OECD Skills Studies

The Geography of Higher Education in Québec, Canada

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The Geography of Higher Education in Québec, Canada

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Preface by the OECD and Council of Innovation

There is an obvious bond between entrepreneurship, innovation, and places. Entrepreneurs and innovators belong to communities and networks that generate the conditions for success. These communities can be entrepreneurial ecosystems, and they are essential to enable creation and innovation. They host innovation commons where groups of passionate innovators connect, learn, share insights and know-how, decipher market needs, and create new solutions.

Higher education institutions (HEIs) can, and must, play a pivotal role in entrepreneurial ecosystems by developing talents & skills, promoting mindsets, spawning discoveries, generating spin-offs, and conducting collaborative research activities to create innovation opportunities and address needs in different localities.

Québec is adopting new policy approaches to engage HEIs and drive innovation and new ventures in their entrepreneurial ecosystems. Within the *Stratégie québécoise de recherche et d'investissement en innovation (SQRI2) 2022-2027*, the province has invested to empower or create organisations connecting publicly funded research with innovation and entrepreneurship, in all of Québec, including rural territories. For example, the NGO Axelys was created in 2021 to accelerate the development and transfer of high-potential innovations resulting from public research. The Council of Innovation works with the government on new and improved policies and on various initiatives to drive innovation and augment the impact and use of all programs and resources available in the province.

This, however, represents only a part of the broad innovation ecosystem that Québec has been able to grow over the past two decades. The ten HEIs included in this study have embraced innovation and entrepreneurship in different ways and adopted different approaches to teaching, research, and collaboration, based on their location and specialisation. They display a range of good practices that can inspire other HEIs at the provincial, federal, and international levels. Actions range from the delivery of comprehensive and widespread entrepreneurship education to engagement in collaborative activities with external stakeholders, for example through the new innovation zones, put forth by the Québec government and led by groups of local community leaders. Québec HEIs can increasingly maximise their potential by becoming "place-responsive" institutions and tapping into the needs and opportunities of their territories.

We hope this report will highlight some of the best practices deployed in the Québec innovation ecosystem and inform the nascent international community of OECD's platform supporting Entrepreneurship Education, Collaboration and Engagement, EECOLE, of which the Council of Innovation is a founding partner.

Lamia Kamal-Chaoui,

Director, Centre for Entrepreneurship,

SMEs, Regions and Cities, OECD

Luc Sirois,

Innovator in Chief of Québec

(Head of Council of Innovation)

Foreword

This publication presents the findings and recommendations of the Geography of Higher Education of Québec, Canada. Considering the policy context, it explores the local and regional impact of higher education institutions (HEIs) on entrepreneurship, innovation and growth. The review was undertaken by the OECD in partnership with the Council of Innovation of Québec (CI) and the Ministry of Economy, Innovation and Energy (MEIE) of Québec as part of the programmes of work of the OECD Local Economic and Employment Development (LEED) Committee and of the OECD Committee on SMEs and Entrepreneurship (CSMEE).

The Geography of Higher Education views HEIs as indispensable actors in driving local growth and well-being in their communities. Whilst the most visible manifestation of this role is often seen in the creation of start-ups, this represents only the tip of the iceberg of a broader system of interactions that HEIs can generate within their communities and networks. Unleashing the full potential of HEIs can support the development of transversal skills, and in turn, drive innovation.

Considering this feature, and in response to growing interest from local and regional policy-makers, businesses, civil society, and higher education representatives, the OECD launched a series of thematic reviews to generate evidence and collect good practices on complementarities among higher education, entrepreneurship, innovation, and regional development policies. As part of the EECOLE platform, the Geography of Higher Education Reviews aim to address these demands. EECOLE connects HEIs' representatives, policy makers, and civil society to promote a multidimensional and multistakeholder policy dialogue centred on places, businesses, and people.

The review is part of the Geography of Higher Education Task-and-Finish Group (TFG), operating under the aegis of the Entrepreneurship Education Collaboration and Engagement (EECOLE) platform hosted by the OECD Centre for Entrepreneurship, SMEs, Regions, and Cities. The TFG is producing a "Handbook on the geography of higher education" which will capitalise on international case studies to identify and classify good practices.

Acknowledgements

This review was a collaborative effort between the OECD's Centre for Entrepreneurship, SMEs, Regions and Cities (CFE) led by Lamia Kamal-Chaoui, Director, the Council of Innovation of Québec (CI), led by Luc Sirois, Chief Innovator of Québec, and the Ministry of Economy, Innovation and Energy (MEIE) of Québec, led by Pierre Fitzgibbon, Minister.

Giorgia Ponti, Policy Analyst and Raffaele Trapasso, Senior Economist and Head of Unit, of the Entrepreneurship Education and Skills Unit in CFE, prepared the report under the supervision of Céline Kauffmann, Head of the Entrepreneurship, SMEs, and Tourism Division, CFE and Lucia Cusmano, Deputy Head of Division. Anne Rimmer, former CFE, provided assistance at the beginning of the report. Michelle Marshalian, CFE, also provided comments. Pilar Philip prepared the manuscript for publication.

In the MEIE, Marco Blouin, Director General, science and partnerships, and Antoine Rayroux, Innovation Analyst, as well as Loick- Alexandre Gautier, Senior Director, Innovation Institute, from the CI, provided guidance, detailed comments and inputs to the report. Albert Meige of Arthur D. Little, and Professor Dominique Foray of the Ecole Polytechnique Fédérale de Lausanne also actively contributed to this report. John Goddard, Emeritus Professor, Civic University Network (CUN), United Kingdom, acted as a peer reviewer and provided suggestions to the report.

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Acronyms and abbreviations

3IT	Interdisciplinary Institute for Technological Innovation
ACELP	Algebraic Code Excited Linear Prediction
AI	Artificial Intelligence
BSE	(*Bureau de soutien à l'entrepreneuriat*)
C2MI	MiQro Innovation Collaboration Centre
CAD	Canadian dollars
Campus MIL	Campus of the University of Montréal
CCMM	Chamber of Commerce of Metropolitan Montréal (*Chambre de commerce du Montréal métropolitain*)
CCTT	College Centres for the Transfer of Technologies (*Collège collégial de transferts de technologies*)
CEE	(*Centre d'entrepreneuriat et d'essaimage*)
CÉGEP	Publicly funded two-year college (*Collège d'enseignement général et professionnel)*
CÉGEP of Gaspésie	(*Cégep de la Gaspésie et des îles*)
CÉGEP of Trois-Rivières	(*Cégep de Trois-Rivières*)
CÉGEP of Victoriaville	(*Cégep de Victoriaville*)
CEU	University Centre for Entrepreneurship (*Centre d'entrepreneuriat universitaire*)
CI	Council of Innovation of Québec
CIRI	Interdepartmental Committee for Research and Innovation
CIRIF	(*Cellule Intégrée de Recherche, Innovation et Formation*)
CMQ	Centre of Metallurgy of Québec
CQDM	Québec Consortium for Drug Discovery
CRIAQ	Consortium for Research and Innovation in Aerospace in Québec
CRIBIQ	Consortium for Research and Innovation in Industrial Bioprocesses in Québec
CRISES	(*Centre de recherche sur les innovations sociales*)
CRITM	Consortium for Research and Innovation in Metal Transformation
CTJS – CÉGEP of Saint-Jérôme	*(Cégep de Saint-Jérôme)*
D3	District 3
DECs	Diploma of College Studies
EE	Entrepreneurial Education
EECOLE	Entrepreneurial Education Collaboration and Engagement Network
ETHZ	Swiss Federal Institute of Technology in Zürich

ETP	Entrepreneurship in Theory and Practice
ETS	(*École de technologie supérieure*)
EU	European Union
EUQAR	(Entrepreneuriat UQAR)
FRQ	(*Fonds de Recherche du Québec*)
FRQNT	(*Fonds de recherche du Québec – Nature et les technologies*)
FRQS	(*Fonds de recherche du Québec – Santé*)
FRQSC	(*Fonds de recherche du Québec – Société et culture*)
GDP	Gross Domestic Product
GoHE	Geography of Higher Education
GPA	(*Groupe de partenariats d'affaires*)
GRIR	Regional Research and intervention Group (Groupe régional de recherche et d'intervention)
HE	Higher education
HEI	Higher education institutions
I-INC	Innovation and Impact network of Canada
InnovÉÉ	Innovation in Electrical Energy
ISED	Innovation, Science and Economic Development Canada
ITAQ	(*Institut de technologie agroalimentaire du Québec*)
IVADO	(*Institut de valorisation des données*)
IZ	Innovation Zones (Zones d'innovation)
KTM	Knowledge Transfer Manager
LFE	Linkable File Environment
MAIN	(*Le Mouvement des accélérateurs d'innovation du Québec*)
McGill	McGill University (*Université McGill*)
MEDTEQ	Consortium for Industrial Research and Innovation in Medical Technologies of Québec
MEIE	Ministry of Economy, Innovation and Energy of Québec
MES	Ministry of Higher Education (*Ministère de l'Enseignement Supérieur*) of Québec
MILA	Montréal Institute for Learning Algorithms
MIT	Massachusetts Institute of Technology
MITACS	Mathematics of Information Technology and Complex Systems
PhD	Doctor of Philosophy
PolyMTL	Polytechnique of Montréal (*Polytechnique Montréal*)
PRIMA	Québec Centre for Research and Innovation in Advanced Materials
PROMPT	Microelectronics oriented research partnership, photonics, ICT and Digital
R&D	Research and development
RSRIs	Industrial research sectoral groups (*Regroupements sectoriels de recherche industrielle*)
SBDC	Small Business Development Center

SDGs	Sustainable Development Goals
SdN	Sentinelle du Nord
SMEs	Small and medium-sized enterprises
SNEE	National student-entrepreneur status
SOPER	(*Société de promotion économique de Rimouski*)
SQ	(*Sherbrooke quantique*)
SQRI	(*Stratégie québécoise de la recherche et de l'innovation*) (2017-2022)
SQRI 2	(Stratégie québécoise de recherche et d'investissement en innovation) (2022-2027)
SVTQ	(*Société de valorisation et de transfert du Québec*)
TRLs	Technical readiness levels
TTOs	Technology transfer services
UAS	University of Applied Sciences
UBE	Unit for Bioentrepreneurship
UdL	Laval University (*Université Laval*)
UdM	University of Montréal (*Université de Montréal)*
UdS	University of Sherbrooke (*Université de Sherbrooke*)
UQ	University of Québec (*Université du Québec*)
UQAC	University of Québec at Chicoutimi (*Université de Québec à Chicoutimi*)
UQAR	University of Québec at Rimouski (*Université de Québec à Rimouski*)
UTSA	University of Texas San Antonio

Reader's guide

The Geography of Higher Education (GoHE) framework

The Entrepreneurial HEI: a growing role for the HEI in their region

Over the past four decades, the role of higher education institutions (HEIs) in their surrounding ecosystems has changed. In connection with their teaching and research, HEIs collaborate with external stakeholders and support entrepreneurs, contributing to growth and well-being, especially in their own communities and networks. The interconnections between HEIs and their stakeholders may enhance the performance and resilience of all the parties involved. We assume that physical proximity plays an important role connecting actors and aligning agendas.[1] For this reason, it is possible to describe these "spaces" as "entrepreneurial ecosystems" (or local ecosystems) and the HEIs as "entrepreneurial universities".

Etzkowitz defines the entrepreneurial university as one that carries out activities beyond teaching and research, to fulfil its "third mission" (Etzkowitz, 2013[1]).[2] Gibb, Haskins and Robertson (2013[2]) further argue that entrepreneurial universities are dedicated to "creating public value via a process of open engagement, mutual learning, discovery and exchange with all stakeholders in society – local, national and international". Now oriented towards external stakeholders, entrepreneurial universities engage with their ecosystem, some universities having turned into drivers of economic development in their own regions.

These HEIs help to motivate individuals with an entrepreneurial mindset, by teaching entrepreneurship, providing incubation facilities, and co-specialising in their research activities. Stanford University in California or the Massachusetts Institute of Technology are two celebrated examples, attracting talent, training a new generation of entrepreneurs and liaising with local technological companies to produce pioneering research and technology (Jaffe, 1989[3]). However, they should not be taken to be absolute benchmarks. HEIs can be entrepreneurial in many ways, by promoting transdisciplinary teaching activities and collaborating and co-creating with stakeholders in their communities and networks.

To be successful, however, entrepreneurship HEIs must strike a balance between supporting their regional communities and generating internationally relevant research (and skills). The COVID-19 pandemic has demonstrated how entrepreneurial, collaborative universities can play a fundamental role in providing knowledge-based solutions and scientific and technological innovation in their respective ecosystems. For example, many HEIs have mobilised scientific and medical resources to address the health emergency, contributing to research but also to the production of medical equipment (e.g. respirators, masks, hand sanitisers). HEIs can continue this work and support their regions by offering teaching and research that reflect entrepreneurial and innovation opportunities. They should not, however, become regional development agencies, and it is important for them to generate activities that are internationally relevant, and to represent a gateway for the communities that host them. Ideally, place-responsive HEIs can achieve a sustainable equilibrium between curiosity-driven research and co-specialisation, managed by an entrepreneurial leadership and organisation that makes use of the fruits of research. (Atta-Owusu; Fitjar; Rodriguez-Pose, 2020[4]).

The Geography of Higher Education, a place-responsive approach to innovation and entrepreneurship

This review is part of a series of national and regional reports on the topic of the Geography of Higher Education undertaken by the OECD Centre for Entrepreneurship, SMEs, Cities and Regions. The reports are part of a policy dialogue that aims to assess the role of universities in their local ecosystems, and explore how they can be drivers of growth for their regions. In assessing how HEIs can support regional economies, it is assumed that collaboration and co-specialisation are more likely to thrive in a set of conditions in which physical proximity plays an important role (Gust-Bardon & Irena, 2012[5]).

Focusing on collaboration and co-specialisation of HEIs in their communities may help to drive reform in higher education policy, to overcome the "space-blindness" typical of this policy area and to encourage complementarities with other policy sectors. Creating synergies between entrepreneurship, innovation, regional development and employment policy, for example, can have positive effects on policy outcomes and public investment.

The review will also draw on the HEInnovate guiding framework, offering a comprehensive understanding of HEIs' entrepreneurial and innovative agendas and of how they are implementing this agenda (Box 1). This study draws inspiration from the guiding framework to understand how HEIs promote entrepreneurship education and co-produce knowledge to support regional innovation. Two key concepts help explain the impact that universities have in their surrounding ecosystems. The GoHE framework builds on HEInnovate, by adding the concept of a "place-responsive" HEI and how each institution adapts its entrepreneurial and innovation activities to their surrounding communities, also taking into account the policy agenda of the given national or sub-national concept.

Box 1. About the HEInnovate guiding framework

HEInnovate is a guiding framework that was created by the European Commission (EC) and the OECD in 2011, for higher education institutions (HEIs) wishing to develop their entrepreneurial and innovative potential. The framework developed by the European Commission in collaboration with the OECD includes an interactive self-assessment tool, which helps higher education institutions assess their entrepreneurial and innovative agenda and facilitates discussion in an institution on how to drive the agenda. The tool also helps HEIs to monitor their progress, take inspiration from material available on the HEInnovate webpage and become part of a community of practice. HEInnovate covers eight broad areas, which include statements for self-assessment:

- Leadership and Governance
- Organisational Capacity, People and Incentives
- Entrepreneurial Teaching and Learning
- Preparing and Supporting Entrepreneurs
- Digital Transformation and Capabilities
- Knowledge Exchange and Collaboration
- The Internationalised Institution
- Measuring Impact

Source: EC/OECD (2022[3]), HEInnovate, https://heinnovate.eu/en, accessed 24 October 2022.

Understanding entrepreneurship education and the entrepreneurial mindset

These reviews assume that entrepreneurs are not born but made. The entrepreneurial mindset and entrepreneurial skills can be taught and learned (Saraiva, 2015[6]). For many countries and education institutions, teaching entrepreneurship has become a priority, and courses have been created at every level of education, from primary and secondary students to lifelong learning courses. Entrepreneurship education introduces students to a set of cognitive skills, such as financial literacy, business plan development and accounting, but also to a set of non-cognitive skills. The set of non-cognitive skills and attitudes includes perseverance, tolerance of risk, leadership and creativity (Bacigalupo et al., 2016[7]).

This combination of transversal cognitive and non-cognitive skills is a value-added for students, whether or not they are interested in starting a business. Entrepreneurship education helps create transdisciplinary pedagogical spaces, which can have a positive impact on individuals (OECD/EU, 2021[8]). These skills help them in the job market, and more specifically, helps them to navigate uncertain and changing labour markets.

In many countries across the globe, entrepreneurship teaching and support initiatives have flourished. The bulk of these initiatives are at the tertiary education level. In Slovenia, for instance, GEA College (the faculty of entrepreneurship) teaches students entrepreneurship courses. Some students have created their own ventures, but some have taken over their family-owned businesses, providing fresh perspectives for existing ventures (OECD/EU, 2021[8]). Many universities have also established infrastructure to support aspiring entrepreneurs, such as centres for entrepreneurship incubators, accelerators, co-working spaces and technology transfer offices. These are designed as “safe spaces” where students can apply their entrepreneurial skills, access a large network of potential funders and meet other student entrepreneurs. Some institutions have a closer relationship with the market than others, for example accelerators and technology transfer offices where entrepreneurial ventures can be matured and tested in the market.

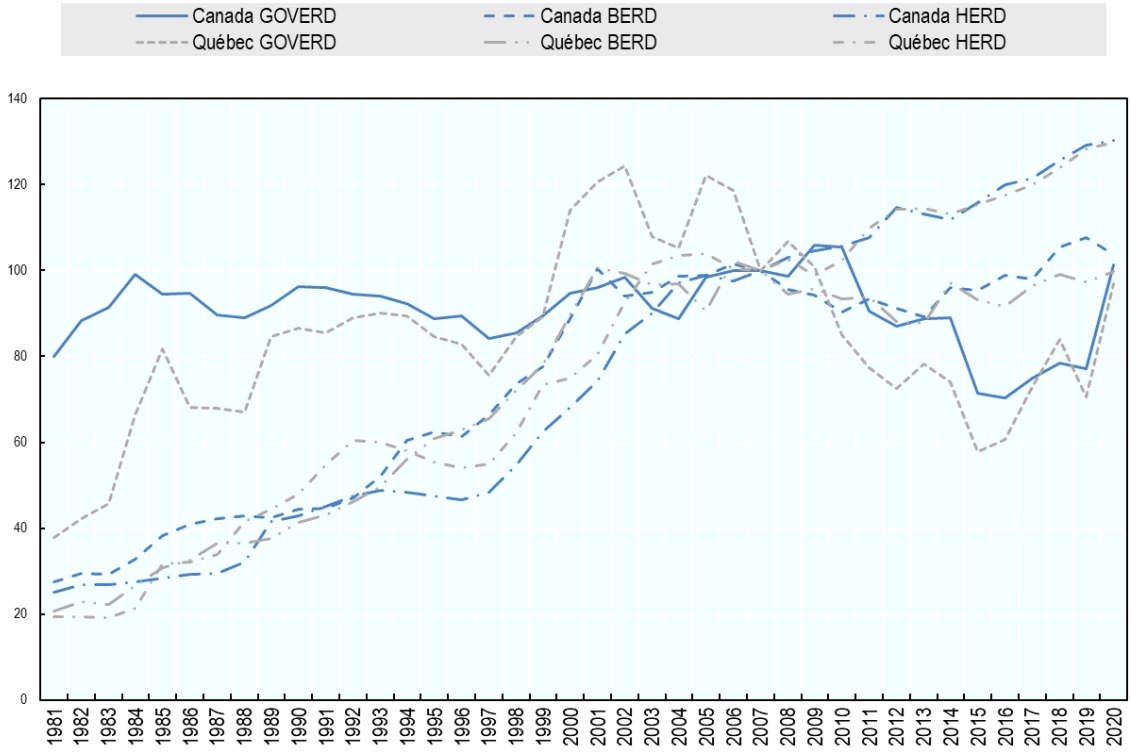
From knowledge transfer to collaboration and co-creation

The third mission of HEIs (Etzkowitz 2001[21], 2003[21]) encompasses any activity that constitutes an exploitation and application of knowledge for socioeconomic development. In practice, this implies connecting teaching and research activities, to link them to the needs of external stakeholders, including businesses, to make them more innovative. In HEIs that have developed a specific focus on entrepreneurship, knowledge transfer and collaboration activities with external stakeholders have become an essential task. Etzkowitz and Leydesdorff (2000[21]) further analyse knowledge exchange between actors as an exchange between government, industry and universities (the “triple helix”), and subsequently the “quadruple helix” (universities, government, industry and civil society interlinkages). (Carayannis and Campbell, 2009[9]) have analysed knowledge exchange between these actors. The concept of a “civic university” as an institution embedded and active in its territory echoes this discussion (Goddard et al., 2016[10]). All these analytical frameworks questioned the linear model of innovation, which proposed that model knowledge is transmitted between actors in a linear fashion, and proposed bi-directional flows of knowledge, making collaboration between HEIs and external stakeholders a central element in the discussion.

HEIs in many countries have recently redoubled their efforts to support innovation, not only through entrepreneurship but also by promoting cutting-edge research and technology development and engagement in societal issues. This is reflected in the fact that in OECD countries in recent decades, the share of higher education expenditure on research and development (R&D) has risen steadily, overtaking government expenditure in such areas. This is particularly true of Canada and Québec, as Figure 1 shows.

Figure 1. Gross domestic expenditure on R&D by performing sector in Canada and Québec (1981-2020)

Expressed in constant USP PPP, index 2007=100



Note: GOVERD, or government intramural expenditure, comprises all expenditure of the government sector in a given territory. Business expenditure on R&D (BERD) comprises business expenditure, and higher education expenditure in research and development (HERD) comprises all expenditures of the higher education sector.
Source: For Canada: OECD calculations based on OECD, Main Science and Technology Indicators Database, November 2022. For Québec: Ministry of Economy, Innovation and Energy, 2023.

The place-responsive HEI

Proximity is important to innovation and entrepreneurship, and knowledge exchange, collaboration and co-production have a strong spatial dimension.[3] Entrepreneurial HEIs are well-placed to respond to the innovation needs, including the need for social innovation, of their own communities and networks. In other words, HEIs are able to generate innovation and entrepreneurship that reflect the needs and opportunities of their communities and networks without replicating collaboration models in a spatially blind way.[4] The place-responsiveness of an HEI can help an institution tap into the needs of its ecosystem and help reduce regional obstacles (Atta-Owusu; Fitjar; Rodriguez-Pose, 2020[1]). Place-responsive HEIs are particularly important in non-metropolitan or less developed regions, where HEIs generate linkages with local stakeholders and can help co-ordinate narratives and policy interventions. Place-responsiveness is driven by three factors:

- the ability of an HEI to co-specialise part of its research, education and innovation activities to respond to the specific needs and opportunities of a given region, both at the economic level (for industries, labour markets and entrepreneurships) and the community level (including the social, cultural and environmental dimensions);

- the capacity of an HEI to offer multilevel responses to regional needs and operate as an international gateway for the community;
- the availability of metrics that recognise "responsiveness" and measure the HEI's impact in the region.

However, place-responsive HEIs are also able to engage in internationally relevant research by identifying a sustainable balance and integration between teaching, research and collaboration. In other words, some co-specialisation appears to be desirable, with the following qualifications:

- full co-specialisation is not desirable, and the aim is to find a balance between developing regional specific assets and maintaining generic programmes;
- co-specialisation should not mean co-obsolescence later. Developing specific assets to respond to regional gaps and opportunities needs to be dynamic. The region and the university will need to engage in strategic interactions to transform the regional system continuously and move together towards areas where the region can build new competitive advantages and manage the transition of its economy. This is the philosophy of smart specialisation – a strategy of regional transformation in which the local university plays a central role.

In this context, the Geography of Higher Education Reviews aim to explore the role of HEIs in their local ecosystems, and how these can be drivers of growth for their regions, enhancing the role HEIs play in supporting regional economies.

The concepts of developing an entrepreneurial mindset; promoting knowledge co-creation; and building a place-responsive HEI are assessed throughout the Geography of Higher Education Reviews. Following an approach that involves a wide range of stakeholder from the assessed country/region/province (e.g. policy makers, HEI leaders, academic and administrative staff members, researchers, governmental representatives, experts and peers from other countries), these reviews identify strengths and discuss areas for improvement, referred to as "recommendations" and based on examples of international good practice that could provide relevant inspiration.

The series of reports at various governmental levels (state/province/region) on the theme of the Geography of Higher Education is conducted by the OECD Centre for Entrepreneurship, SMEs, Cities and Regions. The reports are part of a policy community, the Entrepreneurial Education Collaboration and Engagement (EECOLE) platform, which aims to find innovative solutions to the challenges of the current economic and societal context. EECOLE hosts HEIs representatives, policy makers and civil society to promote a multidimensional and multistakeholder policy dialogue connecting places, businesses and people. While Québec is the first Review undertaken in the Geography of Higher Education (GoHE) framework, similar efforts are under way in Newfoundland (Canada) and the United Kingdom at the time of writing.

