, Executive Director of the CBA, shares, “Biogas is a shovel-ready solution that can deliver reliable and clean energy while reducing Canada’s greenhouse gas emissions and driving economic development in both urban and rural areas. Biogas is a full-package solution for Canada’s climate targets, and there’s opportunity for much more of it.”

Visit the CBA’s dedicated microsite bettergas.ca for an introduction to biogas, project profiles, and FAQs, and to view the Canadian 2020 Biogas Market Report published by the CBA, which offers a snapshot of Canada’s biogas sector and the factors influencing its growth.



To learn more more about the CBA, visit bettergas.ca.

This article was sponsored by the **Canadian Biogas Association**.



Fitec: A Leading Biogas Solutions Provider You Can Trust

Biogas industry leader Fitec is helping its clients to create renewable energy from organic waste.

Tania Amardeil



Tom Ferencevic
CEO &
Environmental
Scientist,
Fitec
Environmental
Technologies Inc.

Creating energy from waste may sound like magic, but it’s 100 percent possible. All over North America, organic material is being converted into biogas — a source of renewable methane gas that can be converted to electricity or heat, or can even be used to fuel vehicles. Though the industry has been around for 20 years, recent growth has been spurred on by government policies geared towards fighting climate change and by industry leaders like Tom Ferencevic, CEO of Fitec Environmental Technologies.

Robust and reliable solutions from an industry leader

“Our current food production system and consumption patterns create a tremendous amount of waste, and so much of it just ends up in landfills,” says Ferencevic. “It’s time we recover this waste and recognize it as a resource.”

This of course requires innovative processing equipment, which happens to be Fitec’s specialty. Fitec’s full-service biogas solutions include a food depackaging system known as the BioSqueeze, a Self-Cleaning Digester, and a pasteurizing system that’s integrated into the digester heating system and designed specifically for abrasive slurries like food waste. The efficiency of the Fitec system is unsurpassed and waste processed by this system produces digestate that exceeds the strictest global quality standards

for residual contaminants.

It’s one of North America’s fastest-growing biogas companies, and for good reason. Ferencevic has been involved in the biogas sector since its very inception in North America and understands the complexity of the industry. He prides himself on offering solutions that are robust, reliable, efficient, and effective.

Authentic leadership you can count on

With 30 years of experience in the industry and a hands-on CEO who’s not afraid to get his hands dirty, Fitec is a clear leader in the biogas space. The company’s exceptional designs and high-quality equipment — with innovative German engineering and quality craftsmanship — give it an edge. It also offers turnkey solutions and personalized service that makes use of skilled local professionals.

Ferencevic is known in the industry for being forthright and scientific. “I love digging into the details and helping to teach and empower people,” he says. “My objective is to cut through the nonsense and solve problems. I want my customers to be successful. That’s where my effort goes, and my customers appreciate that.”

Fitec provides solutions for clients in all

the main organic waste markets, including farmers, municipalities, project developers, waste management companies, and more.

It’s time we recover this waste and recognize it as a resource.

Capturing lost value

As our population continues to grow both nationally and globally and climate change-related crises accelerate, there has never been a greater need for clean energy. And when we let our organic waste rot in landfills, it is just that — wasted. Fitec is actively fighting climate change by closing the loop in organic waste ecosystems. “Let’s get the organics out of the landfill, recover them, create

renewable energy from it, and then put the contaminant-free organics back on the land where they came from,” says Ferencevic.

