



# Institut nordique du Québec

Together for the North

Synthesis — Scientific Program



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# Vision

The Institut nordique du Québec (INQ) vision is to develop a sustainable North through innovation and knowledge creation, and by integrating western science with local and traditional knowledge. In partnership with communities, government authorities and the private sector, INQ aims to help secure the well-being of all people in northern Quebec and the Canadian Arctic, now and in the future, by ensuring access to clean energy, conserving healthy ecosystems and the services they provide, building viable infrastructure, supporting economic prosperity and vibrant cultures, and strengthening northern education and healthcare systems.

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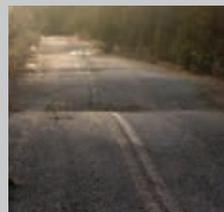
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# A Long Time in the Making

For nearly six years, hundreds of researchers and experts from all over have been meeting to establish the core components of Institut nordique du Québec (INQ). Before INQ was even founded in 2014, key northern researchers and stakeholders were defining the contours of a broad, inclusive northern research initiative that would meet the needs of both decision makers and local communities.

INQ's scientific program is responsive and will adapt to new members and the evolution of issues, society, and technology. The outcome of an exhaustive and inclusive consultation process, this research program makes full use of the solid northern expertise acquired over the years by various centres for excellence in partnership with inhabitants of the North and a number of private-sector and government researchers from Québec and elsewhere in Canada and the world.

The following is a review of the work and pivotal exchanges that marked this unprecedented synthesis of northern research in Québec.

## 2011-2012

Some 50 experts are recruited to discuss northern research issues. Four expert panels are created and led by co chairs, with professors from Université Laval, other universities, and external participants:

- Well-being and development of northern communities
- The economic potential of the North
- Transportation and telecommunications
- Environmental protection.

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## 2012

The findings from the expert panel discussions are outlined in a document: *Mobilizing for a Sustainable North: Research Issues and Priorities*.

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## June 17

The *Mobilized for a Sustainable North* symposium is held, bringing together 175 representatives from universities, the public and private sectors, northern communities, and First Nations.

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## 2013 October 17-18

Montmorency Forest retreat to discuss research platforms. The resulting document outlines 15 research platforms, grouped under six research priorities.

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**2014**  
**August**

Institut nordique du Québec (INQ) is founded as a far-reaching alliance between Université Laval, McGill University, and Institut national de la recherche scientifique, with the contributions of numerous partners, including northern communities, Indigenous communities, public and private sectors and university representatives.

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**Autumn**

An INQ implementation committee is created.

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**2015**  
**May 20**

200 people gather in Université Laval's Hydro-Québec auditorium (Desjardins pavilion) for the first symposium on INQ's research priorities.

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**November**

The Research Priorities Working Group is created and tasked with keeping INQ partners at the cutting edge of innovation, advancing knowledge creation, and applying it to the sustainable development of the North and the circumpolar world.

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**2016**  
**Spring**

Five workshops are held to define the content of the research priorities. In all, the work takes hundreds of hours and involves numerous meetings attended by nearly 150 researchers and organizational representatives.

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**October**

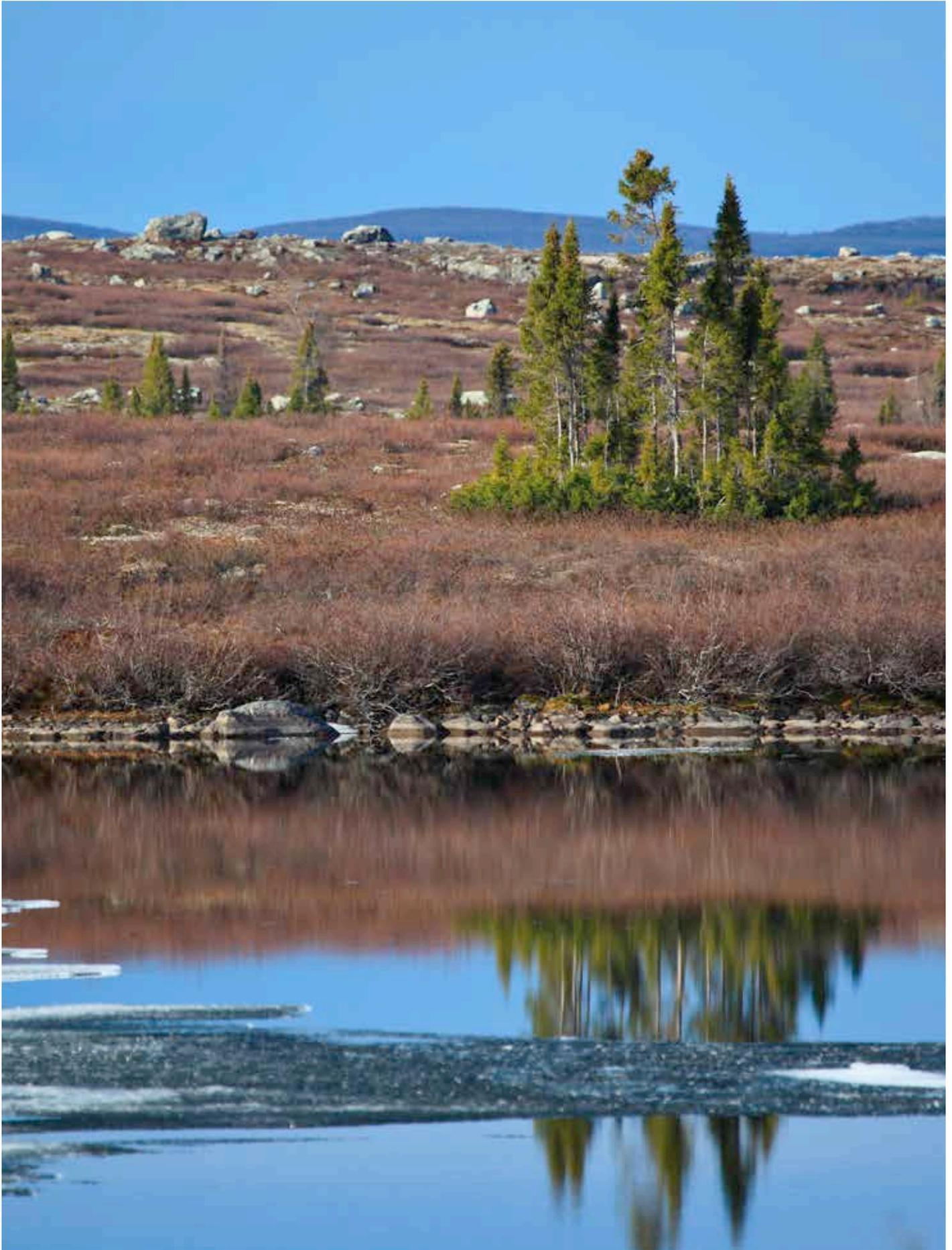
The process for defining INQ's research priorities is presented at the plenary session for Société du Plan Nord partners.

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**2017**  
**March 7-8**

Working with researchers and Indigenous representatives, the research needs of First Peoples are defined during the Forum on the Research Needs of First Peoples, held in the First Peoples Pavilion at the Val-d'Or campus of Université du Québec en Abitibi-Témiscamingue.

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# The Central Issues

Development and climate change pose major transectoral challenges in the North. Tackling the multiple facets of these issues requires significant cooperation and effective partnerships.

To facilitate this approach, INQ has developed a scientific program built around a series of key priorities and themes. Rather than creating silos, these priorities and themes are an effective vehicle for mobilizing and pooling a wide range of necessary expertise.

As the research community converges around shared issues raised by the imperatives of sustainable development, each research theme and priority benefits from a vital synergy. For example, mining development raises a number of interrelated challenges related to community well-being and employment, ecosystem protection, economic viability, energy supply, and transportation and communications. These challenges should not be tackled separately.

Most issues that have to do with development, the well-being of local populations, and ecosystem health are now related to global climate change, the repercussions of which are much more rapid and severe in the North.

## First Peoples' Interests and Aspirations

To ensure that research addresses their priorities, First Peoples want to play a major role identifying research needs. They want the researchers who work on northern issues to be more aware of realities, because research carried out in the North must respect First Peoples' values and ways.

They also want research priorities and initiatives to be reviewed on a regular basis so they can be adapted to changes within First Peoples communities. This will strengthen cooperation between partners and ensure research is rooted in the needs and realities of First Peoples communities.

At the Forum on the Research Needs of First Peoples, held in March 2017, First Peoples participants raised concerns about the geographic and political border created by the 49th parallel and what this issue represents for them in terms of inclusiveness. They asked researchers to take this particular issue into account. Participants at the Forum also discussed the Guidelines for Research in the North, established by INQ's First Peoples Working Group. Researchers are urged to familiarize themselves with these guidelines in order to create research projects that are consistent with First Peoples' interests and concerns.

# Promising Outcomes

INQ's research priorities will draw upon the pooled expertise of northern researchers to generate numerous innovative outcomes. The multiple research themes will allow for a better understanding of the effects of resource development on Québec's northern communities, both Indigenous and non-Indigenous. The research projects will highlight how winter and the northern environment have shaped Québec's culture and will draw attention to Indigenous and non-Indigenous cultural output, thereby helping the local communities and Québec to understand the value and importance of Indigenous culture.

The purpose of all the research priorities is to improve the living conditions of northern populations by developing strategies to keep their communities and environments strong and secure. In the context of climate change, research will establish northern development models that keep ecosystems healthy and promote the sustainable use of resources.

All of the research priorities established by INQ will prioritize social acceptability, community participation, and positive local outcomes by integrating development and knowledge mobilization strategies that benefit northern communities, as well as the global community.