Methodology applied to the Geography of Higher Education of the province of Québec

The province of Québec presents an ideal case study for illustrating the role of place-responsive HEIs and the "geography of higher education". The provincial government is actively promoting innovation and entrepreneurship, and exploring the role higher education institutions play in relation to their own communities. It offers an opportunity to understand the potential of a place-responsive approach to higher education, reflecting on the tension between local needs and international relevance, in terms of teaching, research and engagement activities.

The Review is a collaborative effort between the OECD's Centre for Entrepreneurship, SMEs, Cities, and Regions, the Ministry of Economy, Innovation and Energy of Québec (MEIE), and the Council of Innovation of Québec (CI). The methodology used in the Québec Review uses the standard approach to the GoHE framework, and includes the steps described below:

Creation of Steering Group

To guarantee quality control and complete the information gathered, the Review benefited greatly from the advice and support of the Steering Group (*Comité de Pilotage*). The group is composed of 12 members representing the innovation and higher education landscape of the province of Québec. Members were selected at the start of the Review process by the MEIE and the CI.

Selection of HEI case examples

The selection of HEIs to be covered in the study visits was undertaken collaboratively by the review partners. Several factors were considered in the selection of HEIs, including the type of institution and its academic focus, size (e.g. number of students) and location (e.g. rural, urban areas). The Steering Group, the Ministry of Economy, Innovation, and Energy of Québec, the Council of Innovation of Québec and the OECD jointly selected ten higher education institutions for an in-depth study. These included the following:

1. McGill University (*Université McGill*);
2. Laval University (*Université Laval – UL*);
3. University of Sherbrooke (*Université de Sherbrooke – UdeS*);
4. University of Québec at Chicoutimi (*Université du Québec à Chicoutimi – UQAC*);
5. University of Québec at Rimouski (*Université du Québec à Rimouski – UQAR*);
6. University of Montréal (*Université de Montréal – UdeM*);
7. CÉGEP of Gaspésie (*Cégep de la Gaspésie et des îles*);
8. CÉGEP of Saint-Jérôme (*Cégep de Saint-Jérôme*);
9. CÉGEP of Trois-Rivières (*Cégep de Trois-Rivières*);
10. CÉGEP of Victoriaville (*Cégep de Victoriaville*);

Study visits

In May and October 2022, a delegation composed of OECD staff and international experts completed two study visits to the province of Québec, interviewing each of the case study HEIs listed above. The OECD delegations met with representatives, deans, professors, career offices, technology transfer offices, business incubators, student associations, student and staff start-up companies, students taking entrepreneurship courses, and alumni. In addition to meeting with local and regional representatives, they held several meetings with national stakeholders, including the Ministry of Economy, Innovation and Energy (MEIE); the Council of Innovation (CI); and other federal and provincial governmental actors.

HEI Leader Surveys (research and education) and Entrepreneurial Education Survey

As part of the GoHE Review of Québec, two HEI Leader Surveys were administered to the senior management of HEIs in the province. The first survey focused on entrepreneurial education (the "education" survey), while the second focused on co-specialisation ("research" survey). The aim of the surveys was to illustrate the ways in which HEIs are adapting their activities, institutions and governance to become more entrepreneurial, deliver entrepreneurship education to individuals, and promote innovation in their own communities.

The subjects of the two surveys were HEIs in the Québecois territory. In particular, the "education" survey was targeted to general and professional teaching colleges (Cégeps) and universities; the "research" was targeted to College Technology Transfer Centres (CCTTs) and universities. The response rate was relatively high. At the time of writing (as of January 2023), the total number of responses, and the response rate, for both surveys, was the following:

- Education: the total number of responses received was 42, of which 28 were from Cégeps and 14 from universities. Overall, the response rate was 67.5%.
- Research: the number of responses received was 47 in total, of which 31 were from CCTTs, and 16 from universities. Overall, the response rate was 70%.

The Review also illustrates the results of the Entrepreneurial Education (EE) Survey. Designed in co-operation with the University of Oslo (Norway), the survey aims to assess the entrepreneurial mindset and the impact of entrepreneurial education on HEI students. The survey was administered to students from Québec HEIs, including student unions and associations. The total number of responses received was 290 (as of January 2023).

Quantitative assessment, in co-operation with Statistics Canada

The Review of Québec is also informed by a quantitative study, which aimed to measure the interactions between HEIs and their surrounding communities, and their effects on regional innovation and regional development. This assessment adopted a multidimensional analysis based on census and administrative data. The analysis will use the Linkable File Environment (LFE)[5], an advanced statistical tool that links multiple data sources on the Canadian business environment, on the federal level. The constructed model will be divided into subsamples for different distances between firms and universities and will take into account: R&D transfers; sector of activity; innovative status; Employment size; and value of support for innovation. The study will promote a territorial approach in the higher education policy field. The quantitative study is conducted jointly by OECD Centre for Entrepreneurship, Regions and Cities and Statistics Canada, the federal statistical office of Canada. Further information on the methodology of the research is provided in Annex B of this report.

The content of this report

Chapter 1 presents the entrepreneurship, innovation and higher education frameworks of Québec. It illustrates data and trends in the province, including governmental policies, strategies and funds set up by the federal and, in particular, the provincial government to support innovation, entrepreneurship and higher education in all regions.

Chapter 2 focuses on entrepreneurship and entrepreneurial education practices of HEIs in Québec. In particular, it discusses the way in which entrepreneurial education has developed within the HE system in the province, the impact of entrepreneurship on innovation ecosystems, and how a broader approach to entrepreneurship can help Québec deploy its ambitious innovation policy. In addition, the chapter presents the results from the Entrepreneurial Education survey.

Chapter 3 illustrates the dynamic within provincial efforts to create entrepreneurship ecosystems and discusses opportunities and challenges ahead to promote sustainability and inclusiveness.

Chapter 4 presents the policy side of innovation and entrepreneurship in Québec. In particular, it illustrates the recent provincial efforts to provide a spatial approach to innovation, while leveraging higher education institutions.

Chapter 5 illustrates selected policy recommendations to help Québec succeed in implementing innovative policy actions and reform packages. Recommendations refer to a collection of international good practices identified by the OECD in the past decade.

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Notes

[1] For a discussion about the interaction between different kinds of proximity, see (Boschma, 2005[11]).

[2] Concretely, third mission activities may refer to continuous education or lifelong learning, innovation, knowledge and technology transfer, social engagement (volunteer work, cultural programmes) and entrepreneurship programmes.

[3] In this context, concepts such as collaboration, co-specialisation and co-creation describe the activities and engagement of HEIs with their networks/communities/territories.

[4] A place-responsive strategy refers to a strategy that responds to the needs of a local community in a given territory.

[5] For more information: https://www.statcan.gc.ca/en/about/statcan/lfe. The LFE uses administrative data and survey data from multiple sources, such as the Data from Research and Development in Canadian Industry (RDCI) survey, which collects data on R&D payments to universities and will be used to identify enterprises that have a linkage with universities, as well as the number of researchers working in R&D activities (knowledge base). The Survey of Innovation and Business Strategy 2017 (SIBS) would be used to identify other types of business-enterprise linkages, such as innovation activities and proximity to customers. The Business Innovation and Growth Support database (BIGS) contains information on the value of federal support to innovation. All these data sources will subsequently be combined with other administrative files, from which are drawn: sector of activity, number of employees; revenue, sales, profits, export value and characteristics of ownership, among other data points.

Executive Summary

Québec aims to become an innovation and entrepreneurial leader in North America, giving higher education institutions (HEIs) a central role in this drive. HEIs are pivotal in developing skills and nurturing talent, connecting and contributing to their communities, including firms, public authorities and civil society. The *Stratégie québécoise de recherche et d'investissement en innovation* (SQRI 2) 2022-2027 (Québec research and Innovation Investment Strategy) has entrusted HEIs with an important role to play in provincial innovation and entrepreneurship efforts, including with an explicit spatial approach, through the implementation of "innovation zones", which connect innovation and regional development agendas in non-metropolitan areas, with a focus on sustainable urban development. The SQRI 2 represents a total investment of CAD 7.5 billion (approx. EUR 5.2 billion) implemented over a five-year period that began in 2022.

Against this backdrop, and reflecting an international trend, Québec HEIs increasingly offer educational opportunities for students to develop an entrepreneurial mindset. General and Vocational Colleges (CEGEPs) and college centres for the transfer of technology and innovative social practices (CCTTs), as well as universities in the University of Québec network are peculiar to the provincial system and particularly adept at engaging with local partners.

Québec has made great strides in promoting entrepreneurship and innovation, but still has margins for improvement. The province has mobilised a series of entrepreneurship networks, with a specific focus on scientific entrepreneurship. While the focus on AI and deep-tech start-ups has helped create vibrant technological start-up communities; broadening this focus may strengthen entrepreneurship and innovation in more sectors.

A wide variety of accelerators/incubators offer specialised services to entrepreneurs. However, these entities seem to act as silos, limiting the possibility to stimulate entrepreneurship and innovation by connecting different disciplines (e.g. economics, medicine, business, among others). Moreover, while HEIs are well-engaged in collaboration activities with their partners, the review highlights discrepancies between institutional activities and incentives/career opportunities for researchers that engage in collaborations with external stakeholders and communities.

The provincial government is in a good position to generate complementarities and synergies among higher education, entrepreneurship, innovation, and regional development, as all fall under its jurisdiction. A broader approach to entrepreneurship, and closer coordination between governmental actors in the province, such as the Québec Ministry of Higher Education, can help spur Québec's entrepreneurial and innovative potential, mobilising resources in the metropolitan area of Montréal, which has become a true entrepreneurial hub, as well as in other regions of Québec, including rural ones.

Innovation zones, a recent policy device, deserve specific attention. Innovation zones promote local specialisation in knowledge-intensive sectors, especially in Quebec's non-metropolitan regions. They are forming new models of entrepreneurial ecosystems, connecting different actors, and leveraging on the role of higher education institutions within their own communities. In parallel, at least on paper, innovation zones should aim to promote sustainable, inclusive, urban and regional development, emphasising the social dimension of entrepreneurial ecosystems. Because of these characteristics innovation zones may offer the opportunity to pilot synergies and complementarities among a broad range of policy sectors such as higher education, regional development and innovation policies.

This review involved ten HEIs as case studies, including research universities and CEGEPs – colleges that offer post-secondary technical or pre-university programmes. These case studies represent examples of innovative and entrepreneurial HEIs that connect to provincial and federal policies, and support entrepreneurship and innovation in their communities. In particular, the case studies tell the story of the province of Québec in fostering entrepreneurship and innovation, connecting actors and mobilising resources and policies. The methodology used in this review draws on two on-site visit interviews of the selected HEIs and their partners (university representatives, public authorities and firms collaborating with the HEIs) and a series of remote interviews. The review has also been informed by an HEI leaders survey administered to all HEIs in the province; an entrepreneurial education survey for students, and a quantitative assessment measuring the impact of the spatial dimension between universities and firms on regional innovation, which was undertaken in cooperation with Statistics Canada.

Main recommendations

The review identified four key recommendations based on the interviews, surveys and desk research carried out in support of the work:

- Create more collaborative spaces (colliders) underpinning entrepreneurship education. While blossoming, entrepreneurship education activities in Québec HEIs appear often fragmented across academic disciplines (e.g., economics, health, etc). This affects effectiveness and scale of entrepreneurship education. Provincial authorities could consider the creation of common spaces to reinforce a transdisciplinary approach. The last point is particularly relevant in Montreal, which is on the verge of becoming an international entrepreneurial leader.
- Capitalise on CEGEPs and CCTTs to strengthen entrepreneurship ecosystems in all regions. In particular, CCTTs could deliver entrepreneurship education to individuals and firms (including established ones) thus promoting innovation and growth, across Québec regions.
- Involve the *Ministère de l'Enseignement Supérieur* (MES - Ministry of Higher Education) in entrepreneurship and innovation policies, promoting piloting interventions and reforms in Innovation Zones. The MES could use innovation zones as test beds to introduce incentives and career opportunities for academics and students (e.g., by promoting the status of "student entrepreneur") to unlock the potential of collaboration activities and of the start-up movement, in these zones. Once tested in innovation zones, initiatives could be extended to the rest of the province.
- Promote the social and urban development sides of innovation zones to connect the start-up movement and entrepreneurship education to other agendas related to well-being and sustainability, in all regions of Québec. The social and urban development components are relevant, and they should not be overlooked when implementing innovation zones.

1 The innovation, entrepreneurship, and HE systems in Québec

This introductory chapter presents data and trends about Québec, Canada. It illustrates the governmental policies, strategies and funds established by the federal and, in particular, the provincial government to support innovation, entrepreneurship and higher education in the region.

As Canada's second-largest province in population, Québec is four times the size of France, and the home of North America's 15th-largest[1] city, Montréal. Its metropolitan area has become an important economic and cultural international hub. In 2016, at least 15% of the population of all larger metropolitan centers from Montréal westward was born outside Canada (Phillips and Castle, 2022[1]). Québec also has a highly rural character. Its population density is 7 inhabitants per square kilometre, as compared to the population density of Germany, with more than 200 inhabitants per square kilometre. The province features diverse rural regions stretching all the way from the Atlantic to the Great Lakes and expansive remote regions in the north. With 8 695 659 habitants, of whom 2.3% identify as Indigenous (Phillips and Castle, 2022[1]), it is home to almost a fifth of Canada's total population (Statistics Canada, 2022[2]). East of Montréal and outside metropolitan areas, less than 10% of the population is foreign-born (Phillips and Castle, 2022[1]).

The province has enjoyed robust economic performance, with historically low unemployment and skyrocketing GDP. In this favorable situation, the Québec government is trying to make this growth sustainable by investing in innovation capacity and entrepreneurship. Québec-based HEIs have a central role to play, provided that good practices are identified, and the right policy incentives are in place. Overall, Québec's system includes 18 universities; 48 colleges of general and professional teaching (Cégeps); and 59 college centres for the transfer of technology (CCTTs), rendering it one of the richest provinces in Canada in terms of its higher education.

Québec's economy is performing well, with some challenges in innovation and productivity

This geographic diversity is also reflected in the diverse economy of the province (Table 1.1). The top five sectors of Québec's economy, in terms of weight in 2020 GDP, are finance, insurance and real estate services (18.4%), manufacturing (12.5%), health care and social support (8.7%), public administration (7.8%) and construction (7%) (Institut de la statistique du Québec, 2022[3]).

Table 1.1. Key statistics of Québec's economy

Indicator	Value (as of November 2022)
Total population	8 751 352 residents
Employment rate	64%
Unemployment rate	4.3%
Disposable income per capita	CAD 33 093
GDP at basic prices (variation 2020/2019)	-1.7%
Average hourly wage (2021)	CAD 30.61
Research and development (% of GDP)	2.33%

Note: Some values may refer to earlier years. This table provides select data on Québec's economy.
Source: (Institut de la statistique du Québec, 2022[4])

Skills and employment trends in Québec are positive

The province has a large number of skilled workers, who are taking advantage of positive employment trends, and its workforce is highly educated: 73% of workers have a post-secondary diploma/certificate (Statista, 2021[5]). A large proportion of the population in regions that include the major urban centres have a certificate, diploma or a university degree. This is particularly true of Montréal. In 2016, the share of its population between the ages of 25 to 64 who reported having a bachelor's degree or higher was 31.9%, while 18.4% had a college, Cégep or other non-university certificate or diploma as their highest level of

education, and 15.7% an apprenticeship or trades certificate or diploma (post-secondary total 66%). The percentage with a university certificate or diploma was 36.5% (Statistics Canada, 2021[6]).

Québec's labour market is also performing well, especially in urban regions. Its unemployment rate was 4.1% as of November 2022, one of the lowest in the country (Statistiques Quebec, 2022[7]). Ontario's unemployment rate rose from 5.3% to 5.7%, with a combination of fewer jobs (-19 200) and a larger labour force (+18 500) (Desjardins, 2022[8]). In Québec as of November 2022, employment gains were concentrated in the Montréal area, where employment rose by 25 000 (+1.1%), and the unemployment rate remained unchanged at 4.2%. In the past decade, most regions in the provinces have created jobs, although both Bas-Saint-Laurent (-2.6%) and Gaspésie-Îles-de-la-Madeleine (-6.4%) have seen a decline in employment. A recent OECD report concluded that many of these jobs were in occupations that were at lower risk of automation (OECD, 2020[9]).

However, despite the very low unemployment rates, job vacancies continue to grow. A recent study by the Institut du Québec found only 0.2 unemployed persons per vacant position in health and social assistance, 0.4 in professional, scientific and technical services and 0.6 in construction (Institut du Québec, 2021[10]). This may suggest an increasing need for upskilling and reskilling workers in the near future (Institut du Québec, 2021[10]).

Québec firms are embracing innovation and collaboration, despite low R&D expenditure

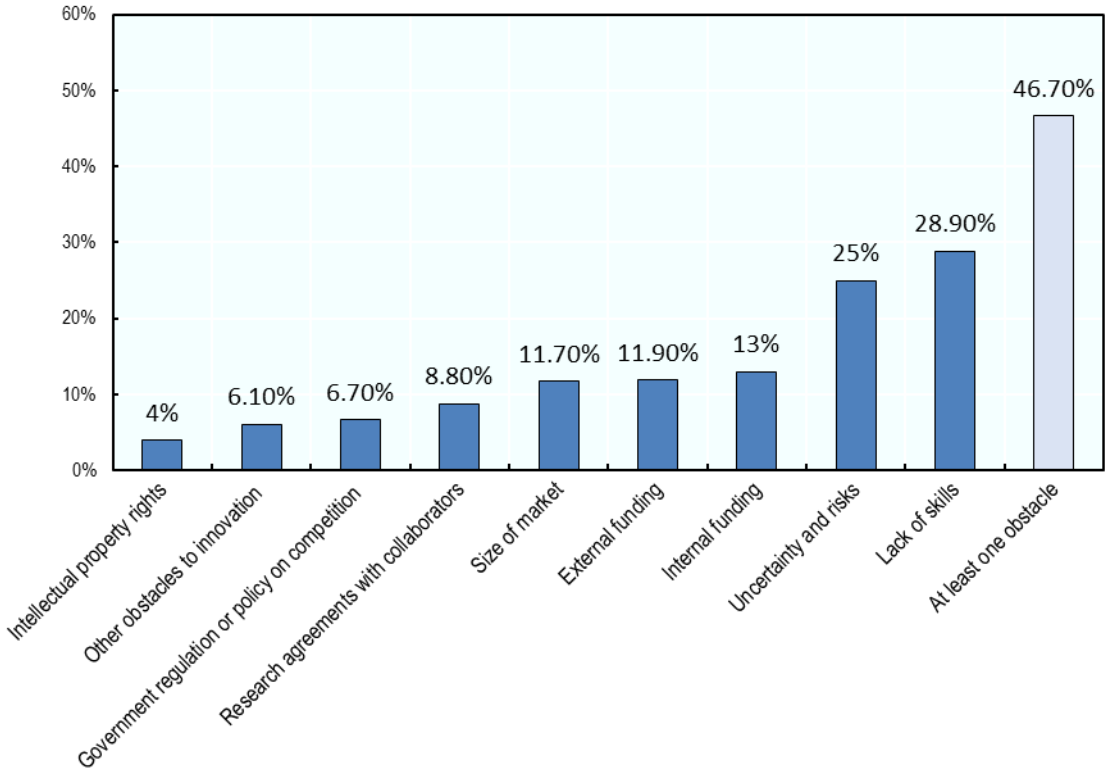
Despite some improvements, Québec shares the national tendency toward low R&D investment. Real growth in the 1990s rose to a peak of about 1.7% of GDP in 2006, but Québec had experienced a decline in R&D investment by 2017, at 1.31% of GDP, compared to 1.24% in Ontario.[2] The OECD average, by comparison, was 1.92% in 2020, after rising steadily for 20 years (Phillips and Castle, 2022[1]). Nevertheless, about 23% of Canadian patents are owned by Québec-based companies or investors. The most important sectors include electronics, accounting for 45% of patents in Québec, followed by machinery, mechanics and transport (18%), instrumentation (17%) and pharmaceuticals (11%) (Phillips and Castle, 2022[1]).

About 78% of Québec firms reported innovating between 2017 and 2019. The large majority of these firms, about 71%, undertook process innovation, while 51.3% reported they focused on product innovation. These percentages are in line with the Canadian average of 79.8% and reflected a wider national trend towards process innovation (Institut de la Statistique du Québec, 2021[11]). Possibly as a reflection of the strength in process innovation, there was variation between sectors. Professional services, finance, manufacturing, wholesalers and the IT sector displayed the greatest innovation, and public services, agriculture, forestry, fishing and hunting and real estate the least (Institut de la statistique du Québec, 2021[12]).

As for significant barriers to innovation, firms in Québec noted a lack of skills (28.9%), and concerns about uncertainty and risk (25%). This is consistent with other regions of Canada (Institut de la statistique du Québec, 2021[12]).

Figure 1.1. Firms that encountered barriers to innovation, Québec

By type of barriers, percentage shares, 2019.

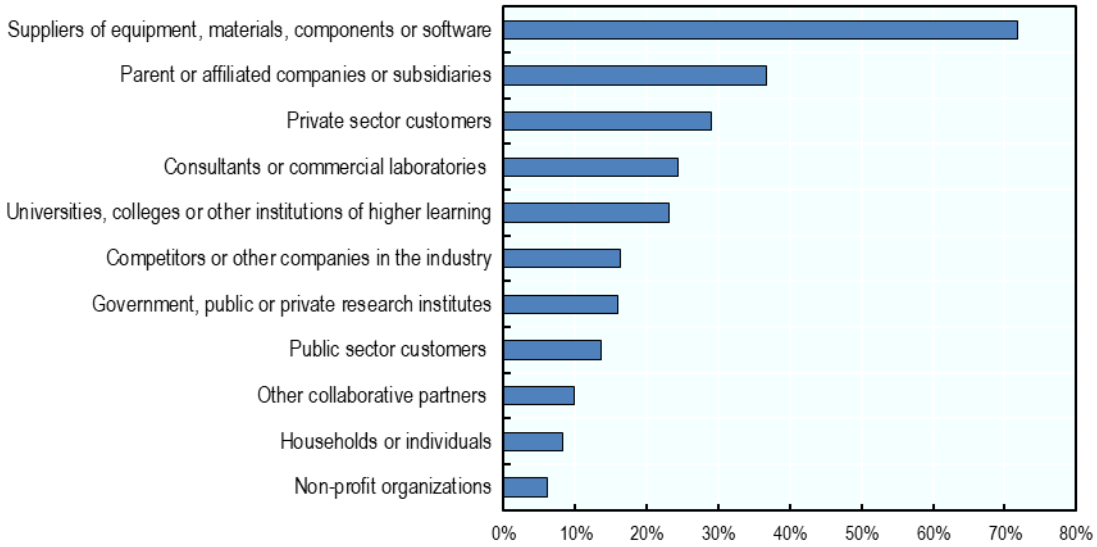


Source: Statistics Canada, Table 27-10-0364-01 Barriers to innovation and actions taken by industry and firm size, [Online]. Doi: 10.25318/2710036401-eng, accessed September 2021. Adapted by the Institut de la statistique du Québec.

In the same 2019 survey of business practices, only 18.8% of firms reported undertaking innovation in collaboration with external partners, although Québec ranked above the national average of 17.8% (Institut de la statistique du Québec, 2021[12]). Collaboration takes place mostly among firms within the same production chain, such as suppliers of equipment, or software (71.8%) or other related businesses (36.8%). Only 23.1% of such collaborations were with higher education institutions, including universities and colleges (Figure 1.2).

Figure 1.2. Firms that conducted innovation activity in collaboration with other firms

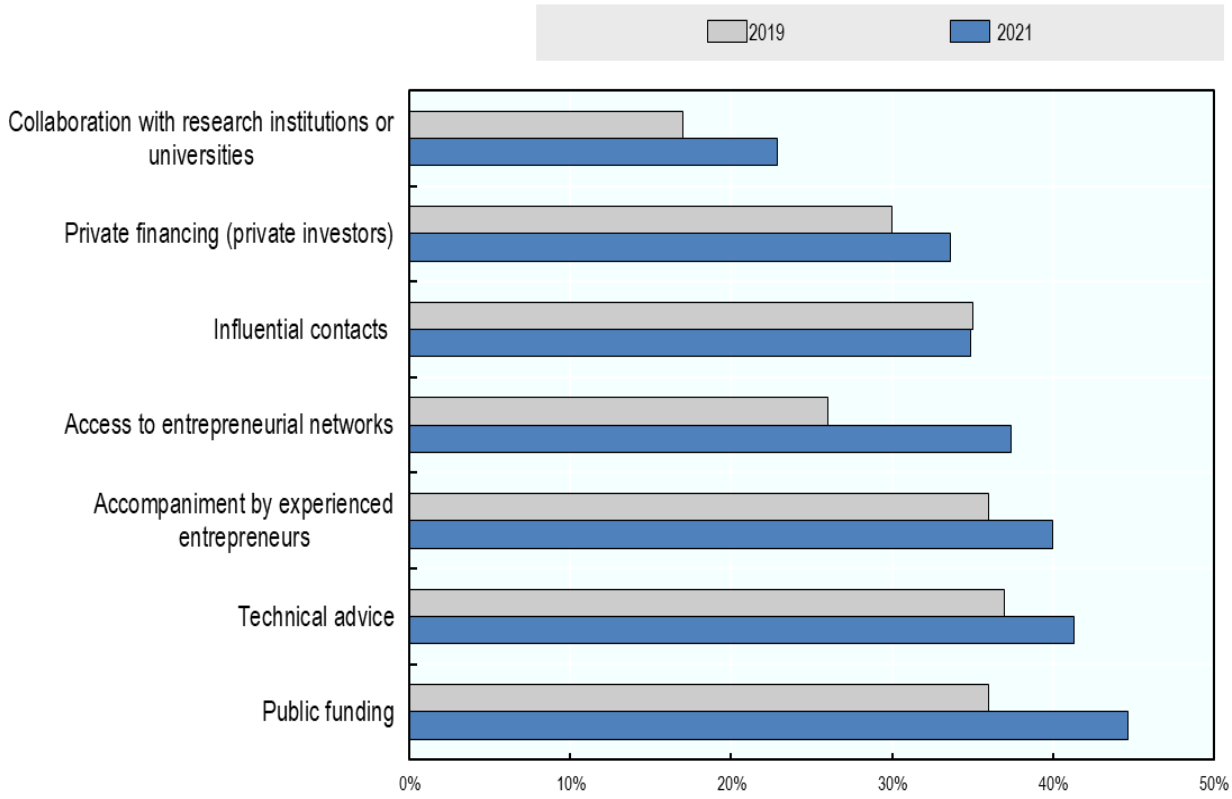
By type of partners



Source : (Institut de la statistique du Québec, 2021[12]).

