NRC·CNRC

From ***Discovery*** *to* ***Innovation...***

Science at work for Canada

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NRC TECHNOLOGY CLUSTER

INITIATIVES

Volume 1 • Number 1 • November 2006

Innovation

Innovative, knowledge-based firms act as a magnet, attracting others with technical and business expertise to locate and invest in the area. Over time, partners grow into a critical mass of skilled people, capital and entrepreneurial drive. P. 3

National Research Council Canada | Conseil national de recherches Canada

Canada

Research and innovation are critically important to Canada's economic growth and national quality of life. One of Canada's challenges is to ensure that the knowledge created in organizations like the National Research Council (NRC) is transformed rapidly into products, services and technologies that will benefit Canadians and help Canada compete in today's aggressive global marketplace.

NRC is Canada's leading resource for science and technology (S&T) development and commercialization. Over the years, NRC has consistently demonstrated its worth by identifying Canada's science and technology-based opportunities and adapting its R&D, industry support and commercialization services, programs and networks to meet national needs and priorities.

The National Research Council works closely with industry, government and academia to increase the competitiveness of Canadian industry through S&T. It mobilizes the public and private sectors to invest in new S&T initiatives and research facilities and to strengthen NRC-initiated technology clusters across Canada. Through the NRC Industrial Research Assistance Program (NRC-IRAP), the NRC Industrial Partnership Facilities (IPFs), and the NRC Canada Institute for Scientific and Technical Information (NRC-CISTI), NRC helps small and medium-sized enterprises adopt new technologies, develop new products and services and become more competitive in today's markets.

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INTRODUCTION

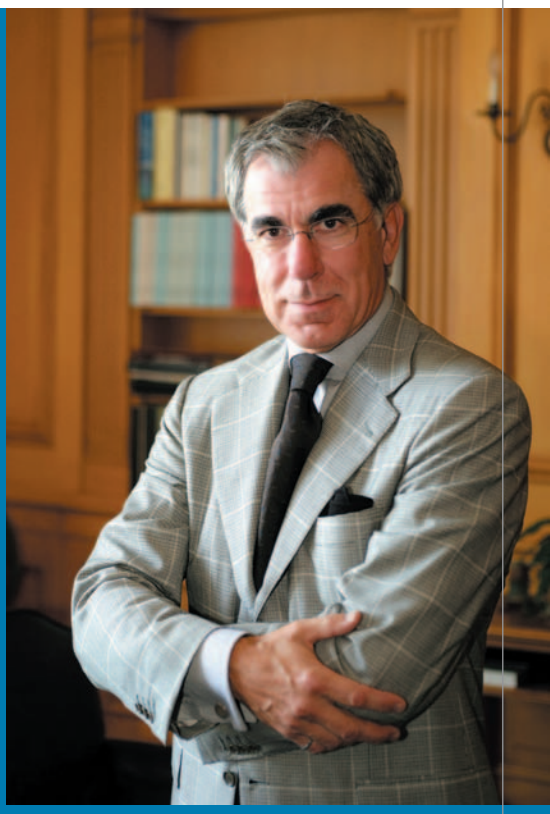
Creating globally competitive technology clusters – concentrations of technology-intensive firms focused on specific sectors – is one of the best strategies for fostering a nation's economic growth. To make Canada a global leader in key fields of technology, NRC has been working closely with industry, government and university partners to stimulate the growth of these clusters in communities across Canada.

In 2000, NRC launched a five-year $110 million Atlantic initiative, positioning NRC research facilities at its hub. Since then, Atlantic Canada – now home to four distinct clusters – has seen communities of partners setting their sights on markets in ocean technologies, information technology and e-business, life sciences and nutrisciences and health. This teamwork has laid a strong foundation for major technology advances in the region. Based on these initial successes, NRC has secured a second round of funding to continue its work.

In addition to the cluster initiatives in Atlantic Canada, NRC has received funding to invest in seven others following the same model: fuel cell and hydrogen technologies in Vancouver; nanotechnology in Edmonton; plants for health and wellness in Saskatoon; sustainable urban infrastructure in Regina; biomedical technologies in Winnipeg; photonics in Ottawa; and aluminium transformation in Saguenay. These industry sectors are all important to the growth of our economy, targeting areas where Canada can be globally competitive. NRC has played an important role in these initiatives by bringing its networks, facilities, research expertise, knowledge and industry support to the table – key assets that are invaluable to our partners.

In 2006, NRC opened two new leading-edge research facilities to nurture emerging clusters and is poised to launch a third. With partners in Alberta, we opened the NRC National Institute for Nanotechnology, a world-class institute designed to provide Canada with a leading-edge multidisciplinary research capacity in this fast emerging field. In Vancouver, we launched NRC's new $20-million fuel cell research facility, boosting B.C.'s status as a global hub for developing and demonstrating hydrogen and fuel cell technology. And we are about to open the doors of the new NRC Nutrisciences and Health research labs in Charlottetown. While these new facilities conduct some of the world's most innovative research, their impact is much greater when coupled with NRC's other strengths in research assistance, information sharing, industry partnership and technology licensing. Through NRC, Canadian companies can access the expertise, knowledge and help they need to develop and market new technologies.

It often takes decades for a technology cluster to mature and deliver its fullest economic impact and benefits. But, as this report highlights, we have come a long way in just a few short years. We are now reaching a critical stage where we must build on the progress made so far. Only a continued commitment can ensure the evolution and the long-term sustainability of each of these initiatives. We believe that our ongoing involvement with all players in these important cluster initiatives will contribute strongly to Canada's future success in the global arena.



Dr. Pierre Coulombe
President

NRC TECHNOLOGY CLUSTER INITIATIVES

GLOBAL REACH—LOCAL TOUCH

NRC has played a critical role in the development of emerging and mature cluster initiatives, acting as a catalyst for technological progress and economic growth in every region of Canada. Its successful clustering model encourages and supports local strengths while leveraging NRC's national and international resources, science and technology capabilities, networks and partnerships. This proven approach ensures that each cluster initiative can develop according to its unique needs, opportunities and challenges.

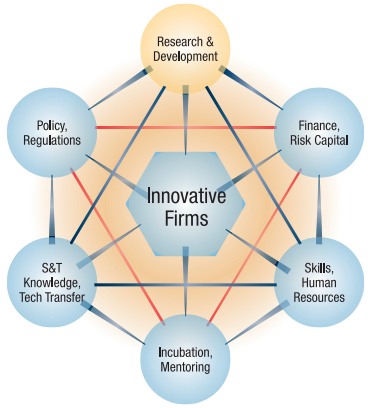
COMMITTED LEADERSHIP

Successful clusters need staying power, often taking decades to mature. The building process must be community-driven and focused, and must have the support of effective networks and committed local champions.

For many years, NRC has distinguished itself as an effective catalyst for cluster development, providing not only R&D expertise, but also the leadership clusters need to move research out of the lab and put it to work for Canada's economy.

GREAT PEOPLE, GREAT MINDS

Recognized globally for cutting-edge research and innovation, the National Research Council helps Canada create a world-class, knowledge-based economy. NRC is home to nearly 4,000 creative and skilled people held in highest regard by their colleagues and collaborators worldwide. NRC employees have earned international acclaim for excellence and for winning innovations – their honours include a Nobel Prize, an Academy Award and helping Canada capture Olympic Gold.



DELIVERING RESULTS

Clustering is a term economists have borrowed from science to describe the significant concentration of innovative companies around a nucleus of R&D facilities in a single locale—the ideal environment for innovation to flourish.

A key ingredient is the presence of a science and technology anchor—usually a government research institution or a university—able to work with local companies, transfer technology and spin off new enterprises.

Innovative, knowledge-based firms act as a magnet, attracting others with technical and business expertise to locate and invest in the area. Over time, partners grow into a critical mass of skilled people, capital and entrepreneurial drive.

NRC STIMULATES THE GROWTH OF WORLD-CLASS TECHNOLOGY CLUSTER INITIATIVES, PUTTING ITS LEADING-EDGE RESEARCH TO WORK IN INNOVATIVE COMMUNITIES ACROSS CANADA.

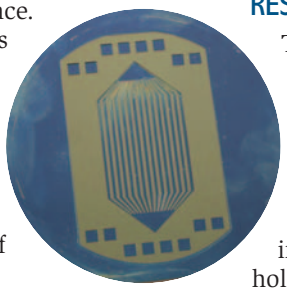
VANCOUVER—FUEL CELL AND HYDROGEN TECHNOLOGIES

NRC's Vancouver-based technology cluster initiative is the world's fastest growing and most sophisticated grouping of companies and organizations focused on fuel cell and hydrogen energy technologies. A study by a leading American market-research company, predicts Canadian fuel cell industries—most of which reside in Vancouver—will seize nearly 30 per cent of an estimated US $2.4 billion share of the world fuel cell market in 2007. By 2017—when experts say the global industry will be worth trillions of dollars annually, NRC's early strategic investments will have primed the Vancouver cluster to obtain a significant market share.

STRATEGICALLY POSITIONED PLAYERS

While pockets of fuel cell research exist in other locations across Canada, Vancouver remains the national hub for groundbreaking R&D, accounting for nearly 70 per cent of some 1,400 Canadian jobs in the field. This concentration of activity coincides with an aggressive development strategy launched by NRC in 1998 to position the region as an important player in the highly competitive global fuel cell marketplace. A key part of NRC's approach was the creation of a task force that determined how best to conduct fuel cell R&D in Canada, with Vancouver as the focal point. The plan sparked a number of important initiatives:

- construction of a state-of-the-art fuel cell research facility at the NRC Institute for Fuel Cell Innovation to build local hydrogen and fuel cell expertise
- creation of Fuel Cells Canada, a national association dedicated to accelerating Canada's hydrogen and fuel cell industry
- development of the Fuel Cell Program, a national research initiative that taps into the talent of NRC's best minds from six of its major research facilities across Canada



PARTNERING TO COMMERCIALIZE RESEARCH

The goal of NRC's cluster initiative is to maintain Canada's early leadership in the emerging field of fuel cell R&D. To reach this goal, NRC supported Canada's Fuel Cell Commercialization Roadmap, a federal government initiative that assembled 40 stakeholders to identify opportunities in fuel cell R&D and map a strategy for technology commercialization. The strategy has been a resounding success. The number of organizations partnered with NRC to bring pioneering technologies to market has doubled over five years, bringing the total to 19 industrial collaborations, 14 university partnerships and eight international projects. NRC has strengthened its relationships with three local universities to help develop highly qualified personnel for local industry, establish hydrogen and fuel cell consortiums and leverage resources.

COMMUNITY ENGAGEMENT

1998	NRC sparks cluster formation with task force
1999	NRC establishes a fuel cell lab at its Vancouver Innovation Centre
2000	NRC helps establish Fuel Cells Canada, a national industry association
2003	NRC and Western Economic Diversification announce $1.5 million for Hydrogen Technology Environmental Chamber, unique in North America
2003	NRC drives the launch of a Canadian Fuel Cell Commercialization Roadmap, a multi-stakeholder initiative
2004	Prime Minister unveils Hydrogen Highway™ at Globe 2004 conference
2004	NRC receives $15 million in new federal funding for NRC Institute for Fuel Cell Innovation
2006	NRC Institute for Fuel Cell Innovation opens its doors

DEMONSTRATING FUEL CELL POTENTIAL

To nurture its Vancouver cluster initiative, overcome barriers to technological deployment and attract the top minds in fuel cell R&D, NRC showcases groundbreaking technologies and companies through a series of demonstration projects that include:

- a hydrogen refueling station and storage tower that power Ford Focus fuel cell vehicles
- photovoltaic panels that transform solar energy into hydrogen to power fuel cells
- a five-kilowatt solid-oxide fuel cell generator that provides heat and power to buildings

CLUSTER FACTS AT A GLANCE

- International fuel cell market will be worth US$2.6 trillion by 2021.
- In 2004, Canadian fuel cell companies generated revenues of $133 million.
- Vancouver is home to more than 70 per cent of the some 1,400 people employed in fuel cell R&D in Canada.
- R&D expenditures increased from $218 million in 2003 to $237 million in 2004 – an increase of eight per cent.
- Hydrogen Highway™ to be operational by 2010 Winter Olympics.