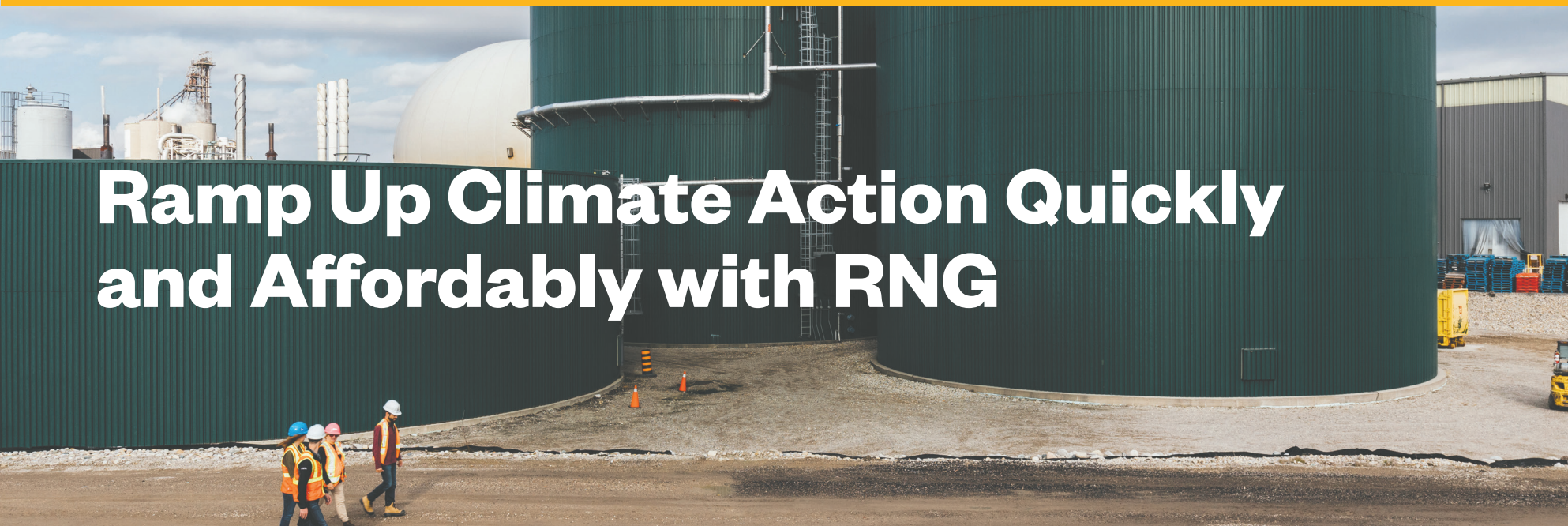
For municipalities, business owners, and farmers who are ready to do things differently and to create something from nothing, there’s good news. Fitec is here.



To learn more, visit fitec.ca.

This article was sponsored by **Fitec**.





Joey Cyples, Business Development Specialist, Alternative Fuels
Steve Rakidzioski, Business Development Specialist, RNG

Climate change is imminent, and decisive action is needed on the best path forward. For governments and business leaders, it's a complex issue: many solutions require significant cost investment, new infrastructure, or decades to effectively transition. As decisions are weighed over longer-term plans, here's why leaders are choosing renewable natural gas (RNG) as an immediate, cost-effective solution to reduce Ontario's emissions.

A pragmatic solution to a tough problem
To step up climate action quickly and affordably, RNG is among the most pragmatic of approaches. More than a third of the food produced and distributed in the country gets discarded.* RNG is produced from organic waste, so that uneaten potato salad or apple core is diverted from the landfill and repurposed as a renewable energy source. RNG is carbon-neutral and can also be added to the natural gas network. Unlike the electricity system, no infrastructure expansion is required to enable greenhouse gas (GHG) emission reductions.

The benefit of producing and using RNG is that it captures methane that would otherwise be released into the atmosphere. Although methane from decomposing organic waste accounts for only 10 percent of GHG emissions, it contributes to global warming — it's about 25 more harmful than carbon dioxide.†

Proven, scalable, and quick to implement, RNG is not the only solution to climate change — but it's an immediate, feasible way to reduce emissions and put Ontario on track for its long-term climate commitments.

With RNG produced from organic waste, vehicles can be carbon-negative
One of the most exciting applications for RNG is in the transportation

sector. Earlier this year, Ontario's first carbon-negative bus in Hamilton set new standards for sustainable transit. Launched in partnership with Enbridge Gas, the bus is fuelled by locally-sourced RNG produced at the StormFisher facility in London, ON. RNG is renewable and plentiful, and its cumulative impact — from diverting methane to displacing diesel emissions — takes the vehicle's emissions to below zero.

The carbon-negative bus is just one example of an effective and scalable step forward. In recent years, Hamilton Street Railway moved away from diesel and expanded its fleet with more than 130 compressed natural gas (CNG) buses. Today, it's uniquely positioned to fuel them with compressed RNG and amplify its environmental impact even further.

The “quick win” of decarbonizing light-duty fleets

So what about vehicles that still have years of useful life? Rather than electrify an entire fleet at once, it's more manageable to convert existing diesel, propane or gasoline vehicles to RNG and reduce emissions right away. There are many opportunities in light- to medium-duty fleets (Class 1 – 6), including:

- Snow plows
- Refuse trucks
- Delivery trucks
- Supervisory vehicles
- Public works vehicles
- Emergency vehicles
- School buses

CNG vehicles serve as a low-risk, low-cost “proof of concept” to support the case for larger RNG projects. In the long run, demonstrating success at a small scale will help strengthen the case for broader RNG fleet conversions.

