

Life Sciences in Nova Scotia

A Sector Profile · 2015



NS Life Sciences: Highlights

Companies: 60 core firms, 100 related firms

Earnings: \$300 million annually, over 90% exports

Growth: revenues doubled from 2004 to 2011

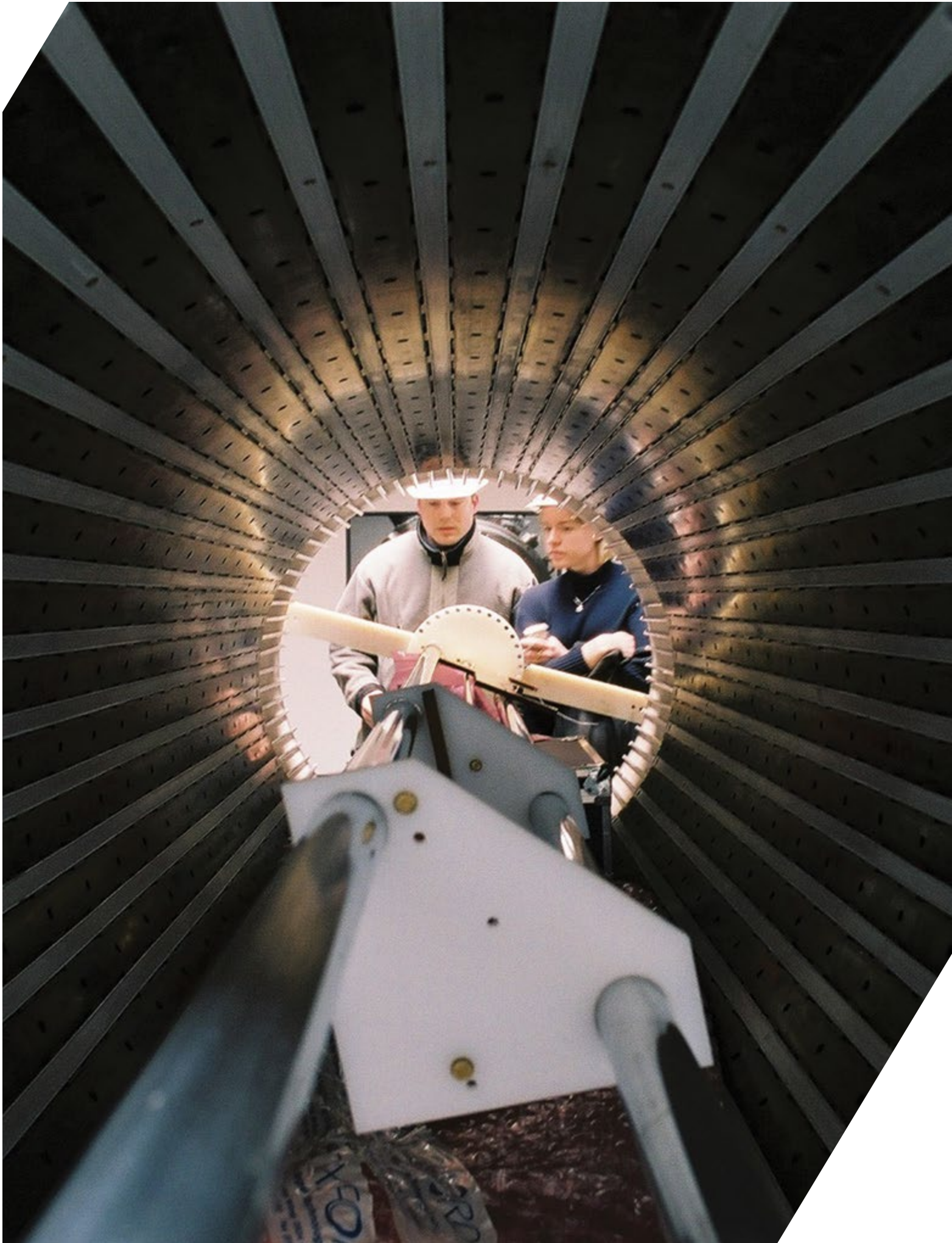
Products: 590 commercialized,
\$78 million committed to new product R&D

