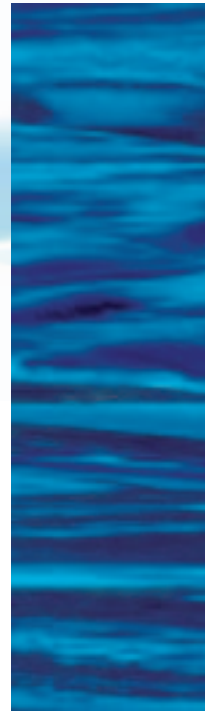


NOVA SCOTIA LIFE SCIENCES ASSET MAP



www.bionova.ca

Nova Scotia's Life Sciences Community at a Glance¹

INDUSTRY

Employment	1100 employees
Average Annual Salary	\$53,000 ²
Total industry payroll	\$58,300,000

Annual sales	\$181,175,000
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Products in the Marketplace	480
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Products in the Pipeline	306
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Value of Research Projects in Progress	\$52,655,000
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Patents	222
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RELATED RESEARCH INSTITUTION ACTIVITY

Employment	2365 employees
Average Annual Salary	\$57,500 ³
Total research payroll	\$135,987,500

Active Projects	310
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Industry/Institution Partnerships	128
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Value of Research Projects in Progress	\$110,000,000
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Patents	85
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1. Based on 2005 data. 2. Estimate based on information supplied by companies. 3. Estimate based on published salary information.

INTRODUCTION TO THE NOVA SCOTIA LIFE SCIENCES ASSET MAP PROJECT

In the spring of 2005, the directors of the Life Sciences Development Association determined that the organization's mandate had been achieved and its activities would wind down. In June of that year, representatives of the province's life sciences community came together to discuss whether a new organization was required and the majority believed there should be a *roadmap* developed to guide the future development of Nova Scotia's emerging cluster before any such decision was taken.

In order to implement this recommendation, a small working group was created, consisting of representatives of the Atlantic Canada Opportunities Agency, BioNova – the Nova Scotia Biotechnology and Life Sciences Industry Association, InNOVAcorp, the National Research Council Institute for Marine Biosciences, Nova Scotia Business Inc. and the Nova Scotia Office of Economic Development. This group quickly determined that before work on a roadmap could proceed, an inventory of the province's life sciences assets was required so that any strategic planning would be based on facts and figures and not anecdotal information. Thus the Asset Map project was born.

Halifax Global Management Consultants Inc. was chosen to take on the project whose purpose was to identify and define the assets that exist in Nova Scotia to support further development of the life sciences industry in the province. The consultants were asked specifically to identify:

- Current and projected life sciences business activity
- Current and projected life sciences focussed research activity in private companies and public sector institutions
- Pertinent, enabling resources that are available to support development of the life sciences industry.

Background data was reviewed, more than 50 key stakeholders were interviewed and more than 60 questionnaires were distributed throughout the community. Information was compiled into a database which contains profiles from some 35 companies and more than 20 research institutions and/or departments. Upon review of the survey data, it was determined that certain components needed to be cross-referenced and in some cases confirmed to assure integrity of the information which would form the ultimate asset map. This follow-up work has now been completed.

The pages that follow will illustrate the assets upon which Nova Scotia is developing its life sciences industry.