# Research Priorities

# Priority 1



Photo : Keith Levesque / Arcticiel

## Societies and Culture

### Themes

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Development and territoriality

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Cultural heritage and representations

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Languages, identities, knowledge transmission, and education

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Physical and human living environments

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Law and governance

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### Description

Indigenous peoples are determined to have their rights recognized and protect their languages, cultures, and heritage. Given the interest in Arctic development and the possible opening of northern shipping routes, many communities and regions are looking for development models aligned with their needs and priorities.

The purpose of this priority is to improve our knowledge of social and cultural issues by studying the different models for northern development as well as the cultural works and heritage, identities, territoriality, knowledge transmission, living environments, economic and geopolitical interests, and local and international governance models of Northern Québec and the circumpolar Arctic.

## Development and Territoriality

### Issues

With the North facing a development boom for renewable and non-renewable resources, the purpose of this theme is to study the consequences of resource development projects and modes of land use and occupancy. Special attention will be paid to the economic, human, social, and cultural impacts of these development projects. Researchers, organizations, and Indigenous and non-Indigenous communities will be looking to identify the resource management and development models that will secure sustainable lifestyles for the communities.

### Objectives

- Consider the social, cultural, human, and economic consequences of renewable and non-renewable resource development projects
- Study modes of land use and occupancy
- Study and design new resource development and management models

### Outcomes

- Better understanding of the effects of resource development on the communities
- New models for sustainable resource development
- Revised land use planning and management that respects occupancy and use

## Cultural Heritage and Representation

### Issues

Much research remains to be done in the fields of Algonquin and Inuit archaeology, heritage, and cultural output in Québec. Little attention has been paid to northern Indigenous and non-Indigenous cultural heritage. Under this theme, researchers will look at Indigenous and non-Indigenous cultures, works, and heritage in Northern Québec, but also in Québec as a whole, as an integral part of the circumpolar world. The research will focus on the history and archeology of Northern Québec and will also study cultural representations of winter and northern life.

### Objectives

- Continue research in Algonquin and Inuit archaeology
- Find ways to recognize and promote Indigenous and non-Indigenous cultural heritage
- Compare cultural situations and works in Northern and Southern Québec, Québec as a whole, and the rest of the circumpolar world
- Analyze cultural representations of winter and northern life, including urban winter, in Québec and the circumpolar world

### Outcomes

- Recognition and promotion of the archaeological and cultural heritage of Northern Québec and Québec as a whole
- Recognition of the role of winter and the North in Québec culture
- Recognition and promotion of Indigenous and non-Indigenous cultural works

## Languages, Identities, Knowledge Transmission, and Education

### Issues

In Northern Québec, the oral tradition still provides an important sense of place, meaning, and identity, as well as a valuable window into the history of Indigenous peoples. Research carried out under this theme in partnership with Indigenous communities and organizations looks at Indigenous identities, traditions, orality, cosmologies, and contemporary cultural practices and expressions. Northern communities and researchers also study language and knowledge with a view to revitalizing Indigenous languages, including through translation. The focus is also on educational processes and key factors leading to academic success and a positive sense of culture and identity.

### Objectives

- Study Indigenous traditions, cosmologies, and identities
- Identify, recognize, and foster contemporary cultural practices and expressions
- Promote orality and knowledge transmission
- Translate and promote cultural products

### Expected Outcomes

- Adoption by the various nations of strategies to preserve, revitalize, and promote their languages and cultures
- Improvement in the transmission and promotion of knowledge and identification of potential solutions for improving academic success and training within Indigenous communities
- Promotion of contemporary Indigenous cultural practices and expressions

## Physical and Human Living Environments

### Issues

The economic and social conditions facing Indigenous populations often put them at a disadvantage in relation to the general population of Québec. The purpose of this theme is to document the living environments and conditions of northern Indigenous and non Indigenous communities. Researchers look at the built environment, socioeconomic conditions, and physical environment of these populations to provide a full socioeconomic account of northern Indigenous communities and to situate Northern Québec relative to other circumpolar communities.

### Objectives

- Study the socioeconomic conditions of Indigenous and non Indigenous communities
- Study physical and human living environments in the North

### Expected Outcomes

- Improved living conditions for these populations
- Development of strategies to ensure the long term viability of northern living environments and communities

## Governance and Law

### Issues

Northern Québec is one of the few northern regions with regional systems of government and territorial identities that are recognized at the administrative level. Internationally, Northern Québec is part of the circumpolar Arctic, which is experiencing profound transformations caused by climate change and the potential for economic development, including natural resource development and new sea routes. On a national level, researchers study the political and legal relationships between Indigenous groups and the various levels of government. Topics addressed include governance, human—especially territorial—rights, political transformation, and the mobilization of Indigenous communities and political organizations. Researchers also take an interest in Indigenous legal traditions and their interactions with state law, as well as modes of regional cooperation between Indigenous and non Indigenous communities. At the international level, research focuses on economic, political, and legal transformations involving state and non state actors in the Arctic and beyond.

### Objectives

- Take into account the pluralism of legal orders and traditions
- Study and document whether human rights (individual and collective) are being upheld
- Study and document Arctic geopolitics and geoeconomics as well as the evolution of legal frameworks
- Study Arctic governance (economic development, resources, environmental protection) and the changing Indigenous political landscape

### Expected Outcomes

- Guidelines and tools to help political and economic actors make decisions when negotiating with other actors
- Valuable analyses of local, regional, and international governance

## First Peoples' research interests and aspirations for this priority

The dissemination of information about current or future research projects is critical for First Peoples, as is access to relevant research results written in plain language. First Peoples want their knowledge to be recognized and valued in the same way as scientific knowledge. They favour action-based research on their stated needs (e.g., innovations to improve sub-standard housing in many communities) and not just on the needs identified by researchers. First Peoples want to continue participating in scientific committees and, as much as possible, to serve as co-researchers and co-directors in research that involves them. They also advocate a multidisciplinary approach. To help them play a more effective role in research activities, they encourage the promotion of research and the job opportunities it creates for youth.

# Priority 2



Photo: Alexandre Forest / ArcticNet

## Health

**Research expertise within the Health Priority cover three large areas:**

1. Health issues
2. Factors shaping health
3. Healing, and health and social services

### Issues

Northern Indigenous populations experience a disproportionately high burden of infectious and non-communicable diseases, e.g. cardiovascular diseases and risk factors, and mental health issues, leading to considerable health inequities with non-Indigenous Canadians. Health and illness are not solely a function of individuals' biological and genetic constitution or behavioural risk factors. Poorer social and environmental living conditions are among the fundamental causes leading to ill health and health inequities. Such health inequities are influenced by the unequal distribution of health determinants at different levels and throughout the life course, including childhood development, cultural continuity, living conditions at home and in the community, health systems, racism and social exclusion, and self-determination, as well as broader environmental conditions such as ecosystem contamination and climate change. In addition to etiological research aimed at improving our understanding of health outcomes and their risk factors, intervention research, both clinical and population-based, is needed to identify potential solutions and best practices to improve the health of northern populations and reduce inequities. In addition to research focusing on illness and diseases, research should also pay attention to resilience, adaptation, and positive aspects of health.

## Objectives

Scholars involved in the INQ Health Priority recognize the importance of conducting research that is relevant to the North, in accordance with priorities that are defined by the North, and using a partnership approach. Under this approach, northern populations and researchers collaborate, to the best of their ability on all aspects of research (from formulating research objectives to disseminating results).

Communities evolve and health research priorities must adapt to these changes. With this in mind, health research themes and goals are flexible and will be periodically revised to reflect health issues and determinants and the care systems in place. This will strengthen collaboration between partners, ensure that research is locally and regionally relevant, and involve communities in the quest for solutions. In general, research conducted under the Health priority aims to:

- Undertake rigorous, high-quality fundamental, clinical, population, and intervention research, the objectives of which are defined in collaboration with northern populations, to ensure that research being conducted is relevant to them and contributes to the advancement of scientific knowledge
- Integrate western and Indigenous knowledge and methods
- Define health holistically and in harmony with Indigenous concepts to include physical, mental, emotional and spiritual dimensions, as well as the factors shaping health at the individual, household, community, environmental, and global levels throughout the life course
- Foster a positive approach to health, where health, well-being and resilience are considered in addition to ill health and disease
- Undertake research projects guided by values such as trust, respect, transparency, honesty, open-mindedness, inclusiveness, engagement, and communication

## Outcomes

- Recognize and value the leadership and self-determination of northern Indigenous peoples, organizations and governments in setting research priorities for their regions.
- Provide an interdisciplinary and cross-sectoral research environment based on respect between academic researchers and northern populations, i.e., an environment in which research is decolonized
- Train a new generation of Indigenous health practitioners and researchers
- Promote and improve health and well-being, and reduce health inequities

## First Peoples' research interests and aspirations for this priority

First Peoples advocate interdisciplinary research that integrates social and ecological approaches. An interdisciplinary approach allows for a fuller understanding of the underlying causes of health problems, their intergenerational effects, and resulting health inequalities (e.g., through the study of government policies and programs). First Peoples want to better understand how poverty and the cost of living affect health (e.g., through research on obesity and diabetes) and health-related behaviours (e.g., drug use). They also want research to target mental health by focusing on substance abuse, life trajectories, and resilience. In addition, they want to promote culturally appropriate health care and make such care available in their communities. First Peoples would like indigenous medical practices (such as midwifery practices and ceremonies) to be documented. Moreover, they want to better understand how climate change, mining activity, and environmental contaminants affect health.