Exports: global reach (80 countries)

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Strategic Assets and Growth Areas

Nova Scotia's life sciences sector is a growth industry: the sector earned \$300 million in 2011, double its 2004 revenues. The sector is also an export industry: over 90 per cent of revenues come from exports (to 80 countries worldwide), with potential for even greater global reach as more products come into development. Key assets within the life sciences sector include the following areas:

Bioproducts, Natural Health Products and Nutraceuticals

Nova Scotia's proximity to the ocean has led to specialization in marine-derived bioproducts, specifically nutraceuticals and functional foods, including leading omega-3 and algae-based innovations. These bio-products are considered one of the fastest growing areas of the life sciences sector,¹ with \$123 billion in sales as a global industry in 2008.

Medical Devices and Diagnostics

Halifax is home to an emerging medical device and diagnostics cluster, built on the strength of top-tier research infrastructure at universities, hospitals and numerous public research organizations. Halifax has created an environment that fosters medical innovation, with over 20 companies operating in the sector.

Digital Health

Nova Scotia companies have produced world-leading solutions in digital health – a fast growing area which represents the convergence of digital solutions and health related opportunities. This includes learning tools for doctors, electronic prescription and decision support systems, and software that helps patients manage their own care and recovery.

Pharmaceuticals, Vaccines and other Bioproducts

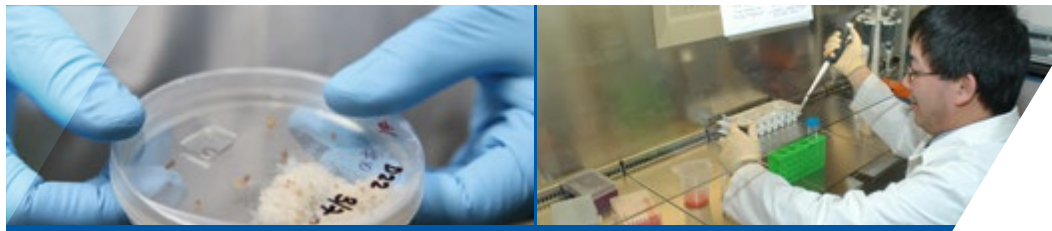
Nova Scotia has a number of emerging companies and researchers who are working to develop innovative ways to treat a variety of illnesses including Immunovaccine, Chelation Partners, DeNova Med and Neurodyn.

Agriculture

Both the Dalhousie University Faculty of Agriculture and Perennia offer a range of agriculture industry services, from research partnerships to incubation space for start-ups. Both institutions boast world-class facilities, supporting specializations that include genomics, DNA marker-assisted selection, bio-actives extraction and analysis. In addition, the Atlantic Wine Institute at Acadia University provides research, outreach and educational support to the region's wine and beverage industries.

¹ BCC Research, 2008

Overview



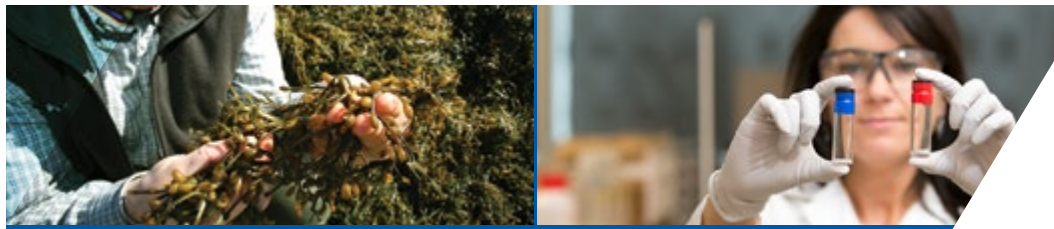
NS Life Sciences Sector

QUICK FACTS:

- Strengths in marine biotechnology and biomedicine (including nutraceuticals and functional foods), medical technology and software
- Additional strengths in pharmaceuticals and vaccines, agricultural applications and contract research
- Export-focused, including partnerships with many multinational biotechnology giants
- *The Scientist* magazine ranked Dalhousie University the #1 university in Canada at which to perform scientific research
- Nova Scotia's Brain Repair Centre is internationally recognized for successful treatment of symptoms of Parkinson's disease
- The Atlantic Innovation Fund (AIF) is a \$300 million pool of research funding available to eligible companies operating in Atlantic Canada
- NS-based Ascenta Health Ltd. has the largest share of Canada's omega-3 supplements market
- NS-based Acadian Seaplants is the world's largest manufacturer of seaweed-based specialty products
- DSM Nutrition is one of the world's largest producers of omega-3 supplements

Universities and Community Colleges

Given Nova Scotia's unique claim to possessing more post-secondary institutions per capita than any other region in North America, it's unsurprising that the province's universities house experts in every possible life science discipline as well as the technology to support their research.



Enabling Infrastructure and Research Support

Public sector research organizations are a significant part of private sector success in Nova Scotia, offering access to the expertise and research infrastructure companies need to develop and improve the next generation of life sciences products.

Life Sciences Research Institute and the Brain Repair Centre

The Brain Repair Centre is a multi-disciplinary collaboration linking more than 100 world-class researchers and physicians specializing in ground-breaking treatments and technologies in the field of brain repair. Housed in the Life Sciences Research Institute, the facilities are able to create synergies between university researchers, biotechnology companies and other research institutions.

Genome Atlantic

Enabling genomics R&D projects, Genome Atlantic works with industry, government and academia to advance genomics research and works to recruit genomics researchers to the region.

Capital Health and IWK

Capital Health and the IWK Health Centre are Halifax's two health authorities. Both are responsible for world-class medical research and house state-of-the-art facilities and research centres.

Innovacorp Enterprise Centre

The Innovacorp Enterprise Centre offers everything life sciences start-ups need – from scientific infrastructure such as reverse osmosis water, a chemical neutralization system and low flow laboratory fume hoods, to flexible leasing arrangements and on-site business support. Innovacorp also invests in early stage life sciences companies.

The National Research Council (NRC)

Nova Scotia's NRC labs house world-leading experts in marine biosciences, plus facilities that include a zebra fish drug testing facility, a bio-fence for unicellular algae rapid growth and testing and a concierge service to match businesses with expertise and services.

BioNova

BioNova is an organization dedicated to developing Nova Scotia's life sciences industry. BioNova represents companies working in pharmaceuticals/vaccines, medical technologies, natural health products/nutraceuticals, digital health and bioproducts. It also represents research organizations, service providers and other supporters.



Life Sciences Sector:

Life sciences are all sciences that have to do with organisms: plants, animals and human beings. The sector comprises companies in the fields of biotechnology (including industrial, agriculture and energy-related biotechnologies) as well as pharmaceuticals, biomedical technologies, life systems technologies and biomedical devices. The life sciences sector also includes organizations focused on research, development and commercialization of new healthcare solutions.

The global life sciences industry is estimated at more than \$1.1 trillion annually. That number is expected to accelerate as a result of both aging populations in industrial nations and rising incomes in emerging economies.

For example, the UN expects the world's median age to grow from 30.4 years in 2012 to 37.9 years by 2050;² in Canada, the median age could reach 45 by 2036.³ This change will drive demand for health-related biotechnologies.

Growth among developing economies will also push demand for all goods and services, creating opportunities for industrial and agricultural biotechnologies to help solve a variety of environmental and sustainability challenges.

Globally, population aged 60 or over is the fastest growing. Population ageing is unprecedented, without parallel in human history – and the twenty-first century will witness even more rapid ageing than did the century just past.