INDUSTRY ASSETS

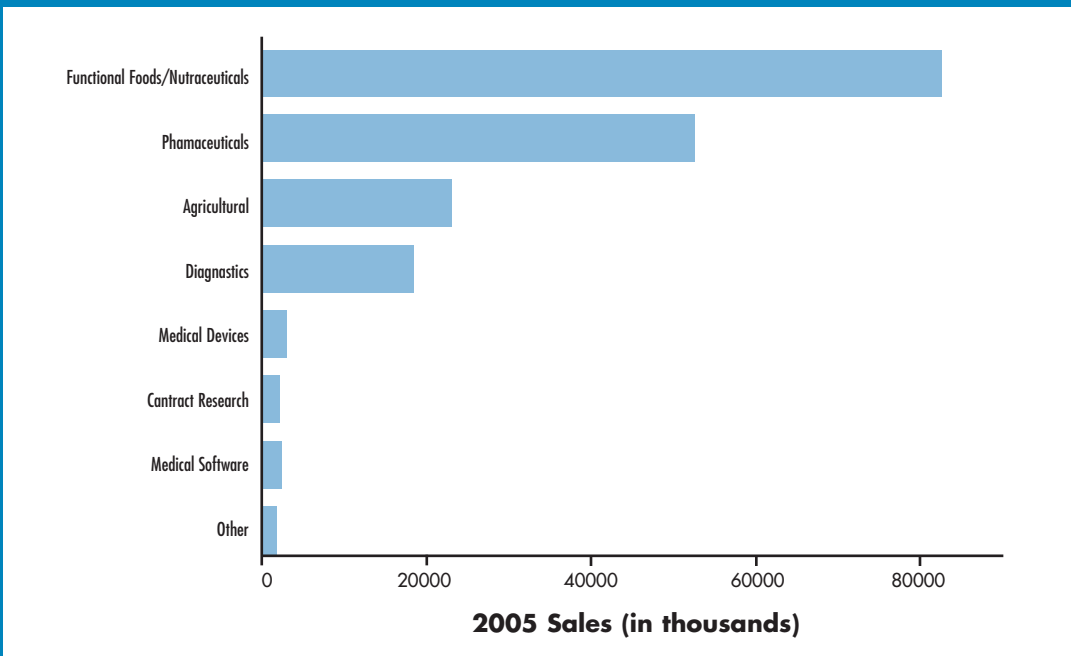
Nova Scotia is home to approximately 50 companies that are considered to be part of the life sciences industry, of which 75 per cent provided information for the asset map. For this project we looked at two distinct definitions in terms of what we were quantifying. When we referred to products either in development or already in the market place, we defined them by the categories in which they are or will be sold (see Figure 1). When we spoke of research, we identified it by the discipline or focus involved (see Figure 2).

The information these companies provided to us revealed an interesting set of life sciences industry assets.

There are over 1 100 people working in the industry, earning an average salary of just over \$53,000 which we estimate to contribute more than \$58 million in payroll to the Nova Scotia economy each year. Further, a high percentage of these jobs are sustainable, wealth-generating jobs which help to fuel the prosperity of the province.

Our life sciences industry has close to 500 separate products competing in the global marketplace

FIGURE 1: TOTAL EXPORT SALES BY PRODUCT BASE



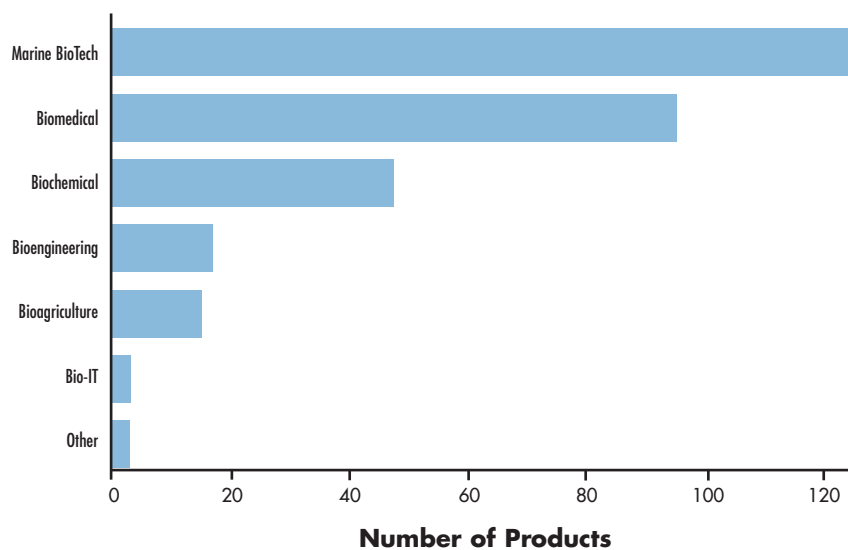


and in 2005 recorded more than \$181 million in sales revenue. Most of the products fall into the functional foods/nutraceutical, pharmaceutical and agricultural categories. (See Figure 1) It is important to note that virtually all of the life sciences products made in the province are exported.

