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THE STATE OF INNOVATION IN NEWFOUNDLAND & LABRADOR AND THE ROLE OF MEMORIAL UNIVERSITY WITHIN THE REGIONAL INNOVATION SYSTEM

Background report for
OECD's Entrepreneurial
Education, Collaboration
and Engagement network

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With contributions from Rob Greenwood,
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Research assistance from Stephanie LeGresley



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Preface: OECD and Harris Centre

This report is a background document for a collaboration of the Harris Centre, Memorial University, and the OECD. It provides a description of the provincial context and role of the university in regional innovation to support the OECD review team, visiting NL June 22-24, 2022. The OECD team will build on this report with sessions with industry, community, government, and university stakeholders to inform their views for the EECOLE project.

OECD

The Organisation for Economic Co-operation and Development (OECD) is an international organisation that works to build better policies for better lives. Together with governments, policy makers and citizens, OECD works on establishing evidence-based international standards and finding solutions to a range of social, economic and environmental challenges. From improving economic performance and creating jobs to fostering strong education and fighting international tax evasion, the OECD provides a unique forum and knowledge hub for data and analysis, exchange of experiences, best-practice sharing, and advice on public policies and international standard-setting.

Harris Centre

The Leslie Harris Centre of Regional Policy and Development is Memorial University's hub for public policy and regional development issues. The Centre links Memorial faculty, students, and staff with groups across Newfoundland and Labrador, supporting active community engagement throughout the research process. Working with all units at Memorial, the Harris Centre builds connections, encourages informed debate and supports collaboration to enhance the Province through mutually beneficial partnerships. Visit the Harris Centre website for more information.

Entrepreneurial Education, Collaboration & Engagement (EECOLE) and Memorial University

Globally, policymakers are increasingly calling on higher education institutions (HEIs) to respond to the most difficult social and economic challenges facing our societies – from digitalisation to social inequality to climate change. As policymakers confront long-term, unprecedented and complex problems, they require the innovative, transformative, and knowledge-based solutions that are the speciality of HEIs.

Yet, HEIs are not automatic cure-alls. To meet the needs of current society and promote innovation in all regions, HEIs need to examine whether traditional approaches to teaching, research and collaboration are effective. For example, developing entrepreneurial, collaborative, and engaging teaching and research can help HEIs become place-responsive and connect some of their research activities with innovation opportunities that reflect their communities' potential.

From 2022 to 2025, the OECD will conduct a series of regional reports on the effects HEIs have on their surrounding communities. At the end of this process, OECD will develop a handbook for policymakers and higher education leaders. As one of the first reviews, Memorial University and the Province of Newfoundland play a leadership role in developing the framework for the rest of the regional reports.

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Map

Figure 1: Map of Newfoundland and Labrador



Source: Britannica, <https://www.britannica.com/place/Newfoundland-and-Labrador> (accessed June 2022).

Introduction

Memorial University represents an important case study of stimulating ocean-related innovation in a small, resource-based economy through engagement and collaboration with private-sector actors and government institutions. As a comprehensive university with more than 19,500 students and 5,200 faculty and staff from more than 115 countries who engage in research, education and training⁶ and public engagement, the university has long held a special obligation to the people of the province. As Newfoundland and Labrador's only university, its largest campus is located in the provincial capital of St. John's, with five additional campuses, including Corner Brook (Grenfell) and Goose Bay-Happy Valley, Labrador ([Figure 6](#)). In recent decades, Memorial University has helped to promote transformative, knowledge-based innovation with a particular focus on ocean technology and ocean-related industries. The university has fostered ocean technology start-ups, conducted ocean-focused research and trained graduates who have contributed to relevant sectors like offshore petroleum, fisheries, marine transport, and other aspects of the ocean economy.

A wide range of ocean-related activities, campuses, institutes, and entities that are connected to Memorial University (such as the Marine Institute (MI), C-Core and the Genesis incubator, among others) undertake research and support business formation and development to solve specific challenges related to offshore industries, as well as to better understand their impacts on coastal communities and the natural environment. This comprehensive and supportive role is evident in the fact that over 40% of the research undertaken at Memorial is ocean-focused.⁷

The province of Newfoundland and Labrador nevertheless faces a series of challenges that may hinder innovation:⁸ the province's [population](#) is small, declining, ageing and geographically dispersed; the make-up of the [business environment](#) is uneven, featuring a handful of large, mostly foreign-based multinational corporations in capital-intensive industries as well as small, locally owned businesses; in recent years, provincial [spending](#) has consistently exceeded revenues, which is largely dependent on [commodity prices](#) like oil.

These innovation-related challenges combine to increase expectations on Memorial University to act as a comprehensive driver of innovation, to increase the province's human capital stock and to generate economic spin-offs.

This report, with support and guidance from the Organization of Economic Cooperation and Development (OECD)'s Entrepreneurial Education, Collaboration and

⁶ Memorial University, 'Campuses,' <https://www.mun.ca/main/campuses/> (accessed June 2022).

⁷ Memorial University, 'About Memorial: Newfoundland and Labrador's university,' (29 September 2021), <https://www.mun.ca/main/about/> (accessed March 2022).

⁸ The Organization of Economic Cooperation and Development (OECD) defines four types of innovation—product innovation, process innovation, marketing innovation and organizational innovation OECD, 'Defining Innovation,' <https://www.oecd.org/site/innovationstrategy/defininginnovation.htm> (accessed May 2022). Dan Breznitz, a leading scholar of innovation, views innovation as 'the complete process of taking new ideas and devising new or improved products and services ... from the first vision, design, development, production, sale, and usage, to the after-sale aspects of products and services.' Dan Breznitz, *Innovation in Real Places* (Oxford: Oxford University Press, 2021), p. 3.

Engagement (EECOLE) network, identifies how Memorial University encourages innovation in ocean-related sectors to meet the needs of the people of Newfoundland and Labrador.

This report serves as background to an OECD final report focused on ways that place-based research has occurred through Memorial University's Public Engagement activities and approaches to generate social and economic value in the province where it is located. The final report will be presented to an international audience of policymakers, higher education leaders and academics in the final months of 2022. This background report is divided into two broad sections. The [first](#) provides an overview of several key innovation-related challenges that Newfoundland and Labrador faces. The [second](#) section introduces Memorial University, its unique history and obligation to the people, its activities relating to the ocean economy and more recently its role in the Canadian federal government's 'Ocean Supercluster' initiative.

Regional & Innovation Context

1.1. Newfoundland-Labrador: An Introduction

The province of Newfoundland and Labrador on Canada's northeast Atlantic coast features several characteristics that has facilitated innovation. The province possesses an abundance of natural resources—above-soil (e.g. hydroelectric power), subsoil (e.g. iron ore, nickel), in coastal waters (e.g. fisheries), as well as subsea (e.g. petroleum).⁹ Moreover, government spending is relatively high, especially for innovation-facilitating public goods like healthcare, education and infrastructure. Likewise, the province's people are famously resourceful, close-knit and make up the workforce of several globally competitive companies and industries.¹⁰ Finally, the province is home to Memorial University, which has consistently contributed through its training of the workforce as well as research in a wide range of fields that are relevant to the province such as marine engineering, oceanography and geological studies. For its part, the university boasts a number of world-class programs and facilities, including the Genesis incubator, C-Core, the Marine Institute (MI), the Canadian Centre for Fisheries Innovation as well as the Ocean Science Centre.

Despite these advantages, the province features several innovation-related challenges, which inevitably impact Memorial University and its research directions.

- First, **population and demographics**. The province's population is small, ageing, decreasing in number and widely dispersed over the relatively large land mass of Newfoundland and Labrador. Periods of high oil prices and major construction projects periodically reverse this trend through net *in*-migration to the province, but these trends are often only temporary in duration.
- Second, **labour markets and migration**. Memorial University has been central to the province's labour market. The nearly 20,000 students currently enrolled across its five campuses represent an emerging labour force that is educated and vibrant. Likewise, some 68,000 Memorial alumni live in the province, accounting for about 13% of the total population, though admittedly a portion of these no longer participate in the labour force.¹¹ The province is also home to a sizable number of skilled workers who often work outside the province but whose skills, capital and entrepreneurial acumen may be harnessed for the province's innovation efforts.
- Third, **economic transformation and commodity dependency**. The fate of the Newfoundland and Labrador economy tends to shift with global commodity prices,

⁹ On resource-based industrialization, see Richard M. Auty (ed.), *Resource Abundance and Economic Development* (Oxford: Oxford University Press, 2001).

¹⁰ Alvin Simms and Robert Greenwood, 'Newfoundland and Labrador,' *State of Rural Canada Report* (2015), <https://sorc.crrf.ca/nl/> (accessed May 2022).

¹¹ 'The Big Reset: The Report of the Premier's Economic Recovery Team' (St. John's, NL: May 2021), p. 158, <https://thebigresetnl.ca/> (accessed January 2022).

especially oil. These fluctuations greatly impact the finances and planning of the provincial government as well as Memorial University. This commodity dependence also impacts the flow of labour and migration into and out of the province.

- Fourth, the **business environment, networks and social capital**. The business ecosystem is relatively lopsided, in part due to the presence of several largely foreign-based multinational corporations (MNCs) focusing primarily on natural resource extraction. Furthermore, because the province is geographically remote and economically peripheral—from both Canada’s larger provincial economies like Ontario, British Columbia and Quebec, as well as to an extent from other parts of Atlantic Canada—the province lacks the critical mass of valuable innovation actors such as financiers and other professionals either to benefit from this ocean economy or to build viable innovative non-extractive sectors. Despite these challenges, the province features some vibrant success stories such as several globally competitive offshore service companies, St. John’s budding tech sector and the enduring presence of tourism throughout the province.
- Fifth, **the public sector, infrastructure and government debt**. The provincial government spends generously on important public goods like healthcare, education and infrastructure, all of which could be harnessed for innovation. However, since the early 2010s, the province’s spending has consistently exceeded revenues. Furthermore, despite this spending, unemployment rates, and dependence on government transfers to individuals remain stubbornly high while the province ranks near or at the bottom in a range of socioeconomic indicators like health and literacy.

These challenges combine to increase expectations on Memorial University which, given its long-standing ‘special obligation to the people of the province’¹² and the province’s particular natural resource endowment, has in recent decades transformed part of the university’s implied mission to comprehensively stimulate innovation in the ocean economy.

¹² Memorial University, ‘About Memorial,’ <https://www.mun.ca/main/about/> (accessed May 2022).

1.2. Population- and demographic-related challenges to innovation

Newfoundland and Labrador boasts a famously friendly, resilient and resourceful population. However, demographic trends in the province also pose several challenges to innovation.

- First, Newfoundland and Labrador is one of Canada's smallest populated provinces.¹³ At the start of 2022, the population was estimated to be slightly less than 522,500 people. The province reached a low of 509,000 in 2007, following a notable and sustained decline in population through much of the 1990s and 2000s, largely due to the closure of the cod fishery which resulted in one of the largest layoffs in Canadian labour history.¹⁴ Since then, the province has experienced modest and periodic growth, including population growth in all four quarters of 2021.¹⁵
- Second, population density in the province is very low, even by Canadian standards. Furthermore, some 42% of Newfoundlanders and Labradorians lived in rural areas as of 2011¹⁶ and nearly 90% of the over 500 communities in the province have a population of less than 1,000.¹⁷ This creates a wide range of challenges not merely for innovation, but also for the provision of healthcare and education, transportation and infrastructure, among other goods and services vital to innovation.
- Third, fewer births and net out-migration have constrained population growth in the province and continue to hamper the provincial government's population growth strategies.¹⁸ One Harris Centre study estimated that continued population decline will result in the province having less than 500,000 people by the mid-2030s, which would represent a decrease of nearly one-fifth from its peak of over 580,000 in the early 1990s.¹⁹ More specifically, out-migration of people under 35 years of age has been

¹³ Only Prince Edward Island is a less populous province in Canada, though it is also considerably smaller in land mass. Statistics Canada, 'Population and dwelling count highlight tables, 2011 Census,' <https://www12.statcan.gc.ca/census-recensement/2011/dp-pd/hltfst/pd-pl/Table-Tableau.cfm> (accessed May 2022).

¹⁴ Heather M. Hall et al., 'From dysfunctional to destitute: the governance of regional economic development in Newfoundland and Labrador,' *International Planning Studies* 22 (2) (2017), p. 52.

¹⁵ Department of Finance, Newfoundland and Labrador, <https://www.gov.nl.ca/fin/economics/eb-population/> (accessed May 2022).

¹⁶ 'Rural areas' are considered locales with fewer than 1,000 inhabitants and a population density below 400 people per square kilometre. Statistics Canada, *Canada goes urban* (2020), <https://www150.statcan.gc.ca/n1/pub/11-630-x/11-630-x2015004-eng.htm> (accessed March 2022).

¹⁷ Municipal and Provincial Affairs, Government of Newfoundland and Labrador, 'Joint Working Group on Regionalization: Report and Recommendations,' (2 February 2022), p. 9, <https://www.gov.nl.ca/mpa/files/Regionalization-Report-and-Recommendations.pdf> (accessed May 2022).

¹⁸ Government of Newfoundland and Labrador, *A Population Growth Strategy for Newfoundland and Labrador, 2015-2025* (St John's, NL: Government of Newfoundland and Labrador, 2015), <https://www.gov.nl.ca/populationgrowth/> (accessed May 2022).

¹⁹ Alvin Simms and Jamie Ward, *Regional population projections for Newfoundland and Labrador 2016-2036* (St. John's, NL: Harris Centre Regional Analytics Laboratory, Memorial University, 2016),

especially pronounced, a demographic widely seen as vital to innovation due to their generally greater tolerance of risk and diversity. Furthermore, the province currently has the second lowest birth rate in Canada. At 1.42 children per woman, this is well below the replacement rate of 2.1.²⁰ Indeed, the number of births in Newfoundland and Labrador has been on a steady downward trajectory since the 1960s. More specifically, the annual number of births has plummeted, from roughly 12,000 in 1974 to less than 4,000 in 2021.²¹ An important contributor to this declining birth rate is the sharp decrease in the number of females aged 15 to 49 in the province. From 1997-2019, the female demographic has decreased by about 30%.²²

These combined trends of out-migration of young people, declining birth rates, as well as a growing but still very limited in-migration from outside Canada²³ have made Newfoundland and Labrador the province with Canada's most rapidly ageing population.²⁴ As such, the province currently features a median age six years *older* than the Canadian average, which impacts the province's finances, politics, social values and innovation prospects.²⁵ For nearly three decades from the 1970s and into the 1990s, the province

https://www.mun.ca/harriscentre/PopulationProject/Population_Projections_for_NL.pdf; Malone Mullin, 'The rest of Canada is booming. Why is NL's population falling behind?' CBC News (20 September 2019), <https://www.cbc.ca/news/canada/newfoundland-labrador/nl-population-projection-1.5289419> (accessed May 2022).

²⁰ Terry Roberts, 'Last year was the worst year in history for births in Newfoundland and Labrador,' CBC News (22 January 2019), <https://www.cbc.ca/news/canada/newfoundland-labrador/births-low-population-1.4980724> (accessed April 2022).

²¹ In 2021, deaths in the province outnumbered births by more than 1,300. Alex Kennedy, 'Birth numbers in NL stagnant in 2021, a trend "almost impossible" to reverse,' say expert,' CBC News (24 January 2022), <https://www.cbc.ca/news/canada/newfoundland-labrador/nl-births-and-deaths-2021-1.6318466> (accessed February 2022).