– United Nations, Department of Economic and Social Affairs

² United Nations World Population Ageing 2009.

³ Statistics Canada Population projections: Canada, the provinces and territories – May 26, 2010.

Nova Scotia's life sciences industry is a growing and increasingly important part of the economy. Provincial revenues in the sector have already doubled between 2004 and 2011, reaching \$300 million, and employing 1,100 people. Export driven, over 90 per cent of revenues come from outside the province, with an offering of more than 590 commercialized products sold to 80 countries around the world.

Fuelled by both public research and private innovation, Nova Scotia's ocean-based economy has led to strengths in the marine biosciences, which in turn have yielded ocean-derived bioproducts, nutraceuticals and functional foods.

Particular strengths in Nova Scotia's sector include:

- marine-derived nutraceuticals and bioproducts (Nova Scotia is a world leader in omega-3 fatty acid supplements)
- medical devices and diagnostics (supported by advanced technologies found at places like the Biomedical Translational Imaging Centre (BIOTIC), which offers a 4T MRI machine and PET, MEG, EEG and transcranial magnetic stimulation capabilities)
- digital health
- applications of biotechnology in the agriculture sector
- supporting infrastructure (including 18 research centres and institutes and 26 research chairs, including five Tier 1 Canada Research Chairs, at Dalhousie University alone)

Testing

In 1987, a mysterious food poisoning spread across Canada. Within just four days of testing, Halifax's team of scientists at the National Research Council lab identified domoic acid as the culprit – and ended the crisis. For years, authorities worldwide used the Halifax lab reference material to test for this deadly toxin. And today, Chester-based Jellet Rapid Testing is a world leader in developing tests for marine biotoxins like domoic acid.



In Focus Market Segments

Bioproducts, Natural Health Products & Nutraceuticals



In general, a bioproduct is any good produced from biomass. This could be fuel from algae-produced oils, polyester fibres from wood pulp or health supplements manufactured from food sources.

Nova Scotia's proximity to the ocean has led to a natural specialization in marine-derived bioproducts. The province has significant expertise in nutraceuticals and functional foods, a sub-category of bioproducts derived from food that have both physiological and health benefits. Considered one of the fastest growing areas of the life sciences sector, estimates suggest the subsector generated \$176 billion in sales worldwide.

OMEGA-3

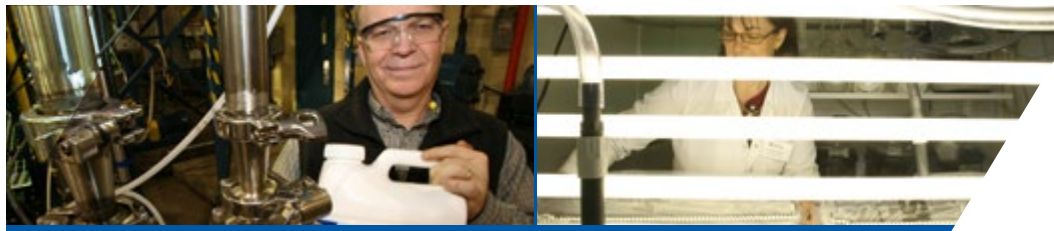
In particular, Nova Scotia is renowned as the birthplace of omega-3. One of the first processes used to separate essential fatty acids from fish oil was developed in the province, leading to the development of a billion-dollar global industry. Several Nova Scotia companies are leaders in omega-3 supplements, producing products from food-enhancing encapsulated powders to liquid supplements promoting healthier skin.

Birthplace of Omega-3

Robert Ackman was a highly respected research scientist and a pioneer in researching polyunsaturated fatty acids. Working for the Fisheries Research Board of Canada in Halifax, Dr. Ackman developed the process to extract omega-3 fatty acids from fish oils, and spawned a global industry.

Dartmouth-based Ocean Nutrition Canada was purchased in 2012 for \$540 million as the world's largest producer of omega-3 ingredients for the supplement and food manufacturing industries. Since then, the newly renamed DSM Nutritional Products Canada has invested millions to expand its research capabilities and process other marine and plant life.