Because of the importance of HEIs in Québec's innovation system, surveys in the province have focused on the possibility of reinforcing the connection between HEIs and the productive sector. Despite the potential to expand collaboration with HEIs, almost a third of the companies interviewed in Québec mentioned lack of skills as an obstacle (Institut de la statistique du Québec, 2021[12]). When asked about innovation support, a growing number of entrepreneurs – up 6% from 2019 – identified research institutes and universities as potential partners, and called for support to improve these collaborations (Figure 1.3).

Figure 1.3. Types of privileged support for innovation



Source: (Marchand, 2022[13])

Québec is poised to become a North American leader in innovation and entrepreneurship

Like other provinces in Canada, given its federal system, Québec has constitutional responsibility for education, health care and significant aspects of economic development policy. As a result, the province has significant institutional capacity and autonomy to develop a coherent set of policies promoting innovation and entrepreneurship in each of its regions. To promote sustainable and inclusive growth, its government has made innovation and entrepreneurship priority policy areas, introducing various strategies to support research and innovation, and placing innovation at the centre of provincial efforts.

The province has adopted a holistic approach to innovation and entrepreneurship

Policy actions promoting innovation and entrepreneurship are part of a multifaceted strategy that has created a provincial “innovation ecosystem” (Figure 1.4). This spans a wide range of organisations and is intended to generate functional linkages between basic research, applied research, innovation and entrepreneurship. The aim is to create a coherent set of policies and incentives and a system that can identify and incentivise the most promising experiences and activities. To maximise the impact of public policies, such as the *Stratégie québécoise de recherche et d’investissement en innovation (SQRI2) 2022-2027* (Québec Strategy to Support Research and Investment in Innovation, or SQRI2), Québec structures mirror the mandate of many federal organisations. Within this framework, higher education institutions are a common overlap point across multiple actors within the same ecosystem and are also involved in funding, production and transfer of knowledge.

Figure 1.4. Québec's Research and Innovation Landscape

Source: Ministry of Economy, Innovation and Energy, 2022.

Québec has made a specific effort to promote implementation research. From a governance perspective, in 2011, the province established the *Scientifique en Chef* (Chief Scientist) position (Box 1.1). This role consists of advising the MEIE on developing research and innovation and on how to stimulate intersectoral research linked to major societal challenges (Phillips and Castle, 2022[1]). Since 2020, a Chief Innovator has worked in tandem with the Chief Scientist. The Chief Innovator heads the Council of Innovation, which acts primarily as an advisory committee for the government on strategies to propel innovation and entrepreneurship ecosystems, as well as to multiply their economic and social benefits in key sectors for Québec's future (Box 1.1).

Box 1.1. The Chief Scientist, the Chief Innovator and the Council of Innovation in Québec

The Chief Scientist

The Chief Scientist advises the Minister of Economy, Innovation and Energy and Québec's government on any matters relating to the development of research and science. He promotes international research partnerships and science diplomacy, as well as scientific culture and collaborations with civil society. As CEO of the three *Fonds de recherche du Québec* (FRQNT, FRQS, FRQSC), the Chief Scientist develops intersectoral research linked to major societal challenges (demographic changes and the aging of the population; sustainable development and climate change, including AI and digital; creativity and entrepreneurship; and the Science and Society challenge (disinformation, democracy, etc.) and promotes careers in research (trainees at all levels).

At the request of the Minister of Education and Higher Education at the time, in 2020-2021, he chaired a working group, entirely made up of university stakeholders, to conduct consultations and discuss the future of the universities. The report issued a series of 12 recommendations and 50 proposals for measures and action, whose implementation is under way, to facilitate their development and ensure the future vitality of Québec's universities.

The Chief Scientist of Québec was a founding member of the International Network for Governmental Science Advice (INGSA) in 2013, and has since September 2021 been president of a network of over 5 000 members from 130 countries. As president, he created the Science Advice in the Francophonie network, a new branch of INGSA, in 2022.

The Chief Innovator and the Council of Innovation

Québec's Innovation system is distinctive for its Chief Innovator and Council of Innovation. Created in December 2020 at the initiative of Québec's Ministry of Economy, Innovation and Energy (MEIE), the *Conseil d'Innovation du Québec* was given the mission of boosting innovation in Québec's businesses and society. Luc Sirois was appointed general director-general of the organisation and chief innovator of Québec.

Acting primarily as an advisory committee, with a team of permanent staff, the members of the council advise the minister on strategies to stimulate innovation and entrepreneurship in the province, and to multiply their economic and social benefits in key sectors. The council has a number of initiatives to achieve this mission, training and connecting hundreds of economic development agents as innovation advisors across the province, and providing useful sources of information on innovation and on the funding available to businesses.

Source: https://conseilinnovation.Québec/en/about-us/.

Increased investment in innovation and research have allowed Québec to stand out

The innovation and research ecosystem in Québec is supported by federal and provincial funding. On the federal level, funding is assured through the "Tri-Council", which provides financial assistance for basic research. This includes bodies such as the Canadian Institutes of Health Research (CIHR); the Natural Sciences and Engineering Research Council (NSERC); and the Social Sciences and Humanities Research Council (SSHRC). The Tri-Council provides financial assistance primarily for basic research (McGill University, n.d.[14]). In addition, the National Research Council of Canada assures funding for industrial research. A notable example is the Industrial Research Assistance Program (IRAP), designed to accelerate the research and development projects of Canadian innovators (National Research Council of

Canada, 2022[15])[3]. There are also other initiatives for research infrastructure on the federal level. The research system in Québec also benefits from “Apogée Canada” projects (“Canada first”), through the research excellence fund of the Government of Canada (Government of Canada, 2022[16]). In the period 2014-2022, Québec received on average 26.4% from the federal granting councils, or CAD 5.1 billion.

During the 1960s and 1970s, the province created three research funding agencies. Since the late 20th century, Québec has invested consistently in the development of research, innovation and entrepreneurship and reorganised its three research funding agencies, focusing on health sciences; natural sciences and engineering; social sciences and humanities. These organisations reflect those of the national government: the *Fonds de recherche du Québec-Santé* (FRQS); *Fonds de recherche du Québec-Nature et technologies* (FRQNT) and *Fonds de recherche du Québec-Société et culture* (FRQSC) (Phillips and Castle, 2022[1]).

The FRQs provide support for the province’s innovation and entrepreneurship framework by investing in different programmes. For instance, the direction of the *grands défis de societé* has channelled more than CAD 3.2 million into entrepreneurial initiatives between 2018-2019 (Fonds de recherche du Québec, 2019[17]). It is expected to invest the same amount for the 2022-2023 period. These funds financed at least eight programmes or initiatives under the three research funds (FRQNT, FRQS, FRQSC). Support programmes focus mostly on technological and life sciences entrepreneurship.

In the life sciences sector, the FRQS has established the Oncopole, a research and innovation centre created with the support of the biopharmaceutical company Merck. Thanks to investments from partners in the life sciences and health sectors, more than CAD 156 000 has been invested in training young talent and young researchers in oncology entrepreneurship.[4]

FRQS’s STIMuLeS programme promotes and helps establish connections between science, technology, engineering and social sciences in regions and across the province.

Box 1.2. The SQRI2 framework: stimulating research and scientific entrepreneurship and responding to societal challenges

The *Fonds de recherche du Québec* (FRQ), with the support of the MEIE, is working to develop favourable conditions that will increase innovation based on high-calibre research, close the gap between the academic community and the entrepreneurial ecosystem, and exchange innovative ideas within transformative sectors of activity:

1. Programmes to support partnership and sustainable research collaborations between universities, colleges and college centres for the transfer of technology (CCTTs), businesses and the general public in Innovation Zones:

- Public-Private Research Chairs to build research capacity and a new generation of researchers.
- Innovation Catalysts in colleges to meet the needs of key knowledge users and accelerate the sharing of research results.
- Linking science, technology, engineering, mathematics and social sciences to build knowledge and encourage accountability and social acceptance of technological developments.

2. Partnership-based initiatives promoting an entrepreneurial culture in Québec and encouraging the next generation of entrepreneurs:

- Support of a trajectory for students across Québec to explore, choose and launch their scientific business in collaboration with V1Studio, Axelys, Mitacs and the I-Inc network: the Québec Scientific Entrepreneurship Programme (*Programme québecois d'entrepreneuriat scientifique*, or QcES); Lab2Market Discover (L2M), an ideation and market validation programme; and a post-doctorate in scientific entrepreneurship, to be launched in 2023.
- Support for internship in venture capital investment dedicated to the next generation of researchers through the Grad2VC program, led by Front Row Venture, an investment fund, in collaboration with FRQ for students on more than 20 campuses in Québec and Ontario.
- Science and Entrepreneurship program, in collaboration with Esplanade Québec, to support research projects, initiated by start-ups and focused on social and environmental impact, that are interested in strengthening their connection to the research community.
- A research and innovation space to develop effective methodologies and support tools with measurable impact with and for the entrepreneurial ecosystem that supports start-ups, in collaboration with MAIN, an organisation with a mission to pool coaching and support resources for all incubators and accelerators in Québec.

3. A unique research programme that welcomes a diversity of societal actors to become involved in research and to provide solutions tailored to the context of Québec in addressing major societal challenges:

- Demographic changes and aging; climate and digital changes; sustainable development, entrepreneurship and creativity; and science and society dialogue.

This renewed and increased investment in R&D, including significant funding for basic and discovery-driven research, is essential for the production of high-impact scientific knowledge and to allow Québec to build its innovative edge, stimulate its economy, attract local and international researchers, students and key partners and position itself on the world scene. The SQRI2 allows for an increase in FRQ scholarships supporting talents with research expertise and an increase in support for networks and poles of research excellence.

An interdisciplinary approach helps make the most of Québec's innovation and entrepreneurial efforts

Québec's government has also adopted an interdisciplinary approach to innovation and entrepreneurship. The industrial research sectoral groups (RSRIs) ensure full and active collaboration to increase the links between its academic research and innovative companies.

Representing Québec's key sectors, RSRIs are in a strong position to help achieve the new government's objectives, as well as to support Québec's economy in its quest for growth. Nine clusters have been designated by the government of Québec to act as intermediation and funding organisations for collaborative research and development (R&D). As successful catalysts of innovation, they have long promoted the transfer of knowledge and technological appropriation by companies in different strategic sectors of the economy, by encouraging relationships between the research community and industry.

With their structured networks and in-depth knowledge of their respective sectors, they have contributed in the past three years to generating CAD 150 million in industrial R&D investments, by supporting more than 371 projects. These projects have yielded significant benefits for Québec, particularly in terms of employment, student training, patent filings, licensing, technology commercialisation, spin-offs and industrial investments, to name a few.

The eight RSRIs currently funded by the Ministry of Economy, Innovation and Energy are: the Consortium for Research and Innovation in Aerospace in Québec (CRIAQ); Consortium for Research and Innovation in Industrial Bioprocesses in Québec (CRIBIQ); the Québec Centre for Research and Development in Aluminum (CQRDA); Consortium for Research and Innovation in Metal Transformation (CRITM); Consortium Québec Centre for Drug Discovery (CQDM); Innovation in Electrical Energy (InnovÉÉ); Consortium for Industrial Research and Innovation in Medical Technologies of Québec (MEDTEQ); Québec Centre for Research and Innovation in Advanced Materials (PRIMA Québec); Microelectronics oriented research partnership, photonics, ICT and Digital (PROMPT).

More recently, there has been significant investment to make Québec a leader in life sciences as well as artificial intelligence. In particular, for life sciences, the government has launched a new provincial strategy to stimulate private investment across the life sciences value chain; develop new future niches; increase the presence of Québec's companies in local and international supply chains (Gouvernement du Québec, 2022[18]).

In artificial intelligence, the investment from both the provincial and federal governments was intended to build off the private sector investment and on the existing strengths of the universities based in Montréal. Between 2016 and 2019, the Québec government invested CAD 501 million, including CAD 53 million in SCALE AI, Québec's supercluster, CAD 75 million in the Montréal Institute for Learning Algorithms (MILA), CAD 65 million in IVADO Labs, CAD 5 million in IVADO, and CAD 25 million in the company Element AI. The government of Canada has also invested CAD 365 million, including CAD 230 million for SCALE AI, CAD 94 million for IVADO and CAD 41 million for MILA. In addition, the provincial government has committed an additional CAD 125 million to support the AI ecosystem in SQRI 2.

Other policies and strategies have also been defined and directed to managing innovation, including in: sustainable agriculture, entrepreneurship, aerospace, aluminium, life sciences, digital transformation, critical and strategic minerals, maritime, and the plan for a green economy.

The structure of the provincial HE system is conducive to entrepreneurship and innovation

The structure of the Québec higher education sector is well-placed to respond to the innovation and entrepreneurship needs of the province (Box 1.3). Universities and colleges offer students and individuals an academic pathway to develop skills and prepare for the world of work. In 2018, the Ministry of Higher

Education (MES), published the *Politique Québecoise de financement des universités*, which included the following vision:

> *The Québecois university system is amongst the highest performing in Canada and internationally; that teaching, research and creation activities serve society and supports the needs of Québec both today and in the future, to be a more educated, more prosperous and more innovative society as well as more open to the world. (Gouvernement du Québec, 2018[2])*

The message that the key function of the universities is to build a stronger society in Québec was further expressed in a policy stating that teaching should ensure that graduates are capable of innovation, that research should contribute innovative solutions to the challenges facing society and that universities should directly participate in the development of their communities (local, national and global).

Box 1.3. Structure of Higher Education in Québec

The structure of the Higher Education (HE) system in Québec includes three different levels: i) college, ii) university and iii) postdoctoral studies. College studies are a distinctive feature of the system.

College level – Cégeps

College studies are offered by the *Collèges d'enseignement général et professionnel* (CÉGEPs), and offer academic studies through three different pathways:

- Pre-university training provides a bridge between high school and university. It leads to a diploma of college studies (DEC) and lasts two years;
- Technical college training gives access to the job market. It can also lead to the university, if the requirements of the chosen university programme have been met. This training leads to a diploma of college studies (DEC) in a specialty and usually lasts three years;
- Short-term college training is for adults who have work experience or who have completed previous training. It leads to an Attestation of Collegial Studies (AEC) and lasts from 6 to 18 months.

Québec has 48 Cégeps. Most are also linked to various college technology transfer centres (*Centre collégial de transfert de technologie*, CCTT), which specialise in applied research in a specific sector and are in contact with the surrounding ecosystem through their daily operations. This allows Cégeps to establish direct links and bridge the gap between academia and their ecosystem.

University level – bachelor's, master's and doctorate degrees

University studies are divided into three cycles and lead to the following degrees:

- the baccalaureate (first cycle) of three or four years, depending on the discipline;
- the master's degree (second cycle) of one or two years;
- the doctorate (third cycle) of three years or more.

Most universities also offer short programmes (certificates, specialised graduate degrees, etc.) of varying duration. It is also possible to carry out postdoctoral studies after university training. Universities have faculties of different disciplines as well as specialised schools, for example for business schools or engineering.

Source: Author's research based on (Gouvernement du Québec, 2021[19])

One of the distinctive functions of the Québecois higher education system is the network of University of Québec. The Université du Québec (UQ), headquartered in Québec City, was founded by the government of Québec on 18 December 1968. It includes 10 institutions (six universities, one research institute and three higher education establishments) throughout Québec. The Université du Québec network was conceived as a vital element in the reform of the Québec education system recommended by the Commission of Inquiry on Education (also known as the Parent Commission). The UQ network responded to the commission's threefold mission: to promote access to university education, contribute to Québec's scientific development, and participate in the development of its regions. Active throughout the province through its network of 10 institutions in 54 cities, it offers comprehensive university education in more than 1 000 programmes of study at the undergraduate, graduate and post-graduate levels (The Canadian Encyclopedia, 2017[20]). Furthermore, the role of Cégeps in supporting applied research, technical support for business, training and information was recognised in Québec as early as 1983, when 10 specialised centers were established within Cégeps. In 1993, these centers took on their current name, the *centres collégiaux de transfert de technologies* (CCTT). Since the 2000s, the CCTTs have become an important vehicle of innovation and commercialisation strategy in Québec.

Today, 59 CCTTs are located across the province. While many have a technological focus and are specialised in a specific sector (energy, the marine economy, aerospace) some of them focus their efforts on developing innovative social practices. Generally speaking, their implantation and their link with the local ecosystem are strong. Half of CCTTs' clients are located within 100 kilometres of their CCTT (KPMG, 2014[3]). CCTTs consist of teams of researchers in a specific sector who conduct more than 7 500 innovation projects annually. They are funded through annual public and private investments of CAD 177 million, resulting in socioeconomic spinoffs of CAD 2.4 billion. The CCTTs are also an important contribution to the development of a highly skilled workforce. Each year, the activities of the CCTTs reach 14 000 students, including 800 who work directly on projects and can become vectors of innovation in the companies and organisations that may host them at the end of their studies (Synchronex, 2021[21]). The network of CCTTs have created "squad" teams, specifically on energy and digital transformation, in an effort to catalyse the CCTTs' resources and multidisciplinary expertise and to offer integrated and innovative solutions that meet the needs of local businesses,. As important actors in the innovation ecosystem, the CCTTs are represented by the network of CCTTs – Synchronex – in Québec's provincial government.

The *Stratégie québécoise de Recherche et d'Investissement en Innovation* (SQRI 2) 2022-2027 (the Québec research and innovation investment strategy) represents the best example of the holistic approach that Québec has adopted to systemically promote innovation and entrepreneurship (Gouvernement du Québec, 2021[22]). The SQRI 2 is the latest in a series of public policy strategies that have steered Québec's science, research and innovation policies since the early 2000's. In 2017, the provincial government adopted Québec's Strategy for Research and Innovation (*Strategie québéçoise de la Recherche et de l'Innovation*, or SQRI) for 2017-2022. This laid out Québec's ambitions to become one of the most creative and innovative societies in the world by 2030. With a budget of CAD 2.6 billion, It Is based on three priority areas: advanced manufacturing, export and entrepreneurship (Gouvernement du Québec, 2021[23]).

After its launch, the provincial government deemed the strategy a success, declaring it relevant, effective and compliant. With 94% of the measures implemented, the SQRI helped to create over 32 000 jobs, with an increase in R&D spending, and investment in more than 22 000 businesses, 10 000 researchers, 7 000 students and 400 organisations (Gouvernement du Québec, 2021[24]). The strategy provided the opportunity and the momentum for a second cycle. In 2022, the provincial government updated the strategy for the 2022-2027 period, in SQRI 2. The updated initiative hinges on five strategic priorities:

1. Excel in research, science, and technology;
2. Create an environment conducive to the development of innovation;
3. Support in-company investments and the commercialisation of innovations;
4. Develop talent and a scientific and innovation culture;
5. Rely on promising sectors and catalyst projects (Gouvernement du Québec, 2021[23]).

The underlying approach is that every aspect of the innovation cycle (research, transfer, innovation, commercialisation) should be linked together more effectively. The novelty of the SQRI 2 is that it mobilises the private sector and other stakeholders such as higher education institutions, whose role is to elevate the knowledge intensity of industries in the province. Implementation of the strategy is managed by the Ministry of Economy, Innovation and Energy, supported by an Interdepartmental Committee for Research and Innovation (CIRI) to co-ordinate government action, with the Chief Scientist and the Chief Innovator acting as advisors.

The new strategy aims to invest more than CAD 7.5 billion to provide Québec with a solid base in research and innovation. This includes an additional budget of: CAD 1.3 billion in budgetary appropriations for the new SQRI 2; CAD 600 million in investment capital financing; and CAD 75 million in investments in the Québec Infrastructure Plan.

Québec's innovation strategy leverages HEIs as drivers of innovation and development

Higher education institutions are an integral component of the research and innovation strategy. This is evident in their direct involvement in four of the five objectives of the 2022 SQRI, objectives 1, 3, 4 and 5. HEIs are to support the link between academia users, social innovation and scientific creativity, and an intersectoral approach to increase entrepreneurial education. While Canada's investment in higher education stalled at around 0.46% in the last decade, Québec's investment reached 0.9% in the same period (Phillips and Castle, 2022[1]; Institut de la Statistique du Québec, 2022[25]).

Efforts of the provincial government have focused on supporting HEIs and their success (Office of the Minister of Higher Education of Québec, 2021[26]). The provincial government has launched the Québec Strategy for Financing Universities (*Politique Québécoise de financement des universités*) (Politique Québécoise, 2018[27]). This aims to enhance the role of universities, stating that teaching should ensure that graduates are capable of innovation, that research should offer innovative solutions to the challenges facing society and that universities should directly participate in the development of their communities, whether local, national or global.

The Ministry of Higher Education (MES) has three reform initiatives that could support the SQRI 2. The first project aims to support collaborative initiatives of research and education. The second project aims to support HEIs in developing technological or social innovation projects for communities and businesses. The third is to promote the development of skills in scientific entrepreneurship and innovation among college and university students, as well as their socio-professional integration[5] (Box 1.4).

Box 1.4. The reform projects in higher education in Québec supporting the SQRI 2

The Ministry of Higher Education of Québec (MES) is supporting the SQRI 2 – and the Innovation Zones – with three different projects that match the axes and actions of the Strategy. Each project is designed to achieve practical goals:

1. Support collaborative research and training initiatives.

- Create five joint research units (*unités mixtes de recherche*, or UMRs) by the National Institute of Scientific Research (*Institut national de la recherche scientifique,* or NRS) in Québec's regional universities;
- Support the creation of two inter-order research, innovation and training cells (CIRIFs) in the designated Innovation Zones.

2. Support higher education institutions in developing technological or social innovation projects for the benefit of communities and businesses.

- Increase collaboration between universities and private companies, social economy enterprises and community action organisations
- Support the reciprocal transfer of knowledge, expertise and skills between partners and researchers at a university institution.
- Stimulate the production of new knowledge and the co-creation of innovative solutions in response to current social, economic, technological and cultural issues.
- Encourage the dissemination and implementation of technological and social innovations.

3. Promote the development of scientific entrepreneurship and innovation skills among college and university students and their socio-professional integration.

- Initiate activities promoting scientific creativity, entrepreneurship and innovation among students, as well as their socio-professional integration.

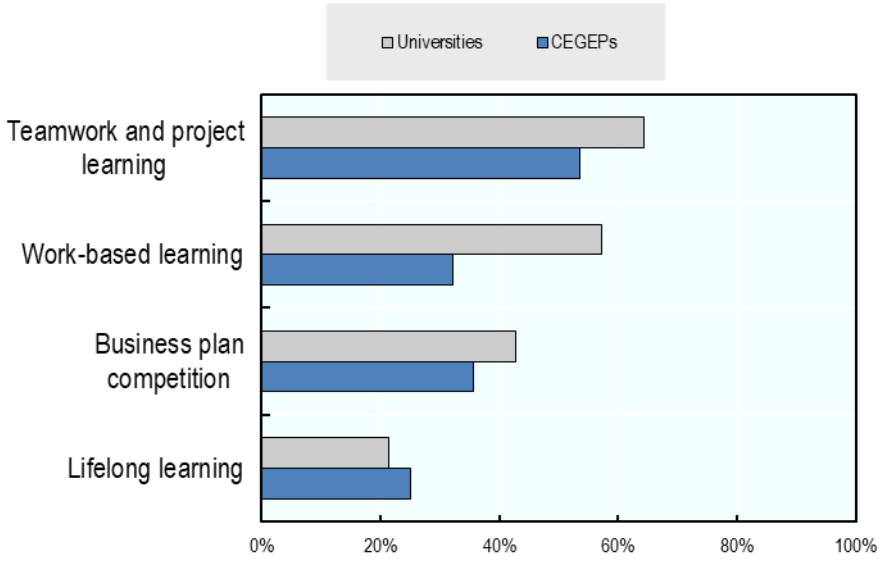
Source: Ministry of Higher Education, unpublished.