In addition to those products already in the marketplace, our industry has a rich pipeline. Industry reported work on more than 300 products which are at various stages of development, from concept to awaiting regulatory approval. Most of the research and development efforts were focused on marine biotechnology, indicating our life sciences industry's orientation towards exploiting ocean resources (see Figure 2).

The pipeline is a strong indicator of the health, sustainability and potential growth of the industry. While it is impossible to accurately predict which of these research projects will actually develop into marketable products, company estimates indicate that the total revenue potential is in excess of \$4 billion.

FIGURE 2: PRODUCTS IN THE INDUSTRY PIPELINE BY RESEARCH FOCUS

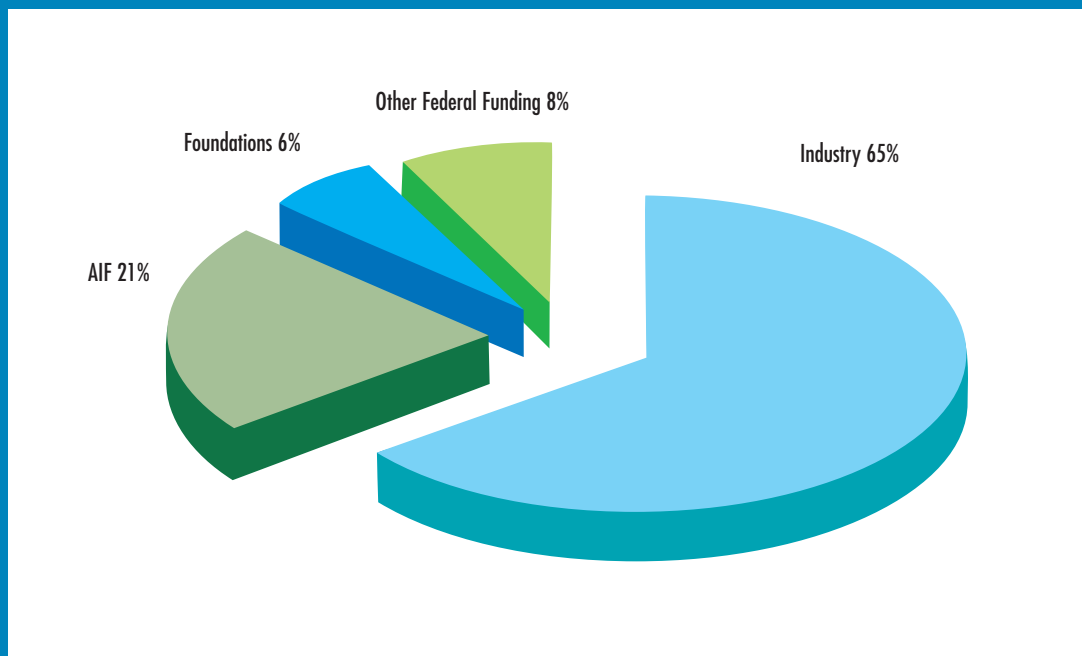


Companies hold more than 200 patents registered in Canada, the United States, Europe, Asia and several other countries.

As one might expect, the life sciences industry is significantly invested in research. While much of the research is conducted in the companies' own laboratories, life sciences firms also depend on partnerships to make the discoveries which lead to new products and/or processes. The businesses surveyed for this project identified partnerships with at least 22 other life sciences companies and some 15 universities, government research organizations and hospitals located around the world.

