



# Defined by the sea:

Nova Scotia's Oceans Technology Sector present and future



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## At a glance:

### Nova Scotia's Oceans Technology Sector

- Over 200 companies. More than 60 innovators of new high-tech products and services.
- 2009 revenues of ocean-technology innovators more than \$500,000,000; doubled since 2003.
- Average corporate taxable income in ocean tech innovators, nine times provincial average. Income growth rate twice that of other sectors.
- Oceans tech companies account for about one-third of all R&D performed by businesses in Nova Scotia.
- Nova Scotia is home to 450 PhDs in oceans-related disciplines. Highest concentration in the world.
- Bedford Institute of Oceanography (BIO): 700 scientists, engineers, technicians, Canada's largest centre for oceans' research.
- Institute for Marine Biosciences (NRC) — world's most versatile marine research facility.
- Defence R&D Canada (DND) — world leading experts in anti-submarine, mine, torpedo defence.
- Dalhousie University: 25 per cent of all federal oceans research grants and the Halifax Marine Research Institute (HMRI) that fosters collaboration among researchers.
- Estimated annual global market value for ocean-related goods and services: \$3 trillion (US). Doubled in last six years.

# Defined by the sea:

## Nova Scotia's Oceans Technology Sector present and future



### Introduction:

It should come as no great surprise that in Nova Scotia, where the sea has been the defining physical and economic feature for centuries, a strong, dynamic oceans technology sector is well established and growing.

However, the diverse nature of the enterprises and the fact that, on a per capita basis, the province boasts North America's highest concentration of oceans technology companies may raise an eyebrow or two. We suppose that is in part our omission — a reserved reluctance to tell the story, until now.

What follows is not the complete compendium of Nova Scotia's private and public sector oceans technology players and assets, but rather an illustrative "map" designed to help the reader understand what is happening in the sector and provide a glimpse into the vast potential for growth and benefits it holds in this province and beyond.

The oceans technology sector comprises "knowledge-based companies that invent, develop and produce high tech products for specific use in or on the ocean; or provide knowledge-intensive, technology-based services, unique to the ocean."

Oceans Technology holds great promise. In economic terms, the global market for oceans-related industries in general has an estimated value of more than \$3 trillion (US) annually and it's growing. Just six years ago, the total value was pegged at half that figure. A market of those dimensions and dynamics offers immense opportunities for local companies to participate, innovate and compete. Nova Scotia's oceans technology sector has proven its ability to do all three.

The world's oceans hold untold benefits. Oceans technology opportunities go beyond the purely economic to include answers to questions on climate change, medical advances, healthy, nutritious food and alternative energy sources.

In Nova Scotia more than 200 companies are engaged in a burgeoning oceans technology sector. Whether you measure success on a balance sheet or in terms of life and environment sustaining discoveries, on the whole, Nova Scotia's companies have performed well. Sixty of those companies would be considered "core" players, building the foundation by inventing, developing and producing technologically innovative products and services that add value to oceans-related enterprise and science. Another 150 or so Nova Scotian companies are either manufacturers or suppliers of high-tech products or provide sophisticated services to oceans-related sectors.

The range of technology and applications, products and services offered by these companies is broad and diverse, but also highlights the interconnections between so much of the oceans technology sector. Nova Scotian companies are pioneers in underwater acoustics and imaging, marine communications, navigation, and a wide variety of enhanced engineering and environmental services. The instruments and equipment developed or in development in Nova Scotia have or will have applications across the gamut of enterprise and activity on and under the water, from defence and security, to weather and climate forecasting to food and nutritional acquisition.

Oceans technology is a dynamic sector, driven by rapid advances in the collection, integration and analysis of data, all of which leads to productivity increases at equally dramatic rates.

### Dimensions:

With 7,579 kilometres of coastline, Nova Scotia is home to thousands of independent fishing vessels, hundreds of aquaculture sites and fish plants, dozens of boat builders, offshore energy projects, ports, shipyards and more oceans-related assets. About 15.5 per cent of provincial GDP, that's more than \$5 billion a year, is from oceans-related industries. Some 30,000 Nova Scotians are directly employed in oceans activities, drawing \$1.6 billion in income, or about six per cent of the provincial total. When spin-off employment is considered, more than 10 per cent of provincial income is oceans-related.

By far the fastest growing sector of Nova Scotia's oceans-related economy is the oceans technology sector, where revenues for innovators doubled between 2003 and 2009 to more than half a billion dollars. These are successful companies, whose corporate taxable income is on average nine times higher than other companies operating in the province, and whose growth in taxable income has doubled that of other sectors during the 2003-09 period. About 75 per cent of the core oceans technology companies are exclusively located in Nova Scotia.

The sector is a mix of primarily small and medium-sized enterprises with a few large multi-national corporations. Exports to the United States, along with growing market development in Europe and Asia, are the key drivers. Some of the larger, more experienced players and multi-nationals are combining a strategic mix of imports, exports and overseas investment activities, engaging in an integrative trade model to ensure success in international markets.

The oceans technology sector is a model of research intensity in the province. The core of the sector accounts for about one-third of total research and development among businesses in Nova Scotia. In 2009, oceans tech companies accounted for 27 per cent of total expenditures eligible for the Nova Scotia Research and Development Tax Credit. This is more impressive, considering these companies represented just five per cent of the 418 R&D tax credit claimants.

