

# COLD CLIMATE TECHNOLOGIES

AN INNOVATION Cluster in Yukon?  
A Yukon Cold-Climate Innovation Centre



**2nd Edition**  
(November 2005)

The Yukon private sector, the National Research Council, the Governments of Canada and Yukon, and Yukon College are currently working together to assess whether an innovation cluster in Yukon could be nurtured. The northern innovation cluster would focus on the development, commercialization and export of sustainable Cold-Climate technologies and related solutions for Cold-Climate regions around the world. It could be a key wealth generator for Yukon.

#### WHY COLD-CLIMATE TECHNOLOGIES AND RELATED SOLUTIONS?

Cold-Climate technologies and related solutions are needed in various parts of Canada and in the Circumpolar market. The Yukon industry, with its knowledge of Cold-Climate conditions and unique skills, can effectively compete with southern firms to expand business and profitability beyond the Yukon market. Construction businesses and Architectural & Engineering Services are among the top private sectors in Yukon in terms of number of firms, jobs and revenues.

To achieve prosperity, Yukon must build on its unique advantages. Today's economic environment is based on free trade, international competition and global business relationships. In such an environment, Yukon's future depends in part on its private sector's ability to compete in the world marketplace. Yukon already has several local firms that are successful outside Yukon.

#### WHAT IS AN INNOVATION CLUSTER?

Clusters are geographical concentrations of companies, dedicated to discovering solutions to known challenges. Once developed, these solutions and products are marketed and sold to the rest of the world. Teams comprised of industry, educational institutions, agencies and business organizations work together to support clusters and maintain networks.

Clusters are think-tanks, laboratories of change and catalysts of new economic opportunities!

Firms range from suppliers of specialized inputs, such as parts, components and machinery to providers of specialized infrastructure, knowledge-based expertise and other services.

These companies look at business opportunities and profitability globally, wherever the potential clients and resources are located. Companies collaborate, enabling them to take risks that they would not have undertaken alone.

In a cluster, government supports and nurtures its industry by investing in training, R&D and innovation, providing access to world-class facilities and expertise, techno-parks and networks and brokers.

Regional governments are also active by being early adopters of products and services.

#### ARE THERE IDENTIFIED BUSINESS OPPORTUNITIES?

To address the immediate housing shortage in Nunavut, a minimum of 3,300 houses is needed. Today, only about 80 houses per year are being built. A plain 740 sq ft social housing unit in Iqaluit costs \$250,000 to build and \$18,000 to operate annually. Costs are almost double in remote communities.

Over 150,000 persons live in rural Alaska and need about 25,000 housing units. Their climate, culture and geography are similar to Yukon's. They lack roads, have water/sewer problems and require municipal infrastructure.

There is an increasing need to monitor geotechnical works, infrastructure and buildings as they may be affected by climate changes. This is an opportunity to establish reliable sensing methods and provide remote technologies and services throughout the north.

In anticipation of major water shortages, China is promoting water re-use or recycling in the northern/colder part of the country. So far, international companies have focused on large Chinese urban infrastructure and have dismissed the rural and colder parts of China.

Future pipelines and other major infrastructure work in the north may require safer and more cost-effective approaches to changing permafrost conditions and in discontinuous zones. For example, innovative foundation designs and monitoring techniques may be needed.

#### HOW UNIQUE IS THIS COLD-CLIMATE INNOVATION CLUSTER?

##### Beyond technology development

— While there is a need in the north for new technologies, finding innovative ways of adapting existing techniques and processes is also a valuable approach. Both needs translate into substantial opportunities for innovative enterprises. The proposal, therefore, is to grow an "innovation cluster" that is inclusive of the process side of technology development.

The value of Cold-Climate innovation in Yukon is found in the practicality and in managing the innovation process and risk. Investors will be able to build, test and troubleshoot solutions and products in conditions that are closer to reality and validate some results. Investors may include inventors progressing into commercialization, or clients and communities wanting to adopt technologies or techniques.