BLAZING A TRAIL

British Columbia's Hydrogen Highway™—led by Fuel Cells Canada and Natural Resources Canada's Canadian Transportation Fuel Cell Alliance—is an integral component of NRC's fuel cell cluster initiative strategy. Envisioned as a key attraction at the 2010 Winter Olympic Games, the highway will extend north from the Vancouver airport to the Resort Municipality of Whistler. The new NRC research facility will be one of seven hydrogen centres along the highway, featuring hydrogen refueling infrastructure and a variety of transportation, micro and stationary fuel cell demonstrations.

UNIQUE OPPORTUNITY FOR SMEs

As part of its strategic investment in fuel cell research, NRC operates a cutting-edge, public testing facility unique in North America. Called the Hydrogen Technology Environmental Chamber, the facility—which can simulate the climactic extremes of the Northern Territories, Winnipeg or Mexico City—enables SMEs to test pioneering fuel cell ideas, and prepare their innovations for commercial markets.

RESPONDING TO INDUSTRY NEEDS

To meet the evolving needs of Vancouver's fuel cell cluster, NRC relocated in 2006 to a new, $19 million research facility on the grounds of the University of British Columbia. At its new facility NRC focuses on three key research areas:

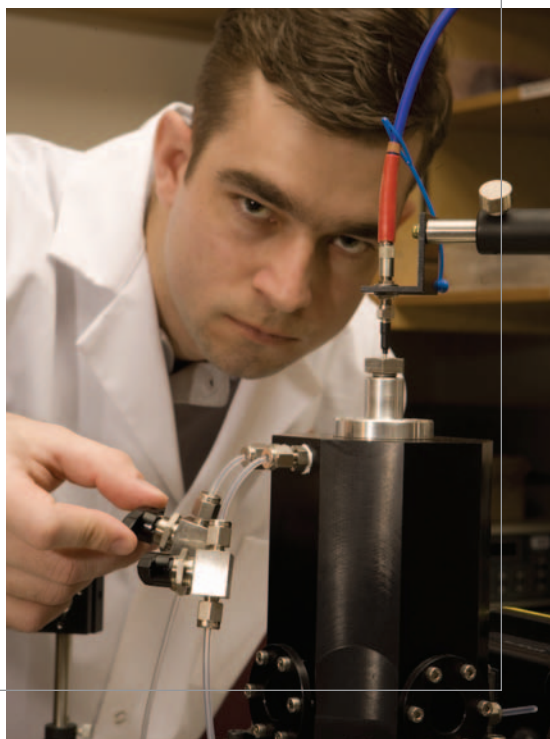
- proton-exchange membrane technologies
- solid-oxide fuel cell technologies
- new materials development to advance hydrogen generation, compression and purification technologies

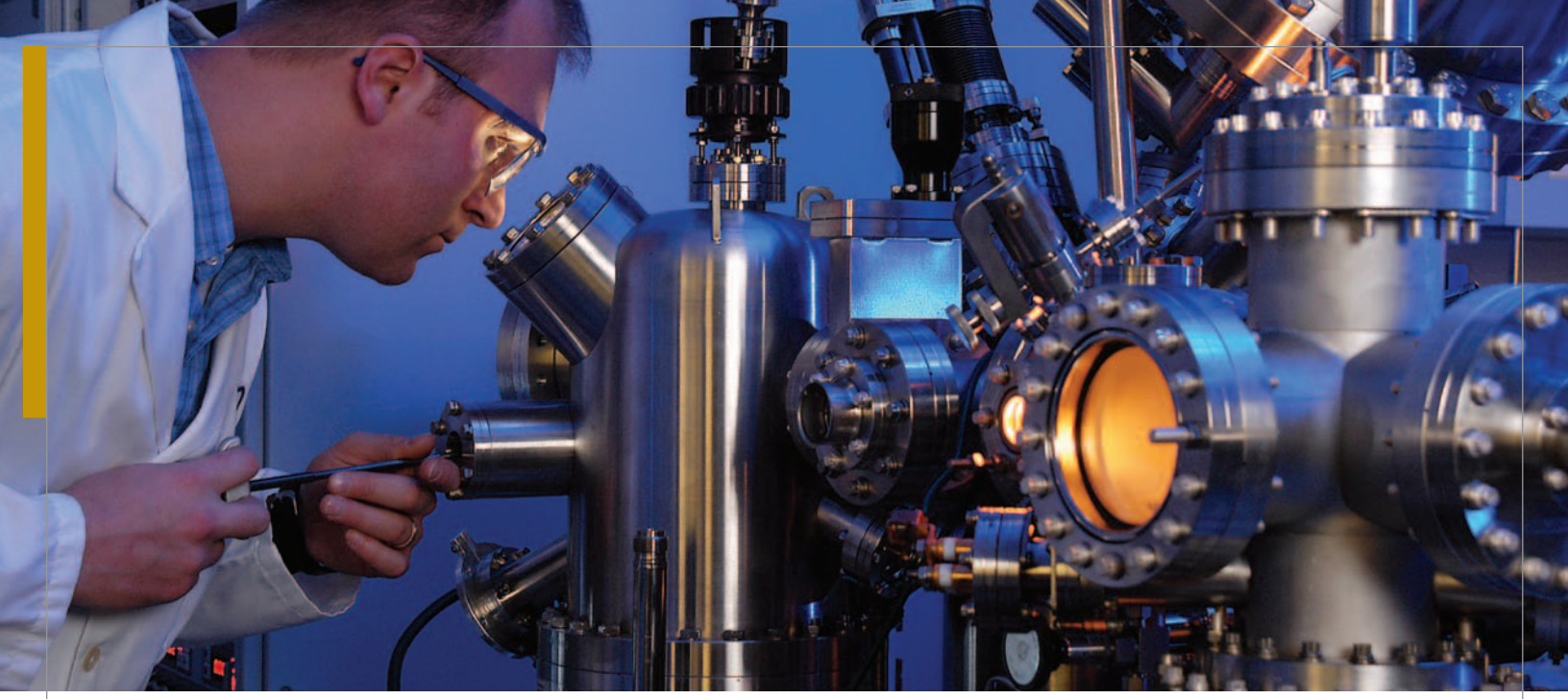
NRC CLUSTER INITIATIVE PARTNERS

- Fuel Cells Canada
- Simon Fraser University
- University of British Columbia
- University of Victoria
- Government of British Columbia
- Western Economic Diversification
- Natural Resources Canada
- Industry Canada
- Environment Canada
- National Defence Canada
- International Trade Canada
- Transport Canada

"NRC-IRAP has been the strongest of all government programs in research that Angstrom has been involved with. They understand their mission, contribute in more ways than money and are a valued contributor to Angstrom's R&D program. In addition they have tried to link Angstrom with other research groups within NRC with the aim of accelerating development and reducing costs. The support has been extensive."

Dr. Ged McLean, Founder and CTO, Angstrom Power Inc.





TINY PARTICLES, COLOSSAL GOALS

Nanotechnology applies the science of controlling tiny pieces of matter—atoms and molecules—to produce revolutionary products and processes. Although still in its infancy, nanotechnology has produced a wide range of improved consumer products such as sunscreen lotions and golf clubs, and has potential to alter the way we make everything, from transistors to skyscrapers. Industry and academia are eagerly partnering with NRC to leverage its R&D expertise and seize a share of this industry that is predicted to grow to $1.5 trillion by 2015.

EDMONTON—NANOTECHNOLOGY

NRC's bold decision to construct a state-of-the-art $120 million National Institute of Nanotechnology (NINT) in Edmonton was taken to secure Canada's position at the vanguard of nanotechnology research worldwide. NRC's new institute is already a hub for Edmonton's rapidly expanding nanotechnology cluster. Established in 2001 as a partnership among NRC, the University of Alberta and the Alberta and federal governments, NINT, and the partnerships it engenders, secure Edmonton's position as Canada's foremost nanotechnology cluster, driving the region to the forefront of nanotechnology R&D globally.

ESTABLISHING A CLUSTER INITIATIVE CHAMPION

The Edmonton cluster consists of 19 commercial organizations with world renowned expertise in specialized nanoscience-related areas. In 2003, NRC helped initiate a formal partnership among industry, the University of Alberta and the Government of Alberta. The result is NanoMEMS Edmonton, a vibrant cluster champion committed to building R&D capacity in 'small tech', not only among local members, but also with similar public-private partnerships around the world.

UNITING KEY PLAYERS

NRC has a proven track record of bringing nanotechnology organizations together around common research and commercialization strategies. In 2002, NRC initiated a roundtable to forge links between NINT and key community stakeholders, including Syncrude Canada Ltd.

BUILDING RESEARCH CAPACITY

NRC and the University of Alberta are committed to recruiting topflight nanotechnology researchers from across Canada and around the world. For example, NINT's unique staffing structure—principal staff may split their time between teaching at the university and leading research groups—has already attracted several leading nanotechnology researchers to Edmonton.

FACTS AT A GLANCE

- NRC aims to make its National Institute for Nanotechnology (NINT) one of the world's top-five nanotechnology research labs by 2010.
- NINT is the most technologically advanced nanotech research facility in Canada.
- The worldwide market for nano-goods and services could reach an astonishing $1.5 trillion U.S. a year by 2015.
- Between them, NRC and the University of Alberta have 55 research teams, comprised of more than 400 researchers, post-docs, technical officers and graduate students, working in the field of nanotechnology.
- A nanometer is one billionth of a metre, or 1/80,000 the diameter of a human hair.

NRC CLUSTER INITIATIVE PARTNERS

- University of Alberta
- Government of Alberta
- NanoMEMS Edmonton

CUTTING-EDGE FACILITIES

Of the original $120 million invested in NINT, one-third was earmarked to construct one of the quietest buildings in Canada. NINT offers lab space with ultra-low vibration and minimal acoustic noise or electromagnetic interference, conditions critical to conducting nanotechnology research and fabrication. NRC has installed more than $40 million worth of state-of-the-art scientific equipment, including a transmission electron microscope equipped with a cold-field emission gun. The six-storey, 20,000-square metre facility has specialty labs for chemical and biochemical synthesis and analysis of atomicscale structures, and can house 30 principal investigators who will collaborate with more than 100 university scientists and 120 NRC researchers and staff.

"By choosing Edmonton as the home of its flagship nanotech lab, NRC has rightly acknowledged the strength of our community's nascent, but rapidly expanding small-tech cluster. Adding NINT to Greater Edmonton's already considerable research infrastructure and established commercial enterprise community will ensure the region attains its goal of becoming one of the leading nanotechnology centres in the world."