Estimates indicate that in 2005, the province's life sciences industry had committed to research projects valued at \$52,655,000, of which \$33,756,000 or almost 65 percent was invested by the companies themselves. The remainder came primarily from government programs, with the Atlantic Innovation Fund (AIF) being the most important in terms of dollar amounts. It should be noted that these figures do not include any reference to Scientific Research and Development (SR&ED) tax credits.

FIGURE 3: SOURCE OF INDUSTRY R&D FUNDS



PUBLIC RESEARCH ASSETS

While a healthy industry is critical to a successful life sciences cluster, the research foundation upon which it is based is also important. Nova Scotia is home to a significant research community comprised of universities, community colleges, hospitals and government labs and the majority of these are engaged in life sciences work. These include Acadia University, Dalhousie University and its medical school, St. Mary's University, St. Francis Xavier University, the Nova Scotia Agricultural College, Cape Breton University, Mount St. Vincent University, the Nova Scotia Community College, the IWK Health Centre, the Capital District Health Authority, the National Research Council Institute for Marine Biosciences and Institute for Biodiagnostics (Atlantic) and the Bedford Institute of Oceanography. In addition, research groups such as the Brain Repair Centre and Genome Atlantic are focusing on specific areas of life sciences research and commercialization. In addition, most universities now have access to industry liaison/technology transfer services through affiliation with Springboard, the pan-Atlantic network created to support the commercialization of academic research in the region.

Along with actual research, public institutions bring infrastructure into the asset map. The IWK Health Centre and the NRC Institutes for Marine Biosciences and Biodiagnostics have added new infrastructure over the past several years but it should be noted that Dalhousie University, the largest university in the province, has not added biomedical research space since 1967 when the Sir Charles Tupper Building was erected. Nevertheless, specialized equipment such as a 4 Tesla research MRI unit, a marine research centre and mass spectrometry are resident in Nova Scotia.

There are more than 2365 people working on almost 300 projects in the province's public research centres. These projects are in various stages of development, from concept to clinical trials and cover all facets of the life sciences. Aside from the importance of this work to this industry and others, we estimate that this activity also provides an economic benefit to the province in terms of more than \$135,987,000 in salaries paid to institutional research personnel.

Researchers are working with partners at 48 companies and almost 80 institutions from Canada, the US and several other countries. Our research institutions report that they hold some 85 patents in the biomedical, bioengineering and marine biotech fields.

New projects define the future direction of the institutions' research programs and thus will influence the technology that will be commercialized in years to come. In 2005, these projects were defined as shown in Figure 4.

Funding for public research comes from a number of sources as illustrated in Figure 5 including federal government, provincial government, industry, private foundations and patient groups and the institutions' own coffers.