##### Capitalizing on development opportunities

— The establishment of alliances with regional governments and/or resource corporations is a valuable approach to bringing together the offer and demand sides of technology development. Pilot projects in selected communities or in large resource development projects are opportunities to apply proven ideas. Successful projects become showcases for further business and export.

##### Managing technical risks through monitoring services

— The remoteness and harsh conditions in the north, combined with the unpredictability and effects of climate change can generate glitches and unexpected failures. Having monitoring services as a tool for innovation during one, two or five years after installation of a Cold-Climate technology or process, will help having timely repairs when needed and/or improve products further. Remote communities and clients will feel more confident about becoming early adopters of technologies.

##### Access to research and development capability

— Industrial partners and entrepreneurs, like builders, cannot afford to do research during the business/construction season. However, during winter, the unique facilities would give them an opportunity to do research activities with partners or perform experiments on their own, unhindered by the conditions or demands of the season. During summer, on the other hand, part of the research facilities and equipment would become available to university-level students and professors from other regions and provinces, wishing to conduct practical research outside the academic season.

*“A long-term effort toward economic growth in Canada’s north”*

**The Yukon Cold-Climate Innovation Centre**

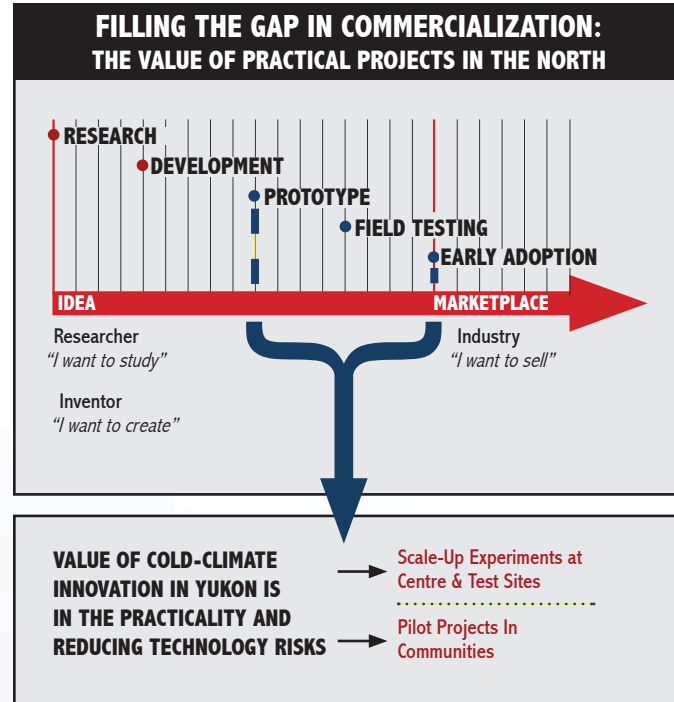
**THE CONCEPT – OCTOBER 2005**

Yukon industry along with the Yukon and federal governments are currently studying the potential for an Innovation Centre as a key component of the Cold-Climate cluster. *The Yukon Cold-Climate Innovation Centre* intends to be a world-class innovation facility devoted to cold climate technologies and solutions. Practical research, scale-up, commercialization, field trials, demonstration activities as well as experiential learning would be performed.

The concerted efforts would be focused in early days to help establish the first phase of the Cold-Climate Innovation Centre at the Yukon College Campus in Whitehorse, Yukon. Over time, the Centre would expand physically and intellectually and work in other Cold-Climate fields. The Centre would also build and maintain a pan-northern network of experts and practitioners in Cold-Climate technologies and solutions, in collaboration with other northern regions.

**THE COLD-CLIMATE INNOVATION CENTRE AND THE PARTNERS WOULD:**

- ➔ Act as the R&D and incubator nucleus of an industry-driven Yukon Innovation Cluster devoted to the development, commercialization and export of sustainable Cold-Climate technologies and related solutions around the world;
- ➔ Perform scientific and monitoring activities and facilitate experiential learning and the sharing of knowledge with research organizations and communities throughout the north; and
- ➔ Contribute to the national innovation agenda through practical research programs with potential national impact.