Leigh Hill, Director, NanoMEMS Edmonton

COMMUNITY ENGAGEMENT

2001	Prime Minister of Canada and Premier of Alberta unveil $120 million plan for NINT
2001	NRC, University of Alberta and Government of Alberta sign Memorandum of Understanding
2002	NRC initiates cluster development roundtable
2003	NanoMEMS Edmonton created
2003	NRC unveils design plans for NINT
2003	NINT begins construction of Canada's quietest research laboratory
2004	NINT hosts Canada's first-ever NanoForum Canada
2004	NINT purchases unique transmission electron microscope
2005	NINT hosts Canada's third annual Nano-Medicine Workshop
2006	$52.2 million NINT Research Facility and Innovation Centre (research transfer facility) open for business

SASKATOON—PLANTS FOR HEALTH AND WELLNESS

Saskatoon is among the world's most dynamic locations for innovation and commercialization of bio-based sciences. The evolution of NRC's agricultural biotechnology cluster from small industrial community to major global player providing more than 1,100 local jobs is a world leading example of how visionary thinking and careful planning can turn federally funded research into marketable products.

POWERFUL CATALYST

NRC has been a catalyst for Saskatoon's spectacular cluster growth for more than 20 years. In 1983, NRC revamped its existing Saskatoon research facility, encouraging plant-biotechnology stakeholders to use it as the cluster's hub. Since then, NRC has delivered pioneering science, sophisticated research labs and top-notch industry support to its partners.

The NRC Plant Biotechnology Institute offers companies a full range of services, including access to laboratory space and leading-edge genomics equipment. The facility also incubates businesses during the critical early years of development, ensuring they have a firm foundation of technology and business expertise.

A STRONG AND GROWING CLUSTER

Now home to more than 40 companies engaged in groundbreaking agricultural biotechnology R&D—30 per cent of Canada's activity in the field—the Saskatoon cluster is using its unique technology experience and commercialization skills to diversify into rapidly expanding markets for functional foods, nutraceuticals and industrial bioproducts. Moreover, the cluster has nurtured North America's largest legume and cereal microbial innoculant manufacturing centres, and ranks as one of the most competitive cities in the world for food processing. Annual revenues from the cluster total nearly $60 million.

CONNECTING VITAL PLAYERS

As the nucleus of Saskatoon's cluster initiative activities, NRC's plant biotechnology research facility has united key partners around critical common goals. For example, NRC along with Agriculture and Agri-Food Canada, the University of Saskatchewan, Protein Oilseed Starch Corp. and Ag-West Bio Inc. have mapped out a vision framework to diversify into natural health products, a potentially lucrative market for the Saskatoon cluster. Meanwhile, the NRC facility leverages its $10 million annual budget by attracting $30 million in investments from its private and public partners. As these players collaborate and develop groundbreaking agricultural biotechnology products, processes and marketing strategies, the University of Saskatchewan provides a deep pool of human resources talent, much of which flows directly into Saskatoon's cluster organizations.

CLUSTER FACTS AT A GLANCE

- 40 Ag-biotech companies, and growing rapidly
- 30 nutraceutical and functional food companies, which generate annual revenues of nearly $60 million from a global market estimated at more than $182 billion a year
- 1,100 staff in the cluster's private and public-sector organizations, including 400 research and technology professionals
- Cluster accounts for 30% of Canada's ag-biotech industry
- Saskatoon's investment in genomics alone amounts to $120 million
- Nutraceutical market worth $172 million (Nutrition Business Journal)
- Cluster's industry partnership facility houses six tenants and provides labs for non-tenants

"Since its inception in 1983, NRC's plant biotechnology research facility has been critical to the success of the bio-economy cluster in Saskatchewan and instrumental in the development and commercialization of innovative technologies."

Dr. Ashley O'Sullivan, President and CEO of Ag-West Bio Inc.

MILESTONES FOR COMMUNITY ENGAGEMENT

1983	NRC lab commits to foster excellence in plant biotechnology R&D
2002	NRC secures $10 million for nutraceutical R&D
2003	$15.4 million industrial partnership facility opens
2004	Ag-biotech, nutraceutical and bio-product cluster groups amalgamate
2005	NRC partners with Bioriginal to complete a technology landscape assessment for producing plant oils with specific health benefits
2006	NRC opens the BioAccess Commercialization Centre

INCREASING SUPPORT

To further the success of cluster-based companies, NRC provided development support for the creation of the BioAccess Commercialization Centre. The Centre will draw on NRC's research strengths, its technology-development expertise and a full network resources to help young companies develop natural health products, functional foods and other value-added plant products for market. In particular, the Centre will provide competitive intelligence support, regulatory advice and services, networking and path-to-market advice to clients with the goal of increasing commercial success.

COMMERCIALIZING SUCCESS

NRC's pioneering efforts decades ago led to the invention of canola. NRC leverages its world-leading authority in the field by partnering with companies as they develop new commercial applications for the crop.

- NRC has renewed a strategic alliance with multinational Dow AgroSciences Canada until 2009. The partnership, worth $10 million to NRC, is focused on improving canola crops through R&D.
- In 2004, NRC signed a partnership agreement with Chromatin Inc. NRC and Chromatin will test a new plant-breeding technique that uses canola.

NRC CLUSTER INITIATIVE PARTNERS

- Agriculture and Agri-Food Canada
- Ag-West Bio Inc.
- Dow AgroSciences Canada
- Saskatchewan Ministry of Industry and Resources
- Saskatchewan Research Council
- University of Saskatchewan
- Western Economic Diversification

SUPPORTING INDUSTRY NEEDS

To support the cluster's diversification priorities, and to increase Saskatoon's and Canada's share of a global biotechnology market estimated at more than US$182 billion, NRC's research facility has realigned its programs to focus on three key industry priorities:

- production of bio-products from plants
- production of compounds from plants that have human health benefits
- genomics research to enhance the performance and market diversity of Canadian crops

"The key for any company is to share their needs with NRC-IRAP. NRC's people have the experience and contacts to really help a company move ahead."

Mark Picard, General Manager, InfraReady Products Ltd.

REGINA — SUSTAINABLE URBAN INFRASTRUCTURE

Vital services like drinking water, storm water and waste water systems, together with community connectors like roads, highways and bridges, are Canada's lifelines. They make cities more productive and improve our quality of life. The upkeep of civil infrastructure is a major challenge for Canada – of the $12-15 billion a year that municipalities spend on infrastructure, 80 per cent goes to system repairs and renewals. NRC is spurring the growth of a sustainable urban infrastructure cluster initiative in Regina and is taking bold steps to ensure that federally funded research will develop new ways of maintaining and developing these community lifelines. With its public and private sector networks, NRC is uniquely positioned to work with stakeholders to develop and transfer technologies and methodologies that address Canada's critical infrastructure needs and create business opportunities.

A "LIVING LABORATORY"

Canada is positioned to take a global leadership role in the development of more socially, economically and environmentally sustainable municipalities. NRC and its partners have identified Regina and region as the "living laboratory" for this initiative. The City of Regina serves as a test-bed for emerging technologies and solutions that need to be piloted in full-scale operational situations. Once tested and validated in practice, emerging technologies and solutions can then become best practices in other Canadian communities. Cluster partners agree that transferring commercialized technologies from Regina to Canada and the rest of the world will be key.

PARTNERING FOR SUCCESS

The collaborative work taking place in Regina is helping the city to develop cost-effective, community-based, sustainable solutions that meet existing and future infrastructure challenges. It is also helping to position Regina and its industries as world leaders in urban infrastructure sustainability. To support this positioning, the cluster's founding partners – NRC, the City of Regina, the University of Regina, Western Economic Diversification and Saskatchewan Industry and Resources – have created Communities of Tomorrow, an organization focused on growing a sustainable urban infrastructure cluster by facilitating collaboration between firms and organizations.

A common definition for sustainable infrastructure is: "the design, construction, planning and maintenance of infrastructure that meets the needs of the present without compromising the ability of future generations to meet their own needs." Ensuring sustainability requires addressing the environmental, economic and social dimensions of municipal infrastructure in a holistic manner or with a systems approach.

ESTABLISHING A RESEARCH HUB

The NRC Centre for Sustainable Infrastructure Research is currently establishing its expertise in infrastructure evaluation and condition assessment technologies, decision support systems for sustainable municipal infrastructure and water quality monitoring and modeling in urban infrastructure. NRC's presence in the Regina region provides Saskatchewan businesses with competitive advantages in the areas of IT applications for municipal infrastructure evaluation, condition assessment and asset management, and in water quality related areas of product and service development.

TRANSFERRING RESEARCH TO COMMUNITIES

In 2003, NRC initiated a community roundtable to mobilize local SMEs to identify areas of research that have the potential to spark growth of Regina's cluster initiative. Potable water, storm water and waste water problems were identified as the cluster's initial research focus. In less than two years, NRC has made headway on these important research mandates and has helped identify industry needs and emerging problems that will develop and focus the cluster and spur the growth of technology-based companies. Collaborative projects between Regina-based cluster participants and researchers from the NRC Institute for Research in Construction in Ottawa include:

- Asbestos cement, cast iron and ductile iron distribution pipes that are used to deliver safe drinking water are susceptible to corrosion and breakage, which can result in water loss, damage to other infrastructure and potential water contamination. NRC researchers have been working on assessing failure mechanisms and breakage history data and developing software tools to help

"I have had the most exciting phase of my academic life by far collaborating with NRC and the Communities of Tomorrow (CT) for the past two years. NRC's people have the expertise and connections for networking with centres of excellence in applied research in North America. In this context, the practical help provided by the NRC Lab in Regina in the form of research tools/space provisions is paramount."

Dr. Mehran Mehrandezh, Assistant Professor, Faculty of Engineering University of Regina

municipal managers make informed decisions about their pipe repair and renewal plans.

- NRC initiated a project in 2004 to help the City of Regina and other municipalities determine why asbestos cement pipes (which account for 68% of the pipes in use in Regina's water main network) have had a high rate of breakage in recent years. NRC researchers are looking for solutions that will help managers extend the life of their asbestos cement water mains and minimize the economic, social and environmental costs of these systems. NRC, the City of Regina and the University of Regina also collaborated on a project focusing on management of leakage in water distribution systems and are developing a smart vehicle for inspection of pressurized water mains.
- In 2005, NRC spearheaded a research initiative designed to integrate asset management processes for road, water and sewer networks. NRC-led research is expected to help Regina and other Canadian municipalities integrate their infrastructure asset data management and renewal decision processes to improve the municipal infrastructure decision-making process and save time and money.
- NRC researchers, together with University of Regina researchers and Saskatchewan Highways and Transportation engineers are investigating whether rubber asphalt cement (using rubber from recycled tires) can provide Canadians with better performing and quieter roads than traditional asphalt.