# Priority 3



## Ecosystem Functioning and Environmental Protection

### Themes

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**Northern terrestrial and freshwater environments**

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**Investigation, monitoring, and management of coastal zones and ice-bound seas**

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### Description

Marine, terrestrial, and freshwater ecosystems play an essential role in the food security and well-being of northern residents by producing an abundant supply of healthy food. Thus there is a real need to evaluate the consequences of the many stresses exerted on these ecosystems, including land and resource use and rapid climate change.

Organized around marine and terrestrial themes, this research priority focuses on issues related to global warming, thaw, freshwater, food security, and the greenhouse effect, with an emphasis on coastal environments, which are home to most inhabitants of the North. This priority will promote the protection of biodiversity and ecosystem services, inform resource management, and contribute to the implementation of innovative measures for mitigation and adaptation.

# Northern Terrestrial and Freshwater Environments

## Issues

The changes caused by the combined effects of accelerated socioeconomic development, strong population growth, and global warming are more significant in the High North. The purpose of this theme is to gain a better understanding of four crucial aspects of terrestrial environments: past changes and the present state of northern geosystems and ecosystems; the benefits of these systems to society; natural and anthropogenic changes affecting these benefits; and environmental and human infrastructure management strategies for mitigating and attenuating these changes and adapting to them.

## Objectives

- Study the temporal and spatial evolution of northern landscapes and biological communities and the factors responsible for their transformation to gain a better understanding of the current state of the environment and better predict changes, particularly in response to climate change
- Incorporate physical, chemical, and biological processes and their interactions, as well as the interconnections between terrestrial systems in order to better understand and model the state of northern environments and their capacity to perform geosystem and ecosystem services
- Evaluate the resilience and vulnerability of northern geosystems and ecosystems in the face of the cumulative effects of disturbances (fire, insects, natural hazards), global changes, and land use
- Develop new management strategies, methods (remote sensing, automated in situ measures, modeling) and approaches to improve long term monitoring of the northern human-environment system, restore disturbed environments, and adaptively manage resources, taking past, present, and future conditions into account

## Expected Outcomes

- Development of strategies for conservation, land-use planning (defining protected areas to maximize biodiversity conservation) and resource management (water supply, healthy caribou populations) based on assessment of multiple scenarios
- New infrastructure development plans (mines, roads, airports) to adapt infrastructure and make it more durable and resilient in the face of new disturbance regimes arising from climate change
- Paradigm shift in approaches to land use in permafrost zones, construction management, and municipal service management, with an approach that recognizes the uncertainties, complexities, feedback loops, and interactions related to the evolving state of the northern environment
- Refinements in observations and models to better predict environmental change (physical properties of snow and climate models, carbon flux and storage, lake and river ice cover for safe transportation of people, rainfall and evaporation, ice jam formation and flood risk)

# Investigation, Monitoring, and Management of Coastal Zones and Ice-Bound Seas

## Issues

Thawing pack ice and rising temperatures in the seas surrounding northern Québec are affecting marine ecosystems and their productivity, causing local and global climate change, opening up new sea routes, facilitating mineral resource development, and affecting the well-being of Québec's northern communities. This theme focuses on the migration of fish species, the impact of new sea routes, and increased shipping of ore and fossil fuels, maritime security vs. economic development, and the protection of iconic marine mammals as well as the coastal marine ecosystems. To study these developments, scientists will monitor the

rapid evolution of northern seas and the services they provide, and Québec's research capacities will be pooled and modernized (oceanography, marine geophysics, and meteorology/climatology) and adapted to conditions in the North.

### Objectives

- Measure and model the consequences of global warming, ice thaw, ocean acidification, and continental inputs for marine ecosystems (biodiversity, productivity, greenhouse gas storage), the well-being of northern residents, and coastal economic development
- In anticipation of the new sea routes and increased vessel traffic, map the ocean floor (bathymetry and geology) and marine habitats and enhance operational oceanography capabilities to maximize security and ecosystem preservation
- Support the development and management of sustainable commercial and subsistence fisheries and devise measures to adapt to changes in the abundance and quality of marine food

- Assess how changes in Arctic marine environments are impacting the oceanic and terrestrial climate at the regional level

### Expected Outcomes

- Knowledge of the current state and probable future of seas with seasonal ice cover to inform decisions, development, and adaptation
- Scientific and ecological monitoring of oil and mining development, navigation, and tourism in northern seas
- Creation of a technology cluster specializing in northern oceanography
- Optimization of the scientific output of the *RV Amundsen*

## First Peoples' research interests and aspirations for this priority

First Peoples stress the importance of creating joint and complementary research groups (with scientists and First Peoples participants). These research groups must adapt their work to the northern environment rather than reproduce research models from the South. Results should be widely and fully disseminated. First Peoples are concerned about how climate change and northern development are affecting their traditional activities, such as fishing and subsistence hunting. They therefore advocate research on the impacts of mining on fishing and aquatic resources; water contamination and its impact on humans and animals; groundwater protection; caribou protection and the impact of muskox introduction on caribou populations; land-use planning and First Peoples fishing and hunting know-how; and the effects of climate change on the health of coastal marine habitats and on the availability and quality of marine foods. First Peoples point out that animals do not observe borders and that the 49th parallel should not be used as a dividing line for research and research funding.

# Priority 4



Photo: Guy Doré

## Infrastructure and Technology

### Themes

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Building sustainable infrastructure

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Information technology

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Environmental technology

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### Description

Developing Québec's North will require new technologies and infrastructure adapted to a harsh environment characterized by a cold climate, isolated populations, and thawing permafrost. New infrastructure (buildings and transportation) must be designed to withstand the impacts of climate change while meeting the needs expressed by Indigenous populations. Advances in communication technologies will be used to facilitate information sharing and improve public and environmental safety. As the North develops, the health of human populations and northern ecosystems will need to be protected. It will be essential to develop and install effective technologies to protect water supplies, restore disturbed sites, manage and reclaim waste, and protect air quality.

## Building sustainable infrastructure

### Issues

In-depth knowledge of the physical environment, available resources, and logistical challenges of infrastructure construction and operation is a prerequisite for any type of development in the North. Transport infrastructure planning and community planning are essential conditions for the sustainable development of northern environments. Geotechnical investigations, as well as design, construction, and management, must all be adapted to northern realities. Plans for dismantling, recycling, and repurposing built structures, restoring sites, and delivering optimal energy efficiency must be determined in advance. These operations require knowledge of the fundamental behaviours and interactions of northern elements and systems, as well as an ability to assess environmental risk and impact in the context of climate change and more frequent extreme weather events. The focus of this theme is transport infrastructure (roads and bridges, airports, railways, energy transport, and communications), resource infrastructure (dams, water and electrical resources, mineral resources) and community infrastructure (public and residential buildings and safety infrastructure).

### Objectives

- Facilitate the design and construction of appropriate, sustainable, reliable, and safe infrastructure for the social and economic development of communities and industry in the North
- Improve knowledge of the physical environment and its interaction with transport and community infrastructures
- Improve existing tools and methods and develop new ones to ensure the sustainable development of infrastructure in northern environments
- Ensure expertise and skills are developed in the communities and knowledge is shared

### Expected Outcomes

- Improvements in quality of life for northern populations and workers through improvements to the quality of transportation and community infrastructure
- Improvements in infrastructure reliability that improve service delivery, the safety of local populations, and the productivity of resource development operations
- Improved social and economic conditions for northern populations
- Development of local skills and expertise

## Information Technology

### Issues

Recent advances in telecommunications and information technology, including telepresence, telemedicine, telecommuting, and distance education, have a central role to play in the development of Northern Québec. To this end, certain technologies will need to be developed for or adapted to the extreme conditions in the North. The purpose of this theme is to create immersive and collective virtual (or augmented) reality environments for small, remote populations, develop robotic applications for use in scientific and mining facilities, and establish a robust, reliable and fully redundant high-speed telecommunications network in the Far North. The research will focus on the viability, durability, and effectiveness of optical, wireless, and satellite solutions for communication needs; on telecommunications components for extreme-weather installations; and the development of materials and components for IT systems adapted to northern climates. There will be an emphasis on designing technological solutions for mining facilities as well as technologies that allow groups in different locations to share a single virtual environment that supports dynamic cooperation and realistic interactions. Operation of monitoring networks and development of smart systems for the North will also be explored under this theme.

### **Objective**

- Design or adapt telecommunication tools and information technology for isolated and remote communities

### **Expected Outcomes**

- Greater community security
- More education options
- Improved social and economic conditions for northern populations thanks to telework infrastructure
- Implementation of the technology required for remote medical consultations

### **Expected Outcomes**

- Reduced incidence of waterborne disease in northern communities
- Decrease in waste production through increased recycling
- Development of alternative energy sources through biomass and waste conversion
- Increased reuse of resources to foster the circular economy

## **Environmental Technology**

### **Issues**

This theme revolves around the development of effective and robust techniques for the safe treatment and distribution of drinking water to northern populations. Wastewater disposal and treatment will be studied, as will the methods for decontaminating sites polluted by human activities. As material resources are often hard to come by in northern regions, it will be essential to develop tools that enable northern communities to optimize waste and biomass recycling and conversion. The issue of technology choice in northern environments will be examined, as will the need to train and educate the local communities.