Many individuals and small industries reflective of the north, as well as leading Canadian industries, would use the Centre and its in-house expertise as an incubator of ideas, solutions, training and implementation.

The unique value of the Centre lies in the intellectual and physical capacity for scale-up experiments while a wide spectrum of Science and Technology activities may occur in parallel at the Centre, or elsewhere.

**PHYSICAL INFRASTRUCTURE FOR INNOVATION**

The infrastructure of the Innovation Centre is designed to allow year-round S&T activities, training and experimentation in the north, even in winter. This would accelerate the pace of innovation and provide visibility to industry initiatives. Laboratory-type research, prototype building and scale-up experiments performed in winter would take advantage of the following short summer season for implementation and field trials.

The Centre takes advantage of shops, mobile equipment, facilities and residences available at Yukon College Campus in Whitehorse. However, the concept requires the construction and operation of four special physical components:

**1 The Innovation Arena, a semi-industrial building large enough for several full-scale year-round Cold-Climate experiments**

The Innovation Arena will be a world-class research & commercialization facility by itself, with two main sections: the indoor experimental section will be comprised of several laboratories and offices.

The indoor experimental section will be comprised of several 15m x 15m zones. The design of this industrial section will allow combining and/or separating indoor zones in order to do construction experiments safely and under full confidentiality. Down to a certain depth, the ground soil in each zone may be changed, dug, heated, frozen or thawed depending on the need of each experiment.

Various scale-up experiments may run, such as house prototypes, more productive construction techniques, small-scale community infrastructure, innovative foundations, testing pipeline sections, etc. Teachers at Yukon College, or at universities, may participate in research activities and offer experiential learning to students. Industry, government researchers and academicians may participate in consortia-type activities. Industry may lease zones and test/store prototypes while preserving business confidentiality if needed.

**2 An Experimental Outside Zone**

Prototypes tested inside the Innovation Arena (or elsewhere) can be rolled outside, further seasoned, tested, fine-tuned and/or inspected by prospective early adopters. As well, the experimental outside zone allows researchers and industrial partners to run comparative experiments on equipment, systems and solutions for several weeks and months, without interference, either at an individual or multi-unit scale. This includes, for example, modular houses and innovative infrastructure at the neighbourhood/micro size, such as water and grey-water recycling and energy storage.



**GOAL AND OBJECTIVES**

The goal of the Cold-Climate Innovation Centre is to improve the capacity in the north to acquire knowledge and to develop innovative products and services for commercial purposes that solve Cold-Climate challenges.

The Centre will provide the required research and incubation infrastructure and expertise for northern organizations and individuals to achieve the following objectives:

- ➔ Create wealth by nurturing an entrepreneurial approach and reach global markets;
- ➔ Enhance the cost-effectiveness and durability of systems and solutions;
- ➔ Adapt to climate change, reduce the ecological footprint and conserve natural resources, including energy and water; and
- ➔ Participate fully and directly to the national innovation agenda.

The Cold-Climate Innovation Centre would not only help develop innovative products and services for a given market, but it would also help increase local and regional skills by encouraging individuals and small industries to participate in Science & Technology activities. This would create opportunities to access the larger international “circumpolar” market.

**SITE PLAN** Charle A. MC Laren Architects Ltd



**3 A Sustainable Buffer Zone surrounding the units**

The buffer zone will maintain a natural setting and ensure the Cold-Climate Innovation Centre “walks the walk” in terms of sustainable development. In particular, a pond will act as water storage for water infrastructure experiments as well as energy storage for heating (heat pump). A small water treatment Centre/lagoon will be required to deal with runoffs and contamination incidents.

**4 Field Facilities**

Field sites will be required to experiment on opportunities not applicable near the College Campus in Whitehorse. For example, geotechnical work, lagoon experiments and permafrost in-situ experiments are not possible at vicinity of the Campus. The Yukon Cold-Climate Innovation Centre will be part of a network of existing test sites in the north.