FIGURE 4: INSTITUTIONAL RESEARCH PROJECTS BY RESEARCH FOCUS

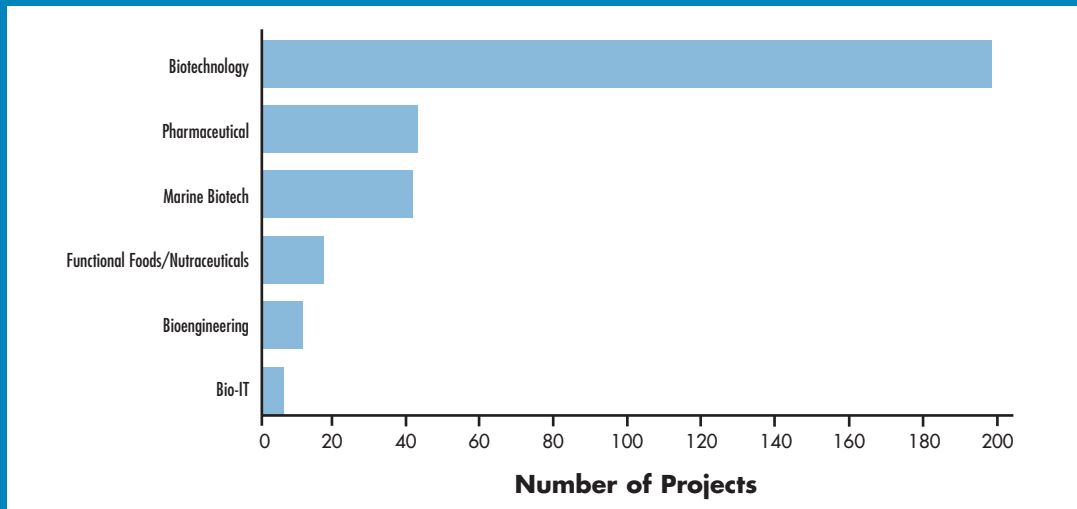
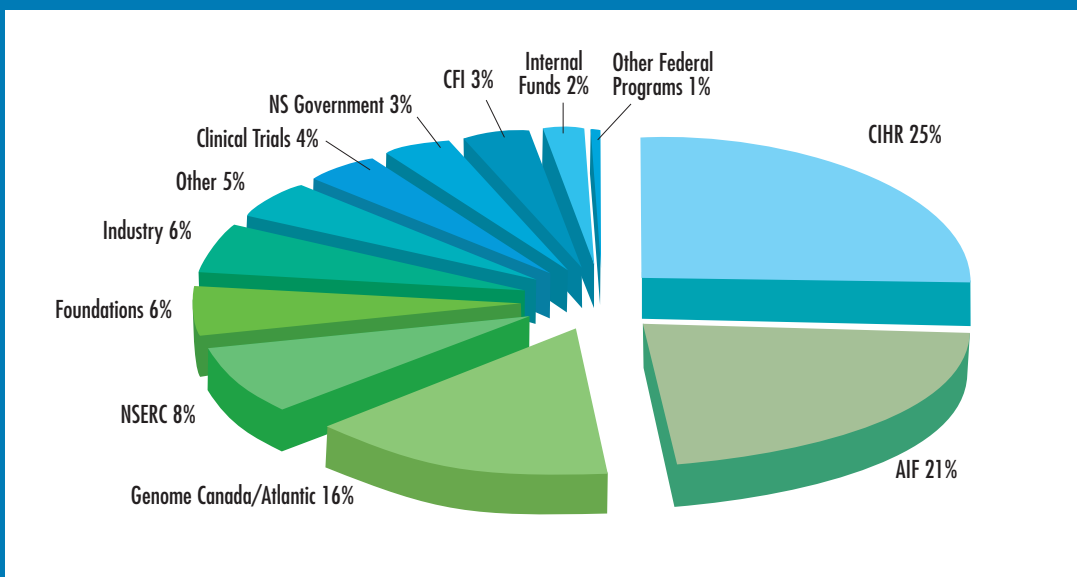


FIGURE 5: SOURCES OF INSTITUTIONAL RESEARCH FUNDING IN 2005



Source: Interviews and Published Reports

EDUCATION ASSETS

One of the critical components of any cluster is an educational system which can support it in terms of research and a reliable source of appropriately-trained owners, managers and employees.

In Nova Scotia, we have 11 universities, a community college system with campuses throughout the province and a number of private training providers. In addition, our close proximity to the other Atlantic Provinces augments our resident educational resources.

Of the 11 universities in the province, nine are engaged in some aspect of the life sciences. All offer undergraduate and post-graduate programs in science disciplines important to this industry, such as biology, chemistry, environmental science, engineering, animal science, plant science, neuroscience, pharmacy and nutrition. Business schools are becoming increasingly important to the cluster as the need for managers who understand the science and the commerce of bio-based companies increases as industry grows. To date no local school is offering a business degree with specific reference to life sciences but such programs are found in other centres where a cluster exists. Dalhousie's medical school is a significant asset both in terms of the research conducted and the medical professionals trained there. And legal professionals required for patent protection, intellectual property management and counsel to growing companies are being trained at Dalhousie's law school.