MILESTONES FOR COMMUNITY ENGAGEMENT

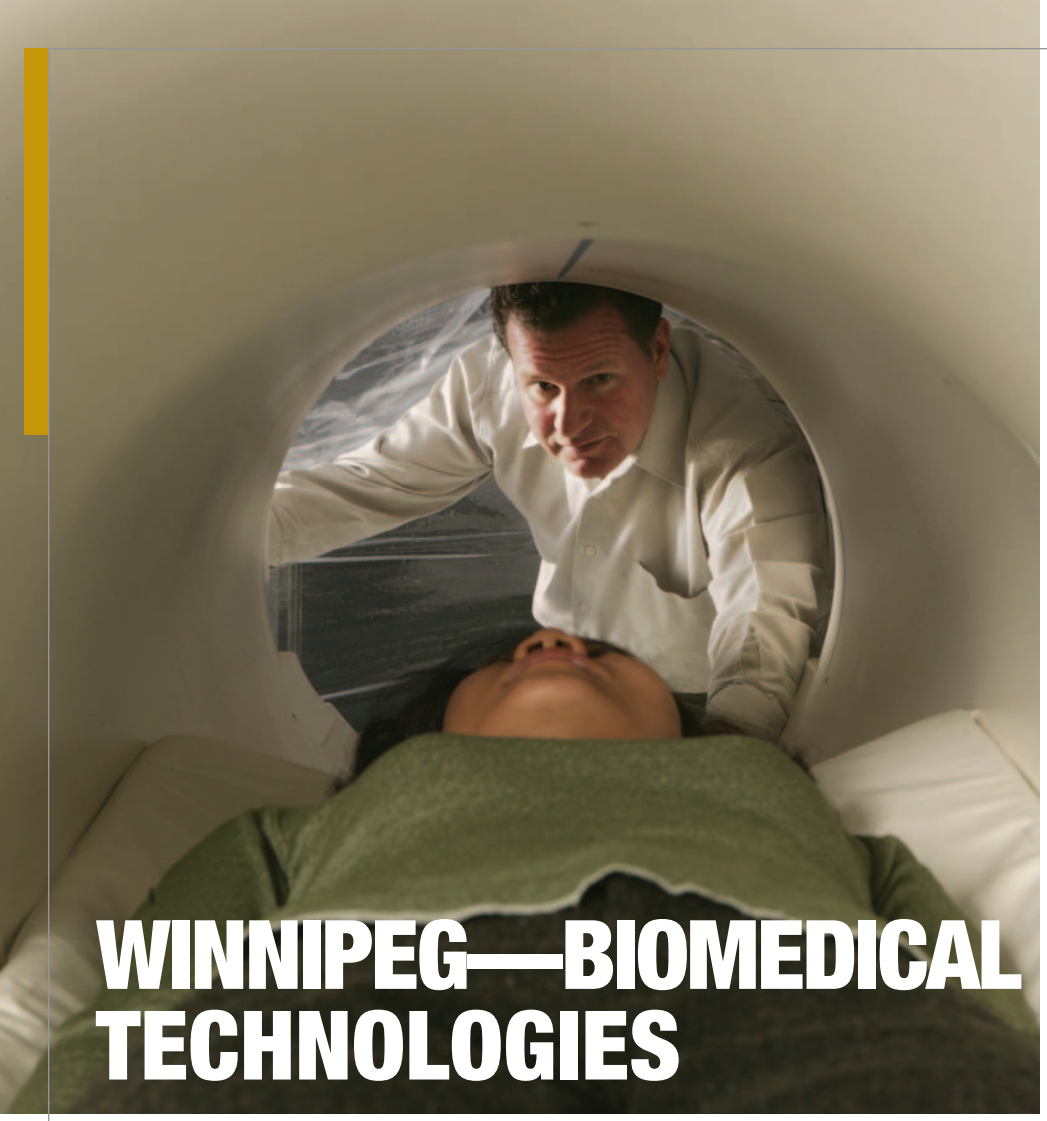
1999	NRC technology advisors and the City of Regina discuss the concept of a Regina-based technology cluster related to environmental management and sustainable cities.
2002	NRC meets with academia, various agencies and all three levels of government to further define NRC's role in building a technology cluster initiative.
2003	NRC hosts an innovation roundtable in Regina to map out a plan for the province's sustainable urban infrastructure cluster initiative.
2003	Plans are unveiled for an NRC Centre for Sustainable Infrastructure Research.
2003	Government of Canada commits $10 million over five years for NRC to spearhead the development of a sustainable urban infrastructure cluster initiative in Regina.
2004	NRC Centre for Sustainable Infrastructure Research opens for business in the Regina Research Park, adjacent to the University of Regina campus.
2004	Cluster champion and non-profit corporation for research on sustainable communities, Communities of Tomorrow: Partners for Sustainability, is created.
2005	NRC-CSIR grows from five to 12 staff.
2006	New lab space is fitted up and equipment for water quality research and infrastructure condition data acquisition is deployed.

CLUSTER FACTS AT A GLANCE

- There are an estimated 1.5 million km of water transmission pipes across North America and more than 50% are older than 60 years
- Estimated replacement costs for water distribution infrastructure (i.e. pumps, transmission pipes, storage tanks, water mains, valves, hydrants) in North America varies from $2-23 billion annually
- The deficit affecting our environmental, social and transportations infrastructure is growing at approximately $13 billion a year
- 47% of Saskatchewan's construction, engineering and consulting services, environmental technologies and services, information and communication technologies firms are located in Regina
- Regina is a major city in one of only two land-locked jurisdictions in Canada and is also a semi-arid area that is very affected by climate variations and weather extremes, making it the ideal "living lab" for NRC's sustainable urban infrastructure cluster initiative

NRC CLUSTER INITIATIVE PARTNERS

- City of Regina
- University of Regina
- Western Economic Diversification
- Saskatchewan Industry and Resources
- Communities of Tomorrow (non-profit partnership created by NRC and its four cluster partners)



WINNIPEG—BIOMEDICAL TECHNOLOGIES

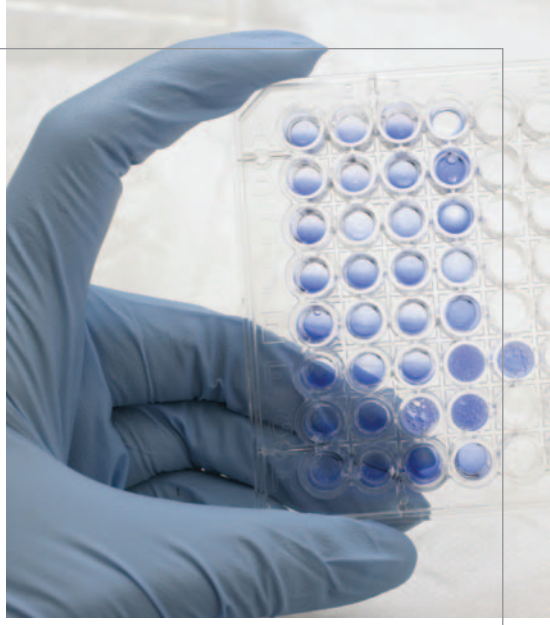
NRC's Winnipeg-based biomedical technology cluster initiative is acknowledged internationally as one of the fastest-growing concentrations of medical devices and life sciences industries in Canada. The 150 health-related companies and organizations associated with Manitoba's life sciences cluster generate sales of more than $440 million a year—a number that grows annually— and employs 4,200 people.

IMPRESSIVE GROWTH

Growth of the cluster has been steady since 1992, when NRC created its Institute for Biodiagnostics to advance Winnipeg's R&D capacity in medical devices and life sciences technology. At that time, the facility housed 25 NRC employees who conducted $2 million worth of research annually. Since then, NRC's commitment to biodiagnostics research has driven an impressive surge in the facility's R&D capacity - currently, 200 researchers, staff and affiliated collaborators are engaged in about $15 million worth of R&D and technology transfer. The facility's revenues from collaborative research with private industry have also grown substantially—an important measure of NRC's success as a cluster catalyst.

SUCCESSFUL TECHNOLOGY TRANSFER

Although the Winnipeg cluster is young, NRC researchers have transferred enough technology to private industry to create five technology spin-off companies — with an aggregate market value of over $200 million. The largest of these is IMRIS Inc., formed in 1997 to commercialize NRC-developed intra-operative MRI systems. NRC scientists collaborate closely with medical researchers and clinicians to ensure rapid technology transfer from the lab to medical practice. The results are improved health-care facilities in Canadian communities and increased economic value for Canada as new technologies become viable products in the global marketplace.



COMMERCIALIZATION A PRIORITY

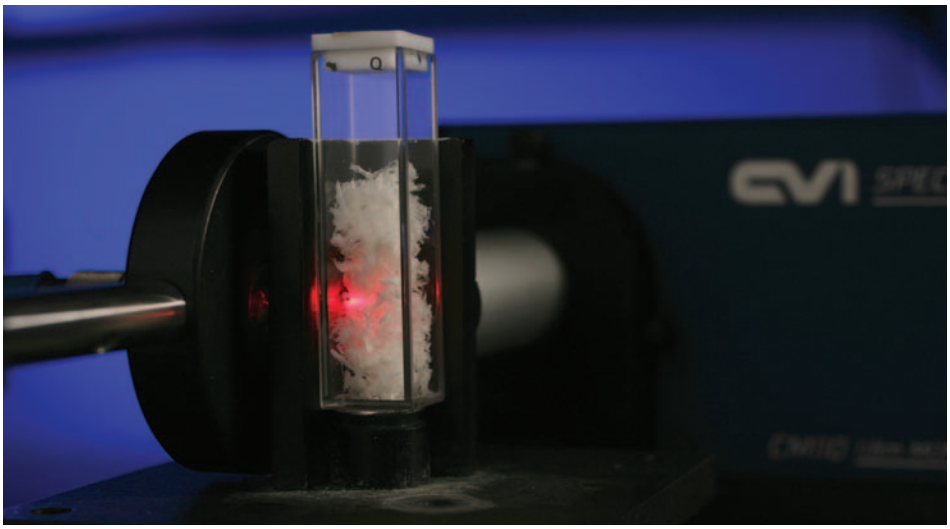
In October 2005, NRC stepped up its contribution to Winnipeg's growing technology cluster by opening the NRC Centre for Commercialization of Biomedical Technology. The Centre is key to NRC's clustering strategy and considered by many as a model for public-private sector partnerships. The Centre provides research facilities and innovation services for up to 40 companies and technology organizations—helping them bring pioneering biomedical innovations to market. It also helps link emerging medical imaging and medical device companies to expertise across Canada and around the globe. Services include support for industrial research as well as access to up-to-date science and technology information and competitive technology intelligence. A suite of business-related services, including business planning, marketing strategy support and intellectual property protection services, is provided by Biomedical Commercialization Canada, a national not-for-profit organization in partnership with NRC and the Manitoba government.

CLUSTER FACTS AT A GLANCE

- Manitoba is home to more than 150 health-related companies that generate sales of more than $440 million a year.
- In Manitoba, jobs in life sciences grew by 960% between 1989 and 2004.
- NRC's biodiagnostics R&D facility has a $30 million-a-year impact on the Winnipeg economy.
- Biodiagnostics companies spun-off from NRC are worth over $200 million.

COMMUNITY ENGAGEMENT

1992	NRC opens Winnipeg-based biodiagnostics R&D lab with staff of 25
1997	NRC spins off IMRIS Inc., formed to commercialize MRI technology
2001	Collaborative research income tops $1 million at biodiagnostics research facility
2002	NRC announces plans for the NRC Centre for Commercialization of Biotechnology (NRC-CCBT)
2003	Province commits $2 million to NRC-CCBT
2004	Agreement with Biomedical Commercialization Canada to provide incubation services to companies in the NRC-CCBT
2004	NRC launches Medical Technology Watch Canada newsletter
2005	NRC Centre for Commercialization of Biomedical Technology opens its doors



NRC CLUSTER INITIATIVE PARTNERS

- University of Manitoba
- University of Winnipeg
- National Microbiology Laboratory and Canadian Science Centre for Human and Animal Health (Public Health Agency of Canada)
- St. Boniface General Hospital and Research Centre
- Health Sciences Centre/Children's Hospital
- Health Care Products Association of Manitoba
- Red River College of Applied Arts, Science and Technology

"This investment (in NRC-CCBT) demonstrates our ongoing efforts to make Manitoba a national centre for medical innovation…"

Gary Doer, Premier of Manitoba

INCREASING COLLABORATION

Stakeholders of the Winnipeg cluster have come together around the concept of a 'BioMed City', visualized to be a designated development zone near NRC, where laboratories and scientists could provide synergies for new research, training, product development, commercialization and company start-ups. This important development underlines NRC's success at sparking collaboration among the cluster's stakeholder groups.

"Since 1990 when the Health Care Products Association of Manitoba (HCPAM) was first incorporated with a membership of four companies, to 2005 with a membership of 80 companies, we have experienced first hand the dynamic growth of the industry in Manitoba. NRC is a major player, providing industry with access to scientific expertise and business development skills that are critical to the growth of the life sciences cluster in the province."