**MAIN FLOOR PLAN** Charle A. MC Laren Architects Ltd



**ROOM INDEX**

Code	Area Name
<b>PA - PUBLIC AREAS</b>	
PA100	Entry Vestibule
PA101	Lobby/Reception
PA102	Viewing Gallery
PA103	Male Washroom
PA104	Female Washroom
<b>AS - ADMINISTRATIVE AREAS</b>	
AS100	Staff Entry Vestibule
AS101	Open Office
AS102-113	Offices
AS114	Copy Room
AS115	Boardroom
AS116	Admin. Storage
AS117	Male Staff Washroom
AS118	Female Staff Washroom
AS119	Janitorial
AS120	First Aid
AS121	Staff Break
AS122	Cloak Room
AS123	Male Unit Washroom
AS124	Female Unit Washroom
AS125	Recycle & General Storage
<b>TS - TECHNICAL SUPPORT</b>	
TS100	Library/Research
TS101	Metal Shop
TS102	Welding Shop
TS103	Woodwork Shop
TS104	Loading Bay
TS105	Materials & Parts
TS106	Secure Storage
TS107	Service Room
<b>EZ - EXPERIMENTAL ZONE</b>	
EZ100	Innovation Area
EZ101	Cold Laboratory
EZ102	Dry Laboratory
EZ103	Wet Laboratory
EZ104	I.T. Room
<b>RS - RESIDENTIAL SUITE</b>	
RS100	Common Room
RS101-106	Bedrooms
RS107	Washroom
RS108	Entry

**PARTICIPATION IN TRAINING AND INTERNSHIP**

Industries known to be innovative are interested in expanding their market and developing research competent employees who are confident and knowledgeable with innovative practices. Training and internship are activities that could be run in an integrated fashion with the innovation programs and managed by a university and/or Yukon College.

Activities at the Cold-Climate Innovation Centre combined with the capability of Yukon College, such as residential services, are opportunities to involve trainees from distant communities and universities in R&D methodologies, S&T projects and the development of manufacturing skills.

Participation of young people in projects at the Centre would give them a greater chance of being hired by industry. Further, it may stimulate them to studying university-level programs. A self-directed learning program interrelated with some formal education and entrepreneurship programs would also be considered as a means to build the skills of younger community members. A comprehensive training program will also require the participation of visiting researchers and experts contributing to the development of knowledge and skills in the north.

**POTENTIAL PROGRAMS IN EARLY YEARS**

A number of programs have been identified as potential activities for the development of the Cold-Climate Innovation Cluster. They offer the potential for achieving early outcomes through a combination of leadership, demonstration (pilot) projects, use of the technology Centre, industry investment, presence of national research organization, etc.

Programs in early years are also opportunities for learning and dealing with interaction issues between collaborators such as training, safety, IP, manufacturing, etc.

The following areas are some examples:

- Consortium on construction processes for cold-weather housing;
- Low-maintenance grey-water and sewage systems for small remote communities;
- Innovative road construction to reduce the cost of the initial construction and long-term maintenance;
- Consortium on information technologies for distance training, inspection and environmental monitoring of geotechnical and construction works;
- Know-how and specialized products and services related to northern applications of wind power generation, such as de-icing systems;
- Remediation of hydrocarbon/chemical spills in permafrost terrain;
- Adaptation to climate change in consideration of rapidly changing permafrost conditions.

The programs in early years will be chosen based on industry involvement, and available resources.

**IS THE INNOVATION ARENA A GIANT COLD CHAMBER? NO**

There are many cold chambers in Canada and abroad. Most of them are in specialized Centres, offering the needed expertise to test products appropriately. However, Canada's north cannot escape its Cold-Climate reality; hence its innovation capacity must embrace some form of cold testing.