Results from the HE Leaders Survey

HEIs in Québec are instrumental in entrepreneurial education

The responses received from HEIs in Québec provide a snapshot of the entrepreneurship education trend in the province. Of the responding institutions, 16 out of 28 Cégeps and 4 out of 14 universities reported that they provide entrepreneurial education to students, in both a complementary and transversal way. The programmes can be offered through formal and informal activities. The most common types of opportunities for Cégeps and universities are teamwork and learning projects. This option can be regarded as a "formal activity". The second and third most common are work-based learning and business competition plans. The latter can be considered informal (Figure 1.5).

Figure 1.5. HEIs in Québec offer both formal and informal learning opportunities for entrepreneurship



Note: The bar graphs show the distribution of answers between 28 Cégeps and 14 universities that provided responses. Each value represented by a bar graph shows the number of Cégeps and universities that chose that option. Respondents could select more than one answer.
Source: HEI Leaders' Survey of Québec "Éducation".

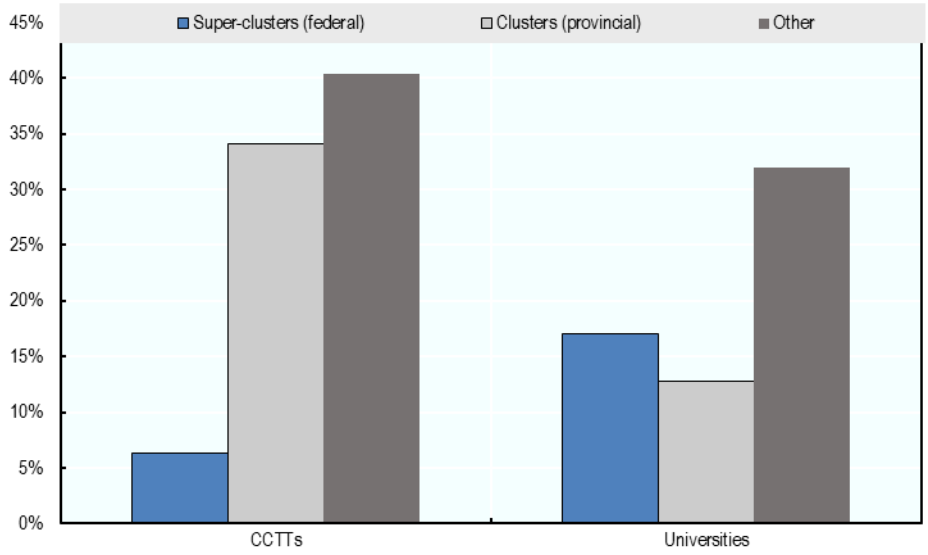
These entrepreneurial education courses are mainly offered to individuals inside and outside the HEIs who are interested in entrepreneurship. The second group includes students in the first cycle, i.e. those in the first years of their programmes, in either type of institution. The only difference between Cégeps and universities is evident with graduates: universities' courses and activities on entrepreneurship are offered to graduates and alumni more than those of Cégeps.

HEIs are catalysts for research and innovation

Most institutions show close collaboration with external partners in their communities. This demonstrates the policy coherence at the federal and provincial level in enlisting HEIs in industrial and development strategies. More than 60% of universities and 80% of CCTTs reported contributing to industrial strategies. Of these, almost half of universities and CCTTs participate in the context of specific provincial strategies, including the Innovation Zones and RSRIs. Moreover, 30% of universities, and 1 in 10 CCTT, take part in federal super clusters (Figure 1.6). These include federal-run programmes that encourage closer collaboration between businesses, academic institutions and non-profits in specific areas, focused on industries in which Canada already had some competitive advantage.

Overall, results show that Cégeps and CCTTs seem to be more engaged with external partners and their communities than with universities. This is partly explained by the nature of Cégeps and CCTTs, which are designed to interact with communities.

Figure 1.6. Institutions active within national and/or provincial industrial strategies

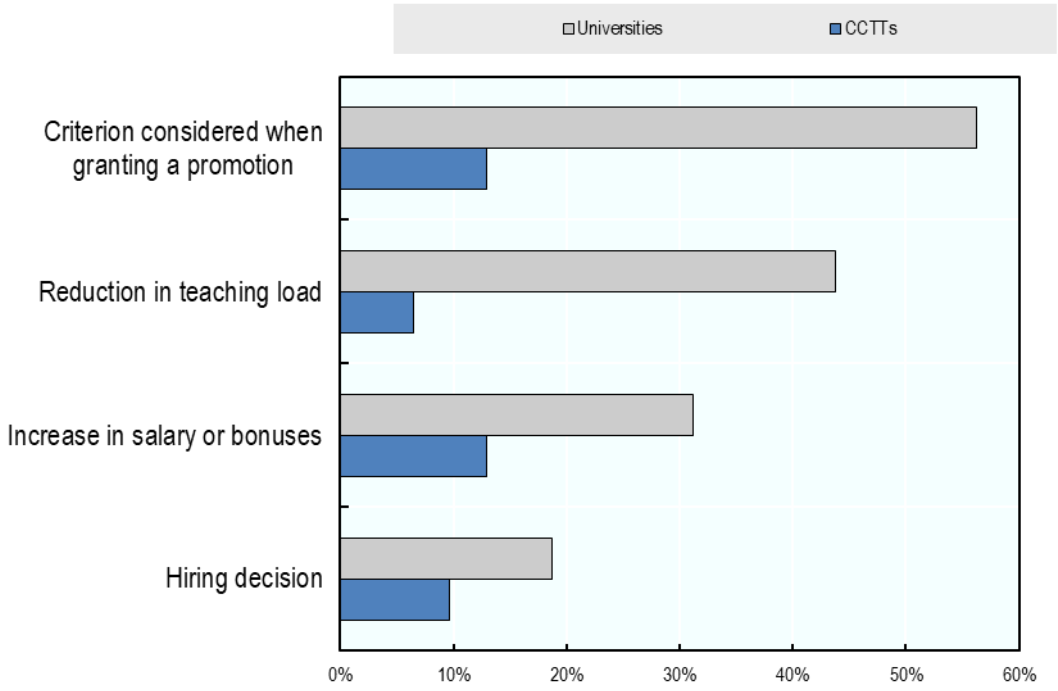


Note: The bar graphs show the distribution of answers for the number of CCTTs and universities that reported that they take part in industrial strategies. Each value represented by a bar graph shows the number of responding CCTTs and universities that chose that option. Respondents could select more than one answer.
Source: HEI Leaders Survey of Québec "Recherche", 2022.

Québec's institutions have set up incentives for professors and/or researchers to collaborate with external stakeholders. Typically, professors and researchers teach and do their research, but their work with external stakeholders goes unrecognised. Incentives, whether financial or in terms of career advancement, can help drive their work with external stakeholders and contribute to their institutions' role in resolving challenges to society.

The most common form of incentive for CCTTs and universities to encourage faculty to take on external collaborations is adding collaboration as a criterion in granting promotions (Figure 1.7). This striking result shows that there may be a discrepancy between institutional conventions and the regulatory frameworks. While the frameworks reward external collaboration in terms of career incentives, HEIs may still be in the process of reflecting this in terms of career support (see Chapter 3).

Figure 1.7. Incentives for external collaboration vary by type of institution



Note: The bar graphs show the distribution of answers for the number of CCTTs and universities that reported providing incentives for external collaboration. Each value represented by a bar graph shows the number of responding CCTTs and universities that chose that option. Respondents could select more than one answer.
Source: HEI Leaders Survey of Québec "Recherche", 2022.

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Notes

[1] Based on https://worldpopulationreview.com/continents/north-america/cities.

[2] Based on https://bdso.gouv.qc.ca/pls/ken/ken213_afich_tabl.page_tabl?p_iden_tran=REPER45Z4G229188537945118fB80J&p_lang=2&p_m_o=ISQ&p_id_sectr=96&p_id_raprt=3472.

[3] At the time of writing, the government of Canada announced that the National Research Council of Canada's Industrial Research Assistance Program (NRC IRAP) will join the Canada Innovation Corporation (CIC), a new agency. Further information is available at: https://www.canada.ca/en/department-finance/news/2023/02/government-releases-blueprint-for-canada-innovation-corporation.html.

[4] The authors are grateful to « *la Direction des Grands défis de société et du Service de la planification et performance des FRQ* » for having shared documentation on these initiatives.[5] The authors are grateful to Jesus Jimenez Orte and colleagues from the MES for having shared documentation on these projects.

2 The entrepreneurial HEIs in Québec

This chapter focuses on entrepreneurship and entrepreneurial education practices of higher education institutions (HEIs) in Québec. It discusses the way in which entrepreneurial education has developed within the higher education system in the province, the impact of entrepreneurship on innovation ecosystems, and how a broader approach to entrepreneurship can help Québec set up its ambitious innovation policy. In addition, the chapter presents the results from the Entrepreneurial Education survey.

The Québec higher education system is mobilised to encourage entrepreneurial education and skills. The SQRI 2 has catalysed this policy effort and provides direct and indirect benefits to HEIs and their ecosystems. These include additional support and funding to CCTTs (initiative 2), to incubators and accelerators (initiative 7), and to skills and talent development (initiative 9) (Gouvernement du Québec, 2021[1]). Québec is home to a network of entrepreneurship centres, incubators and accelerators that are helping to create entrepreneurship ecosystems, in all 17 regions of the province. Many of these entities are part of HEIs. The provincial government is committed to expanding entrepreneurship and has a specific focus on start-ups and spin-offs operating in knowledge-intensive sectors. These represent the most innovative entities in Québec and in the more knowledge-intensive sectors. As a result, entrepreneurship policy in Québec focuses on deep-tech industries, such as artificial intelligence and life sciences.

This approach reflects the needs and potential of metropolitan ecosystems, like Montréal, which has become a global innovation hot spot. Entrepreneurship, however, features also the rest of Québec, although in more traditional sectors, often based on small and medium-sized enterprises (SMEs), and with dynamics that are different from those of deep-tech start-ups and spin-offs.

A recent report from the Global Entrepreneurship Monitor (GEM) shows that framework conditions for entrepreneurship in Québec are improving. The report identifies three overall trends. First, the province is creating opportunities for new entrepreneurs, and pushing for digital transformation. Emerging entrepreneurs were able to seize more opportunities after the COVID-19 pandemic (65.4%) than in 2020. Second, the pandemic prompted 19.6% to adopt new technological procedures for selling their products or services and 31.9% to improve technologies already in place, and generally increased their inclination to use digital technology. Third, team entrepreneurship is more popular in Québec than the rest of Canada: 57.0% of business owners in Québec are part of an entrepreneurial team, and only 36.2% in the rest of Canada. This favourable perception of entrepreneurship in Québec shows a positive trend but is evolving slowly. Throughout the province, people are relatively unfamiliar with entrepreneurs, and perception of the ease of starting a business has progressed only slightly (St-Jean & Duhamel, 2021[2]).

This report provides evidence that unleashing the full potential of entrepreneurship in Québec will require a change in attitudes. HEIs throughout the province can have a positive impact in this respect, generating positive dynamics in labour markets and innovation networks, and engaging more with businesses, including small-medium enterprises (SMEs).

Québec's HE system is promoting entrepreneurship and entrepreneurial skills

Québec is increasingly placing emphasis on entrepreneurship. From business creation to scale-up support, the people of Québec continue to take risks trying to turn their ideas into profit. In 2019, 1 in 5 people manifested an intention to start a business (Azoulay and Marchand, 2020[3]). Throughout the province, entrepreneurship is often associated with deep-tech. Start-ups focus on tech innovation, engineering or significant tech advances. This focus is reflected in the assistance and funding programmes the province supports. As elsewhere, "unicorns" ignite interest in what is new and are considered innovative and inspirational.[1] The province benefits from various entrepreneurial activities, including in the social field.

Entrepreneurship trends in Québec differ from those in the rest of Canada. The driver for starting a business in Québec is often necessity rather than opportunity (Table 2.1) and the average age of start-up entrepreneurs, at 42, in Québec is lower than in the rest of Canada. At the national level, half of entrepreneurs are between 50 and 64, or nearing retirement (Cornell, 2016[4]). "Late bloomers" may face challenges reintegrating into the labour force after changing careers and looking for new opportunities.

Table 2.1. Reasons given for starting a new business or taking over an existing business in Québec

Activity	Intent	Outcome
Desire for personal accomplishment, to realise a dream, a passion	91.5%	87.2%
To be in control of my life	83.4%	81.5%
The need for independence (not to have a boss)	80.2%	80.7%
To increase my income	77.9%	83%
To exploit a good business idea	77.3%	84.2%
To do something useful for society	69.8%	74.8%
The need to have enough income to survive	62.2%	63%
To earn a lot of money	61.1%	61.9%
To better balance work and family	58.6%	61.9%
To achieve a better position in society	54.6%	62%
Insufficient income upon retirement	43.4%	50.2%
Dissatisfaction with my old job	39.6%	47.4%
To follow the example of someone I admired	38.7%	40.5%
Due to the COVID-19 pandemic, I needed a sufficient income to survive	29.9%	38.9%
To continue the family tradition	22.6%	27.8%
The COVID-19 pandemic allowed me to identify a business opportunity	18.8%	39.6%

Source: (Azoulay and Marchand, 2020[3])

Entrepreneurial education and students' entrepreneurial mindset

In Québec, entrepreneurial activities can have a positive influence on students' entrepreneurial mindsets. The European Entrepreneurship Competence (EntreComp) Framework [2] suggests that an entrepreneurial mindset typically involves seven different types of skills, including: financial and economic literacy; creativity; working with others; motivation and perseverance; information management and creative thinking; self-awareness and self-efficacy; collaboration, planning skills and ethical thinking/behaviour. As HEIs increasingly offer entrepreneurial education, students can expand their entrepreneurial mindset, which can be useful not only for starting a business, but in the labour market and society at large.

Results from the Entrepreneurial Education survey (Annex A) confirm this trend in five out of seven skills categories (Table 2.2). Students who reported that they have participated in formal and informal activities offered by their HEIs rate themselves more collaborative, motivated, organised and proficient in managing financial budgets. Students who had been exposed to entrepreneurial education reported engaging more with others, actively pursuing help and advice from others, and demonstrating a stronger will to work with others. However, in creativity, information management and self-awareness and self-efficacy, there was little difference between the two groups of students. This suggests that entrepreneurial education may only have a limited influence on these groups of skills. The next section provides practical examples of formal and informal entrepreneurial courses offered by HEIs in the province.

Table 2.2. Results of the Entrepreneurial Education Survey of Québec

Students not-exposed/exposed to entrepreneurial education: standardized difference between the average score of the answers given to each of the categories of the "entrepreneurial mindset" (only statistically significant results)

Categories/results	Cohen's effect size (d)	95% confidence interval	
Overall Entrepreneurial Index	-.36	-.09	-.63
Financial and economic literacy	-.26	-.03	-.48
Working with others	-.35	-.077	-.63
Motivation and perseverance	-.37	-.13	-.60
Collaboration skills, planning skills, and ethical thinking/behavior	-.33	-.08	-.58

Note: The results are based on 277 observations. The value of the standardised differences reported in the table correspond to Cohen's effect size (d). As we computed the difference between (i) the average scores associated with the answers of the students not exposed to entrepreneurial education and (ii) the average scores associated with the answers of the students exposed to entrepreneurial education, negative values indicate that entrepreneurial activities have a positive association with students' entrepreneurial mindsets. The results presented in this table were also confirmed through a weighted regression analysis. The methodology for the analysis above is presented in Annex A.
Source: Entrepreneurial Education Survey of Québec, 2022 (Annex A)

Québec-based HEIs offer informal and formal entrepreneurship education, including for lifelong learning

To stimulate entrepreneurship in the province, Québec HEIs offer entrepreneurship education and support (Box 2.1). Most HEIs, including Cégeps, have developed entities and activities promoting entrepreneurship education. These are located all over the province, including in rural areas. Support structures, such as incubators and accelerators, have also been created to encourage entrepreneurs and enrich local ecosystems. Entrepreneurship education is offered through both formal and informal activities and is becoming increasingly attractive for students and faculty. It is also provided to adults to improve their productivity or offer them new career opportunities.

Box 2.1. What is entrepreneurship education?

Entrepreneurial education provides academic communities (i.e. teachers, staff and students) with a set of cognitive and transversal skills associated with starting and running a business, including cognitive skills such as finance, business plan development, accounting and human resources, for example. Transversal and non-cognitive skills, however, are key. Entrepreneurship education is practical education that empowers students to conduct business. Entrepreneurship pedagogies and practices are designed to improve leadership, creativity, self-insight, self-efficacy or attitudes such as perseverance, risk-taking, pro-activeness and tolerance of uncertainty, often understood as the "entrepreneurial mindset" (Lackéus, 2020[5]).

A majority of individuals who engage with entrepreneurship education in their tertiary studies will not create or run a business. Nonetheless, the entrepreneurial skills they acquire during their studies will help them make the transition into the labour market. The transversal skills of entrepreneurs can be useful in any career path, including in SMEs, family firms and large companies where intrapreneurial individuals can generate innovation in businesses they did not create or run. In addition, entrepreneurship can also play a role in solving societal challenges and creating value for the public good (OECD/EC, 2015[6]). The outcomes of entrepreneurship teaching thus extend far beyond start-up creation or science-based high-tech companies (Saraiva, 2016[7]) (OECD/EC, 2015[6]).

Various pedagogical approaches to entrepreneurship education have been adopted in universities. Lackéus (2020[5]) has classified these into three different categories:

- Idea and opportunity creation pedagogy, aimed at teaching students how to develop and seek out opportunities to act on new ideas;
- Venture creation pedagogy, focused on the creation of a venture or new organisation. Universities using this approach focus on following students as they create a venture, through mentoring, courses, accelerations and incubation programmes;
- Value creation pedagogy, focused on the creation of value, which exceeds the scope of venture creation, since it is a broader activity meant to create societal value in whatever form it takes (physical, economic, social or ecological).

Source: (Lackéus, 2020[5]); (OECD/IDB, 2022[8]); (Saraiva, 2016[7]);; (OECD/EC, 2015[6])

Formal activities in entrepreneurship education

Québec HEIs have many formal activities for teaching and learning about entrepreneurship. They include: credit-based courses at different levels, including undergraduate, graduate and post-doctoral studies; guest lecturers; and class projects. Formal activities are most common in universities, and less common in Cégeps.

HEIs can take an interdisciplinary approach to formal activities, promoting entrepreneurship education in connection with different disciplines. This is often helpful to reach out to a large number of students (Box 2.2). Québec offers several examples of formal and interdisciplinary entrepreneurship. The University of Sherbrooke (UdeS) is an exemplary case of an HEI that is mobilised and pragmatic about entrepreneurship education, with 20 years of experience. The UdeS approach focuses on promoting interdisciplinary platforms and putting together students from different faculties. Entrepreneurship students engage with real case studies in the area, functioning like a “student clinic”, and helping firms to resolve their challenges. The interdisciplinary approach allows the clinic to offer services in different subjects. They try to avoid competition with local professionals, actively trying to involve them in their efforts. The “clinic” – the capacity of entrepreneurship students to engage with the stakeholders – represents a great value for the community.

Box 2.2. Case study: Linköping University's (Sweden) formal entrepreneurship education

Linköping's doctoral course Entrepreneurship in Theory and Practice (ETP) was launched in 2006 by the Department of Management and Engineering. It primarily targets research students at the Institute for Economic and Industrial Development, but doctoral students in other fields at Linköping and from other universities may also apply. ETP has enrolled more than 200 PhD students in the 15 years of its existence. The course is an elective and has relied on "market pull" to meet enrolment requirements each year. The objective is that by the end of the course, participants shall be able to:

- discuss and reflect on the meaning of entrepreneurship in various settings and situations;
- formulate, develop and present a business idea for a new firm, organisation, process or project;
- co-operate with colleagues in other disciplines and fields of research during concept development;
- understand how an entrepreneurial approach can contribute to the development of the student as a researcher and teacher.

Evaluations of ETP courses in the last 15 years suggest there are four key components of good practice in entrepreneurship education: entrepreneurial teaching must *i)* offer inspiration, *ii)* provide learning tools, *iii)* assemble boundary-spanning networks and *iv)* take advantage of interdisciplinary activities. Experience has shown the importance of balancing theory and practice in attracting students from a wide range of scientific and technological fields.

Source: (OECD / EC, 2021[9])

Within UdeS, entrepreneurship education is becoming especially sought after by doctoral and post-doctoral students. Since only a small percentage of doctoral students will become academics (18%), it is important for them to acquire a more diverse set of skills, including entrepreneurial capabilities that may help them develop their own business. Entrepreneurship education is emphasised by the UdeS organisation, and the current rector is promoting entrepreneurship activities. An entrepreneurial HEI like Sherbrooke must face the challenge of mainstreaming entrepreneurship education throughout its different faculties and departments. The rector has experimented with a variety of ways to describe entrepreneurship education, to attract more students and create a neutral learning environment. This is a common challenge even in the US, where some HEIs use different terminology to increase the appeal of the subject.[3]

Polytechnique de Montréal (PolyMTL) offers a specialised programme in entrepreneurship for engineers, through the *Bureau de soutien à l'entrepreneuriat* (BSE). The BSE was created in 2018 at the specific request of the institution's leadership. At PolyMTL, 70% of the students aim to become entrepreneurs and in three years, the BSE had already attracted 1 200 students. BSE is open to all PolyMTL students, but can also accept individuals who are not part of the PolyMTL system. The specialised service for entrepreneurship in the institution offers students the advantage of proximity to engineers. Specialisation of education can help formalisation, since students belong to the same discipline and share the same culture, for example entrepreneurship for the health sector, artificial intelligence and other fields. However, the fragmentation of entrepreneurship education in the Montréal system may reduce the possibility of cross-fertilisation (transdisciplinary networks). Specialisation in entrepreneurship education also physically disperses the students, reducing spill-overs and the opportunity to create an entrepreneurial community.

Informal education and life-long learning in entrepreneurship

Informal learning opportunities can enrich an individual's understanding of entrepreneurship, outside the traditional format. They can complement formal activities or offer a direct link to the labour market, through

internships and competitions. Most HEIs in Québec offer extracurricular activities in entrepreneurship, but they are most commonly found in Cégeps

McGill University has mainstreamed entrepreneurship throughout its faculties by offering formal and informal teaching and learning opportunities. For example, entrepreneurship education activities can be co-curricular (instead of extra-curricular). Co-curricular education involves practitioners; it does not generate credits but offers direct access to the labour market and operational businesses. The Engine Centre, the entrepreneurship centre of the Faculty of Engineering, is a good example of informal support to entrepreneurs. The faculty and staff involved in these activities, including the entrepreneur in residence, meet every two weeks to demonstrate how their activities promote entrepreneurship and innovation. The Engine Centre's entrepreneurial activities are co-ordinated with the university's Technology Transfer Office, to generate linkages with external stakeholders and enhance the impact of McGill on external communities and networks. This practice is aligned with international trends (Box 2.3).

Box 2.3. Imperial Enterprise Lab (UK)

The mission of Imperial Enterprise Lab is to help students think outside the box, cross boundaries and dare to be different. It provides a space for activities such as student competitions, speaker events, hackathons, skills seminars, co-working space and expert mentors. It brings together people from different disciplines, cultures, backgrounds and life experiences to look at situations from new angles and solve problems. It supports the next generation of entrepreneurs and innovators at Imperial College London and promotes and nurtures entrepreneurial idea development from the student community through to the start-up level. Students become part of energetic and passionate teams, helping to generate the growth of new entrepreneurial ideas from science, engineering, medicine and business.

Source: (Imperial College London, n.d.[10])

Similarly, the Cégep of Trois Rivières co-operates with OSEntreprendre, which organises the "OSEntreprendre Challenge", a large-scale entrepreneurial competition at the local, regional and national levels. With its Student Entrepreneurship component, which recognises young people from elementary school to university, and its Business Creation component, which supports new entrepreneurs, it reaches more than 40 000 participants annually (CÉGEP Trois Rivieres, n.d.[11]). This is supported by the "*Plan Québécois en entrepreneuriat 2022-2025*", whose goals are to support entrepreneurs and encourage an environment that favors business growth (Gouvernement du Québec, 2022[12]). In particular, the OSEntreprendre initiative provides support for growing businesses.

In addition, some HEIs organise entrepreneurship education programmes in connection with lifelong learning activities and as part of collaboration with external partners. The Cégep of Victoriaville offers entrepreneurship education courses in agriculture. It maintains a close co-operation with ITAQ,[4] an institute specialised in agri-food technology, through teaching management skills for farmers. The programme focuses on management skills. It attracts considerable interest, but it also has high drop-out rates, because of the complexity of some subjects and also because farmers leave education once they acquire the competences they are looking for. Given the demand in the labour market, drop-out students are likely to be offered a job immediately. In addition, farmers do not necessarily need to fully develop their management skills, but to identify the business services they need and be able to evaluate their quality.

Entrepreneurship education adapts to the geography of the province

While entrepreneurship education has become quite common in all the Québec-based HEIs, there are differences in the way it is designed, organised and delivered, depending whether the HEIs are based in metropolitan or non-metropolitan regions. The regional typology of surrounding ecosystems can thus influence HEIs' collaborations (see Chapter 3).