Another Dartmouth company – Ascenta Health – makes NutraSea, Canada's number one selling line of omega-3 supplements. Ascenta produces a range of products that span human health, animal health and beauty.



ALGAE

Algae-based life science companies are also emerging in Nova Scotia, with applications ranging from animal feed to jet plane fuels. For example, Acadian Seaplants is a pioneer in the technologies used to process algae into products for the cosmetic, biochemical, agricultural and agri-chemical markets. Many of Acadian Seaplants' products enhance existing products, such as clarifying beer, making larger almonds or making healthier dog food.

More mature algal technologies tend to augment plant and animal feed, but newer algae-based biofuels also hold enormous potential. Nova Scotia is well positioned to break through some of the technological hurdles to commercializing biofuels.

Not only do many of Canada's leading algae experts work with private companies in Nova Scotia, but this expertise also exists in Nova Scotia's public research organizations.

“We’re asking plants to do what they do best. With little more than water and carbon dioxide, algae can harvest sunlight and turn it into energy that could eventually be used to create jet fuel.”

— Dr. Stephen O’Leary, NRC researcher

The National Research Council (NRC) labs in Halifax and Ketch Harbour house some of the leading experts in the marine biosciences. Ketch Harbour is also a leader in identifying productive algae strains and optimizing their growing conditions. The labs possess unique capabilities, including a zebra fish drug testing facility, a bio-fence used to rapidly grow and test unicellular algae and a concierge service to help businesses find the expertise and services they require.

NRC works directly with companies providing technical services, technology development support, collaborative research arrangements, licensing opportunities, credible scientific advice and access to specialized facilities. NRC's aim is to help companies efficiently transform bio-based resources into sustainable, value-added products.

Medical Devices and Diagnostics



With over 20 companies in Halifax's emerging medical device and diagnostics cluster, the province has created an environment that fosters innovation. Bolstered by top-tier research infrastructure at Halifax's universities, hospitals and numerous public research organizations, the cluster is focused on advanced technology, with specializations in a wide variety of products including in-vitro diagnostics and medical imaging.

Medical devices and diagnostics also represent a significant piece of Nova Scotia's life sciences sector: roughly 15 per cent of sales, just over 37 per cent of the business-led R&D and 40 per cent of employment income.

The sector has witnessed a number of new start-ups in recent years, including companies such as ABK Biomedical, Densitas, Springloaded Technologies, Halifax Biomedical, and Mindful Scientific.

Digital Health



Nova Scotia also hosts a growing cluster of companies that use digital technologies to improve healthcare delivery.

As processing speeds and user interfaces have evolved exponentially in the last decade, computer programs and devices are now able to assist in increasingly complex medical situations. This includes learning tools for doctors, electronic prescription and decision-support systems and software that helps patients manage their own care and recovery.

For instance, Halifax-based STI facilitates valuable interactions between physicians, patients, pharmacy and pharma with a variety of card-based programs empowering choice amongst healthcare professionals and patients.

The Rounds offers a physician-only online community where members can access experts and wisdom from all medical specialties.

Digital health has already taken the industry by storm, and its potential for further growth is staggering. An aging population, combined with advances in medical technologies, are pushing up healthcare demand and cost. Digital health technologies have the potential to push those costs back down. The global need to find more efficient methods of healthcare delivery will continue to accelerate the advance of the digital health sector.

Pharmaceuticals, Vaccines and other Bioproducts



With the global pharmaceutical market predicted to double to \$1.8 trillion by 2020,⁴ this subsector will see significant growth and innovation in coming years. Nova Scotia also has a number of emerging companies in biotechnology that are developing products related to health. For example:

- Immunovaccine is a clinical-stage vaccine development company focused on advancing its patented vaccine platform and product candidates for cancer therapy, infectious disease and animal health.
- Chelation Partners is a company developing solutions for the problem of drug-resistant microbial populations, such as superbugs, through the selected removal of iron, which is required for microbial survival, growth and spread.
- DeNovaMed is an early-stage pharmaceutical company specializing in new therapeutic approaches to combat bacterial infections.
- NeuroQuest Inc. is a drug development company focused on modulating nerve transmission and relieving neuropathic pain using bioactives from plant extracts.