The City of Toronto has implemented an initiative to produce and use RNG. Every year, about 35 percent of the City of Toronto's Green Bin organic waste is transformed into RNG, diverting about 55,000 tonnes of organic waste

from landfills. The RNG is used to fuel the city's waste collection fleet and added to the natural gas system, which cuts down on GHG emissions and reduces reliance on landfills.

Expert help to find the lowest-cost path to conversion

Every climate solution has complexity. Enbridge Gas' dedicated team of energy experts are ready to provide you with the technical expertise and information to produce and use RNG. Enbridge Gas works closely with agribusiness, food processors, municipalities, waste management, and other organizations to help identify, facilitate, and get RNG projects off the ground.

As partners in sustainability, Enbridge's team can help find RNG opportunities that leverage existing investments in vehicles or buildings. Take advantage of expertise, insights from successful past projects, and access to the North American marketplace.

RNG will play an important role in the clean energy transition. As plans to reduce emissions evolve, it's a promising and proven way for more leaders to take meaningful climate action.

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Discover more opportunities with RNG. Contact us to discuss how Enbridge Gas can help you get projects underway at enbridgegas.com/rng or rng@enbridge.com.

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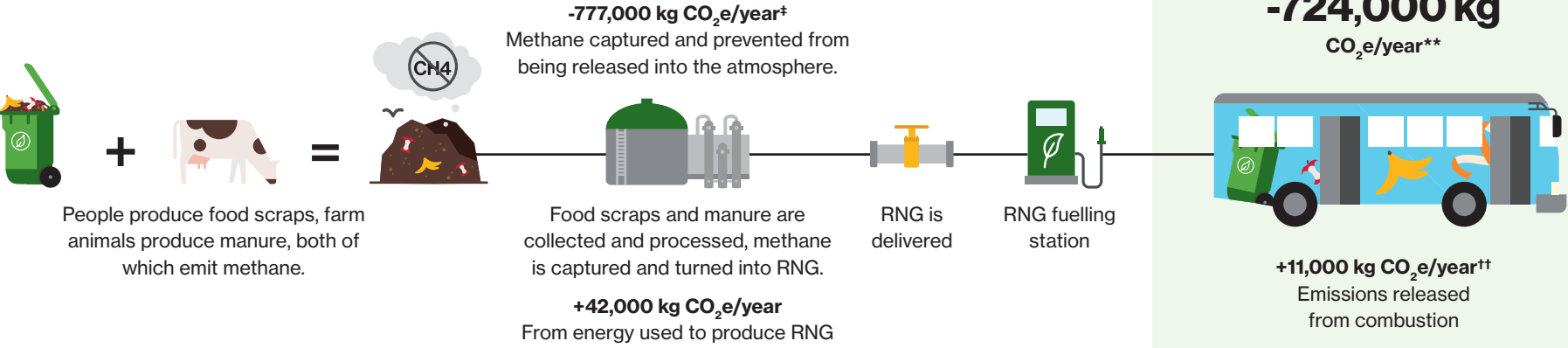
Keep your fleets, green your fuel

10 reasons to buy-in on RNG

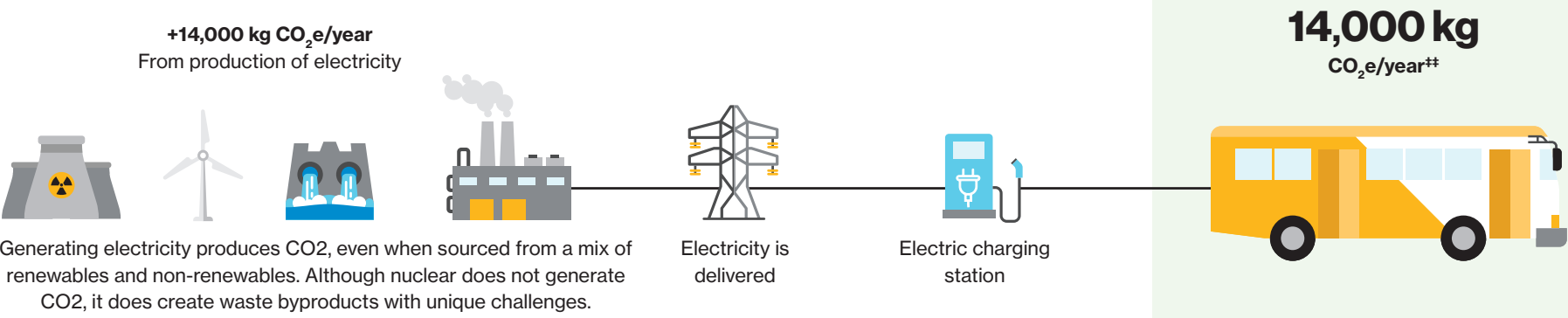
- 1 An immediate path to net zero**
It's ready today, with multiple applications.
- 2 Demonstrated success in market**
RNG fuel has wide-scale use across North America.
- 3 Supports scalable projects**
Mitigate risk by gradually converting fleets.
- 4 Easy vehicle conversion**
From light-duty vehicles to transit buses.
- 5 RNG is carbon-pricing exempt**
Even a blend of RNG can mitigate fuel cost increases.
- 6 Fast refuelling times**
Some RNG vehicles can refuel as quickly as diesel.
- 7 A made-in-Canada solution**
Can be locally-sourced, locally-produced.
- 8 A circular economy approach**
RNG captures energy value from landfills and organic waste streams.
- 9 Reliable and resilient**
Unlike above-ground energy distribution systems.
- 10 Can be carbon-negative**
Not even electric vehicles can achieve this.