In the area of technical training, there are a number of programs in the Atlantic region preparing students to work as technicians in this industry. In Nova Scotia, one private institute has a program for medical lab assistants, the Community College (NSCC) is developing a medical technology program and Cape Breton University, in partnership with Keata Pharma has created a Biotechnology and Pharmaceutical Technology certificate program. Other technology programs which may be applicable to life sciences are available in Newfoundland & Labrador, Prince Edward Island and New Brunswick.

Given that the life sciences industry is relatively new in this area, companies often hire under-qualified employees and provide them with in-house training. And they keep employees current with continuing education courses. In Nova Scotia, business owners are working with the NSCC and private training providers to assist with program development. Many law firms offer courses on IP protection, patenting and other legal issues and through BioNova, courses on regulatory issues and compliance, good manufacturing practices and other priorities identified by industry are made available.

ENABLING SUPPORTS

Both company and institution participants were asked to identify the enabling supports available to them and rate the quality of the services offered.

At early stages, incubation facilities are critical to support life sciences companies. InNOVAcorp and the NRC Institute for Marine Biosciences have such facilities available and InNOVAcorp offers both a formal and informal mentoring program as well.

The life sciences community requires specialized patent agents, lawyers, financial advisors and accountants to guide companies and researchers through the complicated processes of protecting intellectual property, finding financing, facilitating partnerships, structuring deals and all of the other business functions involved. In Canada, most of the professionals with life sciences experience are in Ontario and Quebec and therefore local organizations must “import” this expertise the majority of the time. Most indicated that they had adequate access to legal and financial services and were satisfied with the providers. As the industry grows, this access to expertise may become a more important issue.

Other professional services such as HR recruitment, communication and marketing support were used infrequently and were found to be only somewhat satisfactory. Again, there are few local companies with domain experience and in order to access it, some life sciences organizations are looking outside Nova Scotia.

In the area of research and development support, local companies and institutions have access to a number of sources of assistance.

LOCAL

Atlantic Canada Opportunities Agency (ACOA) – offers a broad range of programs and services designed to improve the climate for business growth including supporting strategic sectors such as life sciences, encouraging increased innovation and commercialization, fostering entrepreneurship and business skills development, as well as facilitating trade and investment activities.

The Atlantic Innovation Fund (AIF) – focuses on R&D projects in the area of natural and applied sciences where these are explicitly linked to the development of technology-based products, processes or services, and their commercialization.

Nova Scotia Business Inc. (NSBI) – is Nova Scotia’s business development agency. NSBI uses investment attraction, export development and financing to support the province’s economy.

Nova Scotia Department of Economic Development (NSDED) – leads the province’s economic-development, innovation, and technology support systems. NSDED works with partners to support specific industry projects.

InNOVAcorp – helps promising early stage Nova Scotia companies commercialize their technologies and succeed in the global marketplace. The organization's High Performance Incubation (HPI)TM business model incorporates incubation infrastructure, business mentoring and seed/venture capital investment to help entrepreneurs overcome traditional hurdles to business growth. The life sciences industry is a key focus area for InNOVAcorp.

NATIONAL

National Research Council of Canada's Industrial Research Assistance Program (IRAP) – provides a range of both technical and advisory services along with financial support for research.

National Research Council of Canada's Institutes – through its Nova Scotia based institutes, NRC provides access to a national framework of research and technology expertise available to assist companies in overcoming technological challenges and developing new products.

Natural Sciences & Engineering Research Council (NSERC) – supports both basic university research through discovery grants and project research through partnerships among universities, governments and the private sector, as well as the advanced training of highly qualified people.

Canadian Institutes of Health Research (CIHR) – the major federal agency responsible for funding health research in Canada.

Canada Foundation for Innovation (CFI) – funds research infrastructure to strengthen the capacity of Canadian universities, colleges, research hospitals, and non-profit research institutions to carry out world-class research and technology development.