Agriculture



This agricultural biotech sector applies life sciences knowledge and biotechnologies to the processing of agricultural goods and the production of organic and agricultural chemicals. With a growing global population, increased concerns about food safety and nutrition and the continuing impact of climate change, it's one of the world's most important industries. Located in Truro, both the Dalhousie University Faculty of Agriculture (formerly the NS Agriculture College) and Perennia (a provincial Crown corporation) offer a diverse array of services to the food and agriculture sector, including:

- world-class research facilities
- research partnerships
- incubation space for start-ups
- capabilities in genomics, DNA marker assisted selection, bio-actives extraction and analysis

The Science of Wine

As a scientist and wine aficionado, Dalhousie University Faculty of Agriculture's Dr. Sean Myles is working to produce a Muscat grape that grows well in the Nova Scotia climate. Normally, crossbreeding grapes can be a long and costly process, requiring five or more years to bear fruit from crossbred seedlings. But with DNA marker assisted selection, Dr. Myles is able to identify seedlings for the right flavour by their marker, greatly reducing the time and cost to fully develop the new variety.



The image shows a spacious, modern office atrium. On the right, a multi-story building facade is visible, featuring a grid of windows and horizontal wooden slats. The floor is a light-colored, polished material. In the foreground, there are several blue armchairs and a small round table. Further back, there are more colorful armchairs and a large, patterned sofa. The ceiling is high, with a large glass skylight and several cylindrical pendant lights hanging from it. The overall atmosphere is bright and professional.

Business Environment

Business Environment



A highly educated workforce, low business costs and a strategic location mean Nova Scotia scores very well on critical indicators of business success.

Workforce

Nova Scotia has a world-class workforce, supported in large part by the technical and professional programs offered by the province's 10 degree-granting institutions and 13 community college campuses. Nova Scotia boasts the highest number of colleges and universities per capita in North America.

Cost Competitive

Nova Scotia offers some of the lowest costs for facility leases and utilities and for salary and wages when compared to other North American and European jurisdictions.

Strategic Location

Located halfway between California and the UK, Nova Scotia is well positioned for either travel or simply communicating through time zones on either side of the Atlantic.

Nova Scotia's international full-service airport provides direct flights to major cities in the US and Europe and is the only airport in Atlantic Canada to offer US customs pre-clearance.

These three indicators contribute to why *fDi Magazine* ranked Halifax, Nova Scotia, sixth out of 405 large cities of the Americas in terms of infrastructure.⁵

Supporting Infrastructure



Nova Scotia's life sciences sector is supported by a number of research strengths that have proven fertile ground for new products. These strengths include:

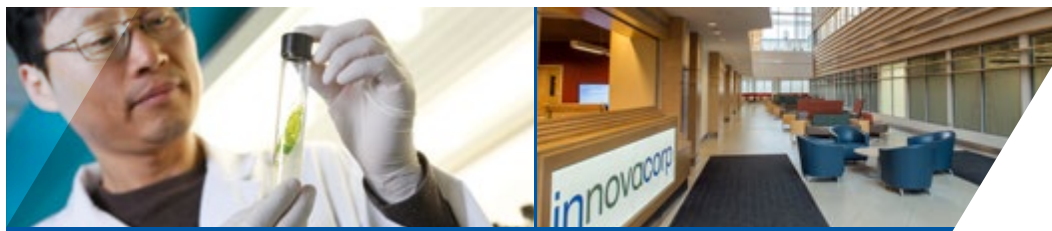
- **marine biotech research** – leading to new natural health products and bioproducts
- **neuroscience research** – leading to both pharmaceutical and medical technology products
- **imaging capabilities** – supporting the commercialization of new products and procedures
- **biomedical engineering** – leading to medical technology products

While many companies in Nova Scotia employ life sciences expertise and biotechnologies to improve their products, they may not have in-house capacity to conduct every specialized aspect of the research they need.