²² Matt Lundy, 'In Newfoundland and Labrador, a demographic crisis gets worse,' *The Globe & Mail* (23 February 2020), <https://www.theglobeandmail.com/business/economy/article-in-newfoundland-and-labrador-a-demographic-crisis-puts-the-economy-at/> (accessed February 2022). For more data, see Newfoundland & Labrador Statistics Agency, Department of Finance, https://stats.gov.nl.ca/Statistics/Topics/population/PDF/PopAgeSex_M.PDF (accessed May 2022).

²³ Lan Gien and Rebecca Law, *Attracting and Retaining Immigrants to Newfoundland and Labrador: Voices from the Newcomers and International Students* (St. John's, NL: Harris Centre Regional Analytics Laboratory, Memorial University, 2016), <https://research.library.mun.ca/8155/>. See also Government of Newfoundland and Labrador, *The Way Forward on Immigration in Newfoundland and Labrador* (St. John's, NL: Government of Newfoundland and Labrador, 2017).

²⁴ In a mere six-year span from 2016 to 2021, the number of adults aged 65 or older increased from 19.4% of the province's population to 23.6%. Sarah Smellie, 'Atlantic provinces will have highest proportion of seniors over 85: census,' CBC, <https://www.cbc.ca/news/canada/newfoundland-labrador/cp-atlantic-provinces-seniors-2043-1.6432892> (accessed May 2022). For example, Newfoundland and Labrador has a total of 40 long-term care homes, 98% of which are publicly owned with the remaining 2% owned by private for-profit organizations. Canadian Institute for Health Information, 'Long-term care homes in Canada: How many and who owns them?' (24 September 2020), <https://www.cihi.ca/en/long-term-care-homes-in-canada-how-many-and-who-owns-them> (accessed May 2022).

²⁵ These median ages are even more stark if broken by economic zone. For example, the median age in Economic Zone 10 (Port aux Basques) on the province's southwest coast is about 55 years-old, while Economic Zone 19

boasted three potential labour force participants for every potential retiree. Now, for every labour force entrant, there are 1.5 potential retirees, reversing that trend and raising the spectre of a ‘demographic burden’.²⁶

The greater St. John’s area or Census Metropolitan Area (CMA)²⁷ is one important exception to these trends, in part due to intra-provincial urbanization—that is, people leaving many of the province’s small rural communities to settle in larger regional centres within the province.²⁸ For example, the total population of St. John’s CMA grew from 165,000 in 1986 to about 213,000 by 2020. Nearly 40% of the province’s population now live in this urban area,²⁹ compared to only 30% in 1992. It is also home to the largest campus of Memorial University as well as to many innovative Memorial-connected entities like the Marine Institute (MI), C-Core and the Genesis Centre among others ([see below](#)). Population growth in the capital city can be explained by in-migration from rural areas as well as from outside the province, drawn to the various dynamic sectors, public-sector jobs and multinational corporations that base themselves in the city ([see below](#)).³⁰

Moreover, the demographics of St. John’s also capture this conglomeration of talent and resources, with nearly one-third (32.7%) of the population between the ages of 18-44 and a mere 12.2% aged 65 years or older.³¹ This contrasts sharply with the province’s broader demographic make-up, wherein the largest population cohort in Newfoundland and Labrador is 50 years or older.

Overall, it appears that St. John’s has succeeded in attracting elements of the ‘creative class’,³² a group commonly cited in the innovation literature.³³ The provincial capital

(Northeast Avalon) is 41.7 compared to 36.2 of the Greater Toronto Area. Statistics Canada, <https://publications.gc.ca/Collection/Statcan/96F0030X/96F0030XIE2001002.pdf> (accessed February 2022).

²⁶ Rob Greenwood, ‘Demographics as destiny? Regional development, population, and productivity in NL,’ presentation to the Bank of Canada Board of Directors (St. John’s, NL: The Harris Centre Memorial University, 12 June 2019), <https://research.library.mun.ca/13984/> (accessed April 2022).

²⁷ Statistics Canada defines the St. John’s CMA as a geographic area that includes St. John’s, Conception Bay South, Mount Pearl, Paradise, Torbay, Portugal Cove-St. Philip’s, and Logy Bay-Middle Cove-Outer Cove. Newfoundland & Labrador Statistics Agency cited in https://stjohns.ca/sites/default/files/files/publication/Demographic%20Survey%20Results_StJohns_CMA_Region_2016.pdf (accessed February 2022).

²⁸ Simms and Greenwood, ‘Newfoundland and Labrador’.

²⁹ This level of concentration of people in one area relative to the rest of the jurisdiction is greater than Tokyo, Panama City and Santiago, Chile, but less than concentrated than Tel Aviv, Ulaan Batoor (Mongolia) and Asuncion (Paraguay).

³⁰ Josh Lepawsky et al., ‘Metropolis on the margin: Talent attraction and retention to the St. John’s city-region,’ *The Canadian Geographer*, 54 (3) (2010): 324-46.

³¹ Newfoundland & Labrador Statistics Agency cited in https://stjohns.ca/sites/default/files/files/publication/Demographic%20Survey%20Results_StJohns_CMA_Region_2016.pdf (accessed February 2022).

³² Josh Lepawsky et al., ‘Kingston and St. John’s: The role of relative location in talent attraction and retention,’ in J. Grant (ed.) *Seeking Talent for Creative Cities* (Toronto: University of Toronto Press, 2018), pp. 201-18.

³³ Richard Florida, *The rise of the creative class and how it’s transforming work, leisure, community and everyday life* (New York: Basic Books, 2002).

has pulled in rural residents as well as ‘come from aways’ from other parts of the country or from outside Canada who bring their spending power and skills to the province and often work on mega-project development or in the offshore petroleum industry. As a result, the unemployment rate in St. John’s CMA is some ten-percentage points lower than elsewhere in the province. Likewise, given that the city serves as the base for the petroleum industry, tech sector and government, this metropolitan area has also witnessed a sustained construction and real estate boom.³⁴ By contrast, the population outside of St. John’s CMA since the mid-1980s has shrunk by one-fourth from about 410,000 in the mid-1980s to about 310,000 today. We now turn to how the movement of people in and out of the province have tended to follow economic trends.

³⁴ Kaitlynn Nordal, ‘Don’t expect the hot housing market to cool down any time soon, says St. John’s realtor,’ *Saltwire* (29 March 2022), <https://www.saltwire.com/atlantic-canada/lifestyles/dont-expect-the-hot-housing-market-to-cool-down-any-time-soon-says-st-johns-realtor-100712063/> (accessed May 2022). Nevertheless, St. John’s has been ranked the second most affordable home market in Canada (second to Moncton) with an average price of resale homes down over 10% from the 2014 peak. Brad Bragg, ‘5 things to know about homes for sale in St. John’s housing market 2020,’ *NL Home Finder* (29 January 2020), <https://www.nlhomefinder.ca/blog/5-things-to-know-about-the-homes-for-sale-in-st-johns-housing-market/> (accessed May 2022).

1.3. Labour markets & migration

The economy of Newfoundland and Labrador features, on the one hand, sectors that contribute significantly to provincial government revenues but tend to directly employ relatively small numbers of people; and on the other, sectors that contribute marginally to provincial revenues but tend to directly employ significant numbers of people.

Figure 2 shows how certain industries like oil extraction; construction; finance, insurance and real estate; and mining each account for sizeable pieces of the province's gross domestic output, but provide relatively little *direct* employment compared to sectors like healthcare, public administration and retail. Only healthcare contributes significantly to the economy and in numbers of jobs.

The impact of capital-intensive industries like petroleum and mining on employment is far greater through the so-called 'jobs multiplier'.³⁵ Statistics Canada estimates that for every job in the petroleum industry, five jobs are created in the rest of the economy, far greater than the multiplier for retail (1.3), education (1.3) health services (1.4) or even manufacturing (2.3). Only iron ore mining (2.6) comes close to the petroleum industry's multiplier.³⁶ Given how major decisions in these capital-intensive industries tends to be made outside the province, the more important question may be about retaining and 'spilling over' this investment.³⁷

The service sector, similar to other OECD countries, is the biggest source of jobs in the province. This highly varied sector contributes four-fifth of the jobs in the province, but makes up about 56% of the province's gross domestic product (GDP). In 2020, pandemic-induced movement restrictions decreased *overall* employment in the province by 6%, but impacted services most gravely, especially in sectors like accommodation and food service, construction, education and retail trade.³⁸

The province has long boasted a prominent goods-producing sector, which made up 44% of the province's gross domestic product (GDP) in 2018, in part due to extractive industries like petroleum and mining. This contribution represents a much higher share than the Canadian average. More specifically, notable primary-sector activities such as fishing, agriculture, forestry and logging that defined long stretches of the province's history now contribute significantly less to the province's economy, whether measured in employment

³⁵ Job multipliers measure how the creation or destruction of output or employment in a particular industry translates into wider employment changes throughout the economy. Josh Bivens, 'Updated employment multipliers for the US economy,' Economic Policy Institute (23 January 2019), <https://www.epi.org/publication/updated-employment-multipliers-for-the-u-s-economy/> (accessed March 2022).

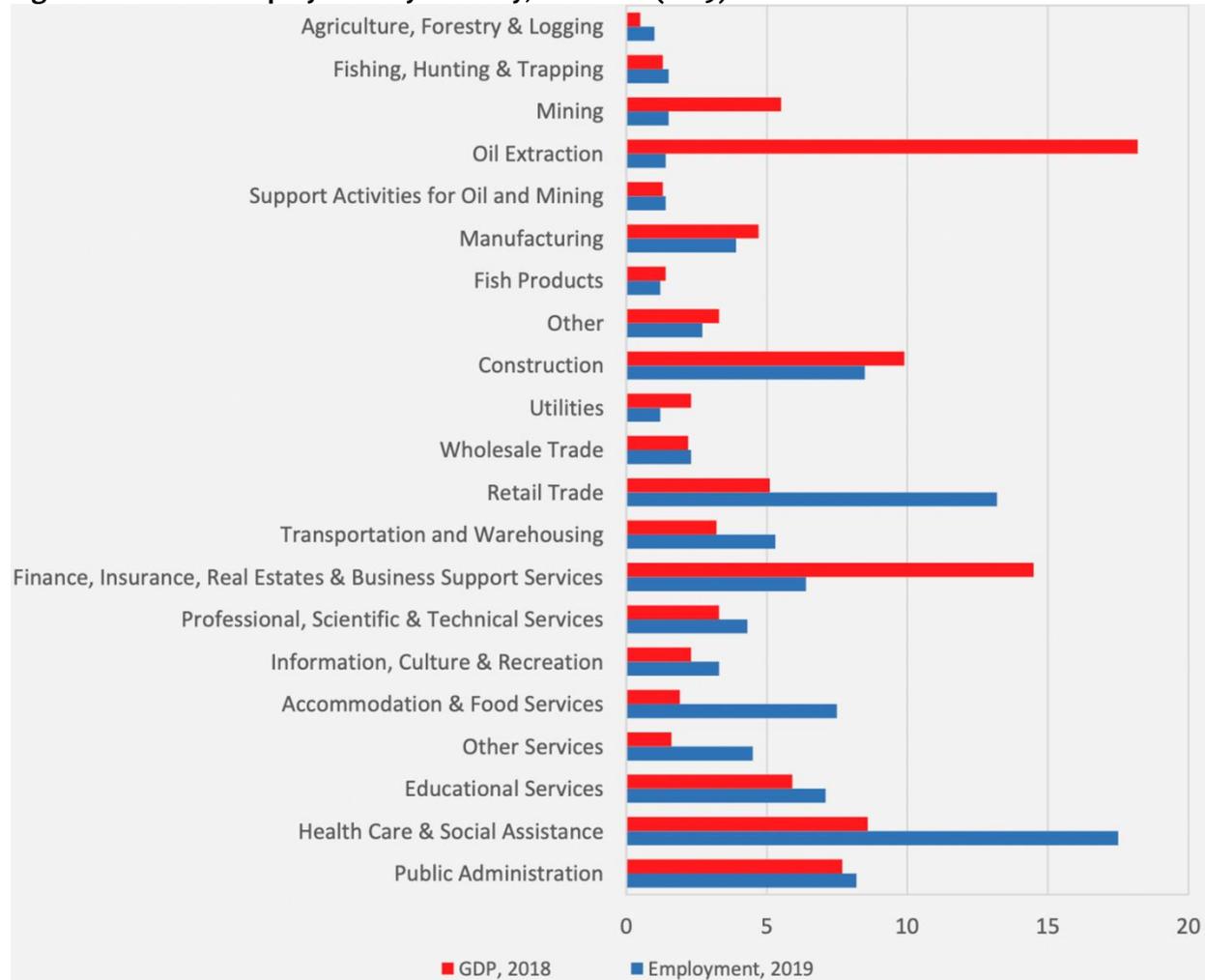
³⁶ Statistics Canada cited in 'The Big Reset', p. 17.

³⁷ The authors thank Richard Shearmur for this point.

³⁸ Standard and Poor Global, 'Province of Newfoundland and Labrador outlook revised to negative on Impact of COVID-19 and low oil prices,' Standard and Poor Global (28 May 2020).

or GDP (Figure 2). Forestry, like fisheries, has experienced significant hardships over the past two decades, accentuated by the closure of two paper mills, which had considerable impact on the local communities where they were based. However, forestry continues to serve as a key employer on the west coast of the province.³⁹

Figure 2: GDP and Employment by industry, % of total (2019)



Source: Statistics Canada (14-10-0023-01); Department of Finance, cited in 'The Big Reset,' p. 16.

After a lengthy period of decline and with particularly devastating effects on rural communities, the fisheries are again a stable contributor to the province's overall economy,

³⁹ Gary Kean, 'Summit in Corner Brook highlights the need to squeeze more value out of forestry sector,' Saltwire, (28 January 2019), <https://www.saltwire.com/newfoundland-labrador/news/summit-in-corner-brook-highlights-need-to-squeeze-more-value-out-of-forestry-sector-279658/> (accessed April 2022); Garrett Barry, 'A decade on, workers—and town—still mourn loss of Grand Falls-Windsor mill,' CBC News (17 February 2019), <https://www.cbc.ca/news/canada/newfoundland-labrador/mill-closure-anniversary-grand-falls-windsor-1.5020839> (accessed April 2022).

though employment is only a fraction of what it was in decades past.⁴⁰ Among the reasons for this stabilization has been a growing aquaculture sector, which has helped compensate for the reductions in the wild fishery, as has the emergence of crab and shrimp fishing.⁴¹

By contrast—and reflecting the structural change that the province’s economy has undergone around the turn of the twenty-first century ([see below](#))—the growth of the petroleum and mining sectors, as well as a myriad of related suppliers, have helped offset some of the losses in jobs and revenue from sectors like fisheries and forestry.⁴² Likewise, these extractive industries tend to feature high-paid and high-skilled jobs, but given their capital-intensive nature, only account for 3.5% of total provincial employment ([Figure 2](#)). The petroleum industry is exceptionally rent-generating⁴³ and the world’s most capital-intensive industry.⁴⁴ As such, its labour needs are both extremely limited and specialized.⁴⁵

The province boasts a relatively sizeable mobile workforce⁴⁶, which one author cleverly called ‘been aways’.⁴⁷ This impressive reserve of skilled workers responds to the lure of high-wage employment in other provinces, resulting in significant amounts of cross-

⁴⁰ In 2020, those working in both harvesting and processing in the wild fishery sector of the province amounted to about 15,000, down from some 55,000 in 1987. By contrast, the value of fishing landings was some CAD\$586m in 2020, up from \$276m in 1987. These figures do not include aquaculture. Department of Fisheries and Oceans (DFO) Canada, ‘Marine sector in Canada summary tables,’ <https://www.dfo-mpo.gc.ca/stats/maritime-eng.htm> (2022) (accessed June 2022).