In addition to the programs available to assist with R&D, business supports including mentoring, incubation, counselling and financial assistance is available from:

Business Development Bank of Canada (BDC) – a financial institution wholly owned by the government of Canada. BDC plays a leadership role in delivering financial, investment and consulting services to Canadian small businesses.

Department of Foreign Affairs and International Trade – helps Canadian companies expand and succeed internationally by facilitating exports and by promoting Canada as a dynamic place in which to invest and do business.

Industry Canada – provides support in program areas such as developing industry and technology capability, fostering scientific research, promoting investment and trade and promoting small business development.

CHALLENGES AND OPPORTUNITIES

Respondents from both industry and research organizations were asked to consider the major weaknesses or threats Nova Scotia's life sciences cluster is facing or will face in the future. The following were identified:

- No strategic focus (or roadmap)– we need to pick key areas of concentration, based on our assets, and work to support continued development
- Absence of political champions and leadership at the provincial government level – commitment is unclear
- The relatively small number of companies – production is concentrated in only a few firms and that could be risky
- Poor harmonization between publicly funded research and private sector commercialization and a research community not considered to be entrepreneurial
- Limited access to risk capital at all stages of business development
- Lack of skilled human resources for a number of key positions such as experienced managers with technical expertise, top level research scientists
- Global competition for life sciences markets

Respondents were also asked to identify the strengths the community possess which could afford us the best opportunities for growth of Nova Scotia's life sciences cluster. These included:

- A strong, globally-recognized research community
- A foundation of existing companies in growth mode which will attract additional life sciences business to the province
- A focus on adding value to our resources, e.g. marine-based bioproducts, agriculture, environmental remediation, biofuel production
- Our current competitive advantages, whether in terms of research or industry involvement, in areas such as diagnostics, functional foods and nutraceuticals, marine resources
- An educated and loyal workforce
- Easy access to US and European markets
- Access to enabling supports from private and public sources



CONCLUSION – WHAT ARE NOVA SCOTIA'S LIFE SCIENCES ASSETS?

Our research tells us that we have a promising life sciences cluster growing in Nova Scotia. We have companies already contributing to the economy of the province; and we have research that's second-to-none happening in industry and in publicly-funded institutions.

In terms of products already in the marketplace, sales figures indicate that our strength is in functional foods and nutraceuticals, pharmaceuticals, agricultural products and diagnostics. The caveat is that four major companies are responsible for more than 85 percent of the total sales and the sales-by-sector statistics do not adequately account for the many companies that may have small sales in other sectors.

In terms of industry's products in the pipeline, the majority of the development work is taking place in the marine biotechnology and biomedical areas. At the public institution level, two-thirds of the research projects are described as *biotechnology* which may include biomedical, biochemical and bio-agriculture activity.

Nova Scotia has companies with products which are exported all over the world, a well-trained work force, industry support services ranging from incubation to technological assistance to funding programs, good transportation infrastructure with easy access to the major markets in the United States and Europe, engaged government officials, an active industry association, a medical school and teaching hospitals and excellent research happening in a number of disciplines important to the life sciences from biotechnology to engineering to marketing.

Our research shows that companies with R&D based in marine biotechnology are leaders in revenue generation despite relatively moderate research expenditures, while companies based on biomedical R&D have relatively high research expenditures relative to their revenues.

A complementary observation can be made upon close examination of the product side - companies with products in the agricultural and functional foods and nutraceutical sectors lead in revenue generation (and number of products in the market), while companies developing pharmaceuticals lead in research expenditures.

In order to build on these assets, Nova Scotia will have to determine what it wants its life sciences cluster to be and take the steps required to achieve this. A *roadmap* which provides clarity, focus and builds upon assets towards a bold yet realistic vision is where we, as a life sciences community need to go next.

BioNova thanks representatives of the Atlantic Canada Opportunities Agency, InNOVAcorp, the National Research Council Institute for Marine Biosciences, Nova Scotia Business Inc. and the Nova Scotia Department of Economic Development for their guidance and support of the Asset Map project.



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