Nova Scotia offers many programs within its public sector research organizations to provide access to both expertise and research capacity. The next generation of life sciences products are often born out of these partnership programs.

For example, BIOTIC is one of the pre-eminent sources of research in magnetic resonance imaging (MRI) and magnetoencephalography (MEG) in Canada. Strategically located in two Halifax-based hospitals, BIOTIC can provide both the equipment and the people necessary to take an idea from scientific innovation to commercial success.

BIOTIC is one of many examples of Nova Scotia's supporting infrastructure to the life sciences sector.



Life Sciences Research Institute and the Brain Repair Centre

The Brain Repair Centre is a multi-disciplinary collaboration of Dalhousie University, the IWK Health Centre and Capital Health. The centre links more than 100 world-class researchers and physicians working with ground-breaking brain repair treatments and technologies.

The Brain Repair Centre is housed in the Life Science Research Institute (LSRI), a facility open to university researchers, biotechnology companies and other research institutions. LSRI's facilities include:

- proteomics
- FACS Aria III flow cytometry
- laser confocal microscopy
- a laser micro-dissection microscopy facility

The Brain Repair Centre has launched several spinoff companies, including Mindful Scientific, whose Consciousness Scanner helps in the diagnosis and care of concussions.

Genome Atlantic

Genome Atlantic supports genomics R&D project funding. The organization also works as an advocate for industry, government and academia to advance genomics research and recruit genomics researchers to the Atlantic region. Genome Atlantic is funded primarily by Genome Canada (funding nearly \$2 billion in genomics research Canada-wide).

“The goal is to combine the best minds – wherever they may be – to produce research that fuels practical and profitable innovation.”

– Dr. Steve Armstrong, President and CEO of Genome Atlantic

Innovacorp Enterprise Centre

The Innovacorp Enterprise Centre offers everything life sciences start-ups need – from scientific infrastructure such as reverse osmosis water, a chemical neutralization system and low flow laboratory fume hoods, to flexible leasing arrangements and on-site business support. Innovacorp also invests in early stage life sciences companies.

The IWK and Capital Health

Halifax is home to two independent health authorities: the IWK Health Centre and Capital Health. Both are respected as world-class medical research centres housing state-of-the-art facilities that include:

- The Biomedical Translational Imaging Centre (BIOTIC) (housing a 4T MRI machine and has PET, MEG, EEG and transcranial magnetic stimulation capabilities),
- Canadian Centre for Vaccinology
- Centre for Pediatric Pain Research
- Maritime Human Genetics Research Centre
- Centre for Clinical Research
- Centre for Research in Family Health

Universities and Community Colleges

Home to 10 universities and a network of 13 community college campuses, Nova Scotia boasts enormous post-secondary strength. Universities house experts in every possible sub-discipline of the life sciences as well as the infrastructure and equipment they need to move R&D forward. Some of their capabilities include:

- Dalhousie University's Nuclear Magnetic Resonance Research Resource (NMR3) – home to a state-of-the-art AV-III 700 spectrometer
- Dalhousie University's medical and dental schools – home to 18 research centres and institutes and 26 research chairs, including five Tier 1 Canada Research Chairs)
- The NeuroCognitive Imaging Lab, supporting the study of neuroplasticity – the adaptive and disruptive effects of experience on the brain's organization

The following page gives a selection of educational institutions that support the life sciences sector in Nova Scotia.