The Innovation Arena is a building with inherent flexibility to raise prototypes and perform scale-up experiments in separate zones:

- ➔ Because its prime function is a research and commercialization facility, not a testing Centre, space would be maintained most of time at a temperature suitable for human activities;
- ➔ When additional heating or cooling is needed in a specific zone, for research purposes, only that area will be served accordingly;
- ➔ Unused spaces are not heated or cooled; alternatively they may be used to store equipment, unused research prototypes or construction materials;
- ➔ Proper management of the experimental zones - time, project, people, safety and energy and ventilation capacity - is key to a cost-effective use of the Innovation Arena.

The expansion of the Innovation Arena to its full capacity will happen only when demand and investments from tenants warrant it (Note: the drawings in this brochure show the innovation arena at its full physical capacity in future years). Meanwhile:

- ➔ The physical infrastructure - built in Phase One – must be attractive to early investors and comprehensive enough to address the immediate needs, national or regional, whether for research or commercialization purposes. Hence, the innovation tools must be sufficiently developed, including some freezing capacity;
- ➔ Given the uniqueness of the Centre and its Innovation Arena, the management and operation during Phase One will necessarily have some research and learning components. Research may touch data acquisitions, portable walls, operational research, energy storage and management, etc. Learning may include experimental design courses, safety procedure, fire drills, dealing with IP in consortia, etc.

**INNOVATION ARENA WHEN FULLY DEVELOPED**

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Testing products in cold conditions, for compliance to client's standards for example, requires both the management of cold rooms and expertise in the technical field.

- ➔ Existing testing Centres, specialized in vehicles or any other technology area, may find the Innovation Arena useful in odd test cases. They could lease some space as needed and bring expertise for the testing;
- ➔ In addition to office space and administration services, cold chambers for storage purpose and for small-scale research are needed as tools for SME incubation and commercialization. As well, these cold chambers may be used to store ice core samples from scientific expeditions.



**PARTNERSHIPS**

Innovation is a long chain of activities that begins with ideas by some individuals and ends with adoption in communities by a wide range of stakeholders. By pooling several interests, the Cold-Climate Innovation Cluster, and its Centre, would have the critical mass necessary to attract additional and continuous participation (both public and private) and create a climate favourable to self-sustainability.

While the Innovation Arena is being built, performers with existing capability are needed to build the momentum, deliver early ideas

and techniques and prepare for early use of the Yukon Cold-Climate Innovation Centre.

The following organizations are currently working together as partners in the feasibility study of the Yukon Cold-Climate Innovation Cluster, and have consulted other key stakeholder organizations:

- ➔ **Federal Government**
  - ➔ National Research Council
  - ➔ Indian and Northern Affairs
- ➔ **Yukon Government**
  - ➔ Economic Development; Highways and Public Works; Yukon Housing Corp; Yukon Energy Corp; Energy Mines and Resources;
  - ➔ Yukon College and the Northern Research Institute
- ➔ **Private Sector**
  - ➔ Yukon Industry
  - ➔ Yukon Chamber of Commerce
  - ➔ Whitehorse Chamber of Commerce
- ➔ **Others**
  - ➔ City of Whitehorse
  - ➔ dana Naye Ventures