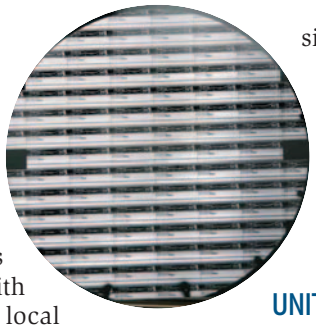
Marguerite Laramee, Executive Director, HCPAM

OTTAWA—PHOTONICS

In the late 1980s, photonics was earmarked as one of the "hot" disciplines in telecommunications and has grown to be a key enabling technology to other scientific fields. To preserve Ottawa's reputation as a seat of pioneering photonics R&D, NRC is mobilizing industry and research organizations to seize the potential of photonics in such fields as nanotechnology and biotechnology. The prospective markets are enormous—ranging from life sciences and manufacturing, to security and solar power.

RESPONDING TO AN EVOLVING INDUSTRY

The excellence of Ottawa's photonics cluster is rooted in a tradition of community cooperation. In the late 1980s, NRC established the Solid State Optoelectronics Consortium, a partnership with Bell-Northern Research, local businesses, universities and government laboratories, in response to a critical need for a collaborative approach to R&D. In 2002, NRC brought together local universities, R&D centres, government and industry to create the NRC Canadian Photonics Fabrication Centre – a $43 million pioneering photonics prototyping facility and leading-edge training ground for skilled workers. The Centre exists to support cluster growth by offering stakeholders a suite of leading-edge commercialization and prototyping services. Services include simulation, design, fabrication, testing and prototyping of photonics technologies—offering companies a competitive edge worldwide by giving them the resources to reduce their time to market.



UNITING MAJOR PLAYERS

To construct the fabrication centre, NRC worked with three partners: the federal government, which contributed $30 million and the Government of Ontario, which added $13 million, of which $3 million is to be used by Carleton University towards the training of highly qualified personnel. In addition, NRC has concentrated the efforts of three of its own research institutes, and launched five photonics-related biotechnology projects and initiated a separate venture focused on the marriage of photonics and medical imaging.

NRC has been a dynamic player in the photonics industry, helping create the Agile All-Photonic Networks Research Network, working closely with the leading edge National Capital Institute for Telecommunications and pursuing a major collaborative research project funded by the Chemical, Biological, Radiological and Nuclear Research and Technology Initiative.

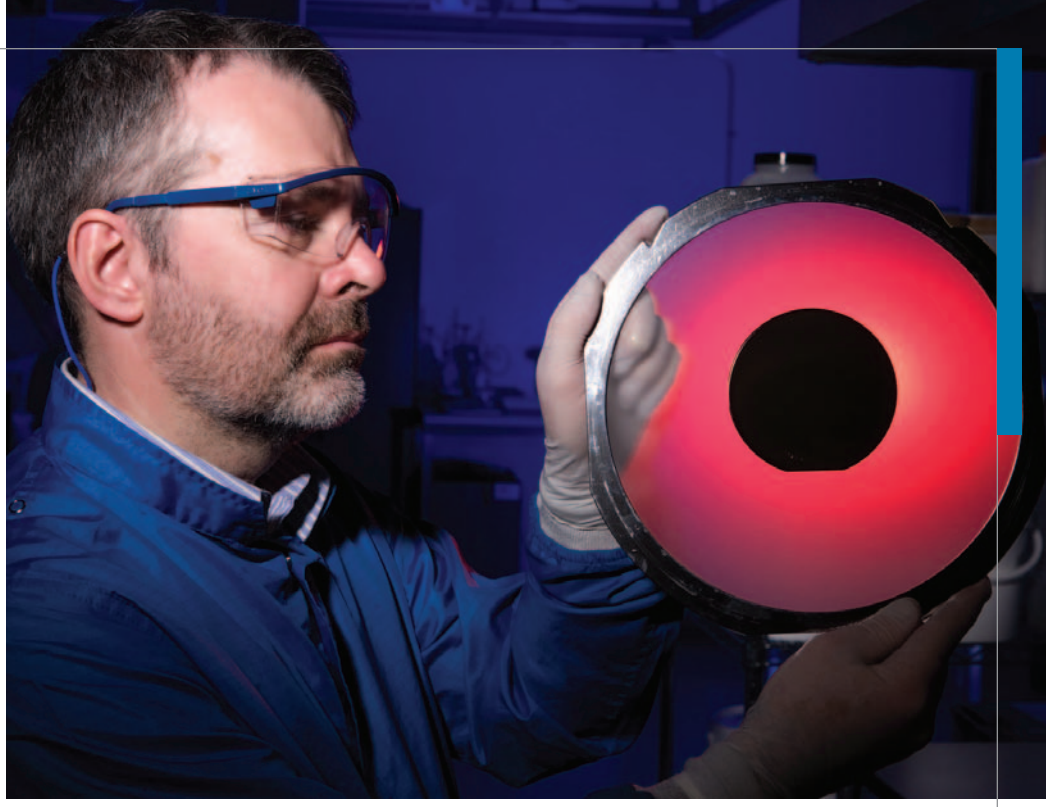
COMMERCIALIZING RESEARCH

An NRC strategy to move cutting-edge research out of federal labs and into the marketplace is typified by the journey of Dr. Derek Houghton, founder of SiGe Semiconductor. Dr. Houghton, a former NRC researcher, established SiGe using pioneering wireless processes developed at NRC. SiGe—now a world leader in wireless technology— incubated at NRC facilities in its crucial early years. Now, the company employs more than 100 and has offices in Canada, the United States and the United Kingdom.

WORLD-CLASS FACILITY

The cutting-edge NRC Canadian Photonics Fabrication Centre consists of a 1056 square-metre clean-room (class 100 and 1000) fabrication facility and a three-story office wing. Operational since

> “The photonics industry is changing rapidly. We have arrived at a juncture where convergence with other technologies creates new opportunities if we can assemble the requisite collaborative, interdisciplinary teams. As a multidisciplinary organization with decades of understanding about collaboration and technology convergence, NRC is poised to shine, and will continue to make meaningful and lasting contributions to the Ottawa photonics cluster.”
>
> **Ray Novokowski, President and CEO, EcoVu Analytic**



2005, the centre features pioneering technology to help Ottawa companies and research organizations maintain the cluster’s position at the forefront of photonics research worldwide. Facilities include:

- a multi-wafer semiconductor growth reactor
- contact lithography and nanoimprinting
- an I-line projection lithography system (stepper)
- a suite of dielectric and metal deposition instruments
- advanced dry and wet etching tools

During the planning phase for the Centre, NRC collaborated closely with Photonics Research Ontario (PRO), a division of the Ontario Centres for Excellence and CMC Microsystems. NRC signed a pivotal memorandum of understanding with both organizations allowing for their presence at the centre, to help attract a critical mass of companies, research organizations and universities.

BUILDING ON A FIRM FOUNDATION

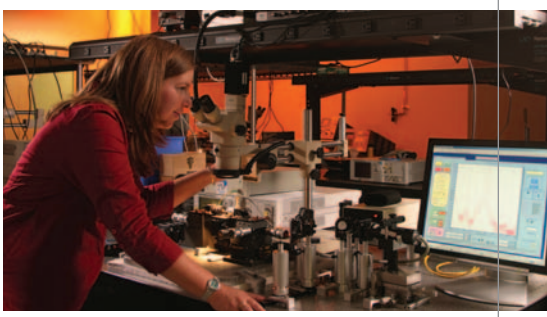
Today, Ottawa has the most vibrant photonics cluster in Canada and among the top five in the world. The community comprises close to 100 pioneering companies, various levels of government and the best minds and research facilities at Ottawa’s universities. NRC has developed a bold strategic plan to build on existing expertise as it leads the cluster in a new direction.

MILESTONES FOR COMMUNITY ENGAGEMENT

1988	NRC leads creation of Solid-State Optoelectronics Consortium
2001	NRC signs memorandum of understanding with Photonics Research Ontario
2002	$43 million funding for NRC Canadian Photonics Fabrication Centre
2005	The NRC Canadian Photonics Fabrication Centre opens its doors
2005	Cluster stages first ever photonics commercialization symposium in Ottawa, including facility tour and special event at NRC
2005	NRC through its ERI initiative funds the formation of the International Photonics Commercialization Alliance, showing leadership and support for the commercialization of photonics in Canada

NRC CLUSTER INITIATIVE PARTNERS

- Carleton University
- Government of Ontario
- Photonics Research Ontario
- Agile All-Photonics Network
- Canadian Photonics Consortium
- Canadian Optoelectronic Packaging and Assembly Consortium
- Advanced Bio-photonics Consortium
- Ottawa Life Sciences Council
- Ottawa Centre for Research and Innovation
- Ottawa Photonics Research Alliance
- National Capital Institute for Telecommunications
- CMC Microsystems
- Canadian Association of Physicists
- International Photonics Commercialization Alliance

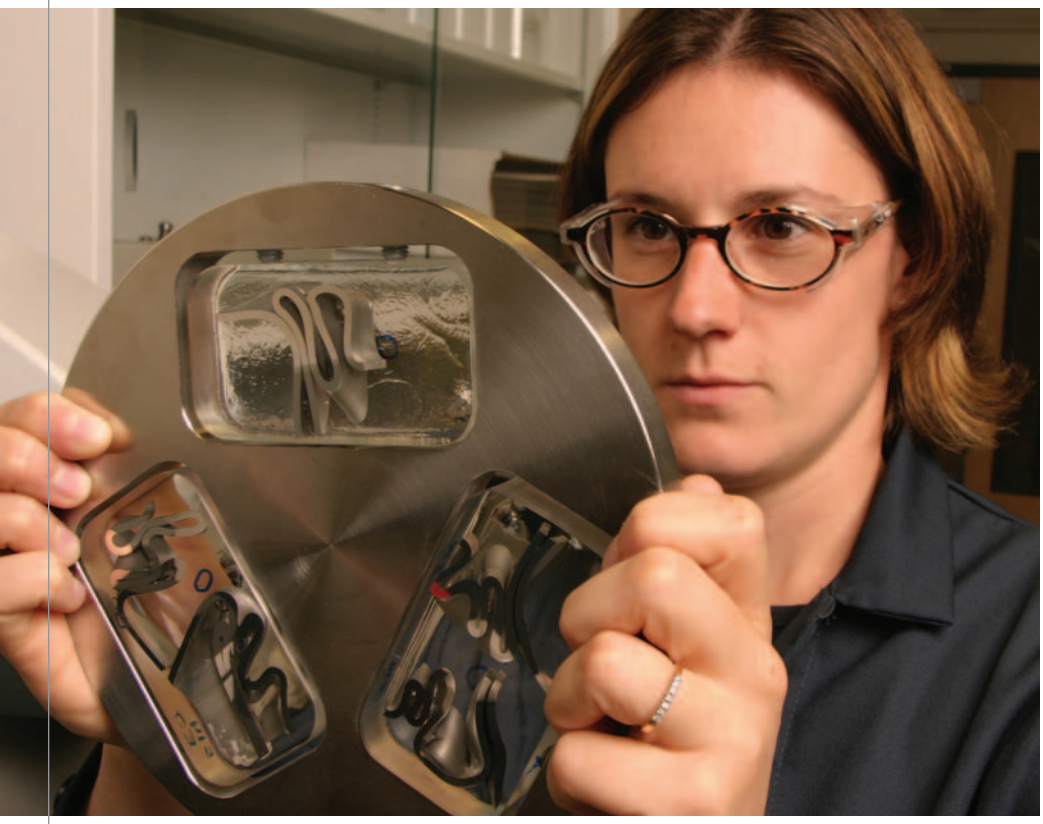


CLUSTER FACTS AT A GLANCE

- Ottawa’s photonics cluster comprises nearly 100 companies, various levels of government and local university laboratories.
- The cluster is Canada’s most vibrant in photonics and among the top five photonics clusters in the world.
- Photonics has evolved into an enabling technology with applications in a wide range of science disciplines.