Entrepreneurship in Montréal features through a metropolitan setting

Montréal is a post-secondary education hub, and one of the most important in North America, given its concentration of higher education institutions and post-secondary students. The Grand Montréal network includes four general (research-intensive) universities, and, notably, four institutes of engineering and scientific research (CCMM, 2016[13]). Montréal was the first-ranked Canadian city for students for 2023 by Quacquarelli Symonds (QS) (QS, 2022[14]).Montréal has become an innovation and entrepreneurial hub in Québec. Its relevance is also increased by its proximity to other entrepreneurial hubs in Canada and the United States (Toronto and Boston are Montréal's main benchmarks, and it has numerous collaborations with these and other metropolitan areas in the region). In the last ten years, the city has been increasingly developing its research and innovation potential. Montréal is specialised in several knowledge-intensive sectors, such as artificial intelligence; engineering, life science and medical technologies. It also benefits from the presence of different agencies supporting entrepreneurs and start-ups. As of 2020, it had more than 1 300 start-ups and 3 000 funders (Aduette-Lagueux et al., 2020[15]).

Centres for entrepreneurship, incubators and accelerators compose the Montréal ecosystem…

The Montréal ecosystem connects a wide variety of actors that support entrepreneurship in different phases of business development. The different actors specialise in different phases and tools. These support structures include (but are not limited to) Québecor's Millennium Initiative and the Centre for Entrepreneurship of Campus Montréal Université de Montréal, CENTECH and District 3, among others. These Montréal-based organisms are discussed in turn below.

The entrepreneurial activities of the Campus Montréal

At the University of Montréal, Millénnium Québecor is working to create a distinctive entrepreneurship support programme. Millénnium Québecor will support entrepreneurship in UdeM's student community and its pool of graduates, faculty and professionals and may also support projects from outside the university. The programme will have three main components. The first is awareness-raising; the second focuses on credit and non-credit courses to develop the entrepreneurial skills and knowledge needed to bring projects to fruition; the third is a support component, including a business incubator and an accelerator (Quebecor, 2021[16]).

The Centre for Entrepreneurship (CEuMontréal) serves all universities in Montréal and in particular the Campus Montréal. Established in 1998, it employs entrepreneurs who have decided to become coaches. The centre does not offer formal (curricular) education in entrepreneurship, and participating in CEu activities is free of charge. It has three main programmes: Datapreneur (AI); Innovinc RBC,[5] and Technopreneur. CEU is particularly active in supporting entrepreneurship for nurses, pharmacists, medical and paramedical professions, in which entrepreneurship or self-employment is common. It is also active in social entrepreneurship, for which demand has increased sharply since the COVID crisis, transforming the social dimension into one of the main pillars of CEu.

Centech

Centech started as the incubator of the *École de technologie supérieure* (ÉTS), the second-largest engineering school in Canada. The world-class business incubator, based in downtown Montréal, focuses on deep-tech and medical technology companies with high growth potential, particularly in the business-to-business market (including medical technology, manufacturing, telecoms and microelectronics). Centech is a non-profit organisation open to everyone (Open Innovation Challenges) and offers two connected support programmes for start-ups: the 12-week Acceleration programme, which is associated with the two-year "Propulsion programme", accessible to the best performers in the previous year.

Centech operates by focusing on technology readiness levels (TRLs) 4-6.[6] It adopts a "market pull" logic, in which inventors identify existing needs and problems and, based on their analysis, create ventures to solve these problems. This is the opposite of "market push", which attempts to introduce a given innovation to the market without considering existing needs or problems (Réseau Capital, 2022[17]). Centech identifies innovation with potential and tries to bring them to industrialisation and commercialisation, to solve a problem on the market. In Québec, the focus is on lower-level TRLs (R&D), with little activity in levels 4 to 6 levels and above.

Since 2018, Centech has also had its own open innovation lab, the Collision Lab (CL). This helps large companies and corporations to set up technology projects by interacting with start-ups and the local entrepreneurial ecosystem. Its choice of modus operandi is due to the fact that the pace of innovation is now so rapid that large companies need to connect with start-ups to keep up. An innovation policy that revolves around start-ups is more open than a system based on patents. In 2019, Centech was recognised by UBI Global as one of the most successful university incubators in the world. Centech has also worked with start-ups and large companies on the United Nations' Sustainable Development Goals (SDGs). A collaboration with the Port of Montréal focused on innovations to reduce pollution.[7]

District 3

District 3 (D3) is a community dedicated to collaboration, innovation and entrepreneurship in Concordia University in Montréal. It is not a formal entity of the university, but Concordia has consistently invested and developed the accelerator, which has become an important element in Montréal's entrepreneurship and innovation ecosystem. The innovation hub strives to: create a hub for all players in the Montréal innovation ecosystem to collaborate; help develop innovation and entrepreneurship skills for students, faculty and alumni; support teams and product development; and collaborate with Concordia's alumni as experts and mentors (Concordia University, 2022[18]). Financing for The Hub comes from three sources: investments from the university; from provincial entities; and from private grants.

Entrepreneurship education activities characterise also non-metropolitan Québec

Entrepreneurship also features in the province in the cities and rural areas outside the Montréal metropolitan area. HEIs are located in Québec City and Sherbrooke, and in rural regions like Saguenay-Lac-Saint-Jean (Chicoutimi), Gaspésie and Bas-Saint-Laurent (Rimouski). HEIs located in cities often have a close connection to Montréal, and in some cases, have a secondary campus located in the Montréal functional areas. HEIs located in rural areas operate in local ecosystems that are much more spread out. Their role is often more relevant in stimulating innovative and entrepreneurial dynamics. A peculiar feature of Québec are Cégeps and their network of college technology transfer centres (CCTTs). Many Cégeps and CCTTs offer entrepreneurial education and have created support structures to encourage entrepreneurship in the province.

The maturity of an ecosystem like Montréal's comes with a certain frame of reference and a way of evaluating the elements. Considering that the regions of Québec present levels of different maturity, it is not surprising to spot differences in entrepreneurship and skills (MAIN, 2020[19]).

Entrepreneurial and innovative HEIs are located in different cities in Québec. The Université Laval (based in Québec City) and Université de Sherbrooke, with about 40 000 and 30 000 students respectively, are relatively large, with a broad range of R&D activities, including in connection with Montréal-based institutions.

Québec City is the provincial capital (*Capitale-Nationale*). Because of its administrative status, the city attracts public and private investment and has become an important start-up hub. Various companies in Québec City make up its ecosystem, in sectors such as electronics, life sciences, communications technologies, artificial intelligence, financial technology, agricultural technology and photonic optics.[8]

Université Laval is the oldest higher education centre in Canada and one of the main research hubs in the country. The university mentions entrepreneurship in connection with its overall mission and conducts entrepreneurial activities through an entrepreneurial programme, *Entrepreneuriat Laval*, and an Entrepreneurship Centre. Initially, the entrepreneurial programme started supporting business creation. More recently, it has been transitioning towards a more inclusive approach to entrepreneurial education, aiming to develop the entrepreneurial mindset.[9]

The entrepreneurial ecosystem of Québec City can also count on several incubators and accelerators, such as Quantino and Le Camp (Box 2.4). It also hosts ECOLE 42, a private school that does not charge fees to enrolled students and provides training programmes in developing digital skills.[10] The school is known for its innovative approach to teaching, which is based on gamification of the curriculum, and for its admission criteria, which are not based on the curriculum or specific competences of applicants but on their personality and attitudes (mindset). ECOLE 42 provides students with tasks to solve through teamwork, incentivising transversal skills such as teamwork and planning, among other things, and connects students to jobs through internships in partner firms, which represent the clients of the school.

The University of Sherbrooke (UdeS), another HEI that has made entrepreneurship the core of its teaching, research and collaboration activities, is known for innovation. Its entrepreneurial trajectory has been influenced by the success story of Algebraic Code Excited Linear Prediction (ACELP), and the resources it has generated for UdeS have helped create a “culture” of collaboration and entrepreneurship. ACELP is used in more than 95% of cellphones on the planet, representing more than 6 billion users. The technology was developed at the University of Sherbrooke, whose Speech and Audio Research Group provided researchers in digital signal processing (Université de Sherbrooke, n.d.[20]).

Box 2.4. Incubators and accelerators and other entrepreneurship support structures present in Québec outside metropolitan Montréal

MAIN (Mirabel)

MAIN is a not-for-profit organisation that aims to strengthen the ecosystem of incubators and accelerators in Québec and increase its impact in the entrepreneurship and innovation development chain. It plays a pivotal role by: promoting collaborations between accelerators and incubators, in particular by ensuring more efficient management and sharing of resources, knowledge and practices created and mobilised in its network; increasing the number and quality of supported entrepreneurial projects, the level of service offered and the value created by the network; and by strengthening the representation of the network and the understanding of the role and impact of business acceleration and incubation in its entrepreneurial ecosystem (MAIN, 2022[21]). Among other activities, MAIN runs the *Espace de recherche* project in collaboration with the *Fonds de recherche du Québec – Santé* (FRQS). It is important i uncertainty n supporting a convergence of efforts in common spaces.

LE CAMP (Québec City)

Le Camp is an incubator/accelerator that focuses on support for technological start-ups. It draws on a wide variety of actors, including local and international businesses and organisations that support entrepreneurship. A network of high-level experts and mentors provide the support and knowledge necessary for the growth and sustainability of the province's start-ups (Camp, 2022[22]).

AED – Accélérateur entrepreneurial Desjardins (Sherbrooke)

The Desjardins Entrepreneurial Accelerator (AED) supports UdeS students to carry out concrete projects. As part of its coaching activities, it offers everyone the chance to realise their entrepreneurial projects. It focuses on collaboration, innovative pedagogical approaches and dynamic events.

Espace.inc (Sherbrooke)

Located in Sherbrooke, Espace.inc is an accelerator that identifies and accelerates the development of emerging entrepreneurial talents. Its network of entrepreneurial peers helps to support them over the long term in building innovative and sustainable businesses. The Espace-inc supra-regional accelerator model, recognised for its innovative practices and its impact on the entrepreneurs it supports across Québec, grew out of an economic development initiative by the city of Sherbrooke and a private non-profit organisation (NPO), the *Comité de promotion industrielle de Sherbrooke* (Sherbrooke Industrial Promotion Committee) in 2015.

ACET (Sherbrooke)

ACET is a technology business accelerator that helps entrepreneurs build the world of tomorrow by promoting innovative technologies with a positive impact on society. It focuses on young entrepreneurs, along three axes: *i)* identify and build innovative ideas; *ii)* support development; and *iii)* propel start-ups that have a positive impact on society.

Quantino (Québec City)

Quantino is a high-tech incubator specializing in optics, photonics, hardware, and medical and quantum technologies. It works with innovative high-tech, providing its incubatees access to first-rate facilities, state-of-the-art technology and world-renowned experts.

The province features a vast variety of incubators and accelerators, amounting to around 50 in all.

Source: (Quantino, n.d.[23]; Espace-inc, n.d.[24]; ACET, n.d.[25]; LE CAMP, n.d.[26]; MAIN Québec, n.d.[27]; AED, n.d.[28])

…and other HEIs operate in more rural settings

Québec is also home to HEIs that operate in rural areas with no large urban centres, where population densities are low. The University of Québec at Rimouski, UQAR, actively promotes entrepreneurship, providing entrepreneurship education to students, alumni and adults looking for new professional opportunities. Entrepreneurship education is based in the business school and has a relatively narrow focus. The UQAR has specialised in marine biology and generated a successful local ecosystem in this field (see Chapter 3), but its entrepreneurship education activities do not reflect such specialisation. UQAR also hosts its entrepreneurial centre, *Entrepreneuriat UQAR* (EUQAR), a University Centre for Entrepreneurship Activities (CEU). The centre offers consulting service and support for the ideation, pre-start-up and start-up phases, offered exclusively to students and recent graduates (within less than two years), for all levels of education studies and for all fields.[11]

The University of Québec in Chicoutimi (UQAC) is also active in entrepreneurship. Situated where the Saguenay and Chicoutimi rivers meet in the north of Québec, it specialises in the "open air" and research programmes on Indigenous peoples. Through its *Centre d'entrepreneuriat et essaimage* (CEE), it promotes entrepreneurship and supports business creation in the communities of Saguenay-Lac-Saint-Jean. Whether to carry out a market study or undertake a business plan, the CEE-UQAC supports future entrepreneurs in their entrepreneurial projects.[12] UQAC also offers a programme of *intervention plein air*, a programme in civil engineering and wood construction, and a programme in *éco-conseil* (ecological consultancy). It also has programmes on minerals and aluminum. These are typical examples of place-responsive processes for building entrepreneurial capacity and realising business opportunities in economic sectors that feature the community where the HEIs is located and in which its teaching and research activities can specialise.

Cégeps are also very important in rural Québec, as they actively promote entrepreneurship and support innovation. The Cégep of Victoriaville, between Québec City and Montréal, offers entrepreneurship education courses in agriculture. It has a close relationship with ITAQ,[13] a Cégep specialised in agri-food technology that teaches management skills for farmers. The Cégep of Saint-Jérôme also offers extracurricular activities through its new entrepreneurship centre, the *Quartier Général de l'Audace*.[14] Since 2020, the Cégep has organised extra-curricular activities through the centre and attracts people from different profiles, including second-generation entrepreneurs, with a specific focus on promoting intrapreneurship and re-start-up (*reprise d'entreprise*, including outside family ownership). The centre is now monitoring all its activities to collect information and keep track of its own impact. Monitoring and evaluation could help mainstream entrepreneurship education, which is still extracurricular in most Cégeps.

Towards a holistic and broader approach to entrepreneurship education

An ecosystem approach to entrepreneurship can unlock Québec's potential…

Provincial policy is building on entrepreneurship to promote innovation and sustainable growth in Québec. At the ministerial level, the Ministry of Economy, Innovation and Energy (MEIE) and the Ministry of Higher Education (MES) support entrepreneurship in HE. The *Stratégie québécoise de recherche et d'investissement en innovation* (SQRI2)[2] has mobilised provincial investments for innovation and entrepreneurship. The MES is increasingly placing emphasis on entrepreneurship education and activities. The aim of the recent reforms is to facilitate the accreditation of degree and creation of new programmes by reducing bureaucracy. The aim is to generate skills that match jobs and fuel new growth opportunities. Recent efforts already show that the province is heading in this direction. Promoting entrepreneurship education in HEIs (Cégeps and universities) can be a way to better connect teaching and learning activities with the needs and potential of localities. Against this backdrop, local authorities can play a larger role in providing the community perspective and in supporting HEIs and entrepreneurship.

Several cities in Québec have developed their own start-up network. These are not yet structured into a fluid collaborative and connected across the province, since the regions are at different levels of maturity and the points of connection are not formalised. These elements lead to duplications and discrepancies in support actions from the point of view of the start-up, which can have different effects on start-ups in different places.

The entrepreneurial ecosystem in Montréal, while lively, is somewhat fragmented due to the lack of space and a lack of policies to encourage collaboration between the different entities (Aduette-Lagueux et al., 2020[15]). This fragmentation can pose problems. Montréal-based HEIs have replicated structures to support entrepreneurship, specialising entrepreneurial education for different disciplines (for example, engineering, medicine and business). Dividing up entrepreneurial education in this way can result in further divisions, making it more difficult to generate transdisciplinary platforms, one of the main characteristics and advantages of entrepreneurship education. Moreover, the fragmentation of different actors can also create problems for scale, as this leads to a proliferation of smaller structures.

…while expanding the understanding of entrepreneurship

Entrepreneurship policy in Québec may be understood primarily through business creation, in deep-tech sectors. Many of the support structures, such as incubators and accelerators, focus on developing technological and deep-tech start-ups. Structures specialise in different technology readiness levels (TRLs). Similarly, studies of the Montréal and the wider Québec ecosystems focus on start-ups within the technological domain.

The rapid success of the Montréal ecosystem serves as an example of innovation and growth. The experience of *the Institut québécois d'intelligence artificielle* (MILA), which has achieved international visibility, serves as a good practice for how to connect entrepreneurship education in all fields. However, it is important to consider the commercialisation dimension and to have a broader understanding of the entrepreneurship dimension, beyond deep-tech.

A broader approach may be beneficial to capitalise on the current positive trend in Québec. In particular, increasing the number of individuals with entrepreneurial (transversal) skills can have a positive impact on skills, helping to upskill individuals and reduce turnover of employees. This, in turn, could increase productivity. In addition, individuals of an entrepreneurial mindset can be more tolerant of uncertainty and better able to engage with multitasking.

Widening the perspective of entrepreneurship can allow development of all localities, regardless of their metropolitan or rural characteristics. For instance, investment from provincial government often goes to large research universities, while Cégeps, and connected CCTTs, receive limited funding to promote innovation and entrepreneurship in co-operation with their communities. Regional HEIs are already showing progress in introducing social innovations in their regions.

Mainstreaming and formalising entrepreneurship education can be a way to generate new education programmes and to attract students who would otherwise not go to college. Entrepreneurial training, whether formal or informal, is offered in all case study HEIs, and the evidence shows that they continue to adapt their training to their territories. Further integration of such formal and informal training can provide benefits to students and future employers in the province.

Incentives for collaboration may help to anchor entrepreneurial ecosystems

Incentives to collaborate for researchers and professors, whether financial or in terms of career advancement, are a key way of encouraging collaboration between HEIs and potential partners. From this perspective, Québec faces a challenge that is common elsewhere: linking entrepreneurship to the HE evaluation framework and incentive systems. As the HEI Leaders Survey shows (Chapter 1), the most common form of incentive for CCTTs/Cégeps and universities for external collaboration is by adding

collaboration as a criterion in granting promotions. However, while frameworks reward external collaboration in terms of career incentives, HEIs may still be in the process of reflecting this in terms of career support (see results of survey in Chapter 1).

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Notes

[1] "Unicorns" refers to privately held start-up companies with a value of over $1 billion.

[2] For more information on the EntreComp Framework: https://publications.jrc.ec.europa.eu/repository/handle/JRC101581#:~:text=Developed%20through%20a%20mixed%2Dmethods,'%20and%20'Into%20action'.

[3] For more information: https://www.kenan-flagler.unc.edu/faculty/directory/vinayak-deshpande/.

[4] For more information: https://www.itaq.ca/.

[5] For more information: https://ceuMontréal.ca/nos-parcours/innovinc-rbc/.

[6] For more information: TRLs 4-6.

[7] For more information: https://centech.co/collisionlab-membres-histoires-a-succes.

[8] For more information: https://start-upqc.com/en/.

[9] La Centrale is the incubator of the university, consisting of physical spaces within the university (that students can reserve, free of cost). The incubator also offers counselling services, with 24 counsellors available, and focuses on business creation.

[10] Ecole 42 is a school providing training programmes for young individuals to develop technical skills (in the digital domain), as well as transversal skills. Based on the French model, it provides a good practice for entrepreneurial education for students. Individuals are asked to solve problems and tasks in group settings, without the guidance of a teacher and/or professor. However, as of now, the programme offered by Ecole 42 is not officially recognised. Participants for now receive a "certificate" for their participation. A working/focus group has been set in place, with the participation of MES and other private actors to establish the legality of certificates and have them recognised officially by the MES.

[11] For more information: https://entrepreneuriat.uqar.ca/.

[12] For more information: https://ceeuqac.ca/?fbclid=IwAR0OfRkBFo2hMdshnfxVzV2Vr9hcYIkgoSBAWI-sHK3LoVNXq00jQTWBbY8.

[13] For more information: https://www.itaq.ca/.

[14] For more information: https://www.cstj.qc.ca/quartier-general-de-laudace/.

3 Higher education institutions in entrepreneurial ecosystems

Collaboration with wider society is a prominent feature of Québec's higher education system and institutions. The provincial innovation strategy leverages this to create entrepreneurship ecosystems. This chapter illustrates this dynamic and discusses the opportunities and challenges ahead for promoting sustainability and inclusiveness.

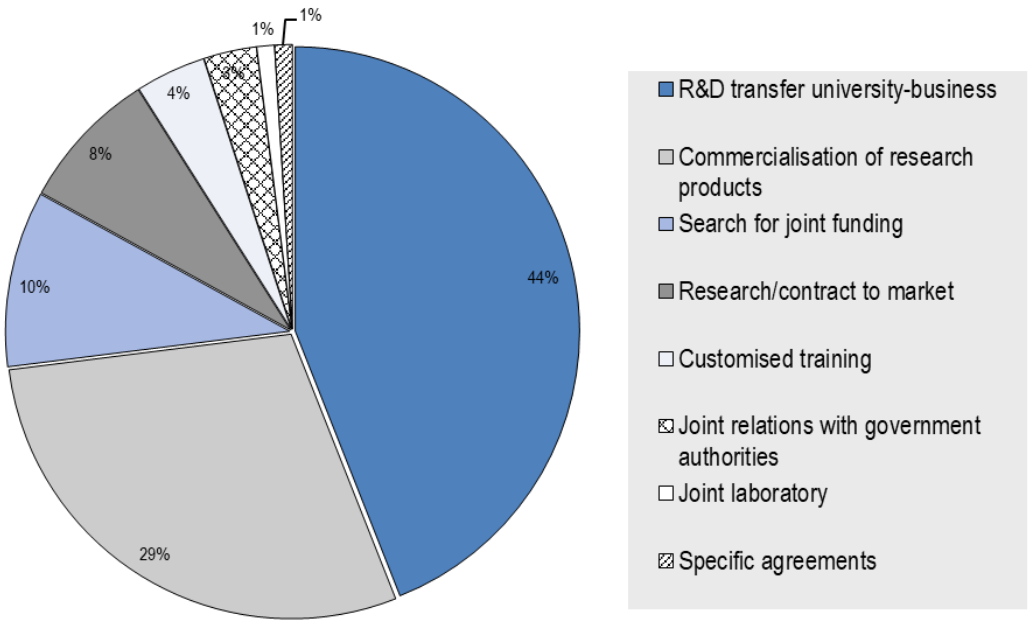
Québec's HEIs are invested in collaborating with their regional ecosystems. Their propensity for collaboration relies on a variety of factors, including for instance, the increasing importance of entrepreneurship in higher education as a specific mandate, as demonstrated in the University of Québec network, and the function of promoting skills in regional communities, as in the case of Cégeps and CCTTs. Québec HEIs have played a pivotal role in the creation of entrepreneurial ecosystems, through incubators and accelerators that support local entrepreneurs and firms. The positive trend in entrepreneurship in the province has a spatial component, and its "entrepreneurial ecosystems" are flourishing. Further incentives for researchers and professors, and better organisation of resources, activities and aims, can spur collaboration and help institutions to become more "place-responsive".

Québec HEIs have a tradition of collaboration with their ecosystems

In general, Québec HEIs collaborate successfully with their regional communities. Collaboration occurs in different forms. HEIs may offer training and education programmes to meet regional labour market needs and opportunities; they engage in applied research and knowledge transfer services to support innovation in regional industries; they offer entrepreneurship education to help students and researchers create local businesses and engage with social entrepreneurial opportunities; and they generate social innovation, enhancing cohesion, trust and inclusion. In Québec, the most typical university-business interactions involve technology transfer and R&D (Figure 3.1). Product commercialisation; co-financing and market research, are also common formats of collaboration.

Figure 3.1. Themes in university-business collaboration in Québec, according to firms

The share of themes representing partnerships between universities and businesses



Source: (Adam, 2016[1])

In Québec, as in the rest of Canada, firms located in a radius of between 10 to 25 kilometres from HEIs are more likely to co-operate with them in R&D projects (measured through R&D expenditure), benefiting from knowledge spill-overs. The province displays slight differences with the Canadian average when taking into account the size of firms collaborating with HEIs, which tend to be larger. This difference may depend on the human geography of Québec, which has denser networks of cities and rural villages than the rest of Canada. On average, more people per square kilometre live in rural Québec than in rural Canada.

Box 3.1. Innovative tools to assess the "geography of higher education": Statistics Canada's Linkable File Environment

Recent research on measuring the impact of knowledge transfers on regional innovation ecosystems in Canada showcases the use of such innovative statistical tools as the Linkable File Environment (LFE). The LFE links a wealth of survey, administrative and census data on the Canadian business environment. It positions these surveys and administrative data to support longitudinal and cross-sectional analysis and offers opportunities to use additional variables to assess entrepreneurship, employment, productivity and competitiveness. The objective is to update the linked files with the most recent year of available data for the various sources, providing a longer series of data for longitudinal and cross-sectional analysis.Using detailed geographic information from different data sources, the LFE can connect data of a specific HEI and specific firms at the micro level to measure the effect of knowledge spill-overs on regional innovation.