### **Objectives**

- Design or adapt technological treatment, purification, decontamination, and management tools to support development in the North and protect northern populations and ecosystems
- Develop wastewater treatments systems and technologies for restoring contaminated sites
- Develop conversion processes for biomass, waste, and residual materials
- Develop effective processes for treating industrial effluent and restoring mining sites

## First Peoples' research interests and aspirations for this priority

First Peoples want better use to be made of existing and future research centres. They also want community facilities to be considered as potential research sites. First Peoples are very concerned about waste management, especially equipment brought in from the South and abandoned on site by companies after they ceased operations, and the effects of this practice on the health of residents and the territory. They also want to reduce their ecological footprint by launching environmental initiatives (such as building environmentally friendly homes, safely harvesting rainwater, creating community gardens, and composting). They also argue that groundwater research is essential to better understand this resource and put effective protection measures in place. Difficulties in accessing technology and the fiber optical network are additional concerns, as they make certain job-creation initiatives problematic or even impossible. First Peoples encourage the promotion of available jobs and the distribution of information about educational opportunities for First Peoples youth, to train the next generation of workers from the North.

# Priority 5



Photo: En haut à gauche: Martin Fortier / ArcivoNet / en bas à gauche: Goldcorp inc.

## Natural Resources

### Themes

Forest planning and management

Responsible mineral development

Energy

### Description

Natural resources and energy are the economic drivers of northern development. Northern Québec has some 200,000 sq. km of high quality forest resources with the potential to foster creation of value-added products and the emergence of whole new fields, such as northern agroforestry. Northern mineral resources include strategic minerals used in technology, which could prove more resilient to the vagaries of the global economy. The region also boasts considerable energy potential representing three quarters of Québec's total hydroelectric production. In addition, the North has significant wind energy potential, as well as considerable solar energy potential during the summer. But the environment is extremely vulnerable to climate change and the impact of human activities. Land access, characterization of the environment, optimization and integration of exploitation systems, environmental issues, community involvement, and local benefits are other topics dealt with under this priority.

# Forest Planning and Management

## Issues

Québec's northern forests span over 200,000 sq. km and account for nearly 40% of the total volume of wood harvested in Québec. These forests generate employment and deliver a multitude of wildlife, cultural, ecological, recreational, and tourism services that are central to the development of northern communities. They must be managed in a way that optimizes the value chain, environmental sustainability, and social acceptability of the forestry regime. Northern forests will help in the fight against climate change by maintaining biological diversity, capturing excess carbon and sequestering it in bio based materials and products, and providing a substitute for products made from non renewable resources. In the interests of an ecosystem-based management approach that takes into consideration the needs of multiple users, northern forestry requires a comprehensive approach that leaves room for other activities such as mining and energy production. Northern development and northern forestry must take ecosystem health into account in a context of resource management and climate change.

## Objectives

- Keep ecosystems healthy in a context of resource management and climate change
- Make optimal use of the resource (wood and other)
- Foster the participation of Indigenous and non Indigenous communities
- Develop and upgrade knowledge and skills in a context of climate change

## Expected Outcomes

- Improved knowledge relating to the development of Northern Québec
- Stimulation of northern community development through capacity building and local spinoffs

- Training of personnel specialized in northern issues
- Efforts to develop new methods, products, and markets to sustain active industries in the North
- Development of new partnerships

# Responsible Mineral Development

## Issues

Mineral resources are one of the main sources of economic development in Northern Québec. Most of the land has been summarily mapped at large scale, except in areas where minerals are being extracted. This vast territory has the potential to greatly increase and diversify Québec's mineral production. Precise data on the geological characteristics of the bedrock and continental shelf is needed to improve land-use planning based on scientific knowledge. Mineral resources must be developed in harmony with local communities and according to best practices, which must be adapted to the conditions and realities of Northern Québec. More specifically, special efforts must be made to reduce the ecological footprint of mining operations and the environmental risk associated with mine tailing storage. In addition to improving geological knowledge of the North, it is essential to improve the energy efficiency of mining operations, optimize extraction and planning, and find innovative ways to recycle and reuse waste materials.

## Objectives

- Acquire geological, geochemical, geophysical, and hydrological knowledge
- Document conditions to establish an environmental baseline
- Create tools for predicting site potential and contamination as well as for mining optimization and strategic planning
- Develop processes for restoration, re naturalization, long-term monitoring, and energy efficiency

### **Expected Outcomes**

- Acquisition of scientific knowledge serving as a basis for decisions about land use and mineral resource potential
- Development of methods designed to optimize resource development along the entire value chain
- Development of methods for storing mine tailings that reduce the long-term ecological impact and environmental risks
- Training of highly qualified personnel specialized in the geology of Northern Québec and methods for optimizing mineral extraction and mine tailing storage in a northern context

### **Expected Outcomes**

- Significant economic benefits due largely to favourable market conditions for mineral and forest resources
- Major scientific and technological innovations driven by ambitious, multidisciplinary objectives

## **Energy**

### **Issues**

Access to energy and the efficient, sustainable use of energy are central to the coherent, integrated, sustainable development of the Canadian North. Even if 75% of Québec's hydroelectric capacity is concentrated within the Plan Nord region, access to sustainable energy is limited north of James Bay. Most energy used in the North comes from fossil fuels. The only exceptions have been a few experimental projects and demonstrations. New, low impact energy sources must be identified and the whole energy supply chain optimized, from construction and production to transportation, distribution, and end use.

### **Objectives**

- Provide an overview of the environment and its evolution over time
- Evaluate the changing needs of occupants
- Study new energy systems
- Aim for social acceptability, involvement by local communities, and benefits to those same communities

## First Peoples' research interests and aspirations for this priority

First Peoples are very concerned about the overexploitation of the northern resources and the consequences for medicinal plants, water, and forests. They support development as long as it is based on the sustainable use of resources and is carried out with the intention of protecting rather than exploiting the territory (e.g., by creating protected areas). First Peoples also recommend that companies that develop natural resources should be responsible for instigating environmental impact studies. Moreover, they suggest that the definition of “North” be reviewed in the context of natural resource development on First Peoples land. First Peoples advocate a collaborative approach to research, in which researchers and First Peoples entities build equally on empirical knowledge and First Peoples knowledge. To this end, it is suggested that First Peoples should be represented at universities and in research groups that study the dynamics of the North.

# Appendices

## Priority 1 / Societies and cultures

**Project leads:**  
Caroline Desbiens and  
Thierry Rodon

### Participants at the working session :

**Ellen Avard**  
Geography  
The Nunavik Research Centre

**Kristin Bartenstein**  
Law  
Université Laval

**Myriam Blais**  
Architecture  
Université Laval

**Hélène Boivin**  
First Nation of Pekuakamiulnuatsh  
rights and comprehensive  
land negotiation  
Mashteuiatsh

**Marie-Pierre Bousquet**  
Anthropology  
Université de Montréal

**Daniel Chartier**  
Cultural studies  
Université du Québec à Montréal  
(UQAM)

**Christian Cocoo**  
Culture and Heritage  
Council of the Atikamekw Nation

**Caroline Desbiens**  
Geography  
Université Laval

**Patrick Evans**  
Architecture  
UQAM

**Valérie Fauteux**  
Naskapie Nation

**Serge Ashini Goupil**  
Tourism  
Uashat Mak Mani-Utenam

**Francis Lévesque**  
Anthropology  
Université du Québec en  
Abitibi-Témiscamingue

**Carole Lévesque**  
Anthropology  
Institut national de recherche  
scientifique (INRS)

**Suzanne Manningham**  
Education  
Université Laval

**Geneviève Motard**  
Law  
Université Laval

**Sylvie Poirier**  
Anthropology  
Université Laval

**Thierry Rodon**  
Political Science  
Université Laval

**Colin Scott**  
Anthropology  
McGill University

**Jean-Claude Therrien-Pinette**  
Uashat Mak Mani-Utenam

**Geneviève Vachon**  
Architecture  
Université Laval

**James Woollett**  
Archeology  
Université Laval

### Participating Research Centres, or Centres likely to participate

Centre de recherche  
interuniversitaire sur la littérature  
et la culture québécoise (CRILCQ)

Chaire de recherche sur l'imaginaire  
du Nord, de l'hiver et de l'Arctique  
Université du Québec à Montréal  
(UQAM)

Canada Research Chair on  
Comparative Aboriginal Condition  
Université Laval

Research Chair on Environmental  
Law  
Université Laval

Centre interuniversitaire d'études et  
de recherches autochtones (CIÉRA)

Centre de recherche et d'intervention  
sur la réussite scolaire (CRIRES)

Northern Sustainable Development  
Research Chair  
Université Laval

Conseil québécois d'études  
géopolitiques (CQEG)

Réseau DIALOG

Groupe de recherche Habitats et  
cultures de l'École d'architecture  
Université Laval

Laboratoire d'archéologie  
Université Laval

International Laboratory for the  
Comparative Multidisciplinary Study  
of Representations of the North  
UQAM

### Collaborators

**Kristin Bartenstein**  
Law  
Université Laval

**Myriam Blais**  
Architecture  
Université Laval

**Jean-Michel Beaudoin**  
Wood and forest sciences  
Université Laval

**Caroline Desbiens**  
Geography  
Université Laval

**Daniel Chartier**  
Cultural studies  
UQAM

**Paule Halley**  
Law  
Université Laval

**Patrick Evans**  
Architecture  
UQAM

**Michelle Daveluy**  
Anthropology  
Université Laval

**Suzanne Manningham**  
Education  
Université Laval

**Geneviève Motard**  
Law  
Université Laval

**Frédéric Lasserre**  
Geography  
Université Laval

**Sylvie Poirier**  
Anthropology  
Université Laval

**Thierry Rodon**  
Political Science  
Université Laval

**Geneviève Vachon**  
Architecture  
Université Laval

## Anticipated partners

Kativik Regional Government

Assemblée des Premières Nations du Québec et du Labrador (APNQL)

Bibliothèque et Archives nationales du Québec (BANQ)

Centre for Indigenous Conservation and Development Alternatives (CICADA)  
Université Laval