**ENTREPRENEURIAL ACTIVITIES ARE THE FUEL THAT DRIVES CLUSTERS — GOVERNMENTS CANNOT INVENT BUT ONLY FOSTER**

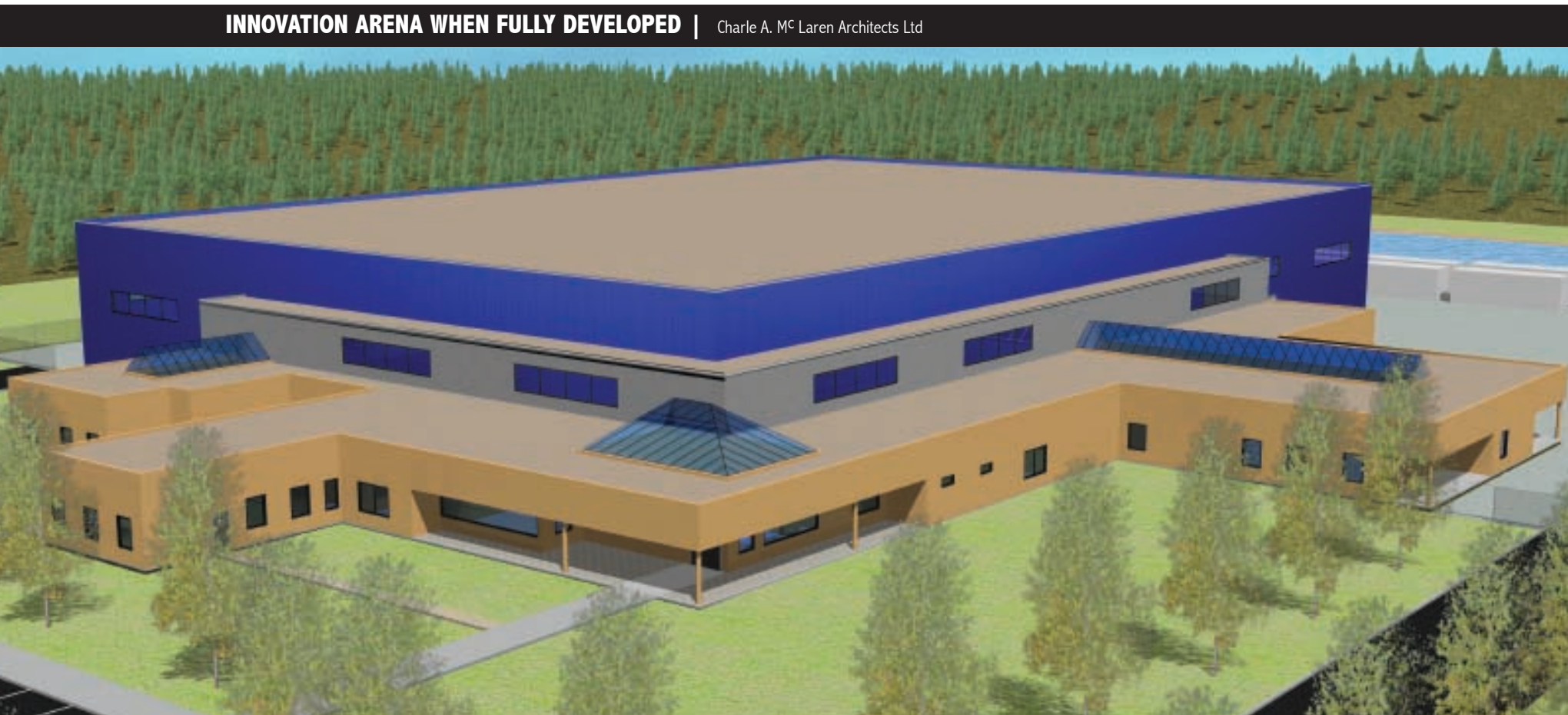
Successful clusters are fueled by innovation, adaptation, and entrepreneurship. While the success of firms depends on their ability to protect their own technological advances, they need to collaborate with other companies and research organizations to continually improve and innovate, maintain their competitive advantage and create spin-off enterprises.

Where it makes business sense and resources are available, governments may invest in and operate laboratories and services to help firms work together, innovate further and grow their business opportunities. The degree of investment depends on the current appetite by Yukon industry to innovate, embrace today's economic environment, and capitalize on identified opportunities. Significant investments are more justifiable when several firms are seriously involved at the beginning and committed to innovation.

Behind every successful cluster is a group of innovative firms led by individuals who value learning, are committed to their community, and are willing to work towards a collective vision for their industry. The key to fostering a cluster's growth rests with industry leaders. In the long term, a cluster is supported by profitable business ventures.

- ➔ Business opportunities and Industry involvement will determine the needed training, R&D and commercialization investments in Cold-Climate technologies.
- ➔ In the early days of a Yukon innovation cluster, industry, researchers and educational institutions would focus on immediate training, skills and research needs. These would grow with the business opportunities. 🔄

**INNOVATION ARENA WHEN FULLY DEVELOPED** | Charle A. Mc Laren Architects Ltd



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