How can a vehicle be carbon-negative?

RNG-fuelled vehicles utilize methane from organic waste which would otherwise be released into the atmosphere.



Battery electric vehicles emit no tailpipe emissions, but are only as green as the electricity grid that charges them.



* Source: www.nzwc.ca/focus-areas/food/issue/Pages/default.aspx
† Source: <https://unfccc.int/process-and-meetings/transparency-and-reporting/greenhouse-gas-data/frequently-asked-questions/global-warming-potentials-ipcc-fourth-assessment-report>
‡ CO₂e stands for carbon dioxide equivalent. It is used to describe different greenhouse gases in a common unit.
** Net emissions from vehicle using 40,000 m³ RNG/year. 40,000 m³ of RNG is the equivalent of 1,623 GJ or 451,195 kWh of energy per year.
†† 85,000 kg CO₂e/yr of CO₂ is released from the combustion of RNG. Since RNG is derived from organic waste produced by plants that take up CO₂, these CO₂ emissions are considered biogenic and not additional to the atmosphere. Trace amounts of CH₄ and N₂O are also produced from the combustion of RNG that result in 11,000kg CO₂e/year of emissions being released.
‡‡ Net emissions from powering electric bus using 451,000 kWh/year based on Ontario grid.
All calculations are based on Ontario's electric grid for illustration purposes only. Actual calculations will be provided when working with Enbridge Gas. © 2021 Enbridge Gas Inc. All rights reserved. ENB 657 09/2021



Learn-Design-Build-Test

Prairie Hub to Power the Bioeconomy with Next-Generation Bio-Inspired Technologies

RNA-based systems, molecular machines, and bio-inspired devices, are the future of the bioeconomy but advancing these technologies from discovery to market can be elusive.

UM Faculty of Science Communications



Dr. Ned Budisa
Canada Research Chair in Chemical Synthetic Biology, Professor, Faculty of Science, University of Manitoba



Dr. Hans-Joachim Wieden
Lead for BioSciences Entrepreneurship and Industry Partnerships, Faculty of Science, University of Manitoba

Accelerating scientific discoveries in natural and synthetic biology into deployable products and knowledge requires a collaborative and integrative ecosystem.

The success of RNA vaccines demonstrates that we're in the golden age of mainstreaming synthetic biology and bio-inspired technologies. This achievement was, however, the culmination of decades of research coalescing under the pressure of the pandemic, and notably was brought to bear outside of Canada. This example highlights the collaborative ecosystem needed to advance biotechnologies. An ecosystem that facilitates the interaction of startups, small- and medium-sized enterprises (SME), larger industry, academia, and government, and that provides access to the equipment and talent available at universities, is required. To address this urgent need for this type of innovation and discovery network in the Prairies, the University of Manitoba recently launched a hub for the exploration of natural and synthetic biology, BioEx[™].

BioEx[™] — creating a vision for biotechnology in the prairies

Dr. Hans-Joachim Wieden, Lead for BioSciences Entrepreneurship and Industry Partnerships, and Dr. Ned Budisa, Canada Research Chair in Chemical Synthetic Biology, were recently recruited to the Faculty of Science at the University of Manitoba (UM) and are leading this hub. We had the opportunity to virtually sit with Drs. Wieden and Budisa for a Q&A to hear more about the future of BioEx[™] and its role in advancing biotechnology.

Q: What was the inspiration behind the launch of BioEx[™]?

Budisa: Although Canada is now investing in vaccine development and manufacturing, a lack of existing framework for the advancement of vaccines meant we were left behind in the race for the COVID-19 vaccine. Here, we're taking a more forward-looking approach by building on the critical mass of research expertise existing in the Prairies in synthetic, structural, and digital biology to provide biologically-based solutions to myriad challenges in diverse sectors such as agriculture, energy, and medicine.