Commission de toponymie –  
Gouvernement du Québec

Conseil de la Nation Atikamekw  
Nehirowisiw

Corporation Archéo-08

Cree Cultural Institute

Cree Nation Government

Groupe d'études en droits et libertés (GEDEL)  
Université Laval

Groupe de recherche sur les sociétés plurinationales (GRSP)  
Université du Québec à Montréal

Avataq Cultural Institute

Institut Tshakapesh

Musée amérindien de Mashteuiatsh

Kativik Municipal Housing Bureau (KMHB)

Première Nation des PekuakamiInuatsh

Société d'habitation du Québec (SHQ)

Société du Plan Nord

Makivik Corporation

Saturviit Inuit Women's Association of Nunavik

Tourisme Autochtone Québec (TAQ)

## Major projects in progress identified by participants

« Habiter le Nord québécois »  
– in partnership with Conseil de recherches en sciences humaines (CRSH)

MinErAL Network –  
in partnership with CRSH

Tshipiminu – in partnership with CRSH

## Priority 2 / Health

**Project leads :**  
**Mylène Riva (with Murray Humphries), Mélanie Lemire (with Gina Muckle and Pierre Ayotte)**

### Participants at the working session :

**Pierre Ayotte**  
Social and preventive Health Care  
Université Laval

**Faiz Ahmad Khan**  
Respiratory epidemiology  
McGill University

**Kendra Tonkin (pour Neil Andersson\*)**  
Family medicine  
McGill University

**Janice Bailey**  
Animal sciences  
Université Laval

**Paul Brassard**  
Clinical epidemiology  
McGill University Health Centre

**Kaberi Dasgupta**  
Diabetes  
The Research Institute of the McGill University Health Centre

**James Ford\***  
Geography  
McGill University

**Christopher Fletcher**  
Anthropology  
Université Laval

**Murray Humphries**  
Food  
McGill University

**Monique Lacroix**  
Nutrition  
Institut national de recherche scientifique (INRS)-Institut Armand-Frappier

**Mélanie Lemire**  
Social and preventive medicine  
Centre de recherche du CHU de Québec – Université Laval

**Michel Lucas**  
Social and preventive medicine  
Centre de recherche du CHU de Québec – Université Laval

**Mary Ellen Macdonald**  
Dentistry  
McGill University

**Gina Muckle**  
Psychology  
Centre de recherche du CHU de Québec – Université Laval

**Mylène Riva**  
Geography  
McGill University

**Frédéric Veyrier\***  
Genomic bacteriology and evolution  
INRS-Institut Armand-Frappier

**Grant Vandenberg**  
Integrated aquaculture and aquaponics  
Université Laval

**Hope Weiler**  
Dietetics and human nutrition  
McGill University

**Cédric Yansouni\***  
Infectious Diseases  
McGill University Health Centre

## Participating Research Centres, or Centres likely to participate

Anishinabe Kekendazone Network  
Environment for Aboriginal Health Research

Cape Breton University

Centre for Indigenous Peoples' Nutrition and Environment (CINE)

Centre for Outcomes Research and Evaluation (CORE)

McGill International Tuberculosis Centre

Centre de recherche du CHU de Québec – Université Laval

Quebec Centre for Biodiversity Science

Research Center of the Sainte-Justine University Hospital

Centre de recherche interdisciplinaire sur la biologie, la santé, la société et l'environnement (CINBIOSE)

Centre intégré universitaire de santé et de services sociaux (CIUSSS)

Centre interuniversitaire d'études et de recherches autochtones (CIÉRA)

Participatory Research at McGill (PRAM)

Nasivvik Research Chair in Ecosystem Approaches to Northern Health  
Université Laval

Division of Social and Transcultural Psychiatry  
McGill University

École des hautes études en santé publique, Rennes, France

Faculté de médecine vétérinaire  
Université de Montréal

INRS-Institut Armand-Frappier

Canadian Institute for Energy Training (CIET)

\* : distance participation

Institut Louis-Malardé, Polynésie française

Public health expertise and reference centre  
University of Southern Denmark

Institut national des langues et civilisations orientales de l'Université Sorbonne, France

Montréal Botanical Garden

Laboratoire de Chimie Analytique Bio-Inorganique et Environnement (LCABIE) de Université de Pau et des pays de l'Adour

Laboratoire de recherche sur les enjeux relatifs aux femmes autochtones  
UQAT

Nasivvik Centre for Inuit Health and Changing Environments

Québec-Océan

Réseau DIALOG

Takuvik

University of British Columbia

University of Winnipeg

Trent University

Unité d'épidémiologie respiratoire et de recherche clinique (RECRU) de l'Institut thoracique de Montréal

Aarhus University, Denmark

The Arctic University of Norway, (UIT)

Université de Moncton

University of Pretoria, South Africa

University of Ottawa

University of California — Davis

University of Guelph

University of Hawaii at Mānoa

University of Manitoba

University of Toronto

University of Northern British Columbia

University of the Sunshine Coast, Australie

University of Victoria

University of Waterloo

Washington State University, USA

Wayne State University, Detroit, USA

York University

### Anticipated partners

Kativik Regional Government

Indigenous and Northern Affairs Canada

Arctic Monitoring and Assessment Programme (AMAP)

Assembly of First Nations Quebec-Labrador (AFNQL)

BD Bioscience Canada

bioMérieux Canada inc.

Biopterre de l'Institut de technologie agro-alimentaire du Campus de La Pocatière

Native Friendship Centre of Montreal

The Nunavik Research Centre

Centre de recherche en organogénèse expérimentale de l'Université Laval /LOEX

Centres Nationaux de Recherche Technologique (CNRT) de l'Université de la Nouvelle-Calédonie

National Aboriginal Circle Against Family Violence

Nunavik Nutrition and Health Committee  
Nunavik Regional Board of Health and Social Services

First Nations of Quebec and Labrador Health and Social Services Commission

Kativik School Board

Community Wellness Worker Program, Nunavik

Inuit Circumpolar Council Canada (ICC)

Cree Board of Health and Social Services of James Bay

Conseil de gestion des ressources fauniques de la région marine du Nunavik

Environmental Protection Agency (EPA), Irlande

Nunatsiavut Government

Government of Nunavut - Department of Health

Micronutrient Initiative

Aurora Research Institute

Nunavut Research Institute

Public health expertise and reference centre of Québec (INSPQ)

Norwegian Institute for Air Research.

Institut Pasteur

Canadian Institutes of Health Research (CIHR)

Inuit Tapiriit Kanatami (ITK)

La Fondation Rotary

Nunavik mayors and councilors

Merinov

Ministère de l'Agriculture, des Pêcheries et de l'Alimentation (MAPAQ)  
Gouvernement du Québec

Ministère de la Santé  
Gouvernement du Nunavut

National Geographic

National Institute of Environmental Health and Sciences (NIEHS)

Nunavut Tunngavik inc.

Kativik Municipal Housing Bureau (KMHB)

Food and Agriculture Organization of the United Nations (FAO)

World Health Organization (WHO)

Pauktuutit Inuit Women's Association

Kahnawake Schools Diabetes Prevention Project

Health Canada

Makivik Corporation

Nunavut Housing Corporation

St. George 's University (SGU), Grenada

Tlicho Community Services Agency

University of Southern Denmark

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## Priority 3 / Ecosystem functioning and environmental protection

**Project leads :**  
**Warwick Vincent and Jean-Éric Tremblay**

**Participants at the working sessions :**

### Earth Environment and Freshwater

**Michel Allard**  
Permafrost  
Université Laval

**Dermot Antoniades**  
(videoconference)  
Paleolimnology  
Université Laval

**Dominique Arseneault**  
Forest fires  
Université du Québec à Rimouski (UQAR)

**Christine Barnard**  
Coordination  
Université Laval

**Monique Bernier**

Remote sensing  
Institut national de la recherche  
scientifique – Centre Eau Terre  
Environnement (INRS-ETE)

**Dominique Berteaux**

Arctic wildlife  
UQAR

**Joël Bêty**

Arctic wildlife  
UQAR

**Najat Bhiri**

Geomorphology/geoarcheology  
Université Laval

**Claire Boismenu  
(pour Line Rochefort)**

Bogs  
Université Laval

**Michael Bonin**

Wildlife  
Université Laval

**Stéphane Boudreau**

Vegetation  
Université Laval

**Karem Chokmani**

Snow/remote sensing  
INRS-ETE

**Steeve Côté**

Wildlife  
Université Laval

**Alexandre Culley**

Aquatic virology  
Université Laval

**Florent Dominé**

Snow  
Université Laval

**Daniel Fortier**

Permafrost  
Université de Montréal

**Samuel Gagnon**

Permafrost  
Université Laval

**Gilles Gauthier**

Arctic wildlife  
Université Laval

**Alexandre Langlois**

Snow/remote sensing  
Université de Sherbrooke

**Isabelle Laurin**

Limnology  
INRS-ETE

**Martin Lavoie**

Dendroecology and paleoecology  
Université Laval

**Nicolas Lecomte**

Arctic wildlife  
UQAR

**Pierre Legagneux**

Arctic wildlife  
UQAR

**Jean-Philippe Lessard**

Entomology  
Université Concordia

**Esther Levesque**

Vegetation  
Université du Québec à Trois-Rivières  
(UQTR)

**Marie-José Naud**

Coordination  
UQAR

**Josée-Anne Otis**

Arctic wildlife  
UQAR, University of New Brunswick

**Reinhard Pienitz**

Paleolimnology  
Université Laval

**Milla Rautio**

Limnology  
Université du Québec à Chicoutimi

**Pascale Ropars**

Arctic wildlife  
UQAR

**Alain Royer**

(videoconference)  
Snow/remote sensing  
Université de Sherbrooke

**Jean-Pierre Tremblay**

Arctic wildlife  
Université Laval

**François Vézina**

Arctic wildlife  
UQTR

**Warwick Vincent**

Limnology  
Université Laval

**James Woollett**

History/archeology  
Université Laval

**Coastal Areas And  
frozen seas****Alain Bourque**

Climatology  
Ouranos

**Marianne Falardeau**

Ecosystem services  
Université McGill

**Michel Gosselin**

Primary production/oceanography  
UQAR, ISMER, Québec-Océan

**Yves Gratton**

Ocean circulation/ice pack  
INRS-ETE

**Mike Hammill**

Marine mammals  
Pêches et Océans Canada,  
Institut Maurice-Lamontagne (IML)

**Patrick Lajeunesse**

Geography/bathymetry  
Université Laval, Québec-Océan,  
Takuviik, ArcticNet

**Daniele Luigi Pinti**

Scientific Director, Isotope  
Geochemistry  
Géotop

**Frédéric Maps**

Digital modeling/zooplankton  
Université Laval, Québec-Océan,  
Takuviik, ArcticNet

**Brigitte Robineau**

Executive Director, Québec-Océan  
Québec-Océan, Université Laval

**Jean-Éric Tremblay**

Nutrients/oceanography  
Québec-Océan, Takuviik, ArcticNet

**Participating Research  
Centres, or Centres likely  
to participate**

Akvaplan-niva  
Tromsø, Norway

ArcticNet  
Université Laval

Other members of INQ  
(ex. : McGill University, INRS, UQAR)

Carotheque INQ

Centre for Forest Research (CFR)

Quebec centre for biodiversity  
Science (QCBS)

Centre for Northern Studies (CEN)  
Université Laval

The Nunavik Research Centre

Centre de recherche sur la géologie  
et l'ingénierie des ressources  
minérales (E4m)  
Université Laval

Water Research Centre (CentrEAU)  
Université Laval

Centre d'optique, photonique  
et laser (COPL)  
Université Laval

Centre national de la recherche  
scientifique (CNRS), France

Centre for Indigenous Peoples'  
Nutrition and Environment (CINE)

Canada Research Chair in Remote  
Sensing of Canada's New  
Arctic Frontier  
Université Laval

Canada Research Chair in Genetic  
Conservation of Aquatic Resources  
Université Laval

Canada Research Chair on the  
Response of Arctic Marine  
Ecosystems to Climate Change  
Université Laval

Chaire de recherche du Canada en  
biogéochimie océanique et climat  
Université Laval

Canada Research Chair  
in Marine Geology  
UQAR

Chaire de recherche du ministère des Pêches et des Océans Canada en acoustique marine appliquée à la recherche sur l'écosystème et les mammifères marins  
UQAR

Chaire de recherche en transport maritime  
UQAR

Geotop

Groupe de recherche interuniversitaire en limnologie et en environnement aquatique (GRIL)  
UQTR

Groupe de recherche sur les environnements nordiques BORÉAS  
UQAR

Groupe de reconnaissance et d'intervention en milieu périlleux (GRIMP)  
Université de Sherbrooke

Initiative Far North of Ontario

Alfred Wegener Institute for Polar and Marine Research  
Germany

Institute for Integrative Systems Biology (IBIS)  
Université Laval

Nasivvik Centre for Inuit Health and Changing Environments

Nunavut Research Institute

National Research Council Canada

Québec-Océan

Réseau Québec Maritime (RQM)

Ressources Aquatiques Québec

Takuvik

The Norwegian College of Fishery Science  
Université de Tromsø

### Potential Collaborators

Kativik Regional Government (Nunavik Parcs)

Arctic College

Arctic Institute of North America (AINA)

Arctic Monitoring and Assessment Programme (AMAP)

Labrador Inuit Association

Association of Canadian Universities for Northern Studies (ACUNS)

Canadian Network of Northern Research Operators (CNNRO)

Circumpolar Biodiversity Monitoring Program (CBMP)

Kativik School Board

Northern Communities

Eeyou Marine Region

Environment and Climate Change Canada

Future Earth (OCEANS and PAGES programs/ Past Global Changes)

Government of Newfoundland and Labrador

Nunatsiavut Government

International Carbon Observatory

International Network for Terrestrial Research and Monitoring in the Arctic (INTERACT)

Inuit Tapiriit Kanatami (ITK)

Quebec ministries (ex. : MTQ, MAMOT, MDDELCC, MFFP, MRN)

Nunavut Wildlife Management Board

Ontario Far North Initiative

Ouranos

Parks Canada

Fisheries and Oceans Canada, Maurice Lamontagne Institute

Northern Scientific Training Program (NSTP), Canadian Polar Commission

Polar Continental Shelf Program, Natural Resources Canada

Polar Knowledge Canada (POLAR)

Canadian Ice Service

Makivik Corporation

Canadian High Arctic Research Station (CHARS), Indigenous and Northern Affairs Canada

Tornat Wildlife Plants and Fisheries Secretariat

Transport Canada

University of Calgary

Yukon College

### Anticipated partners

Baffinland Iron Mine

Hydro-Québec

Manitoba Hydro

Mine Raglan du groupe Glencore

Ministère du Développement durable, de l' Environnement et de la Lutte contre les changements climatiques du Québec (MDDELCC)

Tata Steel Minerals Canada Limited

All northern communities

### Major projects in progress identified by participants

Hudsonie21 - CEN

Gradient nordique - CEN

Caribou Ungava - CEN, Université Laval, Université de Sherbrooke

Acceleration of Permafrost Thaw By Snow-Vegetation Interactions (APT)

GEOCRYOLAB : Northern Ellesmere Island in the Global Environment (NEIGE)

Arctique en développement et adaptation au pergélisol en transition (ADAPT)

CRSNG-RDC PERSISTANCE (Hydro-Québec, Hydro Manitoba et Ouranos) sur l'apport en eau dans les réservoirs du Nord

Programmes CREATE-FONCER: Astrobiology et Environmental Innovation - McGill University

Hydro-Québec Greenhouse Gas project

Construction d'un Centre de recherche et d'innovation CEN à Kangiqsualujuaq - CEN en partenariat avec Nunavik

OHMI Nunavik

Impacts of the Changing Global Environment at Nunavut's Northern Frontier (W. Vincent) - ArcticNet

Permafrost Research for Northern Infrastructures and Improved Community Life (M. Allard) - ArcticNet

Effects of Climate Shifts on Canadian Arctic Wildlife: Ecosystem-Based Monitoring and Modelling (D. Berteaux) - ArcticNet

Population Dynamics and Predator-Prey Relationships in Migratory Caribou of the Québec-Labrador Peninsula in the Context of Climate and Anthropogenic Changes (S. Côté) - ArcticNet

Polar Knowledge Canada (POLAR): Monitoring of small mammals and their predators in the Canadian Arctic (G. Gauthier) - ArcticNet

Permafrost and climate change at CHARS (A. Langlois, W. Vincent, M. Allard) - ArcticNet

Aquatic ecosystems at CHARS (M. Rautio, C. Lovejoy) - ArcticNet

Canada Research Chairs

Sentinelles Nord (projets en développement) - ArcticNet

NSERC-CCAR network VITALS (Ventilation, Interactions and Transports Across the Labrador Sea) aims to understand and model the functioning and vulnerability of the Labrador Sea as a key component of the earth's climate system

NSERC-CCAR network NETCARE (Network on Climate and Aerosols: Addressing Key Uncertainties in Remote Canadian Environments)

CRSNG – Recherche sur les changements climatiques et l'atmosphère (2013-2018) (Abbatt)

NSERC-CRD network BaySys investigates the relative impact of river flow regulation and climate change on the Hudson Bay system (collaboration with Manitoba Hydro and Hydro-Québec)

The NSERC-strategic network CHONe II (Canada's Healthy Ocean Network) investigates the key stressors and cumulated impact that alter marine biodiversity and ecosystem functions and services

Green Edge (Phytoplankton spring blooms in the Arctic Ocean: past, present and future response to climate variations and impacts on carbon fluxes and the marine food web)

NetCOLOR (Network on coastal Oceans and Lakes, Optics and Remote Sensing)

Élaboration d'un atlas interactif en ligne de la vulnérabilité de la population québécoise aux aléas climatiques à l'intention des acteurs locaux et régionaux - Subvention Ouranos

Canadian research Icebreaker Amundsen

CFI – Major Science Initiatives

Véhicule sous-marin autonome (AUV) pour l'étude de la géophysique et de l'écologie des mers arctiques englacées.

Ministère de l'Enseignement supérieur, de la Recherche, de la Science, Programme de soutien à la recherche (PSR-V2)

Autonomous underwater vehicle (AUV) to study Arctic marine geology - the geophysical payload - CFI - John-R.-Evans Leaders Fund

Arc3Bio (Marine biodiversity, biological productivity and biogeochemistry in the changing Canadian Arctic (Tremblay) - ArcticNet

Arctic Cod (Fortier) - ArcticNet

Hidden Biodiversity and Vulnerability of Hard-Bottom and Surrounding Environments in the Canadian Arctic (Archambault) - ArcticNet

Monitoring Marine Biodiversity with eDNA (Bernatchez) - ArcticNet

LTOO (Long-term Oceanic Observatories; Fortier); Mapping of Arctic Canada's seafloor (Lajeunesse) - ArcticNet

Remote sensing of Canada's new Arctic Frontier (Babin) - ArcticNet

Sea ice (Barber, Rysgaard) - ArcticNet

Marine Biogeochemistry and Surface Exchange of Climate Active Gases (Papakyriakou) - ArcticNet

Projets Sentinelle Nord: BriGHT BOND - ArcticNet

Demande FCI Innovation pour une station de recherche côtière à Qikiqtarjuaq

Demande FCI Innovation « Centre multidisciplinaire de scanographie pour les Sciences naturelles, le génie et le Nord »

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## Priority 4 / Infrastructures and technology

### Project leads:

**Guy Doré, Leslie Rusch and Jean-François Blais**

### Working sessions on Research Priorities :

#### Adolfo Foriero

Soil mechanics and modeling  
Université Laval

#### Ali Saeidi

Frost and material behavior  
Université du Québec à Chicoutimi

#### Ariane Locat

Natural risks/geotechnics  
Université Laval

#### Caetano Dorea

Water treatment  
Université Laval

#### Clément Gosselin

Robotics  
Université Laval

#### David Conciatori

Structures in cold regions  
Université Laval

#### Denis Laurendeau

Digital vision  
Université Laval

#### Guy Doré

Geotechnics, cold regions, transport infrastructure  
Université Laval

#### Guy Mercier

Soil decontamination and waste recovery  
Institut national de recherche scientifique (INRS)

#### Jean Francois Dumoulin

Telecommunication services in northern regions  
Kativik Regional Government

#### Jean-François Blais

Waste water purification and waste conversion  
INRS

#### Leslie Rusch

Communications  
Université Laval

#### Louis Lavergne

Telecommunication services in northern regions  
Cree Regional Authority

#### Louis-César Paquier

Air quality  
INRS

#### Maximiliano Cledon

Ecotoxicology and biomass conversion  
INRS

#### Michel Allard

Permafrost  
Université Laval

#### Monique Bernier

Remote sensing  
INRS

#### Patrick Drogui

Water treatment and electrotechnology  
INRS

#### Richard Fortier

Geotechnics/infrastructures/geophysics  
Université Laval

#### Sophie LaRochelle

Communication and Integrated components  
Université Laval

### Participating Research Centres, or Centres likely to participate

Centre for Northern Studies (CEN)  
Université Laval

Centre d'optique, photonique et laser (COPL)  
Université Laval

Centre de recherche sur les systèmes et les technologies avancés en communications (SYTACom)  
McGill University

Institut national de recherche scientifique (INRS)

Regroupement pour l'étude des environnements partagés intelligents (REPARTI)  
Université Laval

Université du Québec à Chicoutimi

Université Laval

McGill University

### Potential Collaborators

Geological Survey of Canada  
Natural Resources Canada

Danish Technical University

Polytechnique Montréal

Polar Knowledge Canada (POLAR)

Université de Montréal

Université du Québec à Chicoutimi

Université du Québec en Abitibi-Témiscamingue (UQAT)

University of Manitoba

Yukon College

Yukon Research Centre

### Anticipated partners

Kativik Regional Government

Agences thématiques (ex.: Société d'habitation du Québec, Kativik Regional Government, Société du plan Nord)

Bureau de normalisation (BNQ) du Québec - MDDELCC

Environmental service companies (ex. : Premier Tech, Magnus, Avensys solutions, Aquatic Life)

Mining companies (ex. :Xstrata, Canadian Royalties, IamGold, Agnico-Eagle, Nemaska Lithium, Métaux Black Rock, Arcelor Mittal, Rio Tinto Fer et Titane)

First Nations Concils,,Town halls, Land corporations of Inuit villages and localities

Gouvernement of Nunavut

Hydro-Québec

L4 Communications inc.

Ministère des affaires municipales et de l'occupation du territoire du Québec

Ministère des transports, de la mobilité durable et de l'électrification des transports du Québec

Ministère du Développement durable, de l' Environnement et de la Lutte contre les changements climatiques. (MDDELCC) du Québec

Several Consulting Engineering and Construction firms

Réseau de communications Eeyou (ECN)

Réseau Environnement

Makivik Corporation

Transport Canada

Yukon College

### Major projects in progress identified by participants

NSERC permafrost engineering research program Arquluk

Programme de Transport Canada sur les infrastructures de transport en régions de pergélisol et réseau d'expertise sur le pergélisol

Programme ADAPT

Programme de recherche Arctictnet

Programme Sentinelle Nord

Études sur l'installation d'un réseau optique au Grand Nord - ARK, ECN

Développement de souches microbiennes actives en climat nordique - Génome Canada

Épuration des eaux usées des institutions de santé - CRSNG Stratégique

Traitement des effluents miniers - Chaire de recherche du Yukon Research Centre - INRS

Fonds de recherche du Québec - Nature et technologies (FRQNT) - secteur minier (ex. : CRC, Mine Arnaud, Eleonore, Cliffs Natural Resources, etc.)

Sols contaminés - CRSNG RDC (Hydro-Québec)

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## Priority 5 / Natural Resources

### Project leads:

**Francis Fournier, Georges Beaudoin, Jean-Michel Beaudoin and Gaétan Lantagne**

### Working sessions on Research Priorities :

**Kodjo Agbossou**

Energy  
Directeur de l'École d'ingénierie Université du Québec à Trois-Rivières (UQTR)

**Andrea Amortegui**

Mines  
Direction générale de Géologie Québec, Ministère de l'Énergie et des Ressources naturelles (MERN)

**Claude Bazin**

Mines  
Université Laval

**Georges Beaudoin**

Mines  
Université Laval

**Jean-Michel Beaudoin**

Aboriginal forestry  
Université Laval

**Louis Bernier**

Forest pathology, forest health  
Université Laval

**Louis Bienvenu**

Mines  
Direction générale du développement de l'industrie minière, MERN

**Denis Bois**

Mines  
Institut de recherche en mines et environnement (IRME), UQAT-Polytechnique

**Andrée Bolduc**

Mines  
Ressources Naturelles Canada

**Jocelyn Bouchard**

Mines  
Université Laval

**Martin Bourbonnais**

Energy  
Chaire industrielle sur les technologies des énergies renouvelables et du rendement énergétique (TERRE) Cégep de Jonquière

**Michel Campagna**

Genetics, reproduction, and ecology  
Direction de la recherche forestière, Ministère des Forêts, de la Faune et des Parcs

**Xavier Cavard**

Forest carbon  
Université du Québec en Abitibi-Témiscamingue (UQAT)

**Alain Cloutier**

Anatomy of wood, wood composites  
Université Laval

**Roussos Dimitrakopoulos**

Mines  
Université McGill

**Alain Forcione**

Energy  
Institut de recherche d'Hydro-Québec (IREQ)

**Gabriel Fortin**

Preindustrial forest of the Gaspé peninsula  
UQAT

**Francis Fournier**

Forestry sector  
FPInnovations

**Michel Gamache**  
Mines  
Polytechnique Montréal

**Michel Garant**  
Mines  
COREM

**François Huot**  
Mines  
Université Laval

**Hussein Ibrahim**  
Energy  
TechnoCentre éolien

**Terence J. Erwin**  
Mines  
COREM

**Jean-Philippe Jacques**  
Fiber conversion Innofibre Centres  
collégiaux de transfert de  
technologie (CCTT)

**Sylvie Legendre**  
Energy  
Laboratoire des technologies  
de l'énergie (LTE)  
IREQ

**Gaëtan Lantagne**  
Energy  
LTE, IREQ

**Claude Laflamme**  
Energy conversion  
Hydro-Québec

**Benoît Lafleur**  
Forest nutrition, silviculture, and  
ecosystem management  
UQAT

**Jacinthe Leclerc**  
Ecosystem management,  
disturbances  
Service canadien des forêts  
Ressources Naturelles Canada

**Guy Lessard**  
Management, silviculture, and  
ecology  
Centre d'enseignement et de  
recherche en foresterie (CERFO)  
Centres collégiaux de transfert de  
technologie (CCTT)

**John Molson**  
Mines  
Université Laval

**Tom Marynowski**  
Mines  
Laboratoire des technologies  
de l'Énergie d'Hydro-Québec

**Jasmin Raymond**  
Energy  
Institut national de la recherche  
scientifique (INRS)

**René Roy**  
Energy  
Ouranos

**Mikhail Sorin**  
Energy  
Université de Sherbrooke

**Carole-Anne Tanguay**  
Regional sustainable development,  
territorial leadership  
Développement régional,  
durable, animation territoriale  
Station Uapishka

**René Therrien**  
Energy  
Université Laval

### **Participating Research Centres, or Centres likely to participate**

Bureau de la connaissance  
géologique du Québec (BCGQ)

Canada's Big Data Consortium -  
Ryerson University

Canada Center for Remote Sensing  
(CCRS)

The Nunavik Research Centre  
Makivik Corporation

Bib Data Research Center (CRDM)  
Université Laval

Computer Research Institute of  
Montréal (CRIM)

Centre d'optique, photonique et  
laser (COPL)  
Université Laval

Centre de recherche en géochimie  
et géodynamique (GEOTOP)  
UQAM

Water Research Centre (CentREAU)  
Université Laval

Centre de recherche sur la géologie  
et l'ingénierie des ressources  
minérales (E4m)  
Université Laval

Centre de technologie minérale et de  
plasturgie inc. (CTMP)  
Cégep de Thetford

Centre d'étude sur les ressources  
minérales (CERM)  
Université du Québec à Chicoutimi  
(UQAC)

Northern Engineering Centre  
(CINEP) Polytechnique Montréal

Center for Interuniversity Research  
and Analysis of Organizations  
(CIRANO)

Centre interdisciplinaire de  
recherche en opérationnalisation du  
développement durable (CIRODD)  
Polytechnique Montréal

Centre interuniversitaire  
de recherche sur les réseaux  
d'entreprise, la logistique et  
le transport (CIRRELT)

International Reference Centre for  
the Life Cycle of Products, Processes  
and Services (CIRAIG)  
Polytechnique Montréal

Centre technologique des  
résidus industriels (CTRI)  
Cégep de l'Abitibi-Témiscamingue

Chaire de leadership  
en enseignement (CLE) en analyse  
de données industrielles en  
génie chimique  
Université Laval

CLE en génie des mines -  
Xstrata Zinc  
Université Laval

CLE en génie minéralurgique - Mines  
Agnico-Eagle Itée et ArcelorMittal  
Mines Canada  
Université Laval

CLE en géologie structurale  
Université Laval

CLE en géophysique d'exploration  
Osisko  
Université Laval

Canada Research Chair in Quantita-  
tive Hydrogeology of Fractured  
Porous Media  
Université Laval

Canada Research Chair in  
Environmental Law  
Université Laval

Chaire de recherche du Canada  
en procédés et matériaux pour  
des énergies durables  
Université Laval

Chaire de recherche du Canada  
sur le développement durable des  
ressources minérales et l'optimisation  
en cas d'incertitude  
Groupe d'études et de recherche en  
analyse de décisions (GERAD)

Goldcorp Research and Innovation  
Chair in Natural Resources and  
Energy Law  
Université Laval

Social Responsibility and Sustainable  
Development Research Chair  
UQAM

Northern Sustainable Development  
Research Chair  
Université Laval

Chaire en entrepreneuriat minier  
UQAT-UQAM

NSERC-UQAT Industrial Chair on  
Mine Site Rehabilitation  
UQAT et Polytechnique Montréal

NSERC - Agnico Eagle Industrial  
Research Chair in Mineral Exploration  
Université Laval

Commission géologique du Canada  
(CGC)

Consortium de recherche en  
exploration minérale (CONSOREM)  
UQAC

COREM

Cree Mineral Exploration Board  
(CMEB)

Diversification de l'exploration minérale au Québec (DIVEX)

Entreprenariat/droit/développement: Canada Center for Remote Sensing (CRLB)

Fonds d'exploration minière de Nunavik (FEMN)

Groupe d'études et de recherche en analyse des décisions (GERAD)

Ingénierie des procédés industriels, miniers et métallurgiques (IPIMM) Cégep de Sept-Îles

Institut de recherche en mines et environnement (IRME) UQAT et Polytechnique Montréal

Institut des algorithmes d'apprentissage de Montréal (MILA) Université du Québec à Montréal (UQAM)

Institut de valorisation des données, (IVADO) Campus Montréal

Laboratoire d'études sur les risques naturels (LERN) Université Laval

Laboratoire d'observation et d'optimisation des procédés (LOOP) Université Laval

Laboratoires des mines et des sciences minérales de CANMET - Mine expérimentale à Val-d'Or CANMET

Laboratoire de recherche Télébec en communications souterraines (LRTCS) UQAT

Center studying distributed intelligent shared environments (REPARTI) Université Laval

Réseau d'expertise en innovation minière (MISA)

Réseau québécois sur les eaux souterraines (RQES-Gries)

Québec Mining Association (SOREDEM)

Stochastic mine planning laboratory (COSMO) McGill University

### Potential Collaborators

Institut national de recherche scientifique (INRS)

Ministère des Forêts, de la Faune et des Parcs du Québec (MFFP)

Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques du Québec (MDDELCC)

Ouranos

Réseau Ligniculture Québec, UQAM

Saskatchewan Research Council

### Anticipated partners

First Nations of Quebec and Labrador Sustainable Development Institute (FNQLSDI)

Conseil Cris-Québec sur la foresterie

Conseil tribal Mamuitun

Conseil tribal Mamit Innuat

EVOQ Architecture

Makivik Corporation

Station Uapishka

### Major projects in progress identified by participants

GEM, Geo-mapping for Energy and Minerals - Natural Resources Canada

TGI, Targeted Geoscience Initiative - Natural Resources Canada

Programme d'acquisition des données géoscientifiques (BCGQ) - Ministère de l'Énergie et des Ressources naturelles du Québec

Programme de recherche en partenariat sur le développement durable du secteur minier (DDSM)

Chaire de leadership en enseignement (CLE) en analyse de données industrielles en génie chimique - Université Laval

Canada Research Chair in Quantitative Hydrogeology of Fractured Porous Media - Université Laval

Northern Sustainable Development Research Chair - Université Laval

NSERC-UQAT Industrial Chair on Mine Site Rehabilitation - Université du Québec en Abitibi-Témiscamingue (UQAT)-Université du Québec à Montréal (UQAM)

CLE en géologie structurale - Université Laval

CLE en géophysique d'exploration Osisko - Université Laval

CLE en génie des mines - Xstrata Zinc - Université Laval

CLE en génie minéralurgique - Mines Agnico-Eagle Itée et ArcelorMittal Mines Canada - Université Laval

Chaire de recherche du Canada en procédés et matériaux pour des énergies durables - Université Laval

Canada Research Chair in Sustainable Mineral Resource Development and Optimization under Uncertainty - McGill University

Canada Research Chair in Environmental Law - Université Laval

Goldcorp Research and Innovation Chair in Natural Resources and Energy Law - Université Laval

NSERC - Agnico Eagle Industrial Research Chair in Mineral Exploration - Université Laval

Social Responsibility and Sustainable Development Research Chair- UQAM

Chaire en entreprenariat minier - UQAT-UQAM

The Research Institute on Mines and Environment (IRIME)

COSMO Stochastic Mine Planning Laboratory - McGill University

Canada Mining Innovation Council (CMIC)-Exploration Innovation Consortium (EIC) Footprints Project

Biopterre, Centre de développement des bioproduits

Centre for Forest Research (CFR)

Centre d'expérimentation et de développement en forêt boréale (CEDFOB)

Centre for Northern Studies (CEN) - Université Laval

Centre de géomatique du Québec (CGQ)

Centre de transfert technologique en écologie industrielle (CTTEI)

Centre de recherche sur la Boréalie (CREB)

Renewable Materials Research Centre (CRMR)

Laurentian Forestry Centre Natural Resources Canada

International Reference Centre for the Life Cycle of Products, Processes and Services (CIRAIG)

Centre d'enseignement et de recherche en foresterie (CERFO)

Northern Sustainable Development Research Chair - Université Laval

Chair on Eco-advising Research and Intervention - UQAC

CLE en foresterie autochtone - Université Laval

Industrial Research Chair on Environment & Biotechnology (CRIEB) - Université du Québec à Trois-Rivières (UQTR)

FORAC Research Consortium

FPInnovations

Innofibre — Centre d'innovation des produits celluloseux	Research across the full span of the value chain; Genetics; Inventory; Silviculture; Harvest; Forest and commercial transport; Transformation (solid wood, hardboards, secondary processing, pulp and paper, bio-products and bio-materials, bioenergy, construction, environment); Cost efficiency; Product and technology development - FPIInnovations
Institut de recherche sur les forêts (IRF) - UQAT	
Laboratoire des technologies de l'énergie - Hydro-Québec	
Réseau Environnement	
Les Buissons Research Center Silviculture; Adaptation; Biodiversity and naturalness; Facilitating and Generic Migration; Forest composition changing, disturbance and climate dynamics; Forest carbon; Soils mapping; Northern ecological inventory - MFFP, DRF	Upheaval; Fire regimes; Forest dynamics; Adaptation to Climate change; Forest genomics; Lands (Ability to extract biomass); Sensitive areas - Laurentian Forestry Centre
Forest Carbon; Forest dynamics;- Peat-dominated Forest, Cryptic species; Carbon sequestration; Northern boundary - Institut de recherche sur les forêts (IRF), UQAT	Genetic; Genomics Molecular biology; Ecology of Populations and Community; Dynamics of forest ecosystems and impacts of forestry practices; New silvicultural approaches - Centre for Forest Research
Carbon sequestration - Uapishka Station	Projets mentionnés dans la politique énergétique du Québec
Forestry (fiber quality management in the leafroller epidemic context; Non-timber forest products (NTFP); new technologies); Agroforestry; Northern agriculture (Insect ecology, little-known bushberries, Mining and industrial sites revalorisation) - CEDFOB	Projects identified in Hydro-Québec's strategic plan
Valorization of fiber; Packaging and preparation of the material; Any type of Biomass; Development of biosourced products (insulating foam, composite materials); Bioenergy and energy efficiency (heating with biomass, pyrolysis, carbonization and roasting); - Innofibre	Advanced integration of renewable energy into the Raglan Mine Industrial Project - Tugliq Energy Co. Montréal
Wood construction; Biomass, bioenergy; Characterization of wood; Marketing of products; New products - Renewable Materials Research Centre (CRMR)	Hydrokinetic power in the Nordic Region - ORPC/ÉnergieMARine du Québec
Technological efficiency; Use of biofuels - Laboratoire des technologies de l'énergie	Compressed Air Energy Storage - Sigma Energy
Ecology; Silviculture; Building; Remote sensing; Agroforestry - CERFO	Small sized Electrical Microarray - TechnoCentreÉolien-TCE
Aboriginal Forestry - raising awareness among the general public; Training; Integrated management model; Community participation; Aboriginal Entrepreneurship - CLE en foresterie autochtone	Integration solutions for small isolated sites - Industrial Research Chair for Colleges in Sustainable Energy Technology and Energy Efficiency (TERRE), Cégep de Jonquière
Efficacité des coûts; Développement de produits et de technologie -	Renewable energy solutions; Hydrogen storage technology - Institut de recherche sur l'hydrogène (IRH)
	Communauté minière nordique-net zéro - École de technologie supérieure (ETS), UQTR-IRH, TechnoCentreÉolien (TCE)
	Cost reduction of electricity in isolated networks - CANMET-Varenes





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