SAGUENAY REGION—ALUMINIUM TRANSFORMATION

Canada is one of the world's top two exporters of primary aluminium. NRC's bold strategy to transform a significant portion of those exports into value-added offerings has created a vibrant technology cluster around the "Aluminium Valley" in Quebec's Saguenay region.



INVESTING IN THE COMMUNITY

In the late 1990s, NRC targeted Saguenay as Canada's most promising investment site for pioneering aluminium transformation R&D. The reason: more than 90 per cent of Canada's aluminium production is situated within a 500 square kilometre area in Saguenay. In 2002, NRC constructed its state-of-the-art research facility—the NRC Aluminium Technology Centre—to serve as a hub for the region's most enterprising researchers. The Centre provides cluster stakeholders with wide-ranging support to explore the most profitable ways to transform aluminium into durable, light-weight components for a host of industries.

BUILDING CRITICAL PARTNERSHIPS

NRC has nurtured several key partnerships with local aluminium transformation stakeholders in Saguenay. These partnerships play a critical role in NRC's efforts to stimulate groundbreaking research, disseminate world-leading knowledge and commercialize promising technologies.

NRC's partners in Saguenay include:

- Alcan Inc.
- the Quebec Centre for Aluminium R&D
- the Trans-Al network, an association of aluminium parts manufacturers
- the Société de la vallée de l'aluminium, a business development organization funded by the Quebec government
- the Université du Québec à Chicoutimi along with REGAL, a provincial university aluminium research network headquartered at Université du Québec

ATTRACTING TOP-FLIGHT TALENT

Located on the grounds of the Université du Québec at Chicoutimi, the $57 million NRC Aluminium Technology Centre attracts top talent by providing pioneering companies with technical support, expertise and lab facilities to develop value-added aluminium products and processes. The Centre's 60 NRC staff, 20 guest researchers and 20 young scientists receive advanced training to bring new technologies to market.

MAKING CARS LIGHTER

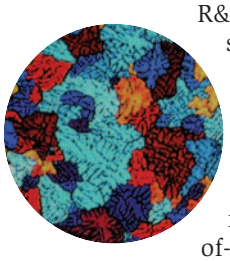
Concerns over energy efficiency, durability and performance have made the auto-parts industry a gigantic market for aluminium transformation technologies. In fact, since 1998, the amount of aluminium used to manufacture cars has risen by more than 130 per cent. Auto giants such as General Motors now clamour for reliable, light-weight aluminium parts, since they can be up to 40 to 50 per cent lighter than steel.

NRC CLUSTER INITIATIVE PARTNERS

- Alcan Inc.
- Canada Economic Development
- General Motors Canada
- Quebec Centre for Aluminium R&D
- REGAL—regroupement université/ organismes en R&D-aluminium
- SVA (Société de la vallée de l'aluminium)
- Trans-Al Network
- Université du Québec à Chicoutimi
- University of Waterloo

TARGETING SUCCESS

To ensure the region's cluster remains focused on the most achievable and potentially lucrative goals, NRC's strategic plan targets two broad categories of development – advanced forming and joining (assembling) technologies. In the first category, NRC guides researchers and emerging companies through training in die-casting, hydroforming and other processes that form solid aluminium into lightweight, usable parts. The second category involves R&D of laser and friction stir welding, adhesive bonding and the mechanical assembly of aluminium parts. NRC provides advanced computer modeling and state-of-the-art instrumentation for visiting researchers, helping to build a critical mass of knowledge and research that the fledgling cluster can use to commercialize its pioneering ideas.



FOSTERING COLLABORATION

While the NRC Aluminium Technology Centre has been up and running for less than two years, it has already signed collaborative R&D partnerships with local SMEs and industry giants such as Alcan and General Motors alike. The Alcan collaboration, worth $10.5 million over five years, focuses on breakthrough processes to manufacture lightweight aluminium parts for the enormous global automotive market. NRC has also negotiated several collaborative agreements with Canadian universities to conduct groundbreaking aluminium transformation R&D. It has inked contracts with the University of Waterloo, the Université Laval and the University of Toronto—with General Motors Canada as the industrial partner.

MILESTONES FOR COMMUNITY ENGAGEMENT

2000	NRC develops Aluminium Industry Technology Roadmap
2001	NRC commits to NRC-ATC (Aluminium Technology Centre) for Saguenay region
2002	NRC unveils design plans for NRC-ATC
2002	Alcan invests $10.5 million in NRC-ATC
2004	Official inauguration of NRC-ATC
2006	NRC and Réseau Trans-Al host Canadian Aluminium Transformation Technology Roadmapping workshop in Hamilton, Ontario

CLUSTER FACTS AT A GLANCE

- Canada is the world's second-largest exporter of primary aluminium
- Quebec produces 90% of Canadian aluminium exports
- Amount of aluminium used in cars is increasing by 5% annually

"This NRC Centre is a prime example of what can be accomplished when the region pulls together to work toward a common goal. It ensures the region of the kind of environment that is conducive to aluminium transformation."

Michel Belley, Rector, UQAC

NEW BRUNSWICK—INFORMATION TECHNOLOGY AND E-BUSINESS

Since 2000, NRC has worked to unite key players in New Brunswick's e-business technology cluster to seize a sizeable share of the global e-business market, where sales have exploded from US$443 million in 2000 to US$8.5 trillion today. Using its state-of-the-art Institute for Information Technology e-Business as a central R&D hub, NRC is helping leading-edge firms turn federally funded research into marketable products.

ACHIEVING COMMUNITY FOCUS

In 2001, NRC assembled a roundtable of more than 100 dynamic community players from private, public and academic organizations. The group established a bold research agenda for New Brunswick's e-business sector, identifying how the cluster could best serve both regional and national R&D priorities. In the first five-year phase of delivering on that agenda, NRC was a driving force, aligning stakeholders' visions and acting as catalysts in all areas of cluster initiative development: policy, mentoring, finance, development of skilled personnel.

> "Unlike most bureaucratic institutions, which are cursed with excessive paperwork and lengthy approval processes, NRC-IIT is nimble, fast and progressive."
>
> **Atlantic Business Magazine**

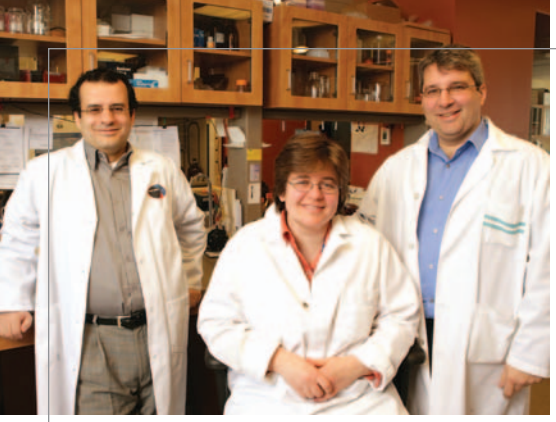
In the current, second phase of cluster initiative building, NRC is focusing even more on its greatest strength: R&D. The organization will fuel New Brunswick's e-business economy by offering enterprising firms a steady flow of intellectual property and continued linkages between research and industry.

DYNAMIC RESEARCH HUB

NRC is a key player in New Brunswick's e-business hub. Broadly defined, e-business is the undertaking of social, political and economic activities by means of computers and communication networks such as the Internet. It capitalizes on information sharing and value-adding applications in trade, commercial transactions, culture, education, governance, health care and a host of other human endeavours.

PROVIDING CRITICAL INFRASTRUCTURE

NRC has earmarked $48 million over five years to provide the cluster's most dynamic emerging companies with much improved infrastructure, including groundbreaking research and technical and business support facilities. NRC has planned key investments with input from local universities and businesses, the provincial government and the Atlantic Canada Opportunities Agency—all major partners in this emerging cluster



initiative. NRC's collaborative approach is yielding impressive results:

- NRC has signed more than 125 formal collaborative agreements with New Brunswick cluster players, for a total project value of $18 million.
- five NRC research labs in Fredericton were designed in close consultation with cluster contributors.
- NRC's Director General, Information Technology, is widely recognized as one of Atlantic Canada's top CEOs and one of Canada's 'Top 40 Under 40.'
- Atlantic Business Magazine has described NRC's New Brunswick research operation as nimble, fast and progressive—emphasizing that industry views NRC as its peer.
- NRC-IIT e-Business staff increased from 14 in 2001 to 39 in 2006.

MILESTONES FOR COMMUNITY ENGAGEMENT

2000	NRC announces New Brunswick site for e-business cluster initiative
2001	NRC convenes Moncton roundtable to establish research agenda for New Brunswick initiative
2001	Construction begins on NRC building in Fredericton
2002	E-Health Forum held in Fredericton
2002	Stakeholder consultation on e-government research agenda conducted in Fredericton
2003	Official opening of Fredericton labs
2003	NRC hosts e-government workshop in Fredericton
2003	First Atlantic Canada Human Computer Interaction Workshop
2004	$11 million NB/PEI research grid unveiled
2004	New Brunswick hosts International Learning Objects summit
2004	NRC opens its Industry Partnership Facility in Fredericton
2005	NRC opens five leading-edge research labs in Fredericton facility
2005	NRC opens the Advanced Collaborative Environment lab in Moncton
2006	NRC signs MoU with university partners (UNB, UdeM, Dalhousie University), the New Brunswick Innovation Foundation and the Atlantic Cancer Research Institute to form the Cancer Populomix Institute (CPxI), a new cancer research organization

ATTRACTING TOP TALENT

In 2004, NRC was an integral partner in the New Brunswick/Prince Edward Island Research Grid, a key infrastructure project that has attracted leading-edge researchers, students and businesses to New Brunswick. The $11 million project provides both provinces with a super-high-speed broadband network, which increases bandwidth by a factor of 30 and provides cluster stakeholders with access to CA*net 4, one of the world's most advanced broadband networks.

CLUSTER FACTS AT A GLANCE

- The global e-business market has exploded in value from US$443 million in 2000 to US$8.5 trillion in 2005.
- NRC will invest more than $48 million in the New Brunswick economy over the next five years.
- NRC's New Brunswick research facility and Industrial Research Assistance Program (NRC-IRAP) have signed more than 125 R&D agreements to date.

NRC CLUSTER INITIATIVE PARTNERS

- Atlantic Canada Opportunities Agency
- Province of New Brunswick
- University of New Brunswick (Fredericton and Saint John)
- Université de Moncton
- New Brunswick Community Colleges
- Centre international pour le développement de l'inforoute en français
- Bell Canada

"NRC's presence in New Brunswick will help improve the innovation capacity of the province, which in turn will contribute to a higher standard of living, more jobs and a better quality of life for all New Brunswickers."

Bernard Lord, Former Premier of New Brunswick

NOVA SCOTIA—LIFE SCIENCES

With more than 50 core companies hard at work on life sciences R&D, and technology cluster champions pouring more than $100 million annually into research, Halifax is rapidly building its capacity to produce pioneering, lucrative life sciences products. NRC is a key cluster catalyst, uniting the industry's major players and encouraging groundbreaking collaborative R&D efforts.