Life Sciences-Related Education Programs at Post-Secondary Institutions

INSTITUTION	PROGRAM	AREA OF FOCUS (SPECIALIZATIONS)
Acadia University	Undergraduate Degree	• Biology • Kinesiology • Nutrition & Dietetics
Cape Breton University	Diploma	• Engineering (Biosystems)
	Undergraduate Degree	• Biology • Science Community Studies (Biodiversity, Integrative Science, Health & the Environment)
Dalhousie University	Diploma	• Plant Technology
	Undergraduate Degree	• Animal Science • Aquaculture • Biochemistry & Molecular Biology • Biology • Food Science • Health Sciences • International Food Business • Marine Biology • Medical Sciences/Medicine • Microbiology & Immunology • Medical Technologies (Ultrasound, Nuclear Medicine, Radiology, Respiratory) • Pharmacy • Plant Science • Science • Statistics (Statistical Genetics and Bioinformatics)

INSTITUTION	PROGRAM	AREA OF FOCUS (SPECIALIZATIONS)
	Graduate Degree	• Agriculture • Anatomy & Neurobiology • Biochemistry & Molecular Biology • Biological Engineering • Biology • Biomedical Engineering • Clinical Vision Science • Clinical Scientist • Computational Biology & Bioinformatics • Food Science & Technology • Health Informatics • Microbiology & Immunology • Neuroscience • Pharmaceutical Science • Pharmacology • Physiology and Biophysics
Mount Saint Vincent University	Undergraduate Degree	• Biology
	Graduate Degree	• Applied Human Nutrition
Nova Scotia Community College (NSCC)	Diploma	• Health Information Management (HIM) • Pharmacy Technology
St. Francis Xavier University	Diploma	• Aquatic Resources • Biology • Human Nutrition • Human Kinetics • Pharmacy
Saint Mary's University	Undergraduate Degree	• Biology
	Graduate Degree	• Applied Science • Technology Entrepreneurship & Innovation

Other Life Science-Related Support Facilities



With one of the largest concentrations of life sciences researchers, facilities and specialists in Canada, many different organizations support the sector across Nova Scotia. Each entity has a number of areas of expertise – here are just three examples:

FACILITY	EXPERTISE
National Research Centre	• Analytical platforms (mass spectrometry, nuclear magnetic resonance)
	• Toxicology
	• Zebra Fish drug testing facility
	• Algae research
IWK/Capital Health	• Vaccinology (Canadian Centre for Vaccinology)
	• Pain
	• Aging
	• Epilepsy
	• Orthopaedics
	• Imaging (BIOTIC)
	• Cancer
	• Mental health
	• Obesity
Brain Repair Centre	• Vision
	• Cardiology
	• Neurological disorders
	• Movement disorders
	• Dementia
	• Aging
	• Glaucoma
	• Parkinson's
	• Epilepsy
	• Brain repair
	• Synaptic plasticity
	• State-of-the-art animal care facility

Programs + Incentives



Selected taxes/incentives:

- Nova Scotia offers R&D tax credits. Depending on the size and nature of the business, federal Scientific Research & Experimental Development (SR&ED) tax credits can be either 15 per cent or 35 per cent of the eligible expenditures. Nova Scotia provides an additional 15 per cent R&D tax credit for eligible candidates.

How We Can Help



Below are contacts, information and links that may provide information on potential partnerships and investment opportunities. These resources can help:

- facilitate introductions, support market entry and provide business information and competitive market intelligence
- gain insight into the challenges and opportunities in the life sciences sector in Nova Scotia
- build strategic alliances and business networks with local and international partners

Nova Scotia Government

Phone: 1-855-325-4668

business.novascotia.ca

Nova Scotia Business Inc.

E-mail: info@nsbi.ca

Phone: 1-800-260-6682

novascotiabusiness.com

Innovacorp

E-mail: info@innovacorp.ca

Phone: 1-800-565-7051

innovacorp.ca



Where We Are

SAN FRANCISCO 8 AM

NOVA SCOTIA 12 NOON

DUBLIN 4 PM



MOSCOW 7 PM

TOKYO 12 MIDNIGHT



novascotia.ca