Source: (Statistics Canada, 2021[2])

Factors that facilitate collaboration between Québec HEIs

Different factors affect HEIs' propensity towards collaboration in Québec. The increasing importance of entrepreneurship in higher education was discussed in Chapter 2, and all case-study HEIs visited in Québec actively support entrepreneurship. In some cases, the engagement with entrepreneurship has affected the organisation of the institution, making it more likely to engage with its ecosystem. This tendency was particularly strong in certain places. Montréal is becoming an entrepreneurship hub, thanks to its HEIs' capacity to generate incubators and accelerators that play an important role in the metropolitan ecosystem. Most Montréal-based incubators are opened to all entrepreneurs and start-uppers, including those who are not linked to HEIs. In addition, the provincial government is co-investing in several of these, including the Campus Montréal in the city, and generates such visible structures as Campus Mil.[1] The best example of the capacity to connect excellent academic research with entrepreneurship and business services provided to the ecosystem is MILA (see below), which is many things at once: a research centre specialised in both basic and applied science, an incubator and a partner for local businesses operating in AI technologies. MILA, notably, emerged from a collaboration of different Montréal-based HEIs, including both the French-speaking Polytechnique of Montréal and English-speaking McGill University.[2]

Entrepreneurship also features collaboration in non-metropolitan Québec. Entrepreneurial HEIs in Sherbrooke and Québec City offer services to entrepreneurs and firms of all sizes and maturity within their own communities and networks. In Sherbrooke, the UdeS supports entrepreneurs and firms through organisations like the *Groupe de partenariats d'affaires* (GPA). Sherbrooke Innopole is the local economic development organisation promoting high-value-added economic activities. UdeS plays a pivotal role in setting up the Innovation Zone of Sherbrooke Innopole, a provincial policy promoting knowledge-intensive businesses in non-metropolitan Québec. GPA connects innovation needs of local businesses with research activities at UdeS. It manages, on the one hand, to overcome the mistrust of businesses of the

possibility of applying academic research, and on the other hand, academic researchers' resistance to engage with applied research that does not generate opportunities for publication. According to local stakeholders, the presence of the GPA in the local ecosystem makes Sherbrooke more attractive for businesses. The GPA is a project of the City of Sherbrooke and of MEIE (funders) and is hosted by the UdeS. It has a yearly budget of CAD 1.3 million.[3]

Some factors supporting the collaboration of HEIs are peculiar to Québec. For example, some HEIs are specifically designed to provide tailored services to their own communities. That is true of the University of Québec (Université du Québec) network, created in 1968, which encompasses 10 provincially run public universities, mostly in smaller cities surrounded by rural areas. In total, this network enrols about 90 000 students and co-ordinates over 300 programmes. These provincial universities have the explicit role of facilitating access to higher education for all, regardless of their location in Québec, and promoting regional economic development through their research and collaboration.

Cégeps are another example of HEIs that are specific to Québec. Cégeps are publicly funded colleges that offer academic, technical and vocational programmes. They are connected to academia, in that they offer two-year programmes that are required to access university education. They can also offer technical and vocational programmes, including three-year professional programmes, micro credentials and adult education. When engaging in these areas, in particular, Cégeps tend to reflect the needs and opportunities of the local productive sector. For example, the Cégep of Saint-Jérôme has a well-developed lifelong learning centre. With 25 staff, the centre partners with local firms to identify skills needs and generate training opportunities accordingly. Co-specialisation of teaching and training helps increase collaboration activities, which are carried out mostly by CCTTs.

These centres of applied research offer technical support, training and specialised information to the local business sector and in particular to small and medium-sized enterprises (SMEs), which represent 61% of CCTTs' partners, on average (Gouvernement du Québec, 2013[3]). CCTTs are specialised in productive sectors, with the goal of generating applied research and support for businesses in the industry that the local productive sector specialises in. CCTTs echo international models, especially from countries where professional higher education is particularly well-developed, such as Inspire AG at the Swiss Federal Institute of Technology in Zürich (ETHZ) (Box 3.2). The interesting feature shared by CCTTs and Inspire AG is the space they occupy in the division of labour between academic institutions and industry. Both Inspire AG and CCTTs are intermediary organisations, staffed with non-academic scientists and engineers. Such staff has a particular profile, different from academic researchers'. They not only have the incentives, but are highly motivated to work with (and even within) companies, and SMEs can benefit. However, the academic environment is not far and many potential connections – through PhDs, postdocs and faculty engagement, allow academic research and knowledge to spill over to the intermediary institution and eventually to the SMEs.

Sectoral specialisation of CCTTs can vary in capital-intensive or in more traditional sectors, related to craftmanship or farming. For instance, the Innovative Vehicle Institute, the CCTT in Saint-Jérôme, promotes specialisation in the automotive sector, capitalising on the regional specialisation of the Montréal functional area, to which Saint-Jérôme belongs. Another example is the *Centre d'innovation en ébénisterie et meuble* (Centre for Innovation in Cabinetmaking and Woodworking, or INOVEM), attached to the CÉGEP of Victoriaville, which generates applied research, technical assistance and business training in the production of furniture and other wood products.

In general, CCTTs are in a positive cycle. The increasing number of clients (with a growth rate of 19% between 2016-2017 and 2020-2021) and the growth of income they generated (a growth rate of 56.9%,[4] in the same period) are indicative of the relevance of this network of organisations for the regional economy. Collaboration activities take place in the surrounding community of CCTTs. For instance, 36% of partnerships with enterprises of the CCTT in Trois Rivières – *the Centre de métallurgie du Québec* (Quebec Centre of Metallurgy, or CMQ) – are within a 5-kilometre radius. Thanks to these trends, the

provincial government is encouraging CCTTs to increase the share of funding they obtain by selling their products and services to businesses. This may generate opportunities for reorganising and reorienting the activities of some centres, by diversifying what they offer to entrepreneurs and firms of every size and maturity.

Box 3.2. Inspire AG – a case study: "*Coasean*" entrepreneurs and responsive professors (Switzerland)

The history of Inspire AG is the story of the formation and development of a Coasean institution – an alternative institutional form that provides a solution to certain market and co-ordination failures – in the area of knowledge and technology transfer. Inspire serves to maximise knowledge and technology transfer from a research institute in the Federal Institute of Technology of Zürich (ETHZ) to the surrounding SMEs. Inspire is a small organisation, composed of 6 ETHZ professors, 60 employees (mostly senior scientists and graduate students) and 10 research groups. In 2017, it ran about 70 projects of knowledge and technology transfers.

Partnerships between an SME and an Inspire research group are directly funded by the SME or subsidized by the federal innovation agency, which can cover up to 50% of the costs. Part of the turnover (27%) is also government-supported (under *la loi sur la recherche*, LERI Article 15) and 6% is ETHZ contribution in kind (time spent by the six professors on oversight and co-ordination).

Inspire thus offers an interesting innovative design, which can greatly increase the responsiveness of a university towards SMEs' needs and opportunities, by solving the two main obstacles. First, it cancels out the disparity in motivation and interest between professors and SMEs, since professors stay in the background, so to speak, and the main contact partners of the SMEs are the research groups. Second, Inspire provides university research with access to a critical mass of projects, cases and opportunities, which makes them (and the SMEs) an interesting partner for ETHZ.

Source: (Inspire AG, n.d.[4])

Intermediary organisations and policies support all HEIs in connecting to stakeholders

Additional factors supporting the collaboration agenda of Québec HEIs are entities and policies put in place by the federal and the provincial government. For example, Mitacs is a federal non-for-profit organisation operating in Canada since 1999 with the purpose of stimulating innovation by driving collaboration and facilitate access to skills and talent. Via various programmes of internships, it connects students (from undergraduates to post-doctorates) of Canadian post-secondary institutions (colleges, polytechnic, and research universities) to external organisations, including businesses, hospitals, municipalities and non-for-profit organisations, to generate solutions to real-world challenges and support job placement.[5] Mitacs has developed several research and innovation programmes and has expanded its original focus on applied research in the field of STEM and social innovation. Importantly, Mitacs has developed specific programmes to support entrepreneurship and transversal skills in higher education (Box 3.3). It benefits from the support and funding of the federal and provincial government through Innovation, Science and Economic Development Canada (ISED), which invested CAD 708 million in 2021 in funding over five years to create 85 000 innovation internships. In addition, under the *Stratégie québécoise de recherche et d'investissement en innovation* 2022-2027 (SQRI2), an additional CAD 60 million from the provincial government has been committed to the Mitacs programme.

In fact, support from provinces is key to Mitacs' success. In Québec, the MEIE contributes on average to 24% of a Mitacs-supported grant, and the partner enterprise to 50%. Mitacs has offices in regional centres

(Montréal, Ottawa, and Toronto) as well as representation across the country, usually under the form of advisors, based on university campuses (MITACS, n.d.[5]).

Box 3.3. MITACS supporting entrepreneurship and transversal skills

Mitacs supports entrepreneurs in higher education as well as transversal skills to promote an entrepreneurial mindset and empower students in relation to the future of work.Mitacs Entrepreneur International (MEI) links start-ups to Canadian HEI's incubators and accelerators that are connected to international networks. They also provide financial support to help with business travel costs. The objective is to help entrepreneurs seek market opportunities abroad and access foreign investment opportunities. Due to the COVID-19 pandemic, the programme's growth for the 2021-22 fiscal year was moderate, with only 28 MEI internships delivered, although this number is expected to increase. In an exit survey, entrepreneurs who participated in the programme reported a 29% improvement of products and services and a 42% increase in attracting investments. In addition, 84% of participants also noted that they received enquiries from investors and partners over the course of the programme.

Mitacs also offers students in Québec and Canada access to special training through courses, workshops and networking events. It offers courses in transversal skills, particularly in project and time management, career planning, R&D management skills, networking and leadership skills. The number of participants in such training programmes has increased continuously since 2016, with a surge in attendance during the pandemic, as courses were offered online. In addition, Mitacs collaborates with the Innovation and Impact network of Canada (I-INC) to enhance knowledge transfer through different initiatives, such as the Lab2Market program, a 16-week programme for graduate, postdoctoral and faculty that provides training to support start-up creation, commercial development and IP development.

Source: (MITACS, n.d.[5])

The Québec government is also active in promoting the collaboration and entrepreneurial agenda of all its HEIs. One of the major initiatives is Axelys, a non-profit organisation that is the main technology transfer and knowledge exchange vehicle in Québec. The provincial government created Axelys in April 2021, by streamlining and centralising the offer of technology transfer services (TTOs) stemming from public research. Axelys is governed by a board presided by the Innovator in Chief of Québec – and is therefore connected with overall provincial innovation strategy and the *Conseil de l'Innovation*, as noted earlier. In a simplified way, Axelys is responsible for promoting transfers between HEI and industry in terms of public research. Beyond technology transfer, its mission includes the development of entrepreneurial ventures stemming from public research, and knowledge exchange of non-technology, social and cultural, innovations. It has deployed CAD2.8 million of funding to collaborative projects to support such mission. They created and led a roundtable where all relevant stakeholders including FRQ, incubators and accelerators, VCs, work on developing a number of new initiatives to promote and grow scientific entrepreneurship, including an awareness-raising activity program. Their "innovation brokers" are agents dispersed in HEIs and can play a role in promoting an entrepreneurial culture within these institutions.

In the vision of the provincial government, and in line with the SQRI 2, "*Axelys will enable Québec companies to improve their competitiveness, increase the number of start-ups, create good jobs, and adopt more innovations that will have an impact on the well-being of Québec's society*" (Société de valorisation et de transfert du Québec (SVTQ), 2021[6]). Axelys focusses on science-based ventures (graduate scientists and researchers) and uses both "push" and "pull" approach to innovation. Push, "idea-driven", is the main approach used by Axelys where it looks for IPOs in HEIs and other PRBs and mobilises its resources to transform these ideas/prototypes/startups into actionable innovations and commercialise them. Axelys increases the value of academic research results by developing an appropriate IP strategy, analysing market opportunities, and financing the later stages of R&D to create high value products or

prototypes. These innovations can then be licenced or sold to companies, but they can also serve as a basis for the business model of a startup company. Such academic startups are then eligible to VC funding, notably to Eureka, a novel CAD 100 M pre-seed venture fund capitalized by the Québec government. The aim of Axelys is to double the number of start-ups in universities and PBRs, in five years. Whereas in the pull approach, Axelys offers to industry and community the possibility to work with their partner research institutions that can offer their expertise and solutions to develop solutions to economic (industrial) and societal problems. Once fully operative, Axelys funding system would be a mix of public and private funding, with the former generating 80% of overall funds. Axelys reflects an international trend supporting the commercialisation of innovation to generate economic development and social benefits. the Axelys model aims to support the commercialisation of academic research results. Other models in the world have gone even further, for example Vinnova in Sweden., which supports the commercialisation of academic research results (Box 3.4).

Box 3.4. Case Study: Vinnova (Sweden)

Vinnova is a Swedish agency under the Ministry of Enterprise and Innovation. With its offices in Stockholm and Brussels, it is also serves as the Swedish contact for the European Union (EU) Framework Programme for Research and Innovation. The agency has around 200 employees and generates long-term visions and strategies for the Swedish research and innovation system. Vinnova encourages the collaboration between universities, industry, public organisations, civil society and others, with a view to international diversification.

In fulfilling its mandate to support innovation, Vinnova finances early-stage innovation ideas. These often entail great risk and require government aid. Thanks to the support of the agency, businesses and other organisations are able to test new ideas before they become profitable, which helps promotes the general propensity towards innovation in the system. Vinnova has an annual budget of approximately EUR 280 million, most of which is distributed to a selection of the many funding proposals submitted. Funded projects are continuously monitored.

Innovation has a better chance when knowledge and skills in different fields can interact and create new, interdisciplinary fields. This is why Vinnova focuses on stimulating cross-collaborations among universities, research institutions, industry and public services. In addition, it supports research to identify solutions to emerging social challenges, such as the ageing population, or the energy transition and sustainability agenda.

Source: (VINNOVA, n.d.[7])

HEIs can help boost the results of innovation. The increased investment in research creates further avenues to promote local collaboration to boost local development. HEIs in Montréal create spill-overs for the locality within the specialised sectors – artificial intelligence, engineering, life sciences – in collaboration with strong players. This can turn into local growth. In turn, HEIs in the rest of Québec create spill-overs in collaboration with external partners. Nevertheless, evidence of their impact is limited.

Finding the right balance between excellence and co-specialisation in regional ecosystems

Reflecting an international trend, collaboration activities of Québec HEIs reflect the features of the ecosystem in which they operate; collaboration agenda of HEIs located in metropolitan areas differs from those in places were there is a lower density of inhabitants and economic activities tend to be more

specialised (Kempton, 2015[8]; Goddard, Kempton and Vallance, 2013[9]). Because of its human geography, and the importance of the rural dimension in the economy and society of Québec, the province represents an ideal case study to discuss the role of place responsive HEIs and the "geography of higher education"[6]. By "spatialising" the analysis, it is also possible to identify common challenges that all HEIs face when trying to fill the gap between research and innovation (through entrepreneurship) in their communities. Québec HEIs are distributed all over the province, in the metropolitan area of Montréal as well as in non-metropolitan regions, which can be divided in turn into cities and rural places.

Innovation leaders in the Montréal metropolitan area

The metropolitan area of Montréal features diffused innovation, with booming start-up dynamics (see Chapter 2). Its entrepreneurial ecosystem is well developed, and it is based on 18 HEIs, including universities and colleges, incubators and accelerators and other entities supporting innovation and entrepreneurship in different forms. Several of the HEIs that operate in this ecosystem are established as research poles, offer a wide variety of programmes under an interdisciplinary lens, and compete and connect with a broad international network of champion HEIs.[7]

Montréal-based large research universities, because of their size and the high density of stakeholders in their community, can mobilise professional resources and functions that specifically support the collaboration and entrepreneurial agenda.[8] For instance, the University of Montréal (UdeM) is expanding from its historical location on the Mont Royal to create a new campus. The goal is to increase interaction between the university community and MILA, in particular, which will be integrated into the new spatial organisation of the UdeM. The campus will also house Millennium Québecor (see Chapter 2), supported by a private donation, which aims to promote entrepreneurship education in the Montréal ecosystem. The localisation of the Campus Mil in the area adjacent to the digital cluster (Montréal being one of the world capitals of the video-game industry) suggests an intent to generate knowledge spill-overs and a vibrant start-up environment. Surprisingly, however, these initiatives appear to be poorly co-ordinated with the local government[9] and are not wholeheartedly supported by the local population. The Campus is located in one of the most impoverished areas of the city, and local households are facing gentrification, with the recent increase in real estate prices and property taxation.

Another important player in the metropolitan area is HEC Montréal. HEC (*Hautes études commerciales*) is a leading business school in North America that has developed a successful programme in entrepreneurship that reflects the characteristics of the local ecosystem.[10] HEC specialises in supporting family businesses and "reprenariat", where university-trained entrepreneurs take over established businesses. On this topic specifically, *l'Observatoire de la base entrepreneuriale*, is a center for research, reflection and exchange on entrepreneurship, business creation and SME takeovers. In addition, HEC is specialised in entrepreneurship in the health system (in hospitals and other types of health centres), one of the main specialisations of the Montréal ecosystem. HEC also houses an entrepreneurship observatory that produces a report and a certification service for incubators (HEC Montréal, 2023[10]; HEC Montréal, n.d.[11])

Another good example of this dynamic is McGill University's Technology Transfer Office (TTO). McGill has started considering patents and inventions in the internal evaluation of its faculty. This is an important step in encouraging collaboration and helping researchers to commercialise the fruits of their research activities. The TTO supports faculty facing the trade-off between publishing and patenting – for instance by offering the possibility of temporary patents.

The HEIs in Montréal differ in the clientele they serve and in their specialisation. HEC, for example, is focused on the Québécois entrepreneurship ecosystem, while McGill tends to have a broader, more international focus, building connections with alumni who have created successful businesses, sometimes outside Québec.

Montréal benefits from the extensive investment in biopharmaceuticals and medical technologies. The city has a critical mass of specialised companies, prestigious educational institutions and centres of excellence. This rich, dynamic environment is particularly conducive to the creation of scientific and industrial partnerships, which have access to a huge pool of talent for developing and commercialising drugs, technologies and other cutting-edge products (Montréal International, 2022[12]). The Greater Montréal area has several other assets in play. A world leader in artificial intelligence, it has attracted a growing number of companies interested in taking advantage of the expertise and networks in place to advance their research activities in life sciences and health technology (Montréal International, 2022[12]).

MILA, the Québec AI Institute (originally Montréal Institute for Learning Algorithms) is the most important attractor of talent in the Montréal area. It is a collaboration between McGill and Campus Montréal (University of Montréal, Polytechnique of Montréal and HEC Montréal), and involves 875 researchers, split into two groups. One is dedicated to basic research (a sort of fellowship mostly based on academics) and the other focuses on applied research and is directly employed by MILA. MILA depends on co-operation with business. Companies pay a fee to have access to MILA's research and the possibility of generating more structured collaborations. In this way, the private sector can support curiosity-driven research but also engage in proof-of-concept activity. Its star researchers make MILA visible and attractive at the international level, but the "extension" structure allows MILA to collaborate with the private sector. MILA actively supports entrepreneurship and generates start-ups that can benefit from using its accelerator, MILA Entrepreneurship Lab (MILA, n.d.[13]). MILA has been inspirational for Québec policies trying to improve its development (which has given the centre a pivotal role in the provincial innovation strategy) and replicates the experience in other sectors/territories. Similarly, IVADO, the provincial research institute in artificial intelligence, is a Québec-wide collaboration in digital intelligence, AI and machine/deep learning, dedicated to transforming new scientific discoveries into concrete applications to benefit society. IVADO received CAD 86 million from the federal government in 2016, under the federal programme Apogée, in line with local HEIs' decision to specialise in AI.[11] IVADO will receive an additional CAD 120 million in the next phase of the project. It is active in education, research and technology transfer, and has a programme in entrepreneurship that assists researchers to become entrepreneurs (Scientist in Action) or to contribute to existing businesses (Scientist in Residence). These activities are inspired by I-Corps (extension services).

From March to June 2022, the 13 participating SMEs completed the first phase of "Looking to Data", a training curriculum in digital intelligence, for which Investissement Québec (IQ) called on IVADO for its access to state-of-the-art knowledge and recognised experts on data science and AI. While the impact of this programme is slight, due to the limited number of SMEs involved, it shows the possibility of connecting AI with different sectors, including traditional ones, to improve innovation capacity and the productivity of firms of all size and maturity.

HEIs in non-metropolitan Québec

HEIs in urban areas

Québec has a network of cities that include Québec City (the *Capitale-Nationale*), Sherbrooke, Trois Rivières and other cities of national relevance. Important economic poles, they enjoy good regional accessibility and, in some cases, direct linkages with the Montréal area. These cities are home to HEIs such as Laval University, which is the oldest in the province, the University of Sherbrooke – both case studies in this report – and several Cégeps and CCTTs.

HEIs located in these cities have developed knowledge exchange activities that meet the specific needs of their communities, which tend to be less economically diversified than the metropolitan area of Montréal and have a less dense productive fabric. Against this backdrop, HEIs can respond to local stimuli while remaining connected with international research networks.

The University Laval is good example of this capacity to operate both internationally and regionally. On the international front, the university contributes to the Sentinelle Nord (SN) programme. This strategy encourages a convergence of expertise, transformative research, development of new technologies and the training of a new generation of interdisciplinary researchers aimed to improve understanding of the northern environment that characterises some regions of Québec. SN brings together a vast network of researchers from more than 40 departments at Université Laval, who work closely with northern organisations, public and private sector bodies, as well as other universities and research institutes in more than 20 countries (Laval University, n.d.[14]). As for the regional level, the university is piloting a model of a "squad", a team of a limited number of researchers dedicated to searching for collaborations with the universities' surrounding ecosystem. The researchers' responsibility is to search actively for private and public partnerships in which the university can play a key role. Laval University is also engaged with the scientific entrepreneurship initiative of the *Fonds de Recherche du Québec* (FRQ) and V1Studio, part of the new Axelys framework.

Sherbrooke also offers noteworthy examples of the capacity to connect to the local ecosystem while generating relevant international research and breakthrough innovations. The UdS is one of the main players in the development of the local Innovation Zone in quantum sciences, one of the main pillars of the provincial innovation strategy (see detailed discussion in the next chapter). The UdeS co-operates closely with local authorities to react to economic downturns (for example, the de-industrialisation that Sherbrooke has suffered in the past decade) and generate innovative development scenarios for the community.

HEIs in rural communities

Québec is also home to HEIs that operate in more rural settings. The economic fabric of these regional urban centres tends to be specialised in a given sector, often connected with resource-based activities. As noted earlier, the provincial government created the system of the University of Québec specifically to provide access to higher education in these rural communities and to promote local economies.

This report assessed several case study HEIs in to this category. The University of Québec in Rimouski, a relatively small HEI with a student body of about 7 000 students, nevertheless produces excellent research, especially in marine biology, Arctic ecosystems and sustainability. This has helped to generate a local ecosystem of organisations and entities directly or indirectly affiliated with UQAR research. They include the *Institut des sciences de la mer de Rimouski* (ISMER), a globally renowned research centre in marine biology, which has attracted research funds from the federal government (as part of Canada's Ocean Supercluster) and from abroad. The concentration of research activities paved the way for intermediation, which is provided by the ISMER. This contributed to the creation of the *Centre de recherche sur les biotechnologies marines* (CRBM), in recognising the need for different players and roles in the innovation ecosystem. CRBM is a research and technology organisation (RTO), active in providing support to firms of all size and maturity, although it is not specialised in incubation/acceleration for start-ups.

UQAR is also active in collaboration and co-creation. The engagement agenda has a central role in UQAR (as in the rest of the University of Québec system), and the university is required to promote regional development and the well-being of the community. The university plays an important role generating innovation spill-overs and is considered to be a local anchor by the *Société de Promotion Économique de Rimouski* (SOPER), which has designed a regional development strategy that leverages the knowledge and innovation capital generated by UQAR. The SOPER has created a local accelerator, NOVARIUM, located in front of the university campus, to generate support for scientists who would like to commercialise their innovations. NOVARIUM, while it is a recent addition, is an important element in the Rimouski ecosystem, given its capacity to provide specialised services supporting academic entrepreneurs (doctoral students in particular). A good example of a provincial network supporting entrepreneurship and start-ups, NOVARIUM is formally and informally linked with the new innovation framework developed around Axelys

and interacts with entities such as CENTECH and District 3, generating a positive dynamic of collaboration in the Québec innovation ecosystem in different regions.

After the pandemic, with the migration of highly skilled individuals to non-metropolitan areas. Rimouski presented an ideal environment for an innovation ecosystem outside the Montréal functional area, thanks to its global relevance and its natural amenities.

UQAR can support such positive dynamics by embracing an entrepreneurial agenda. The university has developed activities promoting entrepreneurship, but these are limited to students, and entrepreneurship education is provided only informally and with extracurricular activities, attracting students who already have a demonstrated interest. Promoting entrepreneurship in a more inclusive way (for students and also for external stakeholders) would help to disseminate entrepreneurial perspectives through the local ecosystem. Rimouski could potentially become an important pole for innovation, in addition to research.

The University of Québec at Chicoutimi (UQAC) is another good example of an HEI located in a rural area that is active in engaging with its partners. UQAC's territory consists of an important Indigenous community. The university has a teaching specialisation on Indigenous communities and employs two "research chairs" on its language and culture. UQAC is located in northern Québec, in the French-speaking region of Saguenay-Lac Saint Jean, and has 6 500 students – a third of whom are from abroad. The close connection to its external partners is mentioned in the institution's vision and mission, which stress the importance of access to knowledge that relies on "proximity" to partners and "contribution" to its communities (UQAC, n.d.[15])

UQAC matches its teaching and research missions on the specialisations of its locality. Typical examples of place-responsive processes to build entrepreneurial capacities and realise business opportunities at UQAC include the programme of intervention *plein air*, the programme in civil engineering and wood construction, and the programme in eco-consulting (*éco-conseil)*. An example of co-creation activities of UQAC is the Regional Research and intervention Group (GRIR), which employs collaboration activities through scientific research, including technology transfer, and social innovation, which offer the university community and professionals and researchers in Saguenay-Lac-Saint-Jean about 15 knowledge transfer activities.

UQAC distinguishes itself as a regional leader in social innovation. The *Centre de recherche sur les innovations sociales* (CRISES) conducts research projects on social innovation and social intervention aimed at tackling the challenges of the locality. CRISES, a research centre that includes researchers from all 16 universities and many colleges, is structured around four research axes focused on the contribution of social innovations to social and environmental justice in the following fields: social policies and practices; territories and living environments; social and collective organisations; work and employment. These projects are carried out in close collaboration with local administrations and actors.

The direction taken by UQAC to go further than technology transfer and connect with its partners is a primary example of an HEI tapping into the needs of its surrounding ecosystem. The engagement with the social agenda can also give a new direction to academic entrepreneurship. During the visits, it was noted that most students who create their own enterprises choose to remain in the region. Furthermore, UQAC is a regional leader in aluminium. The campus's Aluminum Technology Center is funded by the National Research Council of Canada. The Center works with its customers and collaborators in the aluminium processing industry to improve manufacturing processes to produce lighter, more economical and more environmentally friendly products (Government of Canada, 2019[16]). Through the Center, UQAC also connects with the fabric of its territory.

Another example of connecting higher education to local ecosystems in rural settings are Cégeps. Notably, the Cégep of Gaspésie, located in the northern tip of the province, has about 3 000 students and serves to develop technical skills of individuals. The Cégep, given the geographical dispersion of potential students across the region, was an early leader in Québec in providing online courses, even before COVID.

The local economy is driven by a mix of resource-based industries (fishing, forestry, agriculture), public services (health and education), tourism and manufacturing (OECD, n.d.[17]). The Cégep hosts three CCTTs, in wind power, fisheries and sustainable development. In turn, the Cégep has been instrumental in connecting with local partners to boost the development of local skills (OECD, n.d.[17]).

A place-responsive approach to innovation and higher education policies

All Québec's HEIs conduct collaboration activities with their external partners, contributing to economic and societal growth in their communities. Whether in metropolitan or non-metropolitan areas, HEIs capitalise on and help to increase the strengths of their communities. The network of the University of Québec as well as the Cégeps and CCTTs, make it possible to connect institutions and partners, particularly through applied research and social innovation.

Thanks to the key role of HEIs, provincial policies are able to enlist HEIs in their regional ecosystems. The SQRI2 Innovation Zones provide opportunities to capitalise on the role of HEIs to strengthen policy synergies between different sectors, such as higher education and regional development, and help create new models for entrepreneurial ecosystems. HEIs can reach beyond technology transfer and include social innovation in their own communities, generating new opportunities and incentives for place-responsiveness.

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Notes

[1] For more information: https://campusmil.uMontréal.ca/

[2] According to local stakeholders interviewed during field visits, MILA represents an important change in the relationship between McGill and the Montréal ecosystem. MILA generates new opportunities for collaboration and identification. McGill representatives consider MILA foundational in terms of the changing relationships between McGill and its local ecosystem.

[3] Representatives from GPA have stressed the need to adapt the profile of academic researchers to the new role they may play in local economies. For instance, they suggested revising doctoral programmes by considering the possibility that PhD candidates become Chief Technology Officers.

[4] This percentage reflects the network of 49 CCTTs. In 2018, the network added 10 CCTTs.

[5] To connect industry, non-for-profit organisations, municipalities, and hospitals to talent Mitacs developed internship programmes. At the time of writing, Mitacs has two internship programmes, the Business Strategy Internship, the Accelerate, which are opened to all students from undergraduate to post-

doctorates. During these internships, students can apply their knowledge and research skills to help to solve practical problems faced by their employer. Students from diverse study disciplines (law, business medicine) participate in these programmes. Mitacs also has the Elevate Programme, an applied research fellowship for post-doctoral students of Canadian universities. The fellowship is completed in Mitacs' partner organisations to help these get the expertise to solve a pressing research and development (R&D) programme. It also has dedicated international programmes (the Globalink Research Internship programme, the Globalink Graduate Fellowship and the Globalink Research Awards) designed to attract international talent and deploy local talent abroad to help Canadian and international organization solve R&D challenges.

[6] The Geography of Higher Education (GoHE) aims to improve understanding of how Higher Education Institutions (HEIs) are generating value for their surrounding communities and networks. In particular, GoHE focuses on the impact of national Higher Education policies in empowering communities and individuals by responding to the needs of regions and cities. More information and publicaitons can be found at this link: https://www.oecd.org/fr/cfe/pme/geo-higher-education.htm#:~:text=The%20Geography%20of%20Higher%20Education%20(GoHE)%20aims%20to%20improve%20understanding,their%20surrounding%20communities%20and%20networks.

[7] Some HEIs in Montréal are French-speking, while others are English-speaking. HEIs such as McGill use both languages. The bilingual HEIs in Montréal can operate within different international networks, tapping into French-speaking areas.

[8] Because they are located in a globally connected metropolitan area, HEIs have specialised services, benefit from an abundance of partners and can generate a strong interaction with their own ecosystem. However, it is difficult to assess the contribution of HEIs to the competitiveness and sustainability of their own ecosystem.

[9] Information gathered during site visits.

[10] For more information: https://www.hec.ca/programmes/certificats/certificat-entrepreneuriat-creation-entreprise.

[11] For more information: https://www.cfref-apogee.gc.ca/home-accueil-fra.aspx.

4 Place-responsive higher education institutions as policy partners

The Québec research and innovation investment strategy (SQRI 2) supports the role of HEIs as drivers of provincial innovation and entrepreneurship. This depends on a commitment to focus on talent and the ambition to stimulate entrepreneurship and innovation. The Innovation Zones established by the Ministry of Economy, Innovation and Energy (MEIE) also help connect various actors, including HEIs, to generate innovation and social capital in both metropolitan and non-metropolitan Québec. This chapter discusses the provincial innovation strategy and illustrates the nexus between research and local innovation within Innovation Zones.

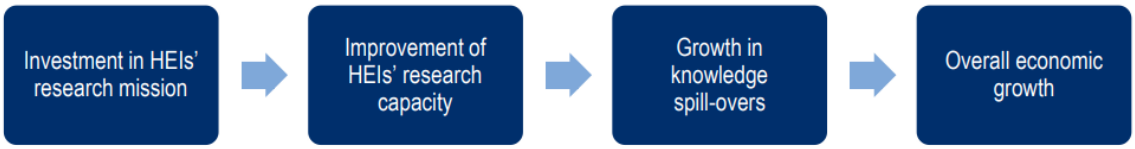
The SQRI 2 has placed an increased emphasis on encouraging talent entrepreneurship and innovation by connecting HEIs with partners, including firms of all size and maturity, in all communities. In particular, the SQRI 2 support the MEIE's ambition to spur a spatial approach for promoting entrepreneurship and innovation, through the "Innovation Zones" (zones d'innovation, or ZI), where HEIs are mobilised to promote entrepreneurship, innovation and talent in their own regional community and in specific sectors selected by provincial authorities, in co-ordination with local stakeholders. Innovation Zones deserve international attention, thanks to the assumption that both non-metropolitan and rural communities can engage with deep technology, and that breakthrough innovation can take place everywhere.

The innovation strategy of Québec is centred on HEIs

In recent decades, the provincial government has heavily invested in academic research. This has produced a steady increase in academic publications and in citations of research-intensive HEIs. Between 2000 and 2019, the number of publications rose from about 8 000 to more than 18 000 for all three major research sectors: natural sciences and engineering, health social sciences and humanities, boosting their international visibility.

Besides supporting high-level research to increase the international visibility of Québec-based HEIs, the public sector also invests in academic research to increase innovation, on the expectation that productive research will enhance the provincial economy. In particular, academic research is expected to trigger more innovation at the local level, along the lines proposed by the linear model of innovation (Bush, 1945[1]; Maclaurin, 1953[2]) (Figure 4.1).

Figure 4.1. A linear model connecting academic research with growth



Source: Based on (Bush, 1945[1]), "Science: The endless frontier", http://dx.doi.org/10.2307/3625196; , (Maclaurin, 1953), "The sequence from invention to innovation and its relation to economic growth", http://dx.doi.org/10.2307/1884150.

The new knowledge generated by these leading research institutions is expected to increase university-industry co-operation. Within this framework, successful companies located in the proximity of the research institutions can benefit from the knowledge spill-overs generated by research activities carried out by HEIs. Proximity is an important factor for knowledge spill-overs, especially as knowledge is sticky and suffers from considerable distance decay effects (Serrano, Paci and Usai, 2004[3]) (Box 4.1). However, empirical evidence shows that the relationship between academic research and local innovation/growth is not linear and that factors can limit HEIs' capacity to engage with their own entrepreneurial ecosystem (Bush, 1945[1]; Maclaurin, 1953[2]).

Box 4.1. Assessing the relationship between HEIs, knowledge spill-overs and local development

A large body of academic research focuses on the relationship between HEIs, knowledge spill-overs and local development. Leading HEIs, such as Stanford University and the Massachusetts Institute of Technology (MIT), have played a central role in the economic success of Silicon Valley in Northern California and of Route 128 around Boston (Henderson, Jaffe and Trajtenberg, 1998[4]). Based on these examples, it is frequently assumed that investment in HEIs' research will provide an important boost for innovation and create new economic activity at the local level. It has also been assumed that dynamic research-led HEIs can attract private-sector activity to an area and improve local productivity (David Neumark and Simpson, 2015[5]).

HEIs are seen as a fundamental source of change in local economies, and policies to promote research in local HEIs have become increasingly important in development strategies (Power and Malmberg, 2008[6]). Empirical results of such strategies, however, are mixed and often contradictory. Using cross-sectional data for the US, (Anselin, Varga and Acs, 1997[7]) first discovered a positive association between HEIs and local innovation.

Similar results have been obtained by (Woodward, Figueiredo and Guimarães, 2006[8]) although the size of the coefficient, and of the link between HEI research and innovation, is considerably smaller when adopting a panel data structure. It has also been found that the positive relationship between HEIs and local growth depends on the period chosen (Goldstein and Renault, 2010[9]). They reported that for the period 1969-1998, the influence of research conducted by US HEIs on regional development was particularly weak. Similarly, (Drucker, 2016[10]) found a weak relationship between university research and regional growth in the US over the period 2001-2011.

A more recent study focusing on the land-grant programme in the US (Liu, 2015[11]) reported that US universities had negligible effects on local output over the short and medium term (up to a maximum of 10 years), but highly positive effects in the long run (over periods of 80 years).

Source: Carlino, G. et al. (2012[13]), "The agglomeration of R&D labs", http://dx.doi.org/10.2139/ssrn.2149008; Jaffe, A. (1989[14]), "Real effects of academic research", http://dx.doi.org/10.2307/1831431; Neumark, D. and H. Simpson (2015[15]), "Place-based policies", http://dx.doi.org/10.1016/B978-0-444-59531-7.00018-1; Power, D. and A. Malmberg (2008[16]), "The contribution of universities to innovation and economic development: In what sense a regional problem", http://dx.doi.org/10.1093/cjres/rsn006; Anselin, L., A. Varga and Z. Acs (1997[17]), "Local geographic spillovers between university research and high technology innovations", http://dx.doi.org/10.1006/juec.1997.2032; Woodward, D., O. Figueiredo and P. Guimarães (2006[18]), "Beyond the Silicon Valley: University R&D and high-technology location", http://dx.doi.org/10.1016/j.jue.2006.01.002; Goldstein, H. and C. Renault (2004[19]), "Contributions of universities to regional economic development: A quasi-experimental approach", http://dx.doi.org/10.1080/0034340042000265232; Drucker, J. (2016[20]), "Reconsidering the regional economic development impacts of higher education institutions in the United States", http://dx.doi.org/10.1080/00343404.2014.986083.

Against this backdrop, the provincial government has adopted an innovation policy with a specifically spatial dimension, to help develop a collaboration framework between (academic) research, teaching and learning activities, businesses of all size and maturity, and local authorities, with a view to generating "ecosystems" concentrating production and improving the quality of life for highly skilled individuals. The policy, known as Innovation Zones, is one of the key pillars of the provincial innovation strategy.

A strategy anchored to local HEIs: the innovation zones

The SQRI 2 aims to leverage HEIs, particularly those outside the metropolitan area of Montréal, and operating in Québec's network of cities and in rural settings, to promote entrepreneurship in deep-tech sectors, breakthrough innovations and a more inclusive social fabric. To achieve this result, the MEIE has

developed a spatial approach called “Innovation Zones” (zones d’innovation, or ZI). These consider innovation a multidimensional process in which economic, environmental and social aspects are connected in a given locality and supported by a coherent basket of public services and investment.

IZs support regional specialisation in “priority sectors”. The provincial government selects IZs based on applications from regional communities, which generate projects in connection with the “priority sectors” identified by the policy. The applications are selected based on their capacity to mobilise local players, including HEIs, to support the innovation ecosystem. HEIs are mobilised to promote talent, research, innovation and entrepreneurship in connection with the local IZ. The IZs aim to improve the appeal of selected places to pool talents, entrepreneurs and major clients, as well as researchers from Québec and elsewhere. Different socio-economic actors are involved in each zone, for example: companies; economic organisations; research and educational institutions; municipalities (Gouvernement du Québec, 2022[12]). The constant connection between actors and sharing of information creates networks and ecosystems that can prompt further innovations and their commercialisation in a given field.

From a HE perspective the capacity of universities and CEGEPs to cooperate in teaching and research activities (an important trait of the Québec system) represents an asset for the successful implementation of IZs as it guarantees the capacity to generate an integrate skills pool mixing technicians, entrepreneurs and researchers. IZs, however, may face the challenge of involving academic researchers in actions to promote local innovation, due to the lack of incentives and career opportunities (see chapter 3).

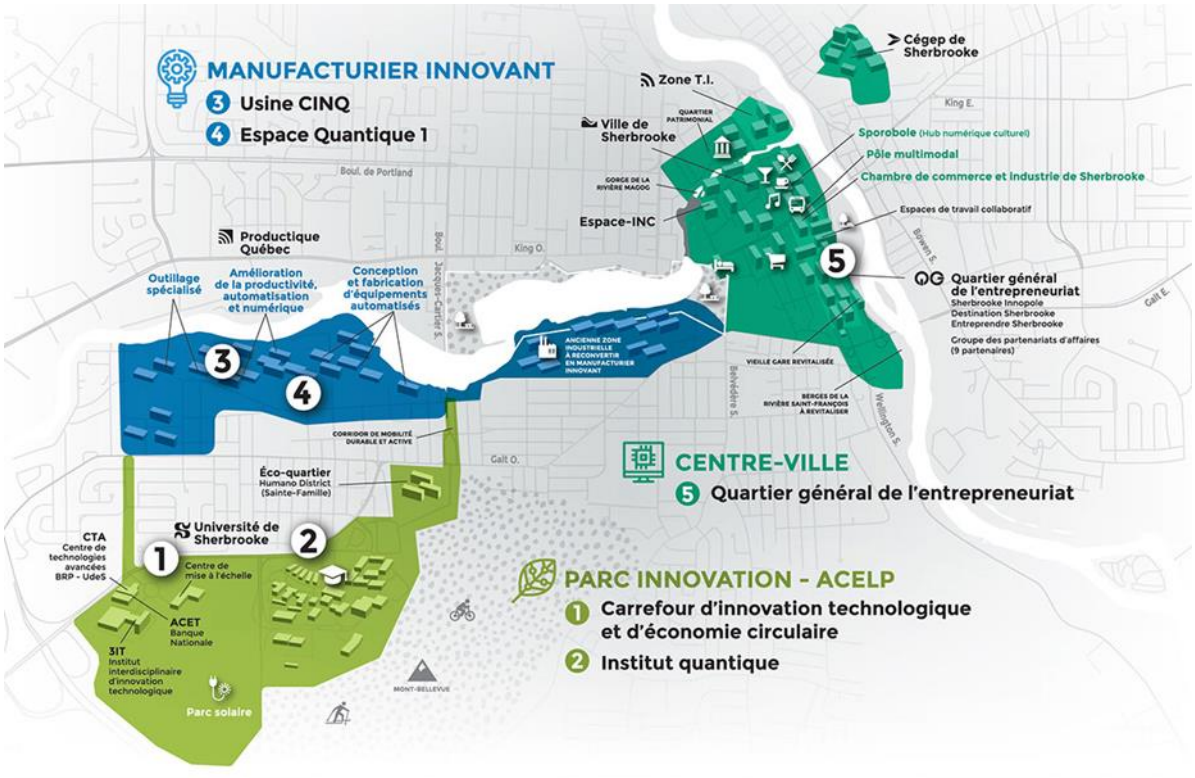
Innovation Zones aim to create new models of entrepreneurial ecosystems…

At the time of writing, two Innovation Zones were announced by the provincial government[1]: DistriQ – *zone d’innovation quantique*; and Technum Québec. While other zones are in the pipeline, the two established zones illustrate the potential and the challenges faced by this approach.

The first Innovation Zone is the DistriQ quantum zone (previously known as “*Sherbrooke quantique*”, SQ), (Infographic 1). Located in the urban area of Sherbrooke, it revolves around institutions such as the University of Sherbrooke, the *Institut quantique*, the Interdisciplinary Institute for Technological Innovation (3IT), the *Cégep de Sherbrooke*, and a large corporation operating in the ICT sector. Quantum physics is generating breakthrough technologies that will have major repercussions in fields such as pharmaceuticals, energy, transport, finance and artificial intelligence (Gouvernement du Québec, 2022[12]).

SQ benefits from a well-established, recognized ecosystem, both in basic and applied research in quantum physics. The university is specialised in quantum calculations and technologies and also in the development of components for quantum computers, and has generated a local “cluster” of scientific, technological and entrepreneurial activities. In addition, the aim of this IZ is to generate a positive dynamic for the urban environment – connecting the development of the “cluster” to the well-being and sustainability of the local community. This generates a “cultural” and “social” component within SQ. According to Québec policy makers, the approach of the Innovation Zones is to connect economic, social and environmental aspects (regional development) (Gouvernement du Québec, 2022[12]).

Figure 4.2. The DistriQ quantum Innovation Zone (formerly known as Sherbrooke Quantique)



Source: (Sherbrooke Quantique, 2022[13])

The second Innovation Zone is the "*Technum Québec*", in Bromont (Infographic 2). This benefits from the dynamism of such key players as the MiQro innovation collaboration centre (C2MI), IBM Canada and Teledyne DALSA. Technum Québec's reach extends well beyond the Innovation Zone. The 700 Québec companies in the intelligent electronic systems sector will also benefit from this initiative. At the heart of the digital transformation of companies in the manufacturing sector, electronic systems are accelerating the growth of strategic industries in Québec's economy, including aeronautics, telecommunications, life sciences, energy and transportation (Gouvernement du Québec, 2021[14]). One peculiarity of this Innovation Zone is that it is less focused on the holistic approach to urban/regional development intended to be characteristic of IZs. The emphasis is on the area's industrial specialisation, with the characteristics of an "industrial cluster".

Figure 4.3. The Innovation Zone of Technum Québec

Source: (Technum Québec, 2022[15])

As noted above, inside the Innovation Zones, the role of HEIs is central. Many institutions, even those that are not located in the declared Innovation Zones, are well-integrated in programmes conducted in the context of the zones. Interviews showed that the University of Montréal is active in seven different projects of the Innovation Zone programmes presented to the MEIE. The IZs have catalysed further collaboration between different HEIs, which appears to be one of the advantages of the Québec higher education system. Some programmes are run jointly by different institutions. For instance, the *Cellule Intégrée de Recherche, Innovation et Formation* (CIRIF) consists of a programme run both by the University and the Cégep of Sherbrooke in the declared Innovation zone. Interviews revealed that Strategic sectors for Québec, conducive to major investments within the framework of Innovation Zones, combine both innovation and access to highly qualified personnel. The variety of training and the different jobs associated with these strategic sectors cannot be covered by a single institution.

… but there is room to enlarge the scope of innovation and strengthen the connection with entrepreneurship

The Innovation Zones established in the province of Québec reflect the priorities of the government. They focus investment on a selected local community to promote specialisation in a pool of priority/deep-tech sectors, which needs to connect to local characteristics and potentials. Policy efforts are focused on non-metropolitan regions, including cities and rural areas. While the assumption that innovation and entrepreneurship can take place in rural areas deserves international attention, the policy, at least in its initial phases, seems to be focused on deep-tech entrepreneurship. Deep-tech companies (often referred to as “unicorns”, that is, companies that have been valued at as much as CAD 1 billion, ignite a sense of

excitement and are therefore considered more innovative and worthy. However, encouraging innovation is not restricted to creation of new technology ("Invention is not innovation") or a focus on deep tech; innovation should also focus on devising new or improved products and services (Breznitz, 2021[16]).

Innovation Zones could support more sectors, including those that are technologically more mature and have the potential to generate valuable and sustainable jobs. HEIs could play an even more important role in this process of self-discovery by generating tailored knowledge, products, talent and research.

Innovation Zones could also become pivotal in promoting entrepreneurship education and entrepreneurship. HEIs could be mobilised to mainstream access to formal and informal entrepreneurship learning opportunities (including adult education). The aim will not only be to create more businesses but to promote an entrepreneurial mindset, training people to be drivers of innovation and introducing them within their organisations. This can also help retain skilled labour. Many of the IZs are in rural (or smaller urban) areas, where the pool of talent is smaller, and which may appear less attractive to workers than larger urban areas.

From this perspective, Québec is establishing a place-responsive approach, and should tailor interventions to the features and potential of localities. Among the characteristics of the policy, there is the attempt to generate spaces for collaboration inside the higher education institutions, including universities and Cégeps, to industrial and entrepreneurial activities, to facilitate the alignment between research activities and social impact, such as quality of life and well-being. However, the selection process for local specialisations seems to depend on top-down decisions, rather than on a process of self-discovery at the local level. The rationale for this approach is to promote deep-tech sectors in non-metropolitan Québec, but it could also reduce the opportunity for diversifying specialisations and growth in regional localities.

Synergies among different policy sectors to connect HEIs to innovation

In general, to be successful, the SQRI 2, and the IZ actions, will need to be supported by policy complementarities among different sectors (Box 4.2). For example, to mobilise academic researchers and strengthen their capacity to engage with collaboration and co-specialisation activities will require specific incentives and career opportunities. In other words, it becomes important that the efforts of academic researchers to promote local innovation are taken into account in their evaluation and career advancement. In this realm, the IZs could be viewed as a test bed where different policy domains come together. The collaboration between MEIE and MES will be pivotal to ensure that the HE policy supports IZs. Québec is experimenting with interesting practices in terms of collaboration and policy complementarities supporting a coherent reform package. This is also reflected in the SQRI2, which includes a pillar on the coherence of government initiatives. The Ministry of Higher Education (MES), for example, is discussing pilot reform projects to support the SQRI2 and the IZs. In the same vein, it will be important to collaborate with local governments (multilevel governance) to ensure that investment in innovation generates synergies with local and regional development strategies and that no "trade-offs" among different policies emerge (see the issue of the localisation of the Campus Mil in Montréal).

Québec authorities could take into account international practices that proved effective in generating connection between HEIs and their surrounding communities to support innovation and entrepreneurship, and in which HEIs were expressly used to deliver a policy connected to regional development or SMEs (Box 4.3).

Box 4.2. Defining policy complementarities

Economic theory, and empirical evidence, illustrate that coordinated reform packages – based on complementarities – are more impactful than piecemeal reforms. Piecemeal reforms can worsen rather than improve policy problems. This is assumption can be justified by the fact that piecemeal reforms (by definition) remove only some constraints to the optimum conditions, but not all of them. As stated by Lipsey and Lancaster (1956[17]): "[…] in a situation in which there exist many constraints which prevent the fulfilment of the Paretian optimum conditions, the removal of any one constraint may affect welfare or efficiency either by raising it, by lowering it, or by leaving it unchanged." Consistent with this theory, empirical works assessing growth performance in European transition countries and developing countries (Braga, Checchi and Meschi, 2013[18]); (Aziz and Wescott, 1997[19]) find that piecemeal reforms that target some but not all distortions have an imperceptible impact on the economic performance in a given country, and may even reduce the overall welfare, in some cases.

The combined effect of reforms is superior to the effect of each factor considered separately under certain conditions. This is due to "complementarity" among the two factors. So, considering two elements – E and E' – and their performance R, it is possible to write that there is complementary if their combined effect is greater than the sum of their individual effects:

$$R(E,E') > R(E) \quad \text{and} \quad R(E,E') > R(E')^{1}$$

The main insight of this approach is quite simple: welfare is maximised when a complementarity exists between an endogenous variable and an exogenous parameter in the sense that having more of the one increases the marginal return to having more of the other – i.e., the optimal value of the former will increase that of the latter. In the case of multiple endogenous variables, then all of them must also be complements in order to guarantee that their increases are mutually reinforcing.

[1] Or, alternatively, $\frac{d^2y}{dx_i\, dx_i} > 0; \forall\, i \neq j$

Box 4.3. Case studies: the university playing a central role in connecting to their surrounding ecosystems

DistritoTec by the Monterrey Institute of Technology (Mexico)

The DistritoTec initiative in Monterrey, led by the Monterrey Institute of Technology-Campus Monterrey, involves the transformation of the 20-kilometre urban radius around the campus as a comprehensive "innovation district". It introduces an economic model supported by high technology firms and innovation-based activities, together with high-quality infrastructure. The ambition is for this campus to become a source of urban regeneration. The university has also helped the government with the creation of 14 technological parks in the past 14 years and undertaken a number of other regional initiatives:

- The campus of Querétaro works closely with the Aerospace Cluster in the state.
- The Mexico City campus works with the health and bio-technology sectors.
- Chihuahua campus' technology park (Orion) is a core element of the state's innovation strategy.

University of Texas San Antonio (UTSA), Small Business Development Center (SBDC) (United States)

In San Antonio, Texas, in the United States, the Small Business Development Center (SBDC) Network provides consulting and technical assistance to the small business community. Its goal is simple: to help small businesses start and grow. The SBDC programme supports the growth and development of the Texas economy by assisting in job creation, economic diversification and business expansion. Rigorously competitive and quantitative, the SBDC methodology is based on close collaboration between the local HEIs who host the network and SMEs.

Source: (OECD/IDB, 2022[20]);

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Note

[1] At the time of writing, other Innovation Zones are to be announced.

5 Unleashing the potential of place-responsive higher education institutions and systems in Québec

Québec has proven to be an ideal laboratory for the "geography of higher education" that assesses the way in which HEIs can ignite entrepreneurship and innovation in their own communities, while producing internationally relevant research. This final section presents and illustrates selected policy recommendations that could improve "place-responsiveness" in Québec's higher education system and institutions.

Québec is mobilised to become an international innovative and entrepreneurial leader. Policy reforms spur higher education institutions (HEIs) to act entrepreneurially and collaborate with external stakeholders, including businesses of all sizes and maturity. New entities have been created to facilitate the connection between HEIs and Québec's multidimensional strategy for innovation, which features an explicit spatial dimension.

The province is experiencing growth after the COVID-19 pandemic but is challenged by the high level of international uncertainty. The present review of the "geography of higher education" offers an international perspective to advance innovation and entrepreneurship in Québec, taking stock of the current initiatives and addressing remaining challenges, including those related to resilience, sustainability and inclusion.Mirroring the overall structure of the report, this succinct final chapter offers recommendations in relationship with entrepreneurship education; entrepreneurship ecosystems; and HEIs as place-responsive policy partners with the objective of accelerating the momentum achieved so far.

As for entrepreneurship education, Québec could consider mainstreaming and deepening formal entrepreneurship education in the HE system and institutions, to cultivate an entrepreneurial mindset in more individuals and to encourage engagement in entrepreneurial activities. Evidence collected through the HEI Leaders Survey (see Annex B) shows that entrepreneurship education affects individuals' mindset, desirable in the context of the innovation strategy. Developing HEIs' impact on entrepreneurial activities in Québec will require a series of policy innovations. For example, it will be important to recognise the status of entrepreneur for students and researchers, to facilitate their respective careers.

Québec should promote collaboration among entrepreneurial HEIs, incubators, accelerators and entrepreneurial centres, to increase scale, increase the value-added and promote transdisciplinary platforms, mixing experiences and cultures. These co-ordinated platforms would operate like "colliders", unleashing new energy and potential. This is particularly relevant in Montréal, which could strengthen its role as a primary international entrepreneurial hub, solving economic and societal problems at the global scale through bolder and more engaged collaborations.

Entrepreneurial HEIs will play a pivotal role in their regional and local ecosystems. The SQRI 2 is already anchoring HEIs to innovation, including in rural areas, a remarkable initiative that may inspire other OECD countries and regions. However, the Québec system will need to create new incentives and career opportunities for academic communities to collaborate with external stakeholders in order to support entrepreneurial activities sustainably, beyond the funding the strategy provides. Without these incentives, co-production and co-specialisation will remain a low priority for faculty and staff in HEIs. Enhanced co-operation between the Ministry of Economy, Innovation and Energy (MEIE) and the Ministry of Higher Education (MES) and other key players such as the funding agencies will be important from this perspective.

Québec can leverage the diversity of its HEIs to promote entrepreneurship ecosystems and broaden the scope of its innovation strategy. The provincial approach should find an equilibrium between the current focus on deep-tech start-ups and artificial intelligence. Innovation should be promoted in all sectors and supply chains, including in the traditional ones characteristic of the provincial economy, especially in non-metropolitan and rural regions. Providing more individuals with transversal skills may increase their productivity and help buffer the current pressure on the provincial labour market. Entities such as the Cégeps and CCTTs could be mobilised to provide entrepreneurial skills – besides technical support – to firms and entrepreneurs belonging to sectors and related supply chains.

As in the case of entrepreneurship education, the success of policies promoting entrepreneurial ecosystems will depend on the capacity to create complementarities: a coherent package of policy reforms that link innovation with higher education, regional and rural development, health and other relevant policy sectors. Synergies can also be generated with policies promoting sustainability and inclusion.

Recommendation 1: Create more collaborative spaces (colliders) underpinning entrepreneurship education

Entrepreneurship education activities in Québec HEIs are thriving, but they often appear to be fragmented across disciplines and places. This affects its effectiveness and scale. Provincial authorities could consider the creation of common spaces to improve the scale of activities promoting entrepreneurship and innovation. While preserving their autonomy, incubators and accelerators could formally share good practices and generate networks of collaboration. To promote transdisciplinary activities, including within HEIs, Québec could consider international examples such as Aalto University in Finland, which has aimed to create a collaboration hub in the university, cutting across different disciplines to maximise the impact of entrepreneurship pedagogies and practices (Box 5.1).

Box 5.1. Internal collaboration to enhance entrepreneurship: the case of Aalto University (Finland)

Entrepreneurship is a major part of Aalto University's strategy. The strategy also includes the ecosystem dimension of entrepreneurship: The aim is to "transform our campus into a unique collaboration hub". To this end, the university seeks to enlarge the central campus at Otaniemi to create a "vibrant centre" and "structure the campus to support thematic, multidisciplinary clusters and open innovation". It intends to establish shared spaces with integrated digital solutions for new ways of working. In experimental spaces, researchers will work together with experts and users to co-create solutions, in particular for sustainable development.

Aalto University defined a broad set of performance indicators to measure the fulfilment of its strategy. On campus, these indicators include results of user and partner surveys, spaces shared with academic units in different fields, and external partners. "Enabling indicators" include energy efficiency and CO_2 emissions, results from employee satisfaction surveys, quality and cost efficiency of services as well as diversity of the funding base. The performance indicators measure the quality of publications, education and creative products and the value of businesses created, as well as external partnerships and employment of graduates. There are also particular indicators for multidisciplinarity: *i)* participation in artistic, innovative and entrepreneurial activities, *ii)* the share of multidisciplinary studies in degrees taken, and *iii)* the share of multidisciplinary projects.

Source: (Aalto University, 2018[1]; Technopolis, 2018[2])

Further incentives are needed to increase the number of students who engage in entrepreneurial education. Formal recognition and added advantages for students who pursue entrepreneurial activities can spur their interest in entrepreneurial education and can allow them to reconcile their curricular programmes with objectives in entrepreneurship, such as business creation. At the moment, students may face a trade-off between engaging with entrepreneurship and completing their curricular activities. For instance, Québec's HEIs could formally recognise the status of the "entrepreneurial student". Several international good practices could inspire policy makers in Québec. France's PEPITE Programme offers an example of how to implement this (Box 5.3).

Box 5.2. Recognising the status of entrepreneur for students and researchers: the PEPITE Programme (France)

An ambitious plan in favour of student entrepreneurship called the PEPITE plan (student centres for innovation, transfer and entrepreneurship) was launched on 22 October 2013 by the Minister of Higher Education and Research. It followed the Beylat-Tambourin report of April 2013 (on innovation, a major challenge for France) which recommended, after observing that the creation of student entrepreneurship centres (PEE) had not generated any real dynamic, to "set up a large-scale programme for learning about entrepreneurship in higher education".

The plan includes four main measures:

1. the creation of student centres for innovation, transfer and entrepreneurship (PEPITE) throughout the territory, including overseas, on the basis of a call for projects;
2. the creation of a national student-entrepreneur status (SNEE) for students or young graduates with business creation projects. The "student-entrepreneur" (EE) establishment diploma (D2E), framed nationally by a charter, completes the system;
3. the dissemination of a culture of entrepreneurship and innovation through training modules integrated into the courses, with the aim of raising general awareness among all students;
4. the creation of the PEPITE prize, a support system for business creation through financial aid.

Source: (Pépite France, n.d.[3])

Unleashing the potential of entrepreneurship in Montréal

Montréal's HEIs deserve specific attention, as they operate in the central entrepreneurship and innovation hub in Québec. Different policies and activities of local HEIs have helped generate a dense entrepreneurial ecosystem, which, however, appears to be somewhat fragmented. Increasing the connectivity and collaboration among the different existing entities and networks may positively affect scale and visibility of the main innovation hub in Québec, as well as the capacity to generate transdisciplinary platforms connecting different domains, including STEM and humanities.

To achieve this result, a shared services entrepreneurial "collider" between existing actors in Montréal would enhance co-ordination by allowing different disciplines and cultures to meet and cross-fertilize. Joining forces would generate scale within the Montréal ecosystem, mobilising more resources and individuals promoting entrepreneurship and innovation. Initiatives such as Millénnium Québecor, which aims to co-ordinate entrepreneurship activities within Campus Montréal, are a step in the right direction to make entrepreneurship a central force within Montréal's HEIs. Inspiration can also be drawn from international good practices, such as the Campus Paris-Saclay in France (Box 5.3).

Box 5.3. Creating a world-class cluster: the Campus Paris-Saclay (France)

The Paris-Saclay campus was created to provide France with a world-class cluster for academic research and leading international industrial players. Bringing together 18 establishments (now 17, after the merger of Centrale-Supélec), i.e. approximately 10 000 researchers and 60 000 students, the University of Paris-Saclay project aims to unite these institutions under the same banner to offer visibility and international appeal similar to major international universities'.

The center of the Paris-Saclay campus includes two zones, the Moulon and the Palaiseau district:

- The Moulon district, with the Atomic Energy and Alternative Energies Commission (CEA) as its centre of gravity, is to bring together the Centrale-Supélec and ENS schools. The HEC business school is located nearby, in Jouy-en-Josas.
- The Palaiseau district groups the *École nationale de supérieure de techniques avancées* (ENSTA), ENSAE, *Institut d'Optique* Graduate School and Telecom Paris Tech. LIST, the CEA's technological excellence laboratory, is also located there, with plans to double its area (currently 28 000 square metres) and to become an international digital centre of excellence (the DIGITEC project).

The perimeter of EPA-Paris Saclay includes five major industrial clusters (within the Public Administrative Establishment, the origin of these maps), including: information and communications technology (ICT), with 37 000 employees in 400 establishments; aeronautics, with 30 000 employees in 60 establishments; mobility, with 27 000 employees in 130 establishments; energy, with 17 000 employees in 31 establishments; health care, with 14 000 employees in 130 establishments.

This concentration of private research players offers an opportunity to develop an open ecosystem of innovation: visible, attractive and efficient on the international level.

Source: (Université Paris-Saclay, n.d.[4])

Recommendation 2: Capitalise on Cégeps and CCTTs to strengthen entrepreneurship ecosystems in all regions of Québec

Cégeps and CCTTs are well-connected to firms and individuals located in their surrounding territories. However, interviews revealed that Cégeps may face challenges updating their educational programmes to reflect the skills needed by firms in their ecosystems. Moreover, CCTTs are organised reflecting the sectoral specialisations of their localities, which may reduce the scope of their co-operation activities. Based on these, Québec could consider facilitating the accreditation process for Cégeps that interested in setting up new (or updated) study programmes and broadening the scope of activities of CCTTs, which could provide entrepreneurship education and innovation services for sectors and related supply chains. By innovating their offer of intermediation services, CCTTs could function as "research and technology organisations" (RTOs) and play a pivotal role facilitating innovation and innovation diffusion in their own communities. International good practices, such as the RISE in Sweden, can also serve as examples (Box 5.4).

Box 5.4. From a fragmented to an integrated RTO sector: the case of RISE in Sweden

From the 1960s to the 1990s, the institute sector in Sweden grew from a handful of research institutes to just over 30 institutes, rather small and closely linked to various industrial and materials sectors. From the mid-1980s onwards, public authorities took action to strengthen the entire sector, which was becoming increasingly weak as the academic sector's research grew.

Actions ranged from reorganisation (the "four-leaf clover" of institutes in related sectors and/or with complementary technologies in four groups) to gathering State ownership in these institutes under a single umbrella (RISE). Since then, RISE (now about 3 000 employees) has operated as a single multisite institute, organised into five divisions and six business and innovation areas, without reference to the original founding members. While the staff is allocated to the five divisions, the six business and innovation areas make it possible to combine expertise and work across all divisions and operations, to be able to respond to long-term and complex challenges through interdisciplinary innovation. RISE, for instance, is the result of the merger of a number of the biggest Swedish research and technology organisations (RTOs) into a single institutional group, which started in 2016.

In addition to five divisions and six business and innovation areas, RISE also has 16 group-wide research areas. Initiatives linked to these areas are often supported by the strategic competence funds provided by the Swedish government to support RISE's national mission. RISE has also identified reinforcement areas in which knowledge development responds to changing societal challenges and needs. Two of the reinforcement areas, applied AI and Cyber security, became RISE centres in 2021. The centres will ensure additional long-term focus and facilitate the acceleration of applied research to strengthen Swedish competitiveness within the field.

Source: (Larrue and Strauka, 2022[5])

In addition, offering recognition of collaboration activities conducted by researchers and professors within CCTTs and Cégeps may encourage them to connect to actors in their local communities. The HEI Leaders Survey shows that while regulatory frameworks propose incentives for professors and researchers to conduct collaboration activities, discrepancies may arise at the institutional level, when these measures are introduced. International efforts can serve as relevant good practices (Box 5.5).

Box 5.5. Indicators to attempt measuring knowledge exchange: the case of the Netherlands

In the Netherlands, the term "valorisation" is used to refer to knowledge exchange activities. In 2010, a comprehensive four-dimensional framework was proposed to measure "valorisation performance", combining quantitative and qualitative indicators. The framework and the indicators can be applicable in a wide variety of settings, including research universities and the University of Applied Sciences (UAS), on several levels and for a variety of evaluation goals. The new approach emphasises a process-oriented measurement, moving away from a focus on quantitative outcome-based indicators. In 2012, when all Dutch HEIs were preparing individual performance agreements with the Ministry of Education, Culture and Science for the first time, the review committee invited the HEIs to make use of indicators to illustrate their ambitions for commercialisation of research. Some HEIs responded to this request and agreed to include a number of indicators in their performance agreement as well as in the (mandatory) annual reports they publish each year to report on their overall activity. However, so far, no commonly defined set of indicators used by every HEI has been established, which makes it difficult to compare results and monitor progress nationally.

Source: (OECD/European Union, 2018[6]; OECD/EC, 2019[7])

Recommendation 3: Increase co-operation with *the Ministère de l'Enseignement Supérieur* in entrepreneurship and innovation policies, promoting piloting Innovation Zones.

The Innovation Zones (*zones d'innovation*, or IZs) show that the SQRI 2 promotes a spatial approach to innovation and entrepreneurship. IZs also prove the efforts of the innovation strategy to promote innovation in non-metropolitan and rural areas, which represents a good practice that deserves international visibility. IZs are implemented by involving different local stakeholders, including local governments, SMEs, private firms, entrepreneurs and of course HEIs, which play a central role in the policy. Québec's *Ministère de l'Enseignement Supérieur* (Ministry of Higher Education, or MES) supports the training and education pillar of the zones in projects intended to maximise research, investment and skills.

Involving the MES in entrepreneurship and innovation policies can create an opportunity to pilot interventions and reforms in Innovation Zones. The MES could use IZs as test beds to introduce incentives and career opportunities for academics and students, for example by promoting the status of "student entrepreneur" discussed above. This could unlock the potential of the start-up movement and the entrepreneurial mindset in these zones. Once tested in IZs, regulatory reforms could be extended to the rest of the province.

Recommendation 4: Promote the social and urban development in IZs, to connect the start-up movement and entrepreneurship education to well-being and sustainability agendas.

The Innovation Zones propose a holistic idea of innovation, which explicitly connects with the need for improved social and urban frameworks. These components are relevant to the development of the whole community and should not be overlooked when introducing IZs. Going forward, IZs could be more explicit in referring to social and urban development, by referring to concepts such as "urban regeneration" and developing local relationships to emphasise these aspects and promote policy complementarities and

synergies. IZs could be explicitly linked to regional development policies and initiatives and offer additional momentum to local initiatives, such as the *Société de Promotion Économique de Rimouski* (SOPER) in Rimouski, which has developed a range of activities supporting innovation and entrepreneurship, including NOVARIUM (see Chapter 4).

To achieve these results, IZs could be supported by specific organisations involving local actors and leaders. The aim would be to link entrepreneurship and innovation with other policy agendas and positively affect welfare and well-being in the host localities. Although rare, there are some international initiatives that operate on the frontier of innovation, entrepreneurship, social and regional development. For instance, the Academy of Smart Specialisation is a good practice example of mobilising all players in the ecosystem that contribute to the region's smart specialisation strategy (Box 5.6).

Box 5.6. Connecting all actors in the ecosystem: The Academy of Smart Specialisation, Karlstad University (Sweden)

Karlstad University (KAU), in the Region Värmland, Sweden, is a good example of an HEI that has created *ad hoc* institutions and practices to connect with regional stakeholders. KAU, capitalising on its long collaboration with the regional government, has established the Academy for Smart Specialisation. The aim of the academy is to better connect research activities with innovation needs and potential in the region, as identified by Region Värmland's Smart Specialisation Strategy. The Academy for Smart Specialisation supports multidisciplinary research centres, including a centre of gender studies co-managed by the university and the regional government. These centres support sustainable development of the regional productive sector and, at the same time, improve the capacity of regional authorities to identify transformative innovation opportunities for the regional productive sector.

Source: (OECD / EC, 2021[8])

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Annex A. Measuring the influence of entrepreneurial education on the mindset of students

This annex presents the analysis of the impact of entrepreneurial education on the mindset of students, done in co-operation with Massimo Loi, from the University of Oslo. The analysis is based on the Entrepreneurial Education survey, reported below, administered to a sample of students at higher education institutions in Québec. The results inform Chapter 2 of the Review of Québec

The methods used for the analysis include:

- Cohen's effect-size, to determine whether the average value of indicators observed in students who did not follow entrepreneurial activities differ statistically significantly from those observed in students who did follow entrepreneurial activities;
- Weighted regression analysis, to establish whether the conclusions based on Cohen´s effect size are confirmed after controlling for respondents´ gender, age and education enrolment. The regression analysis was performed assigning a weight of 1.31 to each respondent exposed to entrepreneurial education and of 0.81 to each respondent not exposed to entrepreneurial education. Overall, the two groups of respondents had the same weight (0.5) in the regression analysis.

Descriptive results

As of December 2022, 290 students responded to the survey. The final analysis is based on 277 respondents, omitting 13 outliers. The descriptive results are the following:

- Exposure to Entrepreneurial Education: 106 respondents (38.3%) reported having participated in entrepreneurial activities; 171 respondents (61.7%) reported not having participated in entrepreneurial activities;
- Gender: 179 respondents (63.93%) identified as female, and 101 respondents (36.06%) identified as male; 10 respondents did not report their gender;
- Age: respondents were born between 1970 to 2004, with the majority born between 1992 and 2002. The analysis showed 13 outliers, born between 1970 and 1976. These outliers are outside the 1.5*IQR interval and were dropped from the econometric analysis;
- Level of Education: respondents represented the four levels of studies in the province: 128 at undergraduate level (44.14%); 73 at graduate level (25.17%); 35 in doctoral studies (12.07%); and 54 at the college/Cégep level (18.62%).

The Entrepreneurial Education (EE) survey

Exposure to entrepreneurship education

- Have you ever attended or participated in formal and/or informal learning opportunities about entrepreneurship?

Financial and economic literacy

- I am able to estimate the financial resources that I need to make a project successful
- I can manage a budget
- I know how to prevent myself from spending too much
- I know how and where to find financial guidance if ever I need it

Creativity

- I improvise if I do not have the right tool for a task
- I can invent new ways to do things
- I can creatively adjust to changes in plans and priorities

Working with others

- I do all that I can to meet people who can be important to me
- It is important to me to be actively involved in the development of my community
- I am a believer in taking chances
- I can easily convince others to engage in my activities
- I can easily ask others for help when starting new projects

Motivation and perseverance

- After a lot of setbacks, I find it hard to continue
- I am often unsure about what I want to do with my life
- I avoid taking risks
- I routinely evaluate the level of risk, and find ways to mitigate risk

Information management and creative thinking

- I often make novel connections and perceive new or emergent relationships between various pieces of information.
- I am good at “connecting dots”
- I am always actively looking for new information

Self-awareness and self-efficacy

- I know my strengths and weaknesses
- I am reflective about my life
- I routinely evaluate my performance, finding ways to improve in the future

Collaboration skills, planning skills, and ethical thinking/behaviours

- When I am working in a group, I ask my group members for feedback
- I actively seek expert opinion on my work
- I believe that companies can achieve profit while also making a positive social impact
- I typically break big tasks down into subtasks and deadlines
- I think about how my actions might impact current and future generations

Annex B. Measuring the impact of location on R&D transfers between universities and enterprises

This annex presents the analysis of the interactions between Québec HEIs' and enterprises in terms of R&D expenditure, taking into account the spatial dimension, in co-operation with Alessandro Alasia, Julio Rosa, and Mahamat Hamit-Haggar from Statistics Canada. The results inform Chapter 3 of the review of Québec.

The data

This assessment uses the Linkable File Environment (LFE), a statistical tool developed by Statistics Canada. The LFE combines administrative data and survey data from multiple sources. In particular, this study uses the following data sources:

- Statistics Canada's Research and Development in Canadian Industry Survey (RDCI) 2017 to 2019 linked to administrative data is the main data source (unbalanced panel of 20,001 R&D business performers).
- Administrative data, including:
  - The Business Register;
  - General Index of Financial Information (GIFI-T1 and T2).

The main variable of interest is the distance between the enterprise and the closest university, among other firms' dimensions such as size; revenue; sector of activity; provinces; public grants; foreign outsourced expenditures. The dependent variables are:

- R&D payments to HEIs;
- Ratio of (Experimental R&D expenditures \ Total R&D expenditures).

Table A B.1. Descriptive variables for Québec, by year

	R&D performers without university link by year			R&D performers with university link by year		
	2017	2018	2019	2017	2018	2019
Variables						
Average number of R&D employees (#)	16.1	16.1	18.4	37.4	35.3	36.4
Average number of total employees (#)	202.7	202.1	216.2	572.4	502.3	541.5
Average revenue (CAD)	81 859 132	89 966 195	107 048 977	333 132 236	320 759 405	353 220 734
Average sales (CAD)	62 253 709	67 537 284	73 953 620	235 853 431	208 702 667	242 925 874

Average total R&D expenditures (CAD)	1 744 614	1 766,245	2 262 659	7 915 360	6 928 607	4 682 538
Average experimental R&D expenditures (CAD)	1 529 985	1 523 564	2 093 367	7 268 133	6 342 794	4 225 301
Average federal support - Grants/R&D expenditures (%)	6.3	6.5	6.9	5.8	6.5	6.0
Average R&D expenditures contracted outside Canada (%)	5.9	6.5	7.1	48.3	35.2	44.5
Average age of the enterprise (Years)	18.9	19.1	19.5	18.6	19.5	19.2
Average distance with the closest university (km)	16.9	17.1	16.1	18.5	18.6	20.9

Note: Custom tabulation, produced for the study “Linkages between academia – firms and regional innovative entrepreneurial ecosystem” by Julio Rosa; Mahamat Haggar; John Baker and Giorgia Ponti.
Source: Linkable File Environment (LFE)-Statistics Canada-Centre for Special Business Projects.

OECD Skills Studies

The Geography of Higher Education in Québec, Canada

Québec is mobilised to become an innovation and entrepreneurial leader in North America, giving higher education institutions (HEIs) a central role in this drive. HEIs are pivotal in developing skills and nurturing talent, connecting and contributing to their communities, including firms, public authorities and civil society. The *Stratégie québécoise de recherche et d'investissement en innovation* (SQRI) has placed HEIs at the fore front of the provincial innovation and entrepreneurship efforts, including with an explicit spatial approach, through the "innovation zones". This review assesses the "geography of higher education" in Québec through the examination of ten case study HEIs. These case studies represent examples of innovative and entrepreneurial HEIs that support entrepreneurship and innovation in their communities. In particular, the case studies tell the story of the province of Québec in creating sustainable entrepreneurship and innovation, connecting actors and mobilising resources and policies. The review offers actionable policy recommendations to generate further progress in this direction.

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