SPURRING INNOVATION

Although vibrant life sciences companies are located throughout Nova Scotia, about three quarters reside in Halifax around the NRC Institute for Marine Biosciences—the cluster's hub. NRC has invested $25 million over five years to expand:

- NRC research programs and facilities, including expanded research in enhanced proteomics, microarray capacity, functional genomics and metabolomics
- equipment and research expertise for the Nova Scotia Brain Repair Centre, a world-renowned facility
- NRC's knowledge and industry support capacity throughout Nova Scotia

To support emerging companies through the risky start-up years, NRC constructed a $4.2 million industry partnership facility. This facility can incubate up to 12 small and medium-sized enterprises, offering them access to pioneering research, and proximity to Genome Atlantic, a large-scale regional undertaking that promotes leading-edge research and lucrative commercial opportunities in genomics.

ATTRACTING INVESTMENT

NRC's research presence and acknowledged leadership in life sciences R&D have attracted an increasing volume of funding over the years from industry. Between 2002 and 2004 alone, income from businesses grew tenfold to roughly $3.5 million, leveraging federal spending on R&D. Additionally, NRC has signed dozens of collaborative agreements with industry partners since 2002.

NRC CLUSTER INITIATIVE PARTNERS

- Government of Nova Scotia
- Atlantic Canada Opportunities Agency
- Genome Atlantic
- Greater Halifax Partnership
- Dalhousie University
- Queen Elizabeth II Health Services Centre
- Capital District Health Authority
- IWK Health Centre
- InNOVAcorp
- BioNova

CREATING BRAIN GAIN

NRC's involvement with the Nova Scotia Brain Repair Centre is paying high dividends to its life sciences cluster initiative. NRC has contributed its research and business expertise, along with an advanced magnetic resonance imaging system, amounting to an $8.45 million investment. The Centre — a joint venture that includes academic, hospital, government and research institutes, along with members of the broader life sciences community — is now supplying world leading researchers and neurosurgeons with unprecedented, real-time views of the brain in action. The project has attracted top physicists from across Canada and around the world who are now collaborating with the centre's 100-strong staff of brain-repair researchers and physicians. Already, collaborators have made major advances to combat debilitating neurological disorders such as Huntington's and Alzheimer's diseases, multiple sclerosis, epilepsy, cancer, spinal cord injury, vision disorders and serious mental illness.

MILESTONES FOR COMMUNITY ENGAGEMENT

2000	Halifax roundtable
2001	NRC initiates incorporation of Life Sciences Development Association
2002	NRC announces research presence at the Brain Repair Centre and plans for the purchase of advanced MRI equipment
2002	Brain Repair Centre begins construction of facility for advanced MRI
2002	NRC begins construction of Industry Partnership Facility
2003	Brain Repair Centre officially commissions its MRI
2004	NRC opens its Industry Partnership Facility
2004	Life Sciences Development Association develops plan for new $30 million Life Science Research Institute

CLUSTER FACTS AT A GLANCE

- The Nova Scotia life sciences R&D base includes 55 core companies that pour more than $100 million annually into the cluster.
- The annual global market for life sciences technologies is estimated at US$1 trillion.
- NRC has committed $25 million over five years to carry out research and support activities within the cluster.
- Research enhancements and new facilities at NRC total $15 million.
- NRC has committed nearly $8.5 million to its research programs and new equipment at the Brain Repair Centre in Nova Scotia.
- More than 120 skilled professionals and dozens of guest researchers work at NRC in Halifax.
- NRC's $4.2 million industry partnership facility can house up to 12 small and medium-sized enterprises, and offers incubation space for emerging life sciences companies.

"The (NRC) lab is already attracting top-flight researchers to our growing life sciences sector—a brain gain that, over time, will create a broad range of health and economic benefits for the province."

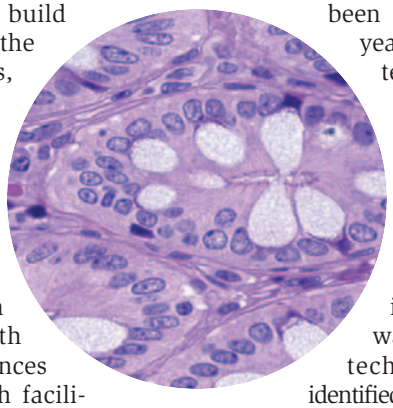
John Hamm, former Premier of Nova Scotia

PRINCE EDWARD ISLAND—NUTRISCIENCES AND HEALTH

To capitalize on a global nutrition market valued at more than $182 billion annually, and to address critical health issues affecting Canadians and the population worldwide, NRC has taken bold steps to turn PEI's established expertise in land and marine-based resources (bioresources) into a wide range of marketable products focused on disease prevention and therapy.

ESTABLISHING A RESEARCH HUB

NRC technology advisors have been working to build PEI's cluster for the past several years, collaborating with researchers and industry to build commercially viable business opportunities. In 2006, NRC strengthened its presence in the community with its new Nutrisciences and Health research facility that has become a dynamic hub for PEI's emerging cluster, attracting top talent from the worldwide bioresources community. NRC's pioneering researchers are already exploring the impact of nutraceuticals and bioactive ingredients on neurological disorders, obesity-related disorders and infection and immunity. To date, researchers have published a host of articles in leading scientific journals and are involved in many collaborative research projects, including a long-term project on Alzheimer's Disease with the University of Prince Edward Island.



MAPPING A PROSPEROUS FUTURE

Growth in PEI's bioresources cluster has been impressive since 2001. That year, NRC participated in a cluster-development roadmap with federal and provincial agencies, the University of Prince Edward Island and several local bioresources companies. The roadmap, which included input from more than 100 North American industry and research experts, was a needs-driven, long-term technology planning exercise. It identified the most promising applications for bioresources R&D that would enable ambitious local stakeholders to convert federally funded research into profitable businesses well into the future.

> "The importance of science and research cannot be overstated. There is much to be gained from having a (NRC) facility of this type, both in terms of knowledge investment and potential commercialization."
>
> Pat Binns, Premier of Prince Edward Island

UNITING STAKEHOLDERS

The roadmap was designed to involve as much stakeholder input as possible. As a result, the biosciences community invested critical funding to undertake groundbreaking research into renewable bioactives. For its part, NRC has invested $20 million in world-leading staff, state-of-the-art equipment and innovative research projects. That investment has been leveraged with $8 million from the Atlantic Canada Opportunities Agency (ACOA), $3.5 million from the provincial government, as well as a prime location provided by the University of Prince Edward Island. The NRC research facility can accommodate up to 100 staff, including scientists and support staff. It will also provide much needed technology incubation space for private sector companies seeking to develop and commercialize natural health products.

Bioresources are renewable, naturally occurring land and marine-based resources. A vibrant and rapidly growing industry has emerged around the application of these resources to new pharmaceuticals, nutraceuticals and dietary supplements.

NRC CLUSTER INITIATIVE PARTNERS

- Atlantic Canada Opportunities Agency
- Province of Prince Edward Island (Technology PEI)
- University of Prince Edward Island
- Agriculture and Agri-Food Canada
- PEI BioAlliance

LINKING LOCAL TALENT

Since NRC embarked on its strategy to promote PEI as a worldwide centre for bioresources R&D, local linkages have grown swiftly:

- NRC has attracted top talent to form its core research team and has coordinated adjunct appointments for them with the University of Prince Edward Island.
- Building on existing linkages established by its Industrial Research Assistance Program (NRC-IRAP), NRC is continuing to strengthen relationships between its researchers and SMEs within the bioresources cluster.
- NRC has hired technical officers, graduate students and research support staff to facilitate the work of its core research team.
- NRC regularly engages in public speaking events throughout PEI, hosts tours and meetings with associations and bioscience interest groups and promotes the province abroad at international research symposia.
- NRC has become a key member of the PEI BioAlliance, a multiparty organization dedicated to building the commercial potential of biosciences in PEI.

Bioactives are molecules that can affect our bodies at the cellular level; they are the key to creating a wide variety of products for improving human and animal health.

CLUSTER FACTS AT A GLANCE

- The North American market for nutritional products was valued at more than $27 billion in 2000
- The global market is currently valued at over $100 billion
- PEI is home to more than six major research organizations and a host of private-sector companies with expertise in life sciences
- NRC Nutrisciences and Health can house up to 100 individuals (research and support staff) and it offers incubation space for emerging bioresources companies

MILESTONES FOR COMMUNITY ENGAGEMENT

2001	Biotechnology roadmapping exercise begins
2002	Roadmap steering committee releases summary and recommendations
2003	Federal and provincial governments announce $31.5 million in funding for a Charlottetown-based nutrisciences and health research facility
2003	NRC hosts Inaugural Research Forum in Charlottetown
2004	NRC Nutrisciences and Health research program launched in temporary quarters
2004	Construction begins on NRC Nutrisciences and Health facility on UPEI campus
2004	NRC Nutrisciences and Health launches science outreach program "Like Science?"
2005	NRC joins new PEI BioAlliance
2005	NRC Nutrisciences and Health core research team established
2005	NRC Nutrisciences and Health hosts 'Open for Business' showcase for potential industry links
2006	Bioscience businesses begin collaborations with NRC Nutrisciences and Health – over 50% of incubator space is committed before facility opens
2006	NRC Nutrisciences and Health collaborates with three recent recipients of ACOA's Atlantic Innovation Fund (AIF): • NRC and UPEI worked together to develop the Atlantic Centre for Bioactive Valuation – a company designed to evaluate natural compounds' ability to benefit human and animal health • NRC, together with ACOA, was instrumental in attracting two private sector companies to the cluster (AIF recipients) and NRC is closely collaborating with each company • These three projects represent a new investment of $13 million to the cluster
2006	Planning begins for NRC's international research conference "Nutrisciences and Health Bioprospecting for Neuroprotectants," slated for July 2007

PROMOTING PEI

NRC held a milestone research forum in 2003 to promote PEI as a major player in the global race to commercialize pioneering nutritional science and health research. The forum not only elevated PEI's position in this burgeoning field, but also paved the way for an international symposium on nutrisciences and health entitled "BioProspecting for Neuroprotectants" to be hosted by NRC in July 2007 in Charlottetown.

"This initiative has come about through a remarkable and sustained collaboration of the whole community, combining the private sector, government and the university with top-level leadership and broad-based enthusiasm. These are essential ingredients for a successful cluster."

Wade MacLauchlan, President and Vice-Chancellor, UPEI

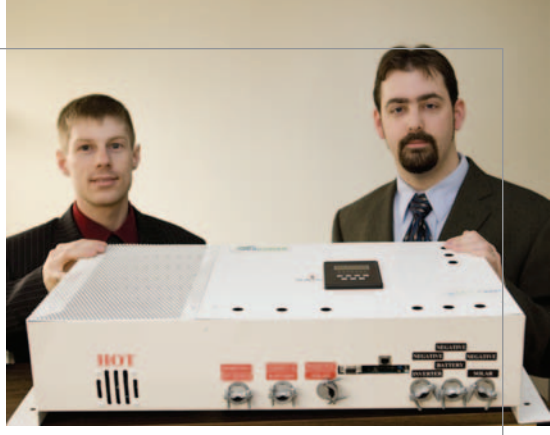
NEWFOUNDLAND AND LABRADOR—OCEAN TECHNOLOGIES

NRC is nurturing a vibrant cluster initiative of public and private organizations in Newfoundland and Labrador to capture a sizeable portion of a global ocean technologies market worth $1.8 trillion. By positioning its pioneering NRC Institute for Ocean Technology as a hub for the community's groundbreaking R&D activities, NRC serves as both cluster catalyst and mentor— it encourages key players to work collaboratively toward critical common goals, and it affords the cluster's roughly 50 small and medium-sized companies an opportunity to prototype and incorporate new technologies using NRC expertise and facilities.