Q: What would be the benefit of accessing this new hub?

Budisa: Fundamental and cost barriers limit the participation of emerging companies and SMEs in the R&D enterprise. Effectively, we're bringing partners together by lowering the access barrier and de-risking participation in research. We're opening the door to partners from all sectors to work together to fast track innovations in synthetic biology and bioengineering through our integrated "Learn, Design, Build, and Test" model.

Q: How do you accelerate scientific discovery into deployable products and knowledge?

Wieden: The "Learn, Design, Build, and Test" model ensures that industry can capitalize on the expertise of the award-winning researchers, technologies, state-of-the-art equipment, and talent found at UM. Within this model, the discovery of natural biological processes will

be accelerated by state-of-the-art technologies and instrumentation. These findings will be interpreted and analyzed (LEARN), which will instruct the (DESIGN) of experiments, technologies, or applications. Further advancement is supported by the capacity to (BUILD) the necessary component, for example genomes, proteins, and so on, which will be characterized (TEST), enabling successful deployment. As discoveries and products advance to market, these can be fed back into the cycle and the next phase of analysis, ultimately lowering technology barriers and mainstreaming access to emerging bio-inspired technologies.

Q: Why a discovery acceleration hub at an educational institution?

Wieden: How can you grow an emerging technology without a pool of well-trained potential employees? The UM is a research powerhouse with particular strength in emerging sectors of the molecular life sciences such as RNA-based technologies, synthetic biology, and bioengineering. Students here are trained in these emerging transdisciplinary areas. As we move forward, we envision a maker space where entrepreneurial students, SMEs, and startups can develop their ideas and tap into cutting-edge research. Why couldn't the next killer-app be bio-engineered here in Manitoba?

Q: What is the takeaway message?

Wieden: We're open for business and we're inviting partners across all sectors to come "Learn, Design, Build, and Test" with us.



To learn more about BioEx[™] and research capabilities at the University of Manitoba, Faculty of Science read the extended article on our research at nationalpost.com.

This page was sponsored by the University of Manitoba.



Faculty of Science



Agri-Food and Innovation: The Need for a National Strategy

Serge Buy



Serge Buy
CEO, Agri-Food Innovation Council

Let's face it — innovation was not a topic during the 2021 federal election. Neither was agri-food. Agri-food in Canada has strong innovative potential and is essential for solid economic recovery and growth.

The lack of focus on agri-food research and innovation is concerning. Canada has been a leader in the sector but the ship now seems rudderless. There's no national strategy, no direction, and no sense of where we're going beyond "let's export more."

We're now 19th in agricultural production globally. Public investments in agri-food research and innovation steadily declined in Canada-based on an Organisation for Economic Co-operation and Development report (and other reports as well).

We need to export more. In order for Canada's agri-food sector to continue to meet the world market's growing demand, innovation must be supported through science-based policy work and needs-specific funding.

Canada is well-positioned in the sector but is facing competition from other countries with cheaper production costs, fewer regulatory

obstacles, and/or more adoption of innovation.

But to export more we need to innovate more and better facilitate the adoption of innovation.

The oft-quoted Barton report (2017) described agriculture and food as a sector that can lead in growth. It also mentions that "the government, in concert with the private sector, can take a targeted approach that would unleash the sector's full potential." We agreed and still do.

However, since then, some of the key suggestions from the report were not or not thoroughly implemented. The recommendation to have the government and the private sector work together toward bold growth objectives was not taken.

Another key recommendation, to have the government put in place an inter-governmental task force to "remove obstacles", was also not put in place.

The Agri-Food Innovation Council is recommending the creation of a national strategy on agri-food research and innovation. Such a strategy would streamline our efforts, and provide a direction, a framework, coordination,

and set goals for research and innovation in the sector.

It would need to be co-led by the federal government and industry and provide a key role to the provincial governments and academia. It would also be essential to ask representatives of Indigenous Peoples to participate fully and help lead the development of such a strategy.

The process to develop the national strategy shouldn't be needlessly complicated. No one wants to see another major consultation effort. The consultation needs to happen but it can be innovative and nimble.

Care must be taken to ensure the strategy doesn't become so convoluted that it becomes another forgotten effort to provide leadership to the sector. It can and should be a living document that supports the sector's growth, enables cooperation, and delivers on results.

While politicians settle back in Ottawa following this last election and while the public service reopens its outreach to the sector, we must reawaken the conversation around the importance of the agri-food sector and the need for a national strategy should be a key priority for our sector.



Visit aic.ca to learn more.

This page was sponsored by Agri-Food Innovation Council.



Conseil de l'innovation agroalimentaire