⁴¹ On controversies in this sector, see Robert Sheppard, ‘Letter: Ban catch and release salmon fishing in Newfoundland in 2019,’ *The Telegram* (30 March 2019). For a counter-argument, see ‘Letter: No reason to ban catch and release salmon fishing in NL,’ (28 March 2022), <https://www.saltwire.com/atlantic-canada/opinion/letter-no-reason-to-ban-catch-and-release-salmon-fishing-in-nl-100711460/>; ‘Will fishing shrimp be worth it this year? Maybe not, say harvesters,’ CBC News (1 May 2021), <https://www.cbc.ca/news/canada/newfoundland-labrador/shrimp-prices-concerns-broadcast-1.6010541> (accessed May 2022).

⁴² Richard Florida, *Is Oil the New Cod? Resource Redux in Newfoundland and Labrador* (Toronto: Martin Prosperity Institute, University of Toronto, 2011).

⁴³ Michael Ross, *The Oil Curse: How Petroleum Wealth Shapes the Development of Nations* (Princeton, NJ: Princeton University Press, 2012).

⁴⁴ The oil and gas industry is almost 3.5 times more capital-intensive than the utilities sector, the world’s second most capital-intensive industry. Heiner Schultz, ‘Political Institutions and Foreign Direct Investment in Developing Countries: Does the Sector Matter?’ SSRN (13 May 2009), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1403983 (accessed May 2017).

⁴⁵ For example, to sustain production at the West White Rose oilfield, the province will contribute CAD\$41.5m alongside Husky Energy, the field’s main operator. But the government estimates that such a sizeable investment will only generate an estimated 331 jobs. CBC/Radio Canada, ‘Life support of \$41.5m given to West White Rose, but no guarantee oil project will restart,’ CBC News (3 December 2020), <https://www.cbc.ca/news/canada/newfoundland-labrador/west-white-rose-1.5826436> (accessed March 2022).

⁴⁶ For example, from 2001 to 2006, some 5,500 Newfoundlanders were commuting back and forth to Fort McMurray as ‘fly-in, fly-out’ workers on oil sands sites. Similarly, from mid-2006 to mid-2007, about 13,000 Atlantic Canadians relocated to Alberta in that twelve-month period alone. Chris Turner, *The Patch* (Toronto: Simon & Schuster, 2017), p. 126.

⁴⁷ Greg Spencer used this term during a Newfoundland and Labrador ISRN team workshop in February 2010, referring to tech-sector employees, but this may also be extended to include tradespeople working in oil and gas, mining and the like.

country commuting in sectors like oil and gas extraction, mining, utilities and construction.⁴⁸ The oil sands of Alberta are a powerful magnet for this almost exclusively male labour force.⁴⁹ From 2007 to 2014, which was a period of particularly high oil prices and robust growth in Alberta's oil sands, some \$900 million per year or about 6% of total provincial earned income was generated *outside* the province.⁵⁰ As a result of this mobile labour force, remittances contribute an unusually high percentage of household income in the province and to the provincial economy more broadly.⁵¹

This mobile labour force may be a positive source of innovation. For one, as skilled workers and potential entrepreneurs, these 'been aways' have the experience, learning and modest amounts of capital to strengthen innovation in the province.⁵² Likewise, these workers are often from rural communities, and thus their high wages—often earned away—contribute to spending in local communities, which one scholar calls a 'de facto rural economic development strategy'.⁵³ However, too often their economic impact within the province takes the form of consumption, such as home-building, spending and basing their families in Newfoundland and Labrador, while awaiting their next assignment outside the province.⁵⁴

The COVID-19 pandemic and the movement restrictions that followed greatly reduced demand for petroleum. During the sharpest fall in prices, Canada's oil and gas sector lost 24,000 jobs in the second quarter of 2020 alone.⁵⁵ The collapse in demand, prices and

⁴⁸ Christopher Macdonald Hewitt et al., *Interprovincial Employees from Newfoundland and Labrador, 2005-2014* (On the Move Partnership, 2018), <http://www.onthemovepartnership.ca/wp-content/uploads/2019/01/NL-IPE-Final-web.pdf> (accessed May 2022).

⁴⁹ Keith Storey and Heather M. Hall, 'Dependence at a distance: The new single-industry community and the implications for policy,' *The Canadian Geographer*, 62(2) (2018): 225-237.

⁵⁰ Total income earned by residents outside the province for the year 2017 was similarly high, standing at \$724 million. Statistics Canada cited in 'The Big Reset', p. 12.

⁵¹ This compares with Pakistan where remittances make up 8% of GDP (CAN\$29.1 million) and Vietnam at 6% (CAN\$22.1m). The World Bank, 'Migration and Remittances Data,' <https://www.worldbank.org/en/topic/migrationremittancesdiasporaisues/brief/migration-remittances-data>.

⁵² Ken Carter et al., 'Newfoundland & Labrador: Missed opportunities but glimmers of hope,' in P. W. B. Phillips and D. Castle (eds.), *Ideas, Institutions, and Interests: The Drivers of Canadian Provincial Science, Technology, and Innovation Policy* (Toronto: University of Toronto Press, 2022), pp. 113-40.

⁵³ Keith Storey, 'From "new town" to "no town" to "source", "host" and "hub" communities: The evolution of the resource community in an era of increased labour mobility,' *The Journal of Rural and Community Development* 13 (3) (2018), p. 102. See also Heather M. Hall and Kelly Vodden, 'Family and community impacts on mobility for work,' Memorial Presents (St. John's, NL: 5 December 2017); Keith Storey, *Commuting to Alberta: The mobile workforce in Newfoundland and Labrador*, Report prepared for the Department of Human Resources, Labour and Employment (St. John's, NL: Government of Newfoundland and Labrador, Harris Centre, Memorial University, 2010).

⁵⁴ For example, Newfoundland and Labrador has the highest number of car sales per capita of all provinces. Timothy Cain, 'Driving by numbers: Province by province pandemic auto sales,' *Driving* (14 April 2021), <https://driving.ca/column/driving-by-numbers/driving-by-numbers-province-by-province-pandemic-auto-sales> (accessed March 2022).

⁵⁵ Statistics Canada, 'Record decline in natural resources real gross domestic product,' (23 September 2020), <https://www150.statcan.gc.ca/n1/daily-quotidien/200923/dq200923a-eng.htm> (accessed May 2022).

revenue also derailed the province's ambitious growth plans for the industry,⁵⁶ prompting the provincial government to launch a task force⁵⁷ and to reiterate its support for the Hibernia offshore platform project in particular.⁵⁸ Anemic oil prices as well as the federal government's uncertain messaging around further offshore oil and gas exploration have delayed further investments, including the \$3.2-billion expansion project for the White Rose oilfield.⁵⁹ In this sense, Newfoundland and Labrador finds itself in a struggle not unlike other oil-rich jurisdictions, torn between promoting a job-creating and lucrative industry against pressures and desires to decarbonize in government and civil society.⁶⁰

For its part, the mining sector directly employed 6,300 people in 2019. While this figure includes those working for the mining companies as well as contractors and construction workers, it doesn't account for jobs in closely related industries such as drilling, transportation services, energy supply and secondary metal fabrication.⁶¹ Mining is vital for Labrador and rural areas especially, where many of the projects—and thus jobs—are located.

Despite the emergence of these rent-generating industries, Newfoundland and Labrador has the highest unemployment rate among Canada's ten provinces. At 13.7% in 2020, its unemployment rate was considerably higher than the national average of 9.5% and perhaps even more disturbingly, higher than fellow Atlantic provinces as well.⁶² This high

⁵⁶ Government of Newfoundland and Labrador, *Advance 2030: A Plan for Growth in the Newfoundland and Labrador Oil and Gas Industry* (St John's, NL: Government of Newfoundland and Labrador, 2019); Government of Newfoundland and Labrador, *The Way Forward on Oil and Gas – Advance 2030: A Plan for Growth in the Newfoundland and Labrador Oil and Gas Industry* (St John's, NL: Government of Newfoundland and Labrador, 2018).

⁵⁷ Government of Newfoundland and Labrador, 'Oil and Gas Industry Recovery Task Force Focuses on Immediate Actions,' Government of Newfoundland and Labrador (25 September 2020).

⁵⁸ Government of Newfoundland and Labrador, 'Provincial Government Announces Support for Hibernia,' Government of Newfoundland and Labrador (23 December 2020).

⁵⁹ Terry Roberts, 'Cenovus to decide on West White Rose "in the coming weeks," says CEO,' CBC News (27 April 2022), <https://www.cbc.ca/news/canada/newfoundland-labrador/cenovus-argentina-white-rose-1.6432691> (accessed May 2022). Government of Newfoundland and Labrador, 'Provincial Government Provides Update on Status of Terra Nova Project,' Government of Newfoundland and Labrador (14 January 2021). The province's offshore fields feature a relatively light carbon footprint when compared with other offshore fields such as those of the US Gulf of Mexico, China's Bohai Bay, or much of the North Sea. Government of Newfoundland and Labrador, *The Way Forward on Climate Change in Newfoundland and Labrador* (St. John's, NL: Government of Newfoundland and Labrador, 2019); Government of Newfoundland and Labrador, *The Way Forward: A Vision for Sustainability in Newfoundland and Labrador* (St. John's, NL: Government of Newfoundland and Labrador, 2017).

⁶⁰ Larry Short, 'Grudge Match in the Oilpatch: Decarbonizers versus Double-Downers,' CBC News (9 November 2019), <https://www.cbc.ca/news/canada/newfoundland-labrador/decarbonize-vs-double-down-1.5352989>

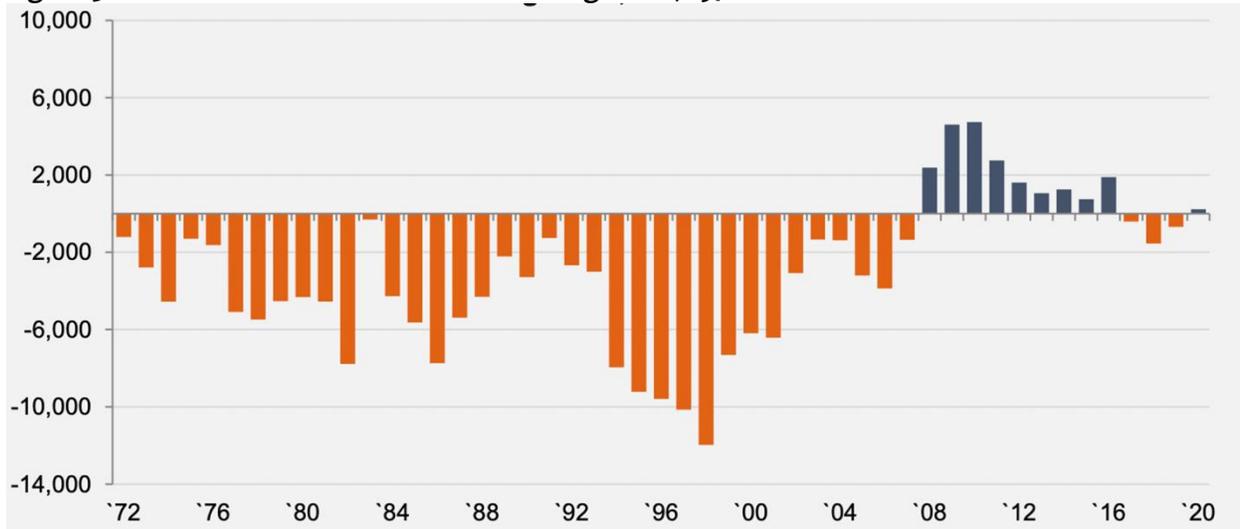
⁶¹ There is a development agreement that requires nickel processing to take place in the province. See 'Six Amendment to Voisey's Bay Development Agreement' (19 December 2014), <https://www.gov.nl.ca/iet/files/royalties-amendment-4-redacted.pdf> (accessed May 2022).

⁶² For the year 2020, the unemployment rate in Prince Edward Island was 10.4%, 9.8% in New Brunswick and 9.6% in Nova Scotia.

and rising rate of unemployment preceded the onset of the COVID-19 pandemic by several years.⁶³

Beyond extractive industries, the province features St. John's budding tech sector with Memorial-incubated success stories like Verafin, a tech company focused on fraud detection and whose founders were originally working on mining-related issues in Memorial's Department of Engineering. Verafin was purchased for US\$2.75bn, the biggest Canadian software buyout since 2007.⁶⁴ The province's tech sector employed over 6,400 people in 2017, contributing nearly \$1.4 billion in economic activity, and continues to grow.⁶⁵ Tourism is important for both the revenue and jobs it generates throughout the province.⁶⁶ In 2018, tourism generated \$567m in non-resident spending, though is constrained by seasonality and characterized by often low-paying jobs. This sector also holds promise for the province's less carbon-intensive diversification efforts.

Figure 3: Newfoundland and Labrador's net migration, 1972-2020



Source: Statistics Canada (17-10-0008-01)

Figure 3 shows how population movements in and out of the province have tended to follow economic trends: net-outmigration during economic downturns, the ending of

⁶³ Jesse Ferreras, 'Unemployment in Newfoundland and Labrador could reach almost 20% in 3 years,' *The Huffington Post Canada* (15 November 2016), https://www.huffpost.com/archive/ca/entry/newfoundland-unemployment_n_12998174 (accessed May 2022).

⁶⁴ Mark Rendell and Sean Silcoff, 'Nasdaq to buy Verafin for US\$2.75-billion in biggest Canadian software takeover since 2007,' *The Globe & Mail* (19 November 2020), <https://www.theglobeandmail.com/business/article-nasdaq-to-buy-canadas-verafin-for-us275-billion/> (accessed May 2020).

⁶⁵ Figures cited in 'The Big Reset', p. 102.

⁶⁶ Gord B. Cooke et al., 'The nuanced nature of work quality: evidence from rural Newfoundland and Ireland,' *Human Relations* 66 (4) (2013): 503-527.

major project construction or the collapse in oil prices (for example, early 1990s to late 1990s; post-2016) and net in-migration during economic upswings and boom periods (2008-15).

The sharpest example of this was the moratorium on the cod fishery in 1992, which affected close to 30,000 people and over 400 communities, and triggered a multi-year exodus of people from the province.⁶⁷ For example, 12,000 people left the province in 1998, the single-year peak of out-migration and directly related to the cod moratorium of the mid-1990s. This came just two years after the absolute number of those employed in the province hit its nadir in 1996.

Conversely, strong commodity prices and major project activity increased labour demand and spurred net in-migration. This resulted in the population growing for nine consecutive years from the late 2000s to mid-2010s. However, net migration again became negative in 2016 following the completion of several mega-projects as well as the fall in oil prices. It is this structural transformation and commodity dependence to which we now turn.

⁶⁷ Hall et al., 'From dysfunctional to destitute'.

1.4. Economic transformation and commodity dependence

The province has undergone significant structural economic change since the turn of the twenty-first century, in large part due to the commercial exploitation and expansion of the offshore petroleum industry. More recently, a mining renaissance in the province, especially in Labrador and to a lesser extent in central Newfoundland, has taken place. Both industries have generated high- and middle-paying jobs as well as significant rents for the province, which in turn can be used for innovation-enabling spending. However, these sectors also deepen the province's dependence on commodity rents and prices, the latter of which is virtually entirely out of the province's control.

The petroleum industry of Newfoundland and Labrador has emerged as a major engine of economic growth and revenue for the province since offshore oil was first commercially exploited in the late 1990s (Figure 4). As a result, the fate of the Newfoundland and Labrador economy now shifts with global commodity prices, especially oil. For example, oil prices fluctuated wildly between 2012-20, from a peak of \$US128 per barrel to a low of US\$9 per barrel, which in turn greatly impacted the demand for labour as well as financing and planning for the provincial government (see below).

If viewed from a global or even national perspective, Newfoundland and Labrador oil production is relatively small. The province contributes about 5% to Canada's overall oil production⁶⁸ and less than 0.3% of global oil output. However, the province's oil output consistently surpasses that of several member-states of the Organization of Petroleum Exporting Countries (OPEC)⁶⁹ and, if a country, Newfoundland and Labrador would be the world's 30th largest oil producer.

The mining sector has undergone a revival in recent years.⁷⁰ This sector is a major generator of jobs and revenue in Labrador in particular. Mining has been considerably less prominent in Newfoundland, though several notable discoveries of gold deposits have heightened mining interest on the island.⁷¹ Since 2000, the mining industry has nearly doubled its share to account for 8% of the province's GDP and private mining companies have invested some CAD\$9 billion in the province. Iron ore still commands the lion's share of

⁶⁸ Canada produces nearly 6% of world oil production, with the bulk of that production coming from Alberta. US Energy Information Administration, 'Frequently asked questions (FAQs): What countries are the top producers and consumers of oil?' US EIA, <https://www.eia.gov/tools/faqs/faq.php?id=709&t=6> (2022) (accessed May 2022).

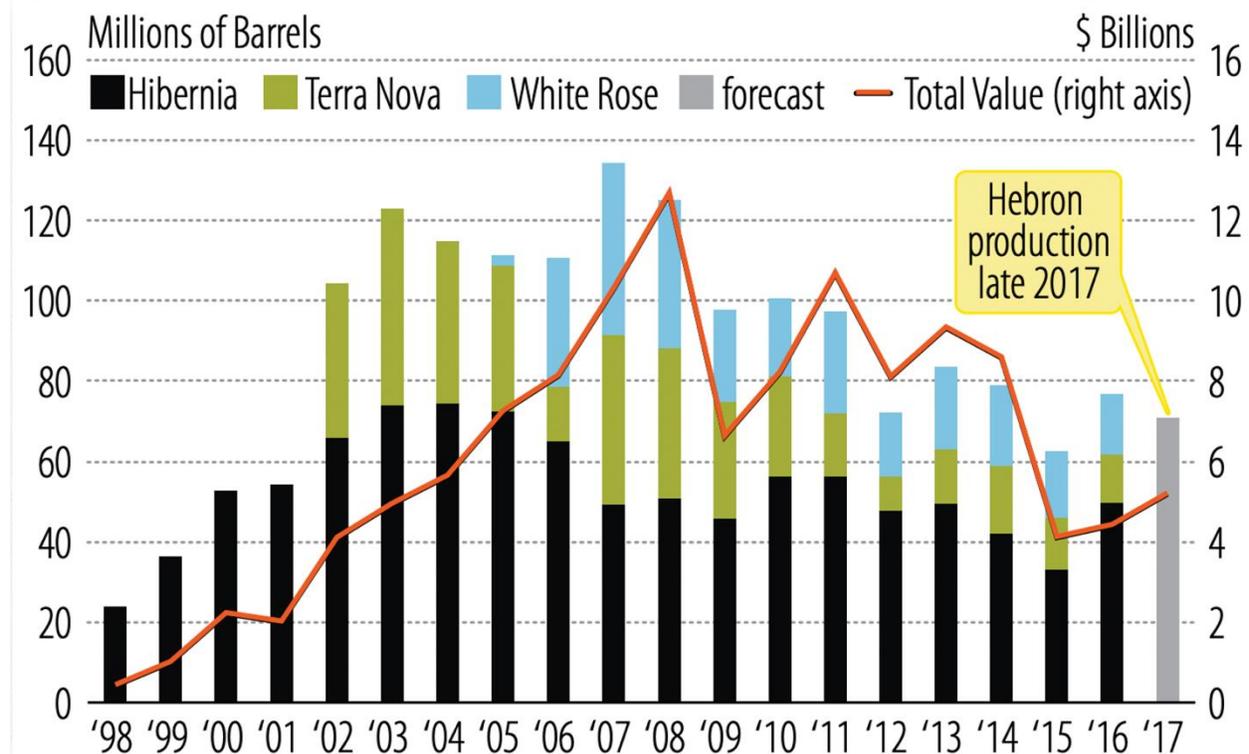
⁶⁹ Newfoundland and Labrador production exceeds that of Republic of Congo (266,000 barrels per day, or bpd) and Gabon (175,000 bpd). BP, *Statistical Review of World Energy* (2021), <https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2021-full-report.pdf> (accessed April 2022), p. 18.

⁷⁰ SaltWire Network, 'Banner year for mineral exploration activity in Newfoundland and Labrador,' Saltwire (11 January 2021), <https://www.saltwire.com/nova-scotia/business/banner-year-for-mineral-exploration-activity-in-newfoundland-and-labrador-539616/> (accessed April 2022).

⁷¹ Nicholas Mercer, 'TRU Precious Metals making headway in central Newfoundland gold properties,' *The Telegram* (8 March 2021), <http://thetelegram.newspaperdirect.com/epaper/viewer.aspx> (accessed April 2022).

this sector, contributing 70% of shipment value in 2019. Nickel, copper and cobalt together contribute much of the remaining share. Altogether, the value of production in 2019 was \$3.7 billion.

Figure 4: Value and volume of offshore oil production, Newfoundland and Labrador, 1998-2017



Source: Canada-Newfoundland and Labrador Offshore Petroleum Board, Department of Finance

Mining investments peaked with the construction of the Long Harbour hydromet plant, mine expansion at Voisey's Bay, and investments by Tata Steel and Tacora Resources. In particular, the Long Harbour processing facility, which is run by the Brazilian mining giant Vale, processes nickel, copper and cobalt using hydroelectricity, among other energy sources.⁷²

Commodity prices have surged in the wake of Russia's invasion of Ukraine in February 2022 as well as the lifting of pandemic-related restrictions in much of the world. Furthermore, the province, with its bounty of iron ore, nickel, cobalt, copper and certain rare earth minerals, has drawn interest from companies sourcing minerals for the unfolding

⁷² Terry Roberts, 'Vale, province celebrate first production at new nickel plant in Long Harbour,' CBC News (19 November 2014), <https://www.cbc.ca/news/canada/newfoundland-labrador/vale-province-celebrate-first-production-at-new-nickel-plant-in-long-harbour-1.2840691> (accessed April 2022).

‘green transition’, including those going into wind turbines, solar panels and electric vehicles.⁷³

Memorial University has helped to increase geological understanding and capacity-building in this area. In 1990, the university opened the Alexander Murray Earth Sciences Building. Research in this field, funded in part by upfront money from the Hibernia offshore project, has yielded breakthrough findings on tectonic plates while helping to deepen the province’s knowledge base of its offshore petroleum resources. In a similar way that Memorial had trained graduates in tasks connected to the offshore petroleum industry which in turn went on to apply their trades and deploy their knowledge outside the province, we may see a similar trend in coming years with Memorial graduates in the mining sector.

The strength of these two extractive industries has been both an opportunity and constraint for innovation in the province, greatly impacting the nature, size and focus of the businesses in the province.

⁷³ The World Bank Group estimates cobalt demand to increase by 460% and nickel by 99% from 2018 production levels by 2050 to achieve the Paris climate targets. The World Bank, ‘Climate-Smart Mining: Minerals for Climate Action,’ <https://pubdocs.worldbank.org/en/961711588875536384/Minerals-for-Climate-Action-The-Mineral-Intensity-of-the-Clean-Energy-Transition.pdf> (accessed April 2022); Lindsay Bird, ‘A low-carbon future means a big demand for key minerals. Can NL’s mines cash in?’ CBC News (6 December 2020), <https://www.cbc.ca/news/canada/newfoundland-labrador/newfoundland-labrador-mining-green-technology-sector-1.5822115> (accessed April 2022); ‘Vale signs deal with Tesla to provide Voisey’s Bay nickel for electric vehicles,’ CBC News (6 May 2022), <https://www.cbc.ca/news/canada/newfoundland-labrador/vale-tesla-nickel-deal-1.6368459> (accessed May 2022).

1.5. The business environment, networks & innovation

The private sector is vital to any innovative environment and often the basis on which sustained economic growth occurs.⁷⁴ However, the structure, make-up and interaction of these private-sector firms must also be considered.

Due to compactness and cultural factors, the Newfoundland and Labrador innovation environment has been characterized as one of dense local relationships and relatively high levels of ‘social capital’.⁷⁵ Scale and size, often seen as impediments in the innovation literature, may indeed be an advantage in Newfoundland and Labrador, with these relatively dense networks enabling stronger rural-urban connections.⁷⁶ Conversely, several scholars of the region have cited this closeness and related insider-outsider dynamic as hindering innovation.⁷⁷ In this sense, the province may mimic the tendencies of other peripheral economies where high levels of social capital, limited local knowledge creation and relatively low levels of technology result in more incremental than radical innovation.⁷⁸

Hall et al. have also identified a series of private-sector challenges in different locales throughout the province. For example, while Corner Brook has struggled with problems such as isolated social networks and retaining skilled and especially young workers, a geographically peripheral area like the Northern Peninsula has lacked more fundamental ingredients for innovation such as an insufficient number of entrepreneurs and access to capital.⁷⁹

⁷⁴ For example, William J. Baumol et al., *Good Capitalism, Bad Capitalism and the Economics of Growth and Prosperity* (New Haven: Yale University Press, 2007), pp. 1-14.

⁷⁵ For example, Robert Putnam, *Making Democracy Work* (Princeton, NJ: Princeton University Press, 1993), pp. 3-16 and 163-185; Walsh, J., & Winsor, B. (2019). Socio-cultural barriers to developing a regional entrepreneurial ecosystem. *Journal of Enterprising Communities: People and Places in the Global Economy*, 13(3): 263-282.

⁷⁶ J. Eder, ‘Innovation in the periphery: A critical survey and research agenda,’ *International Regional Science Review*, 42(2) (2019): 119-146. See also Naralie E. K. Slawinski et al., ‘Building Resilient Rural Communities through Social Entrepreneurship: Lessons from the Shorefast Foundation on Fogo Island, Newfoundland and Labrador (St. John’s, NL: Memorial University of Newfoundland, 2018). Doloreux and Dionne found high levels of concentrated and specialized Knowledge infrastructure, efficient technology and strong human capital in the ‘peripheral region’ of La Pocatière, Quebec. David Doloreux and S. Dionne, ‘Is regional innovation system development possible in peripheral regions? Some evidence from the case of La Pocatière, Canada,’ *Entrepreneurship and Regional Development* 20 (3) (2008): 259-283.; Winsor, B & Carter, K. (2018). Mapping Knowledge Seeking in the St. John’s and Corner Brook Entrepreneurial Ecosystems, Harris Centre Report, Reports and Presentations | The Harris Centre | Memorial University of Newfoundland (mun.ca).

⁷⁷ Lepawsky et al., ‘Metropolis on the margin’.

⁷⁸ A. Isaken and J. Karlsen, ‘Innovation in Peripheral Regions,’ in R. Shearmur et al. (eds.), *Handbook on the Geographies of Innovation* (Cheltenham, UK: Edward Elgar, 2016), pp. 277-85.

⁷⁹ Heather Hall et al., *Challenges, opportunities and strategies for advancing innovation in Newfoundland and Labrador* (St. John’s, NL: The Harris Centre, Memorial University, February 2014), p. 10; Deatra Walsh et al., *Great Expectations: Opportunities and Challenges for Young Workers in Newfoundland and Labrador* (Ottawa: Canadian Centre for Policy Alternatives, 2015).

On the other hand, the province also features a very visible set of large firms—that is, those employing 500 employees or more—that contribute significantly to jobs and revenue for the province. However, these firms are in almost every case from outside the province and possibly from outside of Canada as well, and their levels of activity and interest in the province tend to vary with commodity prices and construction projects. For example, several mega-projects were undertaken during the years 2013-17, including the Muskrat Falls hydroelectric project, construction of the \$14bn Hebron oil platform⁸⁰, the Voisey's Bay nickel mine and the Long Harbour processing facility. Similarly, the West Orphan Basin—thus far undeveloped but widely suspected as being rich in hydrocarbons—is another potential mega-project in which the government and companies have long expressed interest.⁸¹

The St. John's CMA has become the hub for the offshore petroleum industry in the province, where the subsidiaries of multinationals and their myriad equipment- and service-providers are based. For example, Norway's state-owned energy giant Equinor moved its Canadian headquarters from Calgary to St. John's following the company's announcement of a \$6.8bn plan in 2018 to develop the Bay du Nord offshore field.⁸²

The prominence of big Canadian firms and multinationals in the province's economy as well as these capital-intensive projects raise questions about 'spillovers' into the local economy, as well as about the nature of networks, often being more vertically oriented.⁸³ It also raises questions about the long-term viability of this type of carbon-emitting development path. The capital-intensive and enclave-like oil and gas (O&G) sector in particular tends not to naturally generate 'linkages' with the local economy.⁸⁴ Furthermore,

⁸⁰ This original estimate was quickly dwarfed by cost overruns. Rob Antle, 'Hebron oil project gets ok as costs balloon by billions,' CBC (4 January 2013), <https://www.cbc.ca/news/canada/newfoundland-labrador/hebron-oil-project-gets-ok-as-costs-balloon-by-billions-1.1303274> (accessed March 2022).

⁸¹ Nalcor Energy, 'Independent resource assessment identifies significant potential in the West Orphan Basin offshore Newfoundland and Labrador,' Nalcor Energy (24 August 2016); Iain Esau, 'Industry fury as Premier Furey breaks promise to continue funding seismic work offshore Canada,' *Upstream* (7 January 2022), <https://www.upstreamonline.com/exploration/industry-fury-as-premier-furey-breaks-promise-to-continue-funding-seismic-work-offshore-canada/2-1-1141138> (accessed March 2022).

⁸² B. Dean-Simmons, 'Will Newfoundland offshore oil industry reboot with rising oil prices?' *SaltWire* (8 July 2021), <https://www.saltwire.com/atlantic-canada/business/will-newfoundland-offshore-oil-industry-reboot-with-rising-oil-prices-100609490/> (accessed February 2022); Ashley Fitzpatrick, 'Bay du Nord decision will speak to NL's oil role in energy future,' *Atlantic Business* (24 March 2022), <https://atlanticbusinessmagazine.ca/web-exclusives/bay-du-nord-decision-will-speak-to-n-l-oils-role-in-energy-future/> (accessed April 2022); Department of Natural Resources, *Bay du Nord Framework Agreement – Technical Briefing* (St. John's, NL: Government of Newfoundland and Labrador, 2018).

⁸³ On the differences between 'horizontal' and 'vertical' networks, see Anna Lee Saxenian, *Regional Advantage* (Cambridge, MA: Harvard University Press, 1994), pp. 1-9.

⁸⁴ For more on 'linkages', see the pioneering work by Albert Hirschman, *The Strategy of Economic Development* (New Haven, CT: Yale University Press, 1958).

as several scholars have found, multinational companies (MNCs) are not naturally open to transferring or ‘co-creating’ knowledge in the area where they’re operating.⁸⁵

Apart from private-sector success stories like Genoa Design, Sulis Subsea, Kraken Robotics and Cougar Helicopters, homegrown firms have generally struggled to break into the intensely competitive global oil supply chains of the offshore petroleum industry.⁸⁶ Overall, MNCs and Memorial University have collaborated significantly over the past decade, often working together to solve very specific technical issues, but again the levels of interest vary greatly with the fate of the resource economy. On the other hand, foreign-based MNCs have been a major source of funding for research at Memorial ([Figure 7](#)).

Outside the extractive industries, another source of hope is the emerging tech sector⁸⁷, which is overwhelmingly based in St. John’s and often features Memorial University graduates in faculties like Engineering or in business-promoting entities like the Genesis incubator and the Memorial Centre of Entrepreneurship. Moreover, this sector features prominently in government plans to support business innovation.⁸⁸ According to government estimates, the tech sector earned revenues of \$1.6bn in 2019, making it larger than fisheries, forestry or tourism in terms of revenues generated.⁸⁹ It is also an area where Memorial University has played a key role (see [below](#)). However, it is worth noting that one study from 2019 ranks St. John’s 17th overall in Canada on technology talent, tenth in technology concentration, and 13th on education attainment.⁹⁰

⁸⁵ Peter Warrian and Ray Gosine, ‘Degree of Technology Challenge and MNE Knowledge Creation and Sourcing in Host Countries,’ Working Paper, Munk School of Global Affairs (August 2021).

⁸⁶ Scott McKnight and Peter Warrian, ‘Innovating in the oil and gas supply chain: The case of Newfoundland and Labrador,’ presentation to the Innovation Policy Lab, Munk School of Global Affairs, University of Toronto (1 October 2021).

⁸⁷ Katie Breen, ‘NL tech startups had a wildly successful 2019. Can they keep it up?’ *CBC News* (25 December 2019), <https://www.cbc.ca/news/canada/newfoundland-labrador/tech-startups-2019-nl-1.5401391> (accessed March 2022).

⁸⁸ Government of Newfoundland and Labrador, *The Way Forward on Business Innovation* (St. John’s, NL: Government of Newfoundland and Labrador, 2017).

⁸⁹ Newfoundland and Labrador Association of Technical Industries, *2020 Facts and figures*, <https://www.nati.net/facts-and-figures/> (accessed February 2022).

⁹⁰ Coldwell Banker Richard Ellis (CBRE), *Scoring Canadian tech talent, 2019*, <https://researchgateway.cbre.com/Layouts/GKCSearch/DownloadPublicUrl.ashx> (accessed February 2022).

1.6. Public sector, infrastructure and debt

Government spending in Newfoundland and Labrador has increased significantly since the early 2010s.⁹¹ Although oil production in the province began in 1997, it had only marginal impacts on the province's finances given the very low volumes produced and very low world prices at the time.⁹² At this time, too, the province still qualified for equalization payments from Ottawa. It wasn't until 2007-08, following a surge in the province's oil production as well as oil prices hitting historic highs (Figure 4), that royalties truly transformed the province's finances.⁹³ In the year 2008 alone, oil royalties more than *quadrupled*, from \$0.4bn to \$1.8bn and came to represent 24.6% of the province's total revenues. Riding this wave, by 2011-12, the province recorded seven consecutive years of cash surpluses amounting to a whopping \$5.1bn.⁹⁴ From the late 2000s on, the province's finances slipped into a pattern familiar to other resource-rich jurisdictions: Higher commodity prices meant higher royalty payments, which in turn unleashed government spending and capital investments in major projects.

Comparing 2004-05 to 2020-21, the province had nearly doubled its spending, from \$4.97bn to \$8.97bn.⁹⁵ With this surge in revenues especially during the 2009-13 period, the province oversaw the launching of several mega-projects, including the Long Harbour nickel processing facility, the Hebron offshore oilfield, and later the Muskrat Falls hydroelectric project. Largely as a result of these mega-projects, total capital investment in the province increased substantially from 2007-16. After peaking at \$13.8bn in 2016, capital investment is still large for a province with a population of just over half a million people. While oil price gyrations were no doubt beyond the government's control, the province has spent oil and gas royalties as an *annual* revenue source and didn't create a 'heritage fund' as many resource-exporting jurisdictions do.

Much of this spending has been of the 'catch-up' nature, including increasing public-sector salaries; generously subsidizing post-secondary education ([see below](#)); and modernizing or expanding the province's infrastructure, schools and health care system. For example, in part due to this spending, almost one in every three employed persons in the province are employed in the public sector, which is significantly larger than the national average of 25.6%. The provincial government also spends liberally on maintaining a vast

⁹¹ DBRS Morningstar, 'DBRS Morningstar confirms the Province of Newfoundland and Labrador's ratings at A (low), Negative Trend,' DBRS Morningstar (2 December 2020).

⁹² For an analysis of the low oil prices from the late 1990s to early 2000s, see Robert McNally, *Crude Volatility: The history and the future of boom-bust oil prices* (New York: Columbia University Press, 2017), pp. 162-8.

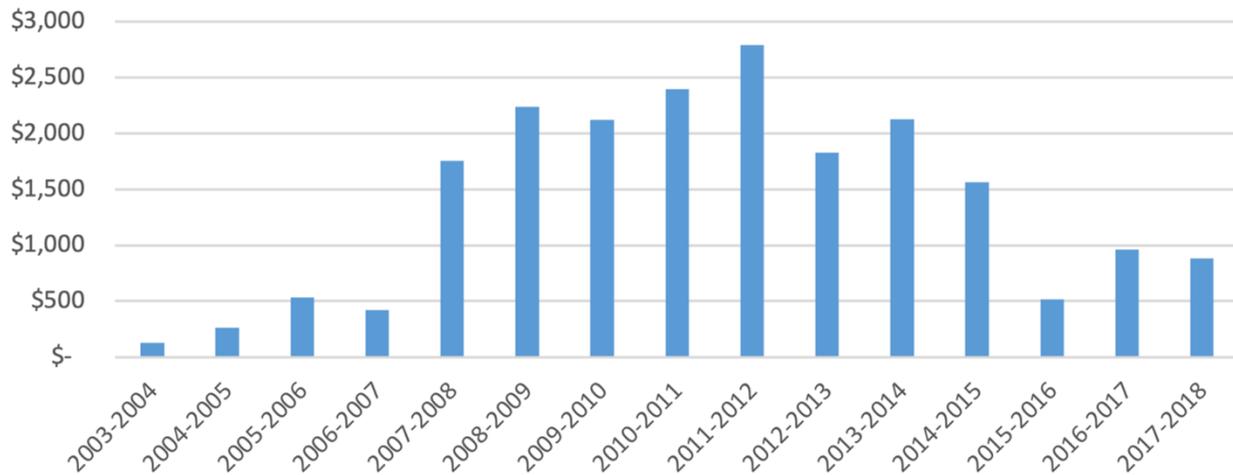
⁹³ Ross found that oil-producing governments on average are nearly 50% larger (as a fraction of their country's economy) than governments of non-oil countries. Ross, *The Oil Curse*, p. 5.

⁹⁴ Figures from 'The Big Reset', p. 37. See also Jack Thrasher, 'Newfoundland Generic Royalty Regime,' *Dalhousie Law Journal* 26 (2) (2003): 365-407.

⁹⁵ Figures from 'The Big Reset', p. 35.

apparatus of infrastructure and social services of various kinds.⁹⁶ This is in part explained by the relatively high portion of the population (42%) living in rural areas as well as on its ageing population. For example, Newfoundland and Labrador spends the most of any Canadian province on health per resident. At CAD\$6,443 per person in 2019, this average figure is considerably higher than even the next highest spenders, Nova Scotia and New Brunswick at \$5,619 and \$5,596 respectively.⁹⁷

Figure 5: Provincial government royalties from the offshore (CAD\$ million)



Source: Nahid, Masoudi, 'Oil and Gas Development in Newfoundland,' NHH and MUN Joint Workshop on Offshore Oil and Gas Development, May 2017.

One overlooked area has been the province's broadband network, which has become indispensable for business growth and, as pandemic-related movement restrictions showed, for education, healthcare and general well-being too. For example, in 2019, only three-fourths of households in the province had access to high-speed broadband services, with the numbers even lower in Labrador.⁹⁸ More disturbing, only half of households in rural areas have access to high-speed services, and no high-speed services existed on First Nation

⁹⁶ Government of Newfoundland and Labrador, *The Way Forward: A Multi-Year Plan for Infrastructure Investment* (St. John's, NL: Government of Newfoundland and Labrador, 2019).

⁹⁷ Despite this spending, Newfoundlanders and Labradorians have worse health conditions with a higher rate of deaths from heart disease, cancer, and stroke; the lowest life expectancy of all the provinces; the highest proportion of older people with three or more chronic illnesses. Health Accord NL, *Our Province, Our Health. Our Future. A 10-Year Health Transformation: The Report* (2022), p. 2, <https://www.gov.nl.ca/hcs/files/Health-Accord-NL-Report.pdf> (accessed May 2022).

⁹⁸ 'Feds pledge \$930k to expand high-speed internet access in Labrador,' CBC News (4 February 2022), <https://www.cbc.ca/news/canada/newfoundland-labrador/labrador-high-speed-internet-funding-1.6339856> (accessed May 2022).

reserves or to Inuit communities in the province.⁹⁹ Indeed, this is a missed opportunity both for the interconnectivity that innovation requires and as a potential long-term solution to stabilize the province’s finances as technology can facilitate new modes of delivering healthcare, education and a wide range of government services.

The government presently runs a sprawling network of infrastructure, from schools, health care sites, ferries, airstrips, highways, bridges, forest access roads, as well as electricity and transmission lines and distribution lines (Table 1) for which there is no straightforward alternative or financing solution. This vast and far-reaching infrastructure should theoretically serve as an important physical base for economic activity and innovation to occur. However, much of the infrastructure and services are underutilized.¹⁰⁰

Table 1: Physical infrastructure run by the provincial government

Type	Quantity
Highways	9,000 (kms)
Forest access roads	12,000 (kms)
Bridges	1,300
Government-managed buildings	800+
Schools	259
Health care sites	180+
Airstrips	20
Ferry routes	12
Electricity and distribution lines	Thousands of kms

Source: Data compiled from various sources in ‘The Great Reset’, p. 48.

In recent years, the burden of filling these gaps in revenue has shown an unsettling trend. While personal income tax and sales tax have risen sharply since 2009-10, reaching \$1.6bn in 2019-20 and \$1.22bn respectively, corporate tax rates in the province have plunged, accounting for a mere \$220m in 2019-20.¹⁰¹ Falling rates of oil production help explain this decline (Figure 4). Making fiscal matters even more challenging for the government, the province hasn’t qualified for equalization payments since 2007-08, given its much enhanced

⁹⁹ Lindsay Bird, ‘Internet, cell service frustrations still rule in rural NL, despite promises to fix it,’ CBC News (2 September 2021), <https://www.cbc.ca/news/canada/newfoundland-labrador/broadband-cell-service-workarounds-rural-canada-federal-election-1.6161285> (accessed May 2022).

¹⁰⁰ ‘The Great Reset’, p. 50; Canadian Institute for Health Information, ‘National health expenditure trends,’ Canadian Institute for Health Information (November 2021), <https://www.cihi.ca/sites/default/files/document/health-expenditure-data-in-brief-en.pdf> (accessed May 2022); Canadian Institute for Health Information, ‘Long-term care homes in Canada: How many and who owns them?’ Canadian Institute for Health Information (24 September 2020),

¹⁰¹ Wade Locke, ‘An overview of Newfoundland and Labrador’s Oil and Gas Sector: Structure, Royalties, Issues, Challenges and Future Directions (2020).

ability to raise revenue within the province, which is the basis for Canada's peculiar equalization scheme.¹⁰²

All of this spending, when combined with the pandemic-induced collapse in oil revenues in early 2020, added to the province's debt and triggered a downgrade of economic outlooks for the province.¹⁰³ For 2022-23, offshore royalties are expected to contribute \$866 million to government revenues, down from the \$1.13 billion handed over in 2021 and a fall from their peak of nearly \$2.8bn in 2011-12 ([Figure 5](#)).¹⁰⁴ This shock may force the province to break from the government's fiscal approach that one critic called 'kicking the can down the road'.¹⁰⁵

¹⁰² The year 2020 was an exception as a change in the equalization payment formula enabled the province to record \$2.4bn. However, the overall trend is one in which revenue to the province has declined since the loss of equalization. 'Q&A: The wonky world of equalization payments,' CBC News (22 November 2016), <https://www.cbc.ca/news/canada/calgary/equalization-payments-frequent-questions-answers-1.3862482> (accessed May 2022). For more, see J. T. Bernard, *The Canadian Equalization Program: Main elements, achievements and challenges* (The Federal Idea: A Quebec Think Tank on Federalism, 2012), <https://ideefederale.ca/documents/Equalization.pdf> (accessed February 2022); Jack M. Mintz, 'Fairness for Newfoundland and Labrador starts with equalization,' *Toronto Star* (9 October 2019), <https://www.thestar.com/opinion/contributors/2019/10/09/fairness-for-newfoundland-and-labrador-starts-with-equalization.html> (accessed March 2022).

¹⁰³ Standard and Poor Global, 'Province of Newfoundland and Labrador "A" ratings affirmed; Outlook remains stable,' Standard and Poor Global (8 August 2019); Standard and Poor Global, 'Province of Newfoundland and Labrador outlook revised to negative on Impact of COVID-19 and low oil prices'.

¹⁰⁴ Terry Roberts, 'Amid hype over Bay du Nord, NL forecasts declining oil production and royalties,' CBC News (7 April 2022), <https://www.cbc.ca/news/canada/newfoundland-labrador/budget-mining-oil-1.6411747> (accessed March 2022).

¹⁰⁵ Wade Locke and Doug May, 'Newfoundland and Labrador's debt management strategy: kicking the can down the road while waiting for a saviour,' A Presentation to the CARE Speaker Series (Memorial University of Newfoundland, 2019); Kyle Hanniman, 'COVID-19, Fiscal Federalism and Provincial Debt: Have we reached a critical juncture?' *Canadian Journal of Political Science* 53, (2020): 279-285.

2. Memorial University & Innovation in the Ocean Economy

2.1. Memorial University – A brief overview

Memorial University, as a comprehensive research university with both its largest campus and the Marine Institute in St. John's, but also significant campuses in Grenfell and Happy Valley-Goose Bay, is the province's only university. Since being granted the status of university in 1949, in the same year as the former British dominion joined as Canada's tenth province, the university has had a 'special obligation to the people of the province'.¹⁰⁶ The nature of this obligation has been interpreted differently over time and evolved with changes in the provincial economy and priorities of governing parties and the university's leadership. The university has at different points been seen and harnessed as a vehicle for modernizing the province.

Given that the province features a one-university, one-public college system (the College of the North Atlantic, CNA), the provincial government has funded these institutions generously and to much greater relative levels than universities in other provinces. It has likewise enhanced the infrastructural footprints of both Memorial and CNA across the province. Since the turn of the twenty-first century, Memorial University has been embraced as a multi-faceted driver of innovation in the ocean economy, with an implicit but not exclusive focus on the offshore petroleum industry, in addition to longstanding attention to the fishery, aquaculture, and marine transportation.¹⁰⁷

Although entities like the Marine Institute, C-Core, Engineering and Earth Sciences have clear connections to industries like petroleum and mining, funding especially from foreign-based businesses since the mid-2000s (Figures 7 and 8) have also helped boost research and learning in many fields with at best only tangential connections to these industries, such as biology, aquaculture and marine transport. Through its COASTS (Cold Oceans and Arctic Science, Technology, and Society) initiative, Memorial highlights its oceans and arctic-related strengths, including in humanities and social sciences, health, business, and education.¹⁰⁸

¹⁰⁶ Memorial University, 'About Memorial,' <https://www.mun.ca/main/about/> (accessed May 2022).

¹⁰⁷ Campuses outside of St. John's have tended to focus on other areas of regional interest and strength, including food and agriculture, forestry and arts and culture. We thank Kelly Vodden for this clarifying comment.

¹⁰⁸ Memorial University, 'Faculty of Humanities and Social Sciences,' 'COASTS', www.mun.ca/wearehere (accessed June 2022).

2.2. The establishment of Memorial University and its special mandate

Memorial University, though granted university status in 1949, had its origins as Memorial University College (MUC), which was founded in 1925 in part to develop and train teachers for the church-run school system.¹⁰⁹ Another motivating factor behind the creation of MUC, given Newfoundland and Labrador's status as a dominion of the United Kingdom, was to honour those who served in World War I on behalf of the British Crown.¹¹⁰ When Newfoundland and Labrador became a province of Canada in 1949, the Newfoundland House of Assembly passed legislation that elevated Memorial University College to status as Memorial University of Newfoundland.¹¹¹

Joey Smallwood, the province's first and longest-serving premier (1949-72), saw Memorial University as a vehicle to modernize the sparsely populated province and its largely resource-based economy. The university, according to Smallwood, could 'foster individual and community independence and self-reliance'. As a result, Smallwood prioritized extension services.¹¹² Throughout the 1950s, Memorial University president Raymond Gushue and political science professor Moses Morgan advocated that the university play a key role in promoting the province's social, economic, and cultural development.¹¹³

From the very beginning, Memorial University was imbued with a 'special obligation to the people of the province'.¹¹⁴ Over time, the university expanded to eventually include what are now the three pillars of research; education and training, and public engagement. In 1961, Memorial established the Institute of Social and Economic Research (ISER) 'to address specifically the social and economic problems of the province'. In 1964, the institute that became the Fisheries and Marine Institute was established. The Marine Institute (MI) has since become a global leader in training, applied research and industrial support for ocean industries¹¹⁵, or what innovation scholars most closely see as a 'functioning networked industrial policy agent'.¹¹⁶

¹⁰⁹ Paul Axelrod and John G. Reif, *Youth, University, and Canadian Society: Essays in the Social History of Higher Education* (Montreal, QC: McGill-Queen's University Press, 1989).

¹¹⁰ Prior to the founding of MUC, students had to travel to Canada or Britain for similar education. Ibid.

¹¹¹ Memorial University of Newfoundland, *Timeline: History of Memorial University*, (21 April 2021), <https://www.mun.ca/main/history/timeline/> (accessed February 2022).

¹¹² J. Webb, 'The Rise and Fall of Memorial University's Extension Service, 1959-91,' *Newfoundland and Labrador Studies* 29 (1) (2014): 84-.

¹¹³ Melvin Baker, 'The establishment of Social & Economic Research in 1961,' *Newfoundland Quarterly* 92(3) (1999): 21.

¹¹⁴ Memorial University, 'About Memorial,' <https://www.mun.ca/main/about/> (accessed May 2022).

¹¹⁵ Marine Institute, 'About us,' <https://www.mi.mun.ca/aboutus/> (accessed March 2022).

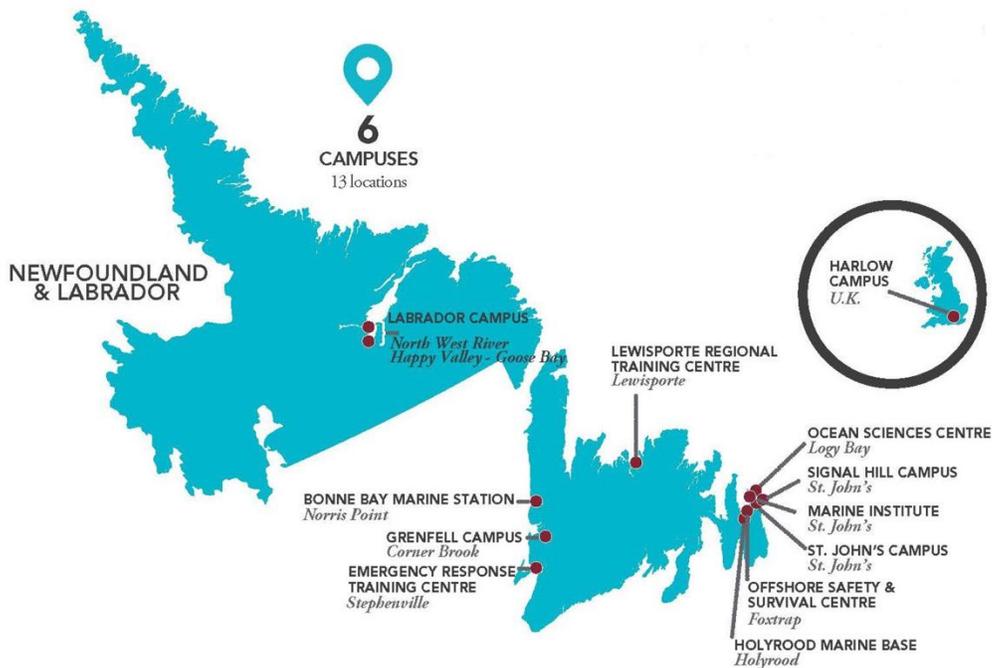
¹¹⁶ Wolfe and Warrian, 'C-Core as a Networked Industrial Policy Initiative'.

Table 2: Key regional innovation events in Memorial University's history

Year	Event
1925	Memorial University College (MUC) opens; Newfoundland is a dominion of the United Kingdom at the time
1949	Newfoundland House of Assembly passes legislation that elevates Memorial University College to university status, becoming Memorial University of Newfoundland (MUN)
1961	The Institute for Social and Economic Research (ISER) is founded to examine social and economic issues relevant to the province
1964	The College of Fisheries, Navigation, Marine Engineering and Electronics (which later the Fisheries and Marine Institute of Memorial University of Newfoundland) is established
1967	The Faculty of Medicine of Memorial University is established
1967	The Marine Sciences Research Laboratory is established at Logy Bay, part of Memorial's mandate to foster greater collaboration in marine research and education programs
1975	The Centre for Cold Oceans Research (now known as 'C-Core') is founded to provide research-based services and technology solutions in remote and challenging environments
1975	The university opens a campus in Corner Brook (which eventually became the Grenfell Campus)
1977	The university establishes the Botanical Garden at Oxen Pond within C.A. Pippy Park for basic and applied botanical research and education
1988	The university forms the Ocean Sciences Centre by merging the Marine Sciences Research Laboratory in Logy Bay with the Newfoundland Institute for Cold Ocean Science, with a research focus on aquaculture
1992	The provincial government merges the Fisheries and Marine Institute with Memorial University, offering degree programs at the undergraduate and masters levels, as well as diploma programs, short-term training and industry research
1997	Genesis is formed (now based at the Signal Hill campus) to support local tech start-ups
1999	Newfoundland and Labrador's Support for People and Patient-Oriented Research and Trial Unit (NL Support) is founded to undertake and support applied health research
2004	The Leslie Harris Centre of Regional Policy and Development is established to coordinate and facilitate the university's educational, research and outreach activities in the areas of regional policy and development
2004	Navigate is established at Grenfell College to provide business development expertise to entrepreneurs in the west region
2010	The Holyrood Marine Base (renamed The Launch in 2021) is created by the Marine Institute to support at-sea research and training for the Marine Institute
2011	Widespread consultations with local and regional stakeholders on Memorial's public engagement activities and priorities results in the Public Engagement Framework
2013	The Craig L. Dobbin Genetics Research Centre is established to provide leading-edge genetics research
2015	The Memorial Centre for Entrepreneurship (MCE) is established to train, guide and connect students to high-growth businesses
2022	The Labrador Institute is converted into a full-fledged university campus in Happy Valley-Goose Bay, building on the School of Arctic and Sub-Arctic Studies (formed in 2020)

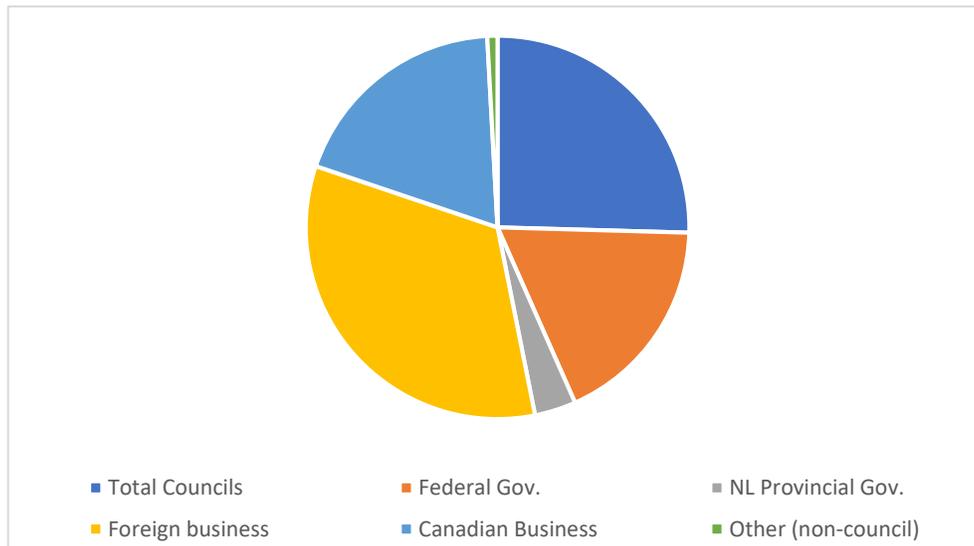
Source: Axelrod and Reif, *Youth, University, and Canadian Society*; Memorial University of Newfoundland, *Timeline: History of Memorial University*, <https://www.mun.ca/main/history/timeline/>, (accessed March 2022).

Figure 6: The six campuses of Memorial University



Source: Memorial University, <https://www.mun.ca/main/campuses/> (accessed May 2022).

Figure 7: Sources of external research funding for Memorial University, 2020-21

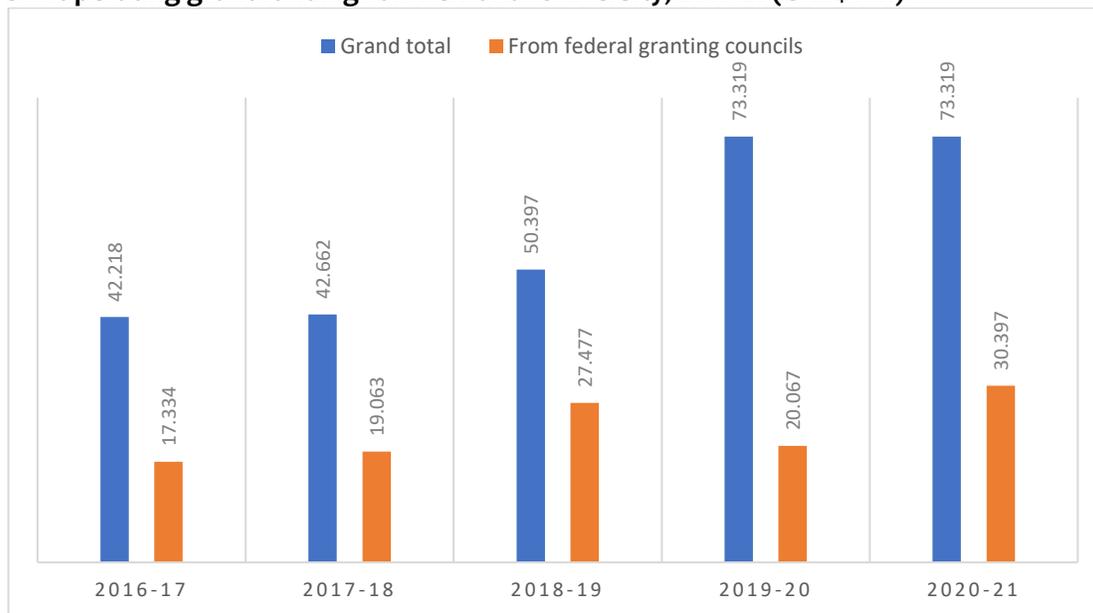


Source: Memorial University, 'Fact Book 2021', https://www.mun.ca/ciap/media/production/ciap/media-library/factbook/fb2021/38_Table_R3.pdf (accessed May 2022).

In 1975, C-Core (originally Centre for Cold Oceans Research) was founded to provide solutions to a wide range of challenging industrial issues in offshore industries. It has since

grown into a globally competitive provider of research and solutions in offshore industries. Also in 1975, the university opened a campus in Corner Brook, which eventually became the Grenfell campus.¹¹⁷ This third campus followed the addition of the Harlow, England campus in 1969 (Figure 6).

Figure 8: Operating grant funding for Memorial University, 2016-21 (CAD\$ mn)



Source: Memorial University, 'Fact Book 2021', https://www.mun.ca/ciap/media/production/ciap/media-library/factbook/fb2021/38_Table_R3.pdf (accessed May 2022).

In 1997, Genesis, an incubator for local start-ups to collaborate and exchange ideas, was formed. In 2018, it moved to the Signal Hill campus of Memorial University. In 2004, the Leslie Harris Centre of Regional Policy and Development (more commonly known as 'The Harris Centre') was established, tasked with 'coordinating and facilitating the university's educational, research and outreach activities in the areas of regional policy and development'.¹¹⁸ Also in 2004, the Navigate Entrepreneurship Centre was established at Grenfell campus to provide business development expertise to entrepreneurs in the west region. In 2011, Memorial University undertook a major consultation with hundreds of public and private stakeholders to develop a framework for the university's collaborations with its many public partners. These contributions informed the Public Engagement Framework, which was endorsed by Memorial's Senate and Board of Regents in 2013.¹¹⁹ In 2022,

¹¹⁷ As of 2021, Corner Brook had a population of about 19,600 people, greater than the next largest Grand-Falls Windsor (12,500), Gander (10,220) and Labrador City (8,800), but much less than St. John's (182,000).

¹¹⁸ 'Harris Centre Priorities, 2014-2015,' https://www.mun.ca/harriscentre/HC_2014-15_final-plan_CW.pdf (accessed March 2022). Statistics Canada, 'Population and dwelling counts: Canada and population centres,' (9 February 2022), <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=9810001101> (accessed May 2022).

¹¹⁹ 'The Public Engagement Framework,' Memorial University, <https://www.mun.ca/publicengagement/memorial/framework/> (accessed May 2022).

Memorial University converted the Labrador Institute into a full-fledged university campus in Happy Valley-Goose Bay, launching nursing and engineering programs in fall 2022.¹²⁰ This builds on the creation of the School of Arctic and Sub-Arctic Studies in 2020.¹²¹

Memorial University has been both a driver and beneficiary of the province's economic transformation, including through research relating to the petroleum industry and through funding from that industry. Due to this funding, governments of various stripes have spent generously on post-secondary education. For example, the province invests 1.4% of its gross domestic product (GDP) in post-secondary education, compared to the Canadian average of about 1%.¹²² Alternatively, the province funds the average full-time student in Newfoundland and Labrador at a rate of \$21,224, well above any other Atlantic province and the Canadian average of \$10,162.¹²³ The province's substantial debt ([above](#)) and potential fiscal crisis looms large over Memorial University, which has already seen its budget reduced and may face further cuts in public funding as well as tuition increases in the near future.¹²⁴ Over recent decades, the university has emerged as a global leader in ocean-related research, to which we now turn.

¹²⁰ Heidi Atter, 'Memorial University expanding to create Labrador campus in Happy Valley-Goose Bay,' CBC News (27 February 2022), <https://www.cbc.ca/news/canada/newfoundland-labrador/memorial-university-labrador-campus-1.6323219> (accessed May 2022).

¹²¹ 'MUN creates Labrador campus to grant university degrees in Happy Valley-Goose Bay,' CBC News (24 July 2020), <https://www.cbc.ca/news/canada/newfoundland-labrador/mun-labrador-campus-1.5660361> (accessed May 2022).

¹²² 'Students, union slam Greene report's proposed post-secondary education cuts,' CBC News (7 May 2021), <https://www.cbc.ca/news/canada/newfoundland-labrador/greene-report-reaction-education-memorial-university-1.6017588> (accessed March 2022).

¹²³ Saskatchewan was second, but at \$15,466, spends nearly \$5,000 less per student than Newfoundland and Labrador. CAUT Almanac of Post-Secondary Education in Canada, 2016-2017, Statistics Canada.

¹²⁴ For example, Memorial University Integrated Planning Committee, 'What We Recommend: Maintaining Excellence in a Time of Reduced Public Funding. Memorial University Integrated Planning Committee, 2020 Memorial University Integrated Planning Committee. Operating Budget Report. Memorial University Integrated Planning Committee, 2019); Jenna Reid, 'Change is in the air for Memorial University,' *The Muse* (25 April 2022), <https://themuse.ca/change-is-in-the-air-for-memorial-university/> (accessed May 2022).

2.3. Memorial University & Ocean-related innovation

Memorial University has emerged as a leader in the research and training of its graduates in a wide range of fields relating to ocean innovation, including marine engineering and oceanography. A recent estimate has over 40% of Memorial’s research being ocean-related.¹²⁵ Since 2010, Memorial University has invested over \$800m in research and infrastructure related to cold ocean and Arctic science, technology, social sciences, and humanities. Given this wealth of knowledge, experience and infrastructure, Memorial University is in a prime position to benefit from—and indeed to contribute to—the continued growth of the ocean economy. There are too many ocean-related programs, facilities, research activities and engagement efforts to mention. There are many science and technology capabilities rooted in Engineering, the Marine Institute, and the Department of Ocean Sciences, but the University’s COASTS initiative highlights oceans and arctic strengths across humanities and social sciences, health disciplines, business and education, as well. Many initiatives are now interdisciplinary.¹²⁶ One illustration of the interdisciplinary oceans’ orientation is the Marine Biomass Innovation Project at Grenfell campus, which includes a consortium of university, Mi’kmaw and industry partners, that was awarded nearly \$15m through the federal New Frontiers in Research Fund-Transformation Stream in January 2022 to investigate how repurposed marine biomass can develop new products and create a more sustainable future for the province’s rural, coastal, and Mi’kmaw communities.¹²⁷

Memorial University is a partner within the Ocean Frontier Institute, which was founded in 2016 and is a collaborative research initiative aimed at ‘harnessing the vast potential of the world’s ocean’.¹²⁸ Newfoundland and Labrador’s thriving ocean hub is supported by Memorial’s Genesis incubator, as well as by ocean-centric tech and industry ‘cluster’ organizations like TechNL and OceansAdvance, as well as the program Lab2MarketOceans, in partnership from the Ocean Startup Project of the Ocean Supercluster Program (see below).¹²⁹ Memorial is home to 18 active Canadian Research Chairs, whose research focuses on a range of cutting-edge fields, including ocean mapping, neuroscience and brain repair.¹³⁰ Memorial University also hosts the National Research Council, Ocean, Coastal, and River Engineering Facility, on its campus. Memorial’s ocean and

¹²⁵ Memorial University of Newfoundland, ‘About Memorial: Newfoundland and Labrador’s university,’ (29 September 2021), <https://www.mun.ca/main/about/> (accessed March 2022).

¹²⁶ Memorial University of Newfoundland, ‘Faculty of Humanities and Social Sciences,’ ‘COASTS,’ <https://www.mun.ca/hss/engagement/coasts/> (accessed June 2022).

¹²⁷ ‘Engaged research: Sustainable solutions to marine biomass innovations,’ News releases (12 January 2022), <https://grenfell.mun.ca/campus-services/Pages/News-Description.aspx?NewsID=545> (accessed May 2022).

¹²⁸ Ibid. Ocean Frontier Institute, ‘About us,’ <https://www.ofi.ca/about> (accessed March 2022).

¹²⁹ Ocean Startup Project, ‘Lab2Market Oceans,’ <https://oceanstartupproject.ca/lab2market-oceans/> (accessed June 2022); Jeff Green, ‘“Innovation to market”: Program focusing on training PhDs, post-doctoral scholars to become corporate innovators,’ Memorial University, <https://www.mun.ca/research/news.php?id=13703&type=news> (accessed June 2022).

¹³⁰ Memorial University, ‘Canada Research Chairs,’ <https://www.mun.ca/research/explore/chairs/crc.php> (accessed June 2022).

naval architectural engineering undergraduate program is rated one of the top programs of its kind in North America; in fact, it is the only Canadian university currently ranked in the Shanghai 2021 Global Ranking of Academic Subjects for the study of marine/ocean engineering.¹³¹ It is also the only Canadian Engineering Accreditation Board (CEAB) accredited ocean and naval architectural engineering program in Canada (and the only one in the world with mandatory co-operative education).¹³²

Memorial University and several of its affiliated entities have long recognized that technology research and development (R&D), although potentially transformative to a wide range of industries, is nevertheless too high risk for commercial lenders, and so has sought to fill that gap. In particular, Genesis, which is housed at Memorial University, has been a major driver of entrepreneurship and innovation in the province. First opened in 1997, Genesis has raised more than \$620 million in private capital, generated \$220 million in recurring annual revenues and created more than 2,000 jobs.¹³³ As part of its supportive role, the incubator provides mentorship and guidance to a range of tech start-ups, while also providing them with a physical space for their growth and collaborations. Several of the province's budding tech champions emerged from Memorial's Engineering Department, MI, Grenfell-based Navigate and with the help of Genesis, including Genoa Design (providing advanced services for shipbuilding and offshore industries), Verafin (a financial crimes' software company), and Mysa (a thermostat company), among others.

Innovation in ocean-related industries can also be extremely capital-intensive. In this area, too, Memorial University has been important as the university and its affiliated institutions in different parts of the province boast significant infrastructure that can be tapped for ocean-related innovation. For example, the Ocean Sciences Centre is a cold ocean research facility in Logy Bay. Similarly, The Launch (formerly Holyrood Marine Base) handles at-sea training relating to ocean science, ocean technology, fish harvesting technology, fishing handling methods, aquaculture and the marine ecosystem more broadly.¹³⁴ Home to a boat-launch facility, The Launch partners with the municipality's ocean-industrial park and incubator. It also provides access to vessels, technology, technical expertise and collaborative partnerships. Furthermore, within the St. John's campus itself, a new Core Science Facility opened in 2021 with construction costs estimated at \$325m.¹³⁵ Moreover, the Bonne Bay Marine Station is a research, teaching and conference centre in Norris Point on the west coast of the island.

As mentioned earlier, Memorial's support for the mining industry through the Alexander Murray Earth Sciences Building and Johnson GEO Centre (a geological

¹³¹ ShanghaiRanking, '2021 Global Ranking of Academic Subjects,' <http://www.shanghairanking.com/rankings/gras/2021/RS0222> (accessed June 2022). <https://www.mun.ca/engineering/ona/>

¹³² Memorial University, 'Ocean and Naval Architectural Engineering,' <https://www.mun.ca/engineering/ona/> (accessed June 2022).

¹³³ 'The Big Reset,' p. 158.

¹³⁴ 'Holyrood Marine Base,' <http://holyrood.ca/business/oceans-holyrood-initiative/holyrood-marine-base/> (accessed May 2022).

¹³⁵ Memorial University, 'Core Sciences Facility,' <https://www.mun.ca/csf/> (accessed May 2022).

interpretation centre) also extends into the oceans space, and may help enable the transition to a carbon-neutral economy.

Other Memorial-connected entities have been crucial to the province's ocean economy. C-Core, founded in 1975, has consistently provided research, advisory services and technology solutions for companies operating in the remote and challenging offshore environment. C-Core is a university-owned entity that 'acts more like a business-led research network', according to Warrian and Wolfe, with continuity in key personnel, institutional memory and important datasets from past projects.¹³⁶

Another significant actor in this ocean innovation space has been the Marine Institute, which more closely resembles a textbook 'networked industrial policy agent', bridging otherwise unconnected actors who operate a similar or related area through the input-output linkages that the Marine Institute facilitates.¹³⁷ The MI conducts research and provides a wide range of short-term training, degrees and diplomas. Both MI and C-Core, though quite different themselves, are based within Memorial University and have proven vital to the province's ocean cluster.

Homegrown companies, at times with help from Memorial, have found operational solutions to the unique challenges of operating in Newfoundland and Labrador's offshore environment, providing underwater cameras (such as Sulis Subsea), subsurface imaging (Kraken Robotics), standardized services like transport (such as Cougar Helicopters) and offshore accommodation and food (such as East Coast Catering). Among these local particularities has been coping with the harsh weather and icebergs that migrate southward from Greenland.¹³⁸

Despite the undeniable importance of entities like C-Core and the MI, Warrian and Gosine found that in segments of the O&G business like geophysics, construction and engineering, or the manufacturing of advanced equipment, Newfoundland and Labrador-based firms have struggled to capture market share from MNCs and from their preferred service- and equipment-providers.¹³⁹

Overall, MNCs and Memorial University have collaborated significantly over the past decade, often working together to solve very specific technical issues, though these levels of interest vary greatly with the fate of the resource economy ([see above](#)). These fluctuating levels of interest and financing have been both a blessing and a curse for Memorial University, empowering the university in boom times but adding stress to its operations and

¹³⁶ Warrian and Wolfe, 'C-Core as a Networked Industrial Policy Initiative'.

¹³⁷ Peter Warrian and David Wolfe, 'Research and Technology Transfer at the Marine Institute, Memorial University of Newfoundland,' (Memorial University, April 2017).

¹³⁸ Icebergs threaten supply and exploration vessels, pipelines, cabling and platforms, but do not exist in neither oil and gas production in the North Sea nor the Arctic, thus technologically sophisticated oil operators like Equinor (formerly Statoil) and its range of advanced suppliers have not yet mastered this problem. Arctic exploration is mostly challenged by pack ice rather than mobile icebergs. McKnight and Warrian, 'Innovating in the oil and gas supply chain: the case of Newfoundland'.

¹³⁹ Warrian and Gosine, 'Degree of Technology Challenge and MNE Knowledge Creation and Sourcing in Host Countries'.

finances during downturns. Memorial University, given its various ocean-focused programs and entities, is naturally positioned to play a central role in the Canadian government's 'Ocean Supercluster' initiative, to which we now turn.

2.4. Memorial University and the ‘Ocean Supercluster’ initiative

Memorial University is central to the province’s involvement in the ‘Ocean Supercluster’ initiative that the Canadian federal government launched in 2017. The Oceans Supercluster is one of five national superclusters and the only one based in Atlantic Canada.¹⁴⁰ The Oceans Supercluster touches on a range of ocean-related industries, including oil and gas, fisheries, oceans monitoring, defense and so on, with a wide range of sub-industries and related sectors (Figure 9). Given this eclectic nature, the Oceans Supercluster includes private sector companies, academic and research partnerships, and is supported by modern research infrastructure, some of which is housed at Memorial University. Formally endorsed by the federal government and led by the government ministry Innovation, Science, and Economic Development (ISED)¹⁴¹, the Supercluster is an industry-led partnership anchored in but not exclusive to Atlantic Canada.¹⁴² The federal government describes the aim of the Ocean Supercluster as bringing together companies of various sizes to grow the ocean economy ‘sustainably, inclusively, and digitally’, in the words of ISED.¹⁴³ This cross-sector effort to develop and commercialize globally relevant ocean solutions fits with the province’s efforts to train and prepare workers for tech sector jobs given the inevitable technology-centric focus of this initiative.¹⁴⁴

Broadly defined, the Ocean Supercluster aims to develop and commercialize ocean solutions, positioning Canada, as a ‘three-ocean country’, to become a global leader in ocean innovation. The Canadian government envisions fostering innovation and entrepreneurial capacity through funding and leveraging cluster-building activities that will benefit the collaborative projects.

¹⁴⁰ The other four include Digital Technology (based in British Columbia), Protein Industries (based in the Prairies) (based around Ontario’s ‘Golden Horseshoe’), and Scale Artificial Intelligence (based in Quebec).

¹⁴¹ The Superclusters are led by Innovation, Science, and Economic Development (ISED), but each are independent not-for-profit entities with own board of directors. Minister of Innovation Science and Economic Development, Government of Canada, ‘About Canada’s Innovation Superclusters initiative,’ Innovation Superclusters Initiative (22 June 2021), <https://www.ic.gc.ca/eic/site/093.nsf/eng/00016.html> (accessed February 2022).

¹⁴² Innovation, Science and Economic Development (ISED) Canada, ‘Canada’s Ocean Supercluster,’ Government of Canada, <https://oceansupercluster.ca/about/> (accessed February 2022).

¹⁴³ Innovation, Science and Economic Development (ISED) Canada, ‘Canada’s Ocean Supercluster’ (22 June 2021), <https://oceansupercluster.ca/> (accessed February 2022).

¹⁴⁴ Government of Newfoundland and Labrador, ‘New talent strategy to prepare workers for careers in growing tech sector,’ Government of Newfoundland and Labrador (14 January 2021).

Figure 9: Aspects of the Ocean Technology Cluster

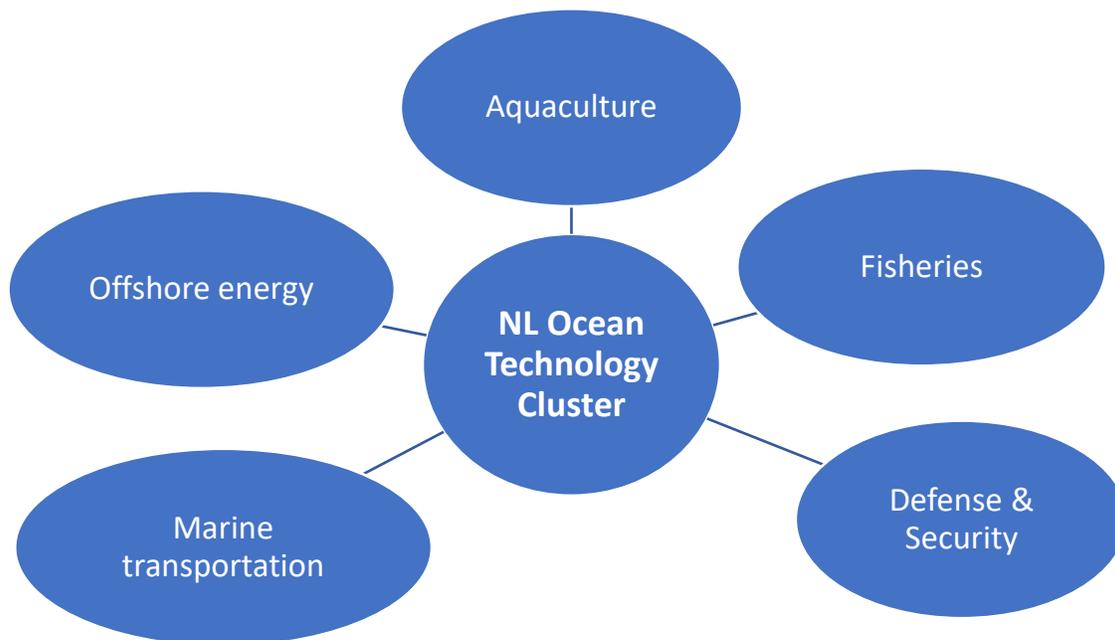


Table 3: Canada's Ocean Supercluster pursues five main objectives

Objectives
'Strengthen links between ocean-based value chains and providers of enabling technologies'
'Develop, deploy, and export innovative technology platforms applicable to multiple ocean industries'
'Fill capability gaps in the innovation ecosystem through the attraction, recruitment, training, and retention of diverse, highly qualified personnel'
'Extend the global reach, attraction, network and market opportunities for Ocean Supercluster partners'
'Address global challenges related to sustainability, reducing carbon foot-print and improving energy efficiency'

Source: David Doloreux and Richard Shearmur, 'Moving maritime clusters to the next level: Canada's Ocean Supercluster initiative,' *Marine Policy* 98 (2018): 33–36. <https://doi.org/10.1016/j.marpol.2018.09.008>

Using policy or government funding to stimulate ocean-based innovation isn't without precedent in the region. In St. John's, the Ocean Technology Cluster grew rapidly in parallel with the oil industry.¹⁴⁵ While 'clusters' have long been a driving force in the global economy and a core concept in the innovation literature, the key players within clusters are not merely companies, but also include academic institutions and not-for-profit

¹⁴⁵ B. Colborne, 'St. John's ocean technology cluster: can government make it so?' *Canadian Public Administration*, 49 (1) (2006): 46-59.

organizations that each contribute to boosting growth and innovation in a particular area.¹⁴⁶ The notion of ‘supercluster’ builds on this, but spans various sectors, making it ‘a cluster of clusters’ in the words of Doloreux and Shearmur.¹⁴⁷ So, while clusters tend to focus more on specific industrial sectors and their sub-contractors, ‘superclusters’ aim to look at the entire value-chain and to facilitate the cross-fertilization of knowledge and ideas between previously unconnected or distantly connected sectors.

Although Canada’s five official ‘superclusters’ are regionally and sectorally focused, partners from other regions are welcome to participate. Indeed, at present, the ocean-focused Supercluster has members from nine of Canada’s ten provinces, as well as from one of Canada’s three territories and six partners from outside Canada. Under this initiative, the federal government matches every dollar that the private sector puts forth.¹⁴⁸ In the case of the Supercluster based out of, but not exclusive to Atlantic Canada, six categories of ocean technologies have applications across the aquaculture and fisheries, renewable energy and oil and gas: sensors and imaging; satellite technologies; computerization and big data; autonomous systems; subsea engineering and technologies; and advanced materials ([Figure 10](#)).

As of mid-2022, the Ocean Supercluster has some 460 members enrolled, with \$360m pledged in project commitments, about half of which comes from industry partners. The lion’s share (86%) of these projects are led by small- and medium-sized firms. Furthermore, some 70 projects have been approved, another 47 projects announced, which includes over 110 new ‘made-in-Canada’ ocean products, processes and services. ISED estimates that 4,300 jobs may be created from these projects.

The university, through the Marine Institute, C-Core, Genesis, Memorial’s Engineering Department as well as the Harris Centre among other entities, act as a meeting ground for these promising cross-sectoral exchanges to occur. Expectations for the Ocean Supercluster are high. According to Canadian government estimates, the expected impact over ten years is more than 3,000 new jobs and more than \$14bn added to the province’s GDP.¹⁴⁹ The Government of Canada reinvested in the Global Innovation Clusters program for Budget 2022, with \$750 to March 2028. The allocation of funds between the 5 clusters will be determined through a competitive process.

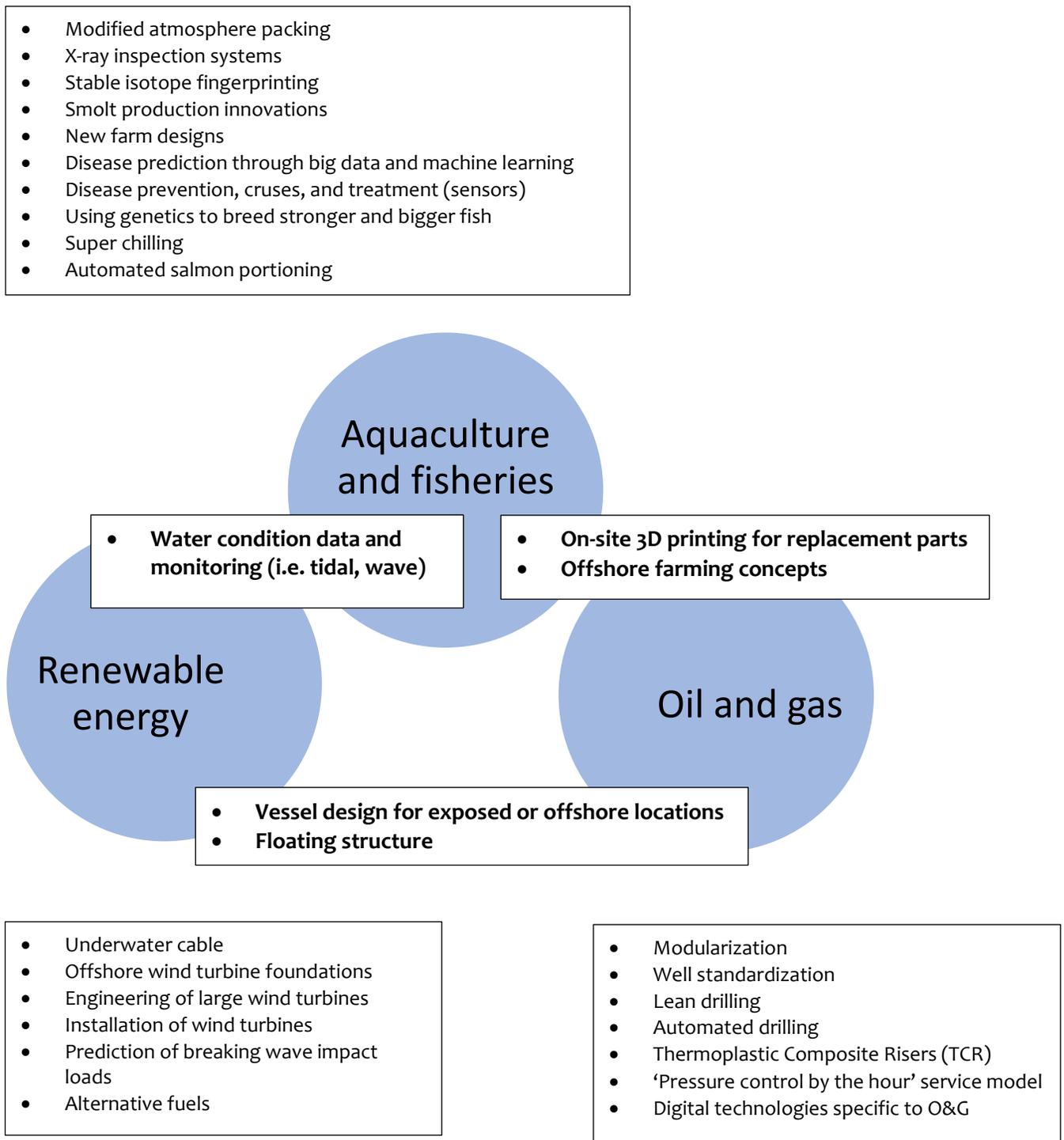
¹⁴⁶ For example, David A. Wolfe and Meric S. Gertler, ‘Clusters from the Inside and Out: Local dynamics and global linkages,’ *Urban Studies* 41 (5/6) (May 2004): 1071-1093.

¹⁴⁷ David Doloreux and Richard Shearmur, ‘Moving maritime clusters to the next level: Canada’s Ocean Supercluster initiative,’ *Marine Policy* 98 (2018): 33–36.

¹⁴⁸ Minister of Innovation Science and Economic Development (ISED), Government of Canada, *About Canada's Innovation Superclusters initiative* (Innovation Superclusters Initiative, June 2021), <https://www.ic.gc.ca/eic/site/093.nsf/eng/00016.html> (accessed February 2022).

¹⁴⁹ ‘Canada's Ocean Supercluster’, (22 June 2021), <https://oceansupercluster.ca/>(accessed February 2022).

Figure 10: Productive inter-sectoral collaboration and technologies in the ocean economy



By 2021, some four years after the initiative was first launched, there was \$170m committed, including \$86m in industry commitments. Technologies targeted include digital sensors and monitoring, autonomous marine vehicles, energy generation, automation, marine biotechnology, and marine engineering technologies.¹⁵⁰ Furthermore, program steams include ocean sensing and characterization, operational intelligence, data analysis and visualization, and fostering the innovation ecosystem more broadly. Though as [Figure 10](#) shows, there are still plenty of possible areas for collaborations, breakthroughs and improvement. In all of these areas, Memorial University will prove crucial, as a hub to foster partnerships and innovative projects between government, investors, non-profits, research and industry.

Table 4: A select list of Newfoundland and Labrador-based members of the Ocean Supercluster

C-Core
CoLab Software
College of the North Atlantic
Industry, Energy and Technology (formerly Department of Tourism, Culture, Industry and Innovation, Newfoundland and Labrador)
Marine Institute
Memorial University
Newfoundland and Labrador Environmental Industry Association
Energy Research & Innovation Newfoundland and Labrador (formerly PRNL)
SmartICE Sea-ice Monitoring and Information Inc.
Tech NL

Table 5: A select list of Ocean Supercluster projects based in Newfoundland and Labrador

Name	Project in brief
CoLab Software	Received \$1.1 million in funding from Canada’s Ocean Supercluster, along with \$1.6 million from other investors. This project works to provide manufacturers and engineers with a better way to collaborate and assess designs
Marine Search and Rescue (SAR) Helicopter Mission Simulation Project	The Marine Search and Rescue (SAR) Helicopter Mission Simulation Project (led by Bluedrop Training and Simulation, partnering with Cougar Helicopters and the Marine Institute of Memorial University) helps better prepare SAR technicians for marine rescues in extreme weather and sea conditions. Graduate students from Memorial University also contribute to this project.
SmartICE (Sea-ice Monitoring and Real-Time Information for Coastal Environments)	With about \$1.1 million provided by the Ocean Supercluster based in Nain, Labrador to enable Inuit to participate more fully in the ocean economy. This project helps Inuit participants across Inuit Nunangat develop technical skills training.

¹⁵⁰ Ibid.

The concept, however catchy and politically popular, raises questions about the economic logic of lumping these still quite distinct provinces together. The Ocean Supercluster has already shown challenges of networking across different sectors and businesses that have not traditionally engaged with each other in the past. Furthermore, there are doubts about the capacity of locally based businesses to drive this innovation on their own. For example, the Ocean Supercluster network contains 360 members, of which 40% are located outside Atlantic Canada.¹⁵¹ On this note, over 80% of the Ocean Supercluster projects are led by small- and medium-sized enterprises (SMEs). For example, in November 2020, Canada's Ocean Supercluster announced funding for three projects based in Newfoundland and Labrador, collectively worth about \$6 million. In another example, the Ocean Startup Challenge has awarded more than \$1.4 million to fund entrepreneurs developing ocean industry solutions, with the St. John's-based Ocean Seat attempting to build an ocean data marketplace for organizations to access, store and profit from data-sharing across a wide range of ocean-related industry.¹⁵²

¹⁵¹ J. Knubley, 'Building Superclusters for Canada Institute,' Brookfield Institute for Innovation and Entrepreneurship (April 2021), https://www.brookfieldinstitute.ca/wp-content/uploads/Superclusters_Final2.pdf (accessed February 2022).

¹⁵² Charlize Alcaraz, 'Powered partners with ocean set to build blockchain-powered ocean data marketplace,' Betakit (16 May 2022), <https://betakit.com/mpowered-partners-with-ocean-set-to-build-blockchain-powered-ocean-data-marketplace/> (accessed May 2022).

Conclusion

This background report outlined how Memorial University has attempted to harness its ‘special obligation to the people of the province’ to stimulate ocean-related innovation in the small, resource-based economy of Newfoundland and Labrador. Harnessing its more than 19,500 students and 5,200 faculty and staff across its six campuses, the university has engaged in research, education and training as well as public engagement. Across a wide range of ocean-related faculties and departments, and institutes and entities that are connected to Memorial University, such as the Marine Institute (MI), C-Core and the Genesis incubator among others undertake research to solve specific challenges related to offshore industries as well as to better understand their impacts on coastal communities and the natural environment.

This report also highlighted a series of innovation-related challenges that the province faces, including its small, declining, ageing and geographically dispersed population; the uneven make-up of its business environment; the dominance of several foreign-based multinationals in capital-intensive industries; and growing provincial debt as commodity prices, especially oil, have fluctuated greatly in the past decade. These innovation-related challenges combine to increase expectations on Memorial University to act as a comprehensive driver of innovation, to increase the province’s human capital stock and to generate economic spin-offs.

The Organization of Economic Cooperation and Development (OECD)’s Entrepreneurial Education, Collaboration and Engagement (EECOLE) network supported and guided this research. This overview, including its analysis and findings, will inform the final report about how place-based research has occurred through Memorial University’s Public Engagement activities and approaches to generate social and economic value in the province where it is located. The final report will be presented to an international audience of policymakers, higher education leaders and academics in the final months of 2022.

References

Alcaraz, Charlize, 'Powered partners with ocean set to build blockchain-powered ocean data marketplace,' Betakit (16 May 2022), <https://betakit.com/mpowered-partners-with-ocean-set-to-build-blockchain-powered-ocean-data-marketplace/>

Antle, Rob, 'Hebron oil project gets ok as costs balloon by billions,' CBC (4 January 2013), <https://www.cbc.ca/news/canada/newfoundland-labrador/hebron-oil-project-gets-ok-as-costs-balloon-by-billions-1.1303274>

Atter, Heidi, 'Memorial University expanding to create Labrador campus in Happy Valley-Goose Bay,' CBC News (27 February 2022), <https://www.cbc.ca/news/canada/newfoundland-labrador/memorial-university-labrador-campus-1.6323219>

Auty, Richard M. (ed.), *Resource Abundance and Economic Development* (Oxford: Oxford University Press, 2001).

Axelrod, Paul, and