The province's potential as a hub, or cluster, of oceans technology comes into clearer focus when we add the knowledge capabilities offered by world-class public sector research capacity, universities and colleges with a specific concentration on oceans-related research and academic programs, and increasing networking and cooperation among business, government and research facilities. With 450 PhDs with connections to the ocean — among the highest concentrations in the world — the province is a leader in oceans technology research and development.

### **Positioning:**

Nova Scotia's oceans technology sector is comprised of sub-sectors that are forecast for growth internationally. Strategic areas of concentration include: acoustics, sensors, and instrumentation; marine geomatics; marine biotechnology; marine unmanned surface and underwater vehicles; marine data, information, and communications systems; and naval architecture. The market segments where these technologies and applications are required and applied are primarily defence and security; shipbuilding and marine transportation; ocean science and observation; offshore and coastal energy; and aquaculture and fisheries.

### **The following sections highlight Nova Scotian companies' involvement in the six key areas of concentration:**

#### **Acoustics, Sensors, and Instrumentation:**

Acoustics, sensors, and instrumentation includes a sub-sector of companies that develop and deploy surveillance equipment and collect and process data for applications such as oceanography, meteorology, defence, search and rescue, fishing, marine transportation and offshore energy exploration and development. Acoustics allow oceanographers to measure temperature and currents, oil companies to explore mineral deposits in the seabed, the navy to determine positioning of enemies, and fishers to identify where the fish are. Nova Scotia has one of the highest per capita concentrations in North America of companies that manufacture navigational and guidance equipment. This industry has grown to become one of Nova Scotia's top 15 goods exporters.

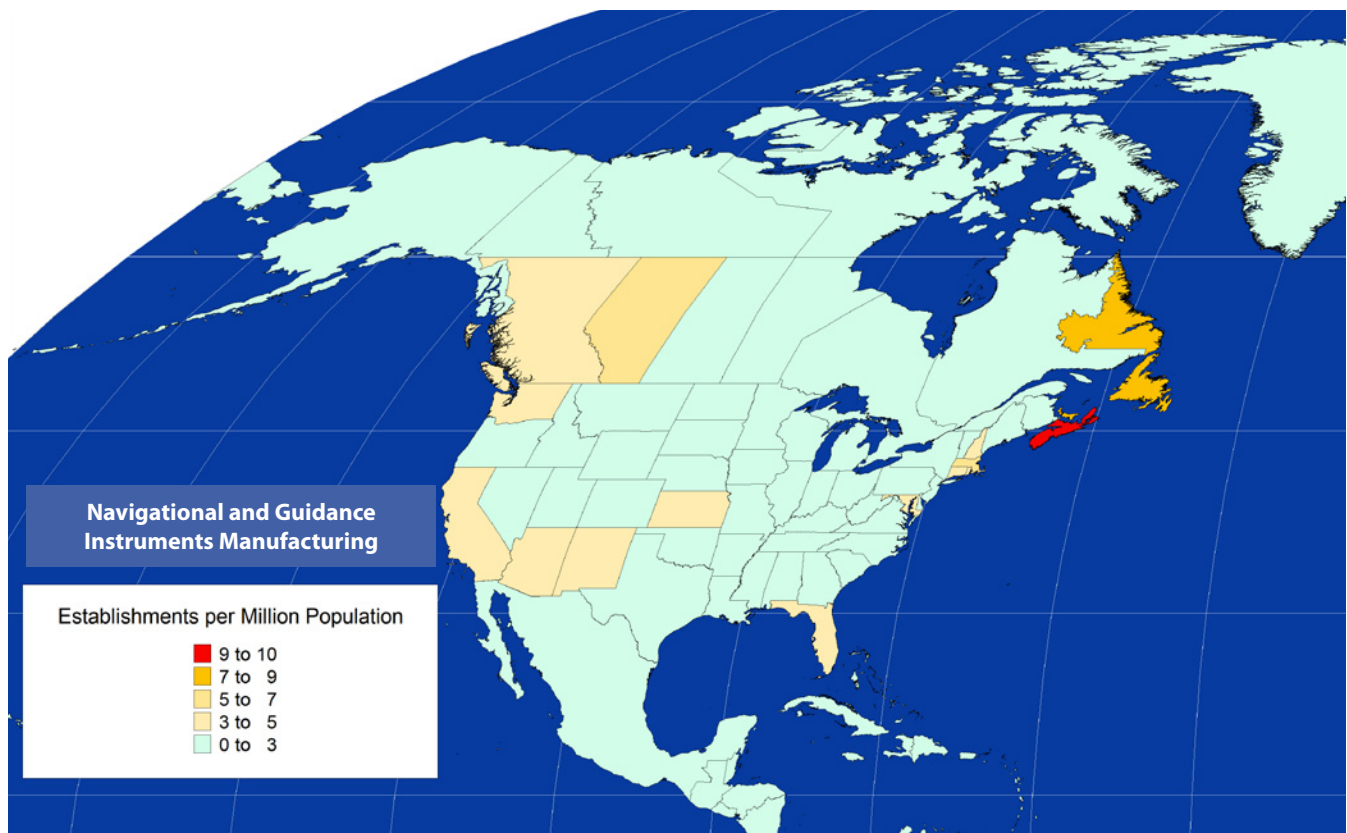
Some of the key Nova Scotian companies in the subsector that manufacture innovative products include Ultra Electronics Maritime Systems Inc.; Lockheed Martin Canada Inc.; and L-3 Communications Electronics Systems Inc. MetOcean Data Systems Ltd.; Satlantic Inc.; Vemco (Amirix Systems Inc.); Geospectrum Technologies Inc.; Cobham Tracking & Locating; and ODIM Brooke Ocean, which was recently acquired by Rolls Royce Naval Undersea Systems. Other companies such as Akoostix Inc. and Instrument Concepts Inc. develop supporting software and provide related services.

Since 1985, MetOcean has been the world leader in design and production of drifting buoys with tracking capabilities and sensors that collect scientific data for the oceanographic, meteorological, and oil & gas markets. Satlantic, founded in 1990 by a Dalhousie professor, produces sensors and mooring systems that monitor water quality and are used in environmental research by institutions like the Monterey Bay Aquarium Research Institute, Rutgers

University and the University of Southern California. Nortek Scientific has established itself as a Centre of Excellence, working with Dalhousie University and Memorial University of Newfoundland on research and development of innovative underwater acoustic instrumentation to measure current velocity and suspended sediments in aquatic environments. Companies such as Vemco and Geospectrum Technologies manufacture hydrophones that detect acoustic signals in the ocean in the same way microphones collect sound in the air.

Ultra Electronics, Lockheed Martin, General Dynamics Canada and L-3 Communications are among the companies that develop advanced systems for defence and security sectors. For example, Ultra manufactures sonobuoys used for submarine surveillance and underwater acoustic research.

Smaller companies in Nova Scotia are also beginning to make waves with their innovative technologies. For example, Instrument Concepts Inc., designs and manufactures sensor technology — smart hydrophones that listen for sounds in the ocean with a focus on ocean observation and science applications. Akoostix Inc. works on surveillance-related acoustics-based technology with defence, ocean science, and offshore energy applications.



**Source:** U.S. Census Bureau, 2007 Economic Census; Statistics Canada, Canadian Business Patterns (Dec 2009); Statistics Canada, CANSIM Table 051-0001

### **Data, Information, and Communications Systems:**

As technology advances information and communications technology applications grow, evolve and permeate most industry sectors. The oceans sector is no exception. Companies within the Data, Information, and Communications Systems sub-sector develop hardware, software, and integrative systems to meet the needs of oceans-related industries.

Products and services that make up this sub-sector enhance efficiency and effectiveness in all aspects of oceans-related activities. In terms of maritime defence, information and communications systems support all military operations. C<sup>4</sup>ISR stands for command, control, communications, computers, intelligence, surveillance and reconnaissance. L-3 Communications Electronics Systems Inc. and MacDonald Dettwiler & Associates (MDA) Ltd. develop C<sup>4</sup>ISR systems that combine data sources into comprehensive information used for real-time decision making in the field. Other applications in this sub-sector include the use of wireless voice and data communication systems (i.e. radio and satellite) to provide vessel tracking, emergency aid, system monitoring, or onboard internet access. CarteNav Solutions Inc. develops software that controls modern sensors and integrates numerous sensors to collect, process manage data. JouBeh Technologies manufactures leading data collection and delivery platforms for scientific, search and rescue, and fisheries management communities. Nautel Ltd., one of the largest ICT manufacturers in Atlantic Canada, is a global leader in the design, manufacture, sales and support of high power Radio Frequency products for AM and FM broadcast, navigation, industrial and space-based applications.

### **Marine Geomatics:**

Marine geomatics companies develop innovative technologies that gather, analyse, and interpret geographic information that can be used in surveying or mapping the ocean floor. Marine geomatics can be used for any number of applications such as seismic surveys to identify sub-sea energy resources or hydrographical mapping to create nautical charts.

Over the past decade, Nova Scotia's geomatics companies have consistently posted profit margins above the Canadian average in this sub-sector. Aside from its contribution to the offshore energy market, ocean surveying and mapping have also become increasingly important tools in understanding climate change and determining issues like Arctic sovereignty.

McGregor Geoscience has, since 1973, been involved in planning, management and execution of hydrographical and marine geoscience projects. The company's innovative use of existing technologies provides a suite of data acquisition tools for seabed and seafloor mapping, imaging and sampling.

Canadian Seabed Research Ltd. provides marine geophysical surveys including precise positioning, hydrographic surveying, seafloor imaging, sub bottom profiling, geotechnical analysis and comprehensive reporting and mapping. Hyperspectral Imaging Ltd. is a geomatics firm specializing in the collection, processing and analysis of remote data for resource and environmental applications. Some of the other companies in the sub-sector range from small local companies such as Seaforth Geosurveys Inc.; Seismap Consulting Inc.; TekMap Consulting, to branches of multi-jurisdictional companies such as Fugro Jacques Geosurveys Inc., and Compusult Ltd.

### **Marine Biotechnology:**

Marine biotechnology involves the use of the ocean's diverse living species for the development of new products and processes for use in many aspects of our lives. Nova Scotia has competitive advantages in the marine biotechnology sub-sector. In addition to the province's renowned companies and universities, the National Research Council Institute for Marine Biosciences plays an integral role in research using marine bioproducts for the discovery, characterization and development of bioactives, natural toxins, functional foods and nutraceuticals.

Nova Scotia-based Ocean Nutrition Canada Limited (ONC) is the world's largest supplier of Omega-3 EPA/DHA ingredients to the dietary supplement and food manufacturing markets. ONC also has the largest privately-owned



marine research and development facility in North America. Acadian Seaplants Ltd. (ASL) is another of the province's success stories, and created an industry that did not previously exist. The company is a globally recognized leader in processing seaweed-based products for food, biochemical, agricultural and agri-chemical markets. ASL is a fully integrated company that manages every stage of its operation from sustainable harvesting and cultivation of marine plants, technology development and engineering, manufacturing and quality assurance to market development, sales and customer support.

Other notable marine biotechnology companies in Nova Scotia include: Jellett Rapid Testing which developed screening tests to identify paralytic shellfish poisoning. Kenney & Ross Ltd. produces marine extract products, is the world's largest manufacturer of fish gelatin products, and uses seafood by-products to produce an anti-inflammatory for the pet market.

### **Unmanned Surface and Underwater Vehicles:**

Unmanned underwater vehicles (UUV) are any vehicles that are able to operate underwater without an operator on board. They can be remotely operated vehicles (ROV) or autonomous underwater vehicles (AUV) which operate independent of an operator. The term unmanned surface vehicle (USV) refers to any vehicle that operates on the surface of the water without a crew. UUVs and USVs come in all shapes and sizes. They range from free-drifting water blimps to sub-sonic jet powered craft. In the defence and security sector, UUVs are used to map and scan dangerous areas, to locate mines and to aid in the detection of submarines. The offshore energy and ocean observation and science sectors use UUVs to map the seafloor before building subsea infrastructure and to gain a deeper understanding of the seabed and of marine life.

A number of Nova Scotia-based companies produce components and/or systems that are used in the production of Unmanned or Autonomous Vehicles. Nova Scotia-based branches of Rolls Royce Naval Marine Canada, Lockheed Martin Canada Inc., Ultra Electronics Canada, MDA Systems Ltd., Moog Corporation, and Martec Ltd. all have a presence in this global market. A number of local companies also contribute to this growing industry, including OmniTech Electronics Inc., Deep Vision Inc., A.F. Theriault & Son Ltd., and Welaptega Marine Ltd.

A.F. Theriault & Son Ltd. — one of the largest, privately owned boat builders in the Atlantic region — partnered in the development of the Hammerhead Unmanned Surface Vehicle Target - a radio-operated training boat designed for navy training exercises. Several Hammerhead hulls have been sold to the Canadian Navy, generating interest from naval forces around the world. The unmanned military vehicle segment is projected to grow in value by 40 per cent, or from \$5.8 billion in 2010 to \$8 billion by 2016. Welaptega Marine Ltd. produces a 3D video toolkit that enables remote manipulation of safety critical equipment including moorings, pipelines, risers and other subsea equipment.

### **Naval Architecture:**

Naval Architecture is often described as the science and design in shipbuilding. It involves basic and applied research, design, development, evaluation and calculations during all stages of the life of a marine vehicle. This includes everything from ship structural analysis/design to determining which materials to use within a particular ship. Nova Scotia's shipbuilding history and infrastructure have spurred specialization in naval architecture. Fleetway is staffed with professionals whose composite experience includes all major Canadian Navy warship designs, concept and functional design for Coast Guard Vessels, oceanographic and fisheries research ships, ferries as well as

commercial vessels including tugs, barges and specialty vessels. Grantec Engineering Consultants Ltd and Martec Ltd. conduct structural analysis and design. Among other products, Martec has developed analysis software for naval architecture and marine engineering applications. Spar Marine Ltd. provides customized electrical solutions for all types of non-recreational vessels. Other companies, such as Hawboldt Industries and Advanced Precision specialize in integrated design, manufacturing, and assembly of precision components and complex fabrications used in marine vehicles.



# Markets

Companies within the Nova Scotia oceans technology sector typically service one or more of five broad market categories. Although a number of core companies specialize within their niche market, many offer products and services that are used across a range of market segments. The following section segments the oceans technology sector by markets. It provides an overview of the opportunities that Nova Scotia offers to oceans technology companies in each of the market categories. Highlighted are some of Nova Scotia's assets in each category, some examples of marine technology applications, multinationals that have a presence in the province along with a brief description of activity taking place from a global value chain perspective.\*

## Defence and Security:

A variety of Nova Scotia's oceans technology companies invent, develop, and produce technology-based, ocean-related products and services for military, port security, surveillance, and search and rescue activities.

Canadian Forces Base Halifax is Canada's largest military base and home to Canada's Atlantic naval establishment. Approximately 10,000 people are employed at the base injecting about \$600 million a year into the local economy. Its main facilities include HMC Dockyard in Halifax, base for the fleet of frigates, supply vessels, submarines and coastal defence vessels; 12 Wing Shearwater, home to the navy diving school, the Sea King helicopter base, and a jetty for docking NATO submarines. Shearwater will become headquarters for the Maritime Helicopter Program, the replacement for the Sea King. Defence R&D Canada (DRDC) operates a research centre in Dartmouth with world-leading expertise in anti-submarine warfare, mine and torpedo defence and modelling and simulation of ship and combat systems. In addition to supplying Canada's military, many oceans technology companies operating in this market export their products and services to defence and security clients of other countries.

Halifax also hosts the Regional Headquarters for the Canadian Coast Guard (CCG), the Marine Security Operations Centre (MSOC) and Joint Rescue Coordination Centre (JRCC) Halifax, which is responsible for the coordination of all Search and Rescue (SAR) operations associated with aircraft and marine emergencies in eastern Canada.

\* A value chain is a term used to describe the full range of activities that firms undertake to bring a product or service from conception to end use and beyond. This includes supply chain activities and value added activities including research, design, distribution, marketing, and after sales support. In recent decades, global trade barriers have been dismantled, communications have improved, IT innovation has enabled global operations management and transportation costs have been cut. Large international companies can now identify the most beneficial location for each activity to maximize efficiencies and quality. The emergence of global value chains and growth of the lead companies that control them has resulted in a dramatic change in the nature of international commerce.

About a dozen multi-national defence companies have acquired or located a link in their global value chain in Nova Scotia. These facilities primarily provide components or value-added services to major clients such as Canada's Department of National Defence. Global leaders in navigational and guidance instruments, such as Lockheed Martin and L-3 Communications, have established operations in Nova Scotia. The province is also home to Rolls Royce Undersea Division, General Dynamics, MacDonald Dettwiler & Associates, Ultra Electronics, Raytheon, and Thales.

Canadian Defence Review Magazine recently ranked Irving Shipbuilding, operator of the Halifax Shipyard, fifth among defence companies in the country, based on economic impact, innovation, contribution to national security and support for Canada's military.

#### **Shipbuilding and Marine Transportation:**

Oceans technology companies operating within the Shipbuilding and Marine Transportation market invent, develop, and produce technology-based, ocean-related products and services for naval architecture, navigation, communications, performance evaluation, vessel monitoring, and safety/evacuation. Oceans technology shipbuilding and marine transportation activities contribute to the construction of ships and other high-tech boatbuilding, and the various transportation activities that occur in the oceans' environment, including marine towing, navigation and communications and shipping.

Modern facilities, an exceptional track record, and a highly skilled workforce make Nova Scotia the prime location for shipbuilding in Canada. Irving Shipbuilding Inc. has approximately 1,300 employees and offers one of the best combinations of shipbuilding, offshore fabrication, ship repair and engineering services in North America. The company has ISO 9001-2000 certified facilities in Halifax, Woodside and Shelburne, all of which are ice-free, deep water facilities with year round access. The company's largest facility and head office site, Halifax Shipyard provides a complete range of services to build new ships as well as ship repair for vessels up to Panamax size. From the age of sail, to the most sophisticated warships of today, Halifax Shipyard has been a centre of naval excellence since 1889.

Nova Scotia's boatbuilding sector consists of some 35 yards at various locations along the coast, but concentrated in southwest Nova Scotia. Another 45 or so firms provide support services. The sector serves mainly the fishing industry, but in recent years has diversified.

Approximately 90 percent of world trade in goods travels by sea. The marine transportation sector is a key component of the Nova Scotia economy. Our well-serviced ports and strategic location on the main north Atlantic shipping route facilitate the efficient movement of international cargoes to markets in central North America.

There is a substantial research and development and ship design capacity in Nova Scotia. Much of the research and development is being undertaken by multi-national corporations operating in the region, primarily to service Canada's Department of National Defence. The existence of a cluster of multi-national lead companies undertaking high value R&D work in this industry is a key asset to secure the future of the industry.

### **Ocean Science and Observation:**

Oceans technology companies operating within the Ocean Science and Observation sub-sector invent, develop, and produce ocean-related products and services, primarily for government departments. These products and services include coastal zone management, marine observation, ocean mapping, monitoring, modeling, forecasting, and tracking.

Applications cross Nova Scotia's niche sub-sectors and include Lidar technology, computer-based modeling, meteorology, acoustics, drifting buoys and seismic profiling, environmental monitoring, hyperspectral imaging, remediation, remote submersibles and acoustics, oceanography, geophysics, survival training, computer-based training modules and simulations.

Oceans Technology companies in the government services sector provide goods and services to a number of provincial and federal agencies. The Department of Fisheries and Oceans (DFO) is a main client and lead federal government department responsible for developing and implementing policies and programs in support of Canada's economic, ecological and scientific interests in oceans and inland waters. The mandate includes responsibility for the conservation and sustainable use of Canada's fisheries resources. The Coast Guard provides search and rescue, icebreaking, navigational and marine communications and traffic services. Environment Canada has a broad mandate for environmental conservation and protection on Canadian lands including the oceans. Transport Canada is another major user of oceans technology goods and services. Transport Canada's activities include inspecting ships, examining construction documents, ancillary policy such as source pollution from vessels, ports maintenance, and activities related to offshore drilling.

The global market for ocean observation systems was estimated at approximately US\$1.8 billion in 2006 and was expected to grow to US\$2.2 billion by 2011.



### **Offshore and Coastal Energy:**

Oceans technology companies operating in the Offshore & Coastal Energy market invent, develop, and produce technology-based, ocean-related products and services for offshore drilling, exploration, seismic surveys, production, processing, and transportation to and from offshore infrastructure, as well as the development of processes and equipment involved in harnessing tidal and wave energy. This may

include oceans-based pipeline composition, tidal power turbine technology, construction, monitoring, and deployment, and electricity capture and gridline linkages.

Oceans technology companies in the offshore and coastal energy sector in Nova Scotia have been involved with both exploration and field development over the past few decades. Exploration consists of seismic surveys and exploration drilling to determine the existence of commercial petroleum reserves. Exploration in Nova Scotia had been carried out over a long period before any commercial discovery was made, with the first major development project in Nova Scotia (Sable) taking place in the late 1990s, some 20 years after the discovery well was drilled. The Sable Offshore Energy Project (SOEP) and others have generated billions of dollars to the Nova Scotia economy.

Global interest in oceans renewable energy is growing and Nova Scotia has the potential to become a world leader in tidal energy. The Bay of Fundy pushes over 100 billion tonnes of water every tide — more than all the freshwater rivers and streams in the world combined — and holds the potential to deliver clean, renewable power for generations to come.

Nova Scotia's offshore and coastal energy companies include oil and gas multinational corporations that have located here to engage in various offshore energy projects. There are a number of substantial energy companies — Emera, Exxon Mobil, EnCana — with facilities in Nova Scotia. Numerous oceans technology companies sell goods and services to these multinationals.

More recently, a tidal demonstration facility in the Bay of Fundy has attracted involvement from OpenHydro, Marine Current Turbines Ltd., and Alstom. The companies will be partnering with Minas Basin Pulp and Power, Nova Scotia Power and Clean Current. The latest planned project involves Irving Shipbuilding and Lockheed Martin partnering with Atlantis Resources Corporation — an international developer of tidal current turbines with offices in United Kingdom, Singapore and Australia.

### **Aquaculture and Fisheries:**

Oceans technology companies operating in the Fisheries and Aquaculture market invent, develop, and produce technology-based, ocean-related products and services relating to fish and seafood harvesting, monitoring,



or processing and/or equipment and site development related to aquaculture. This may include innovative fish cage design and construction, development of spawning technologies, seafood processing, or marine biotechnology.

Nova Scotia's commercial fishery targets over 30 species. Shellfish is the main species group, with lobster, scallop, snow crab and shrimp the main species. The coastal waters of Nova Scotia also support some 400 aquaculture sites, producing a range of fin and shellfish species.

In 2010, fish and seafood products were the province's third top export, valued at over \$800 million. Lobster destined for the United States was the top seafood product. Nova Scotia-based Clearwater has more than 1,000 employees and is a vertically integrated seafood company that is a global leader in harvesting, processing and distribution of shellfish.

Nova Scotia's Fisheries and Aquaculture Industry is linked into a number of global value chains. Marel Canada, from Iceland, is an example of a multinational that has a presence in Nova Scotia and is providing products and services to the fishing and aquaculture industries

There are a number of companies in the oceans technology sector that provide high-value technology-intensive products and services to clients in a number of industries, including Fisheries and Aquaculture. For example, Dynamic Systems Analysis is an engineering firm conducting high-value mechanical design and analysis of aquaculture farm structures. Joubeh Technologies and Vemco provide high value data analysis and management solutions across many industries.

## Research

Anchored by the world-renowned Bedford Institute of Oceanography and Dalhousie University, Canada's leading university in oceans-related research, Nova Scotia generally and the Halifax area in particular, are identified as among the top international centres of excellence world-wide in oceans science.

Located on the Dartmouth side of Halifax Harbour on the shores of Bedford Basin, BIO brings together some 700 scientists, engineers, technicians, contractors and staff working in a range of disciplines. As Canada's largest centre for oceans research, BIO scientists perform government-mandated investigations, and offer advice and support on environmental, health, safety, defence, fisheries and other natural resources, and on the increasingly critical issue of ocean sovereignty. Under the UN Law of the Sea Convention, Canada could gain underwater territory equivalent in size to the three Prairie Provinces. This territory holds immense economic potential. Research teams from four federal government departments — Fisheries and Oceans; Natural Resources Canada; Environment Canada; and National Defence - are located at BIO.

With its comprehensive array of life sciences laboratories in Nova Scotia, the National Research Council Institute for Marine Biosciences (NRC-IMB) is considered one of the world's most versatile marine research facilities. Multidisciplinary teams from NRC-IMB are on the leading edge of research into natural toxins, foods and nutraceuticals from marine organisms. They are also experimenting with the use of microscopic algae as a biofuel to reduce greenhouse gases and water pollution. At its Ketch Harbour Marine Research Station, 30 minutes outside Halifax, NRC researchers are cultivating and studying seaweeds and microalgae in controlled lab and pilot sites to determine the extent of the commercial, environmental and health enhancing potential of the rich bioactive compounds.

National Defence research and development activities in Nova Scotia are both extensive and diverse, and include underwater sensors, command and control information systems, naval and air platforms and materials. These activities support planning, acquisition and maintenance decisions required by Canada's Navy.

Nova Scotia is home to 11 universities and an exceptional community college system, virtually all of which contribute and further understanding of the world's oceans. Research related to oceans and ocean life at Nova Scotia's largest research-intensive institution, Dalhousie University is centred in the faculty of science, but also reaches into the faculties of engineering, law and computer science. The Science Faculty is home to the Aquatron Laboratory, a multi-purpose facility capable of simulating marine environments within massive, controlled tanks, measuring as much as 15 metres in diameter and 11 metres in depth.

Dalhousie's claim as Canada's leading ocean research university is supported by its ability to attract more than 25 per cent of all federal university grants for scientific ocean research and the global leadership of its faculty members in areas of marine research and conservation. Dalhousie is home base to the world-wide Ocean-Tracking Network that will add significant knowledge about the global condition and movement of marine life. OTN was made possible by more than \$45 million in federal research grants. Dalhousie also recently attracted the \$10 million Canada Excellence Research Chair in Oceans Science and Technology.

Acadia University's Centre of Estuarine Research, established in 1985, conducts research on estuaries and nearshore coastal ecosystems — with a focus on the potential and implications of tidal power development in the Bay of Fundy. Multi-disciplinary research projects, involving students and scientists from any number of regional, national, and international institutions assist the Centre in studying marine environmental effects in bays and estuaries, fish ecology and tracking of movements, and Bay of Fundy tidal energy related environmental impacts.

The Centre for Marine Research at Université Sainte-Anne focuses on applied research activities designed to help local industries and the marine aquaculture sector to meet new challenges they face. The Centre provides resources to work in collaboration with industry to develop and test new devices, improve current practices, and explore new opportunities in developing existing ocean species. (Table 2 provides a more complete list of oceans technology capabilities and expertise of Nova Scotia's public sector research resources.)

**Table 2: Oceans Technology Capabilities/Expertise of Nova Scotia's Public Sector Research Resources**

|                                                 | Offshore or Coastal Energy |                         |                          |                        | Marine-based Resources       |                        |                                                |                       | Marine Transportation                           |                       |            |                                    | Defence and Security         |                   |          |               | Education and Training |                |                    |                  | Ocean Observ. and Science |                                 |                |                  | Marine Recovery/ Remediation |                        | Government Services                |             |      |
|-------------------------------------------------|----------------------------|-------------------------|--------------------------|------------------------|------------------------------|------------------------|------------------------------------------------|-----------------------|-------------------------------------------------|-----------------------|------------|------------------------------------|------------------------------|-------------------|----------|---------------|------------------------|----------------|--------------------|------------------|---------------------------|---------------------------------|----------------|------------------|------------------------------|------------------------|------------------------------------|-------------|------|
|                                                 | Oil and Gas Extraction     | Oil and Gas Exploration | Natural Gas Distribution | Tidal Power Generation | Aquaculture Site Development | Aquaculture Fish Stock | Nutraceuticals extracted from Marine Resources | Sources of Bio-Energy | Fisheries harvesting, monitoring and processing | Marine Communications | Navigation | Weather forecasting and monitoring | Marine safety and evacuation | Vessel Monitoring | Military | Port Security | Search and Rescue      | Earth Sciences | Harsh Environments | Vessel Operation | Coastal Zone Management   | Ocean modelling and forecasting | Ocean Tracking | Seafloor Mapping | Waste/Spillage Management    | Underwater Exploration | Department of Fisheries and Oceans | Coast Guard | Navy |
| Acadia University                               |                            |                         |                          |                        |                              |                        |                                                |                       |                                                 |                       |            |                                    |                              |                   |          |               |                        |                |                    |                  |                           |                                 |                |                  |                              |                        |                                    |             |      |
| Cape Breton University                          |                            |                         |                          |                        |                              |                        |                                                |                       |                                                 |                       |            |                                    |                              |                   |          |               |                        |                |                    |                  |                           |                                 |                |                  |                              |                        |                                    |             |      |
| Dalhousie University                            |                            |                         |                          |                        |                              |                        |                                                |                       |                                                 |                       |            |                                    |                              |                   |          |               |                        |                |                    |                  |                           |                                 |                |                  |                              |                        |                                    |             |      |
| Dalhousie University Aquatron Laboratory        |                            |                         |                          |                        |                              |                        |                                                |                       |                                                 |                       |            |                                    |                              |                   |          |               |                        |                |                    |                  |                           |                                 |                |                  |                              |                        |                                    |             |      |
| Nova Scotia Agricultural College                |                            |                         |                          |                        |                              |                        |                                                |                       |                                                 |                       |            |                                    |                              |                   |          |               |                        |                |                    |                  |                           |                                 |                |                  |                              |                        |                                    |             |      |
| Nova Scotia Community College                   |                            |                         |                          |                        |                              |                        |                                                |                       |                                                 |                       |            |                                    |                              |                   |          |               |                        |                |                    |                  |                           |                                 |                |                  |                              |                        |                                    |             |      |
| Saint Mary's University                         |                            |                         |                          |                        |                              |                        |                                                |                       |                                                 |                       |            |                                    |                              |                   |          |               |                        |                |                    |                  |                           |                                 |                |                  |                              |                        |                                    |             |      |
| St. Francis Xavier University                   |                            |                         |                          |                        |                              |                        |                                                |                       |                                                 |                       |            |                                    |                              |                   |          |               |                        |                |                    |                  |                           |                                 |                |                  |                              |                        |                                    |             |      |
| Université Sainte-Anne                          |                            |                         |                          |                        |                              |                        |                                                |                       |                                                 |                       |            |                                    |                              |                   |          |               |                        |                |                    |                  |                           |                                 |                |                  |                              |                        |                                    |             |      |
| Canadian Hydrographic Service                   |                            |                         |                          |                        |                              |                        |                                                |                       |                                                 |                       |            |                                    |                              |                   |          |               |                        |                |                    |                  |                           |                                 |                |                  |                              |                        |                                    |             |      |
| DRDC - Atlantic                                 |                            |                         |                          |                        |                              |                        |                                                |                       |                                                 |                       |            |                                    |                              |                   |          |               |                        |                |                    |                  |                           |                                 |                |                  |                              |                        |                                    |             |      |
| Fisheries and Oceans Canada, BIO                |                            |                         |                          |                        |                              |                        |                                                |                       |                                                 |                       |            |                                    |                              |                   |          |               |                        |                |                    |                  |                           |                                 |                |                  |                              |                        |                                    |             |      |
| Fisheries and Oceans Canada, BIO, Ocean Physics |                            |                         |                          |                        |                              |                        |                                                |                       |                                                 |                       |            |                                    |                              |                   |          |               |                        |                |                    |                  |                           |                                 |                |                  |                              |                        |                                    |             |      |
| Geological Survey of Canada, Nat. Res. Canada   |                            |                         |                          |                        |                              |                        |                                                |                       |                                                 |                       |            |                                    |                              |                   |          |               |                        |                |                    |                  |                           |                                 |                |                  |                              |                        |                                    |             |      |
| NRC - Institute for Marine Biosciences          |                            |                         |                          |                        |                              |                        |                                                |                       |                                                 |                       |            |                                    |                              |                   |          |               |                        |                |                    |                  |                           |                                 |                |                  |                              |                        |                                    |             |      |

**Source:** CFN Consultants (Atlantic) Inc. and Partner International. "Innovation Support for the Oceans Technology Sector" — Prepared for Department of Economic & Rural Development & Tourism; March 2011

# Enabling Environment

## Education and Training:

Nova Scotia's oceans technology sector is comprised of highly skilled professionals across a wide range of disciplines and educational backgrounds. The sector employs engineers, naval architects, geophysicists, geologists as well as software developers, information systems analysts, and mapping technicians, among other occupations.

Nova Scotia's universities and community college provide a wide array of relevant education and training to develop a skilled labour pool for the oceans technology sector. Oceans-related general and applied science programs can be found in virtually every post-secondary institution in the province. For each of the past five years, more than 2000 undergraduate and graduate students graduated from Nova Scotian engineering and applied sciences programs.

Dalhousie University's Department of Oceanography is Canada's premier location for oceanographic research and education. Over 110 faculty members, students, researchers and staff focus on graduate education and post-doctoral training in physical, biological, chemical, and geological oceanographic studies. Dalhousie also offers graduate programs in fisheries engineering, naval architecture, and marine and petroleum engineering within its Faculty of Engineering.

Nova Scotia Community College offers a significant number of relevant trades and technology training programs including engineering and applied science, information technology, geomatics, marine navigation, marine engineering, among others. The college's Centre of Geographic Sciences is a world leader and Canada's largest geomatics-focused learning environment. Diploma programs are offered in the fields of surveying, mapping, and related computer programming. Students can also earn advanced diplomas in marine geomatics, remote sensing, geographic information systems (GIS), and business geographics.

## Networks and Industry Associations:

There are a variety of ocean-related industry associations in Nova Scotia, including the Oceans Technology Council under the Aerospace and Defence Industries Association of Nova Scotia (ADIANS), The Environmental Services Association of Nova Scotia (ESANS), Offshore Onshore Technologies Association of Nova Scotia (OTANS), and Nova Scotia Boatbuilders Association (NSBA), among others. National associations, such as Ocean Networks Canada, the Alliance for Marine Remote Sensing, and the Ocean Management Research Network are also strongly connected to Nova Scotia's oceans technology sector.

Headquartered at Dalhousie University, the Ocean Tracking Network (OTN) unites leading ocean scientists around the globe. OTN is conducting the

world's most comprehensive and revolutionary examination of marine life and ocean conditions, and how they are changing as the earth warms. OTN data will lead to a global standard for ocean management in a way never before possible.

The Halifax Marine Research Institute (HMRI) fosters collaboration among researchers to apply world-class science to economic, social and environmental challenges for regional and global oceans. The Dalhousie-based institute with its government research partners is another enabler to increase the competitiveness of the Nova Scotia marine community.

### **Nova Scotia Funding and Support Programs:**

The Nova Scotia Government is committed to assisting businesses in the oceans technology sector throughout the business life cycle. A variety of programs geared towards finance and capitalization, research and development, workforce development, and trade have been accessed by numerous oceans technology companies throughout the province.

The Department of Economic and Rural Development and Tourism's (ERDT) Productivity and Investment Program is designed to encourage business to become more productive, innovative, and globally competitive through two distinct incentives: the Capital Investment Incentive (CII) and the Workplace Innovation and Productivity Skills Incentive (WIPSI). CII contributes toward the cost of technologically-advanced machinery, clean technology, equipment, software and hardware with preference given to exporters in qualified industries. WIPSI provides funding to companies to encourage investment in skills development and certification to help companies adapt to the introduction of new technology and innovative processes, improve productivity, and strengthen international competitiveness.

The Department of Finance offers tax relief to Nova Scotia corporations that incur qualified federal Scientific Research & Experimental Development Tax Credit expenditures made in Nova Scotia. The tax credit promotes and supports the development of unique and advanced skills, knowledge and technological capabilities that will enable businesses to better compete in domestic and international markets.

ERDT also offers the Productivity and Innovation Voucher which is a credit note that small and medium-sized enterprises can use to acquire the direct assistance from Nova Scotia universities/colleges that they need to help make their business more innovative and productive. Nova Scotia Business Inc's Go Ahead Program assists exporters convert leads into sales by helping cover the costs of market prospecting.

Other financial assistance and support programs available to businesses in Nova Scotia can be found at the following link: [www.novascotiabusiness.com](http://www.novascotiabusiness.com)

*“Take the collective strength of oceans-related research capacity in the province; combine it with the proven entrepreneurial vision of Nova Scotia’s oceans technology leaders and companies; add committed government support and promotion and the opportunities for economic growth are limitless; the solutions to some of the most vexing problems of our time are within reach.”*



**Premier Darrell Dexter**