UNITING KEY PLAYERS

The momentum behind the cluster's impressive growth stems from a broad-based collaborative initiative involving NRC, all levels of government, local businesses, industry groups and Memorial University of Newfoundland. An NRC-initiated roundtable in 2000 attracted 85 ocean technologies stakeholders, resulting in the development of a bold action plan that has enabled the community to identify key strategies and goals for cluster development. Here are some key initiatives that have sprung from the roundtable:

- The NRC Industrial Research Assistance Program (NRC-IRAP), with the collaboration of several stakeholders, helped to establish the influential private sector ocean technologies cluster development forum, OceansAdvance. OceansAdvance facilitates collaboration among industry stakeholders, builds the community's R&D capacity, expands lucrative business and export opportunities and identifies the industry's most promising investment prospects.
- NRC has established a new $6.5 million industry partnership facility at its research complex in St. John's. The facility, which transfers research from NRC labs to vibrant start-up companies, now houses five pioneering firms and also operates a technology incubator that houses four more.
- The City of St. John's launched a nationwide advertising campaign that branded the city as Canada's Centre of Ocean Excellence. This campaign has helped St. John's attract top talent and investment from across the country.
- The St. John's Board of Trade partnered with the City of St. John's to establish Ocean Industries Week, which highlights the economic importance of ocean industries and draws attention to the strategic importance of St. John's as a centre of excellence in the field.



COMMERCIALIZING RESEARCH

One of NRC's goals is to encourage collaborative R&D that puts federal research to work in the private sector. Significant strides have come in recent years: in 2004-2005 alone, the value of NRC's collaborative agreements with stakeholders in the St. John's cluster initiative tripled to nearly $9.1 million – or about $2.9 million annually.

> "The ocean technologies cluster is catalyzing companies in Newfoundland and Labrador to build individual strengths into powerful collective efforts. More and more, the industry is assuming strategic leadership for the sector. The province sees this sector as a major element of its new economy."
>
> **L.G. O'Reilly, Executive Director, OceansAdvance**

NRC CLUSTER INITIATIVE PARTNERS

- Province of Newfoundland and Labrador
- OceansAdvance
- City of St. John's
- St. John's Board of Trade
- Memorial University of Newfoundland, including the fisheries and Marine Institute
- Atlantic Canada Opportunities Agency (ACOA)
- Newfoundland and Labrador Association of Technology Industries
- Newfoundland Ocean Industries Association
- Petroleum Research Atlantic Canada
- Canadian Centre for Marine Communications
- C-CORE

CLUSTER FACTS AT A GLANCE

- Ocean-related economic activities comprise 25% of Newfoundland and Labrador GDP. The ocean technologies component of this figure is growing at twice the rate of the remaining components.
- Ocean industries contribute $20 billion and 350,000 jobs to the Canadian economy annually.
- St. John's is home to roughly 50 ocean technologies companies.
- The world market for ocean technologies is $1.8 trillion and growing at a rate of 2.5% annually.
- NRC's $6.5 million industry partnership facility houses 10 companies.

MILESTONES FOR COMMUNITY ENGAGEMENT

2000	NRC and Industry Canada launch technology roadmap exercise
2001	St. John's roundtable attracts 85 participants from industry, academia, various agencies and all three levels of government
2001	NRC acquires $20 million in new federal funding for its Institute for Ocean Technology
2002	NRC spearheads the creation of OceansAdvance, a public-private joint venture that aims at making St. John's an international location of choice for ocean technology
2002	NRC organizes $60 million Ocean Partners Investment Fund and trade mission to Ireland
2003	NRC opens an industry partnership facility in St. John's
2004	NRC announces BioSeas Partnership
2005	Cluster champion OceansAdvance is incorporated
2005	NRC, the Atlantic Canada Opportunities Agency and the Government of Newfoundland and Labrador launch New England Trade Initiative concentrating on ocean technology
2005	NRC's Ocean Technology Enterprise Centre graduates its first two companies
2006	OceansAdvance signs an MOU with the Marine and Oceanographic Technology Network, a U.S. business development association

WORLD-LEADING CLUSTER INITIATIVE

Although knowledge-intensive ocean technologies companies are located throughout the province, more than 40 are located near NRC facilities in St. John's, securing the city's position as one of the world's most important emerging ocean technologies centres. NRC has made a $20 million investment in the dynamic community to ensure its impressive start will be followed by substantial advances in R&D and the commercialization of federally funded research.

MAPPING A PROMISING FUTURE

NRC and Industry Canada led a technology roadmap exercise in 2000, the outcome of which reflected the community's priorities in a cohesive, common plan. The roadmap identified four areas that hold special promise for ocean technologies R&D in the Newfoundland cluster. Cluster stakeholders will concentrate on developing innovative technologies for:

- oil and gas services
- energy-efficient marine transportation
- eco-sensitive ocean harvesting, critical to maintaining sustainable fisheries and aquaculture
- climate and ocean monitoring

"NRC's work in ocean technologies has been instrumental in positioning St. John's as a centre of ocean excellence. With a common vision and purpose, we are experiencing progress and are poised for even greater development in this sector. The City anticipates considerable benefit from our ocean technologies community for many years to come."

Andy Wells, Mayor, City of St. John's

NRC-IRAP — A CRITICAL COMPONENT OF CANADA'S STRATEGY TO STRENGTHEN AND BUILD OUR ECONOMY

The NRC Industrial Research Assistance Program (NRC-IRAP) is the Government of Canada's best tool for helping small and medium-sized firms develop new technologies that result in the commercialization of new products, processes or markets. NRC-IRAP's technology and business advisory network, coupled with the shared financial support it offers to innovative companies and organizations, strengthens Canada's innovation system and ignites the growth of NRC's technology cluster initiatives in Canada.

NRC-IRAP'S ROLE IN BUILDING TECHNOLOGY CLUSTERS

- Diagnosing emerging opportunities
- Proactively facilitating growth of cluster infrastructure
- Accelerating the flow of knowledge and technology to groups of firms
- Forging connections within cluster supply chain regionally, nationally and internationally
- Linking firms to clusters to ensure research relevance
- Providing industry and market intelligence
- Collaborating with other government and non-government organizations, programs and associations, to ensure industry succeeds in the commercialization of technology
- Strengthening regional innovation systems to improve Canada's productivity and competitiveness

NRC-IRAP FACTS AT A GLANCE

- Unique professional network consisting of 260 technical, business and innovation network advisors spread throughout 100 communities across Canada
- More than 9000 clients assisted annually
- Shared financial assistance to over 100 organizations that provide technology and business services
- Support to firms for international technology missions throughout North America, Asia and Europe

CLOSING THE GAP FROM DISCOVERY TO COMMERCIALIZATION

Just like no two cluster initiatives are alike, NRC-IRAP's role in cluster building differs with every SME client. NRC-IRAP is highly regarded within Canada and around the world because of the program's ability to bring government organizations and industry together—facilitating collaboration and spring boarding ideas.

"NRC-IRAP has been the strongest of all government programs in research that Angstrom has been involved with. They understand their mission, contribute in more ways than money and are a valued contributor to Angstrom's R&D program. In addition they have tried to link Angstrom with other research groups within NRC, with the aim of accelerating development and reducing costs. The support has been extensive."

Dr. Ged McLean, Founder and CTO, Angstrom Power Inc.

TWO EXCELLENT EXAMPLES...

OCEAN TECHNOLOGIES

NRC-IRAP and NRC-IOT have been working closely to strengthen NRC's ocean technologies cluster initiative in St. John's, Newfoundland. At the hub of this initiative, NRC continues to impact the evolution of the cluster's activities and its results.

Visibility and recognition for the ocean technologies cluster has largely been achieved through the broad community integration initiative, OceansAdvance – a not-for-profit incorporated partnership between firms, research institutions, academia and government. NRC and OceansAdvance offices are located on the Memorial University of Newfoundland Campus, where key ocean technologies cluster partners such as C-Core and the Marine Institute are also located. This close geographic proximity fosters intellectual and technical exchanges on various oceans-related matters.

Another collaborative initiative established in 2003 is the Ocean Technology Entrepreneurship Centre (OTEC), located at NRC-IOT. The Centre's goal is to promote the development of ocean technologies-related business in the province by providing a supportive environment at NRC-IOT, technical mentoring and co-location facilities to encourage collaboration between NRC scientists, NRC-IRAP staff and client firms.

PHOTONICS

In addition to providing advisory services and networking opportunities to individual firms, over the years NRC-IRAP has leveraged its clients' opportunities to foster the acceleration of technology innovation within the SME community through financial assistance. In 2004-2005, NRC-IRAP supported initiatives with SMEs, including, photonic and related device prototype fabrication, scale-up process control research and collaborative device research with the NRC Canadian Photonics Fabrication Centre.

NRC-IRAP's photonics outreach has included joint participation in various international conferences to encourage the application of optical and photonic technologies in the industry. Active participation in regional clusters (Ontario Photonics Technology Industry Cluster and the Ottawa Photonics Cluster) has also been an NRC-IRAP priority activity, with a goal of promoting and linking firms and research institutes, resulting in industrial research collaboration.

NRC-CISTI—BEST AVAILABLE SCIENCE AND TECHNOLOGY LITERATURE

NRC is a world leader in electronic publishing and Canada's largest and best resource for scientific, technical and medical information. The S&T information services delivered by the NRC Canada Institute for Scientific and Technical Information (NRC-CISTI) are integral to NRC's cross-Canada cluster initiative strategy, providing growing companies with the vital information they need to produce cutting-edge innovations.

NRC INFORMATION SERVICES FOR SMES AT A GLANCE

- ground-breaking technical information
- literature searches, including patents
- cutting-edge industry and market information
- rapid delivery of up-to-date full text articles from online sources
- referrals to industry experts or organizations
- patent landscape analysis
- competitive technical intelligence

HELPING SMES DEVELOP INVENTIVE IDEAS

In support of NRC technology cluster initiatives, NRC-CISTI Information Specialists and Technical Business Analysts offer competitive technical intelligence to innovative SMEs. By providing decision-makers in technology-based small businesses with the best analysis of technological trends, these firms are in a better position to maximize results and returns on their research and development investments.

NRC-CISTI also offers Strategic Technical Information Analysis (STIA) to growing companies located in all NRC cluster initiatives. STIA helps innovative companies capitalize on the unique technical and commercial information that can be gathered from patents and specialized S&T and business information databases. It helps decision makers confirm the potential value of R&D projects and develop strategies that will translate knowledge into commercialized technology.

CROSS-CANADA, MISSION-CRITICAL INFORMATION

- In 2002, NRC-CISTI expanded its St. John's-based team of Information Specialists working in its ocean technologies cluster initiative, improving NRC's ability to deliver value-added intelligence and information to local SMEs. Services include a weekly newsletter and other offerings for the ocean technologies companies that are housed at NRC's industrial partnership facility.
- Since 2004, NRC has produced an award-winning newsletter in support of Winnipeg's biomedical technologies cluster initiative. Medical Technology Watch Canada, which is distributed internationally, delivers timely, relevant information about the medical technology industry in Canada to partners in the cluster, and beyond.
- In NRC's Fredericton-based IT and e-Business cluster initiative. NRC-CISTI is a proactive research partner of the Centre international pour le développement de l'inforoute en français, an organization that is spearheading the formation of an information technology cluster in Edmundston, New Brunswick.
- In 2006, Edmonton-based Technical Business Analysts began applying competitive technical intelligence knowledge and expertise to NRC's nanotechnology cluster initiative, to help decision-makers better focus their efforts, better understand the market context when making project decisions and better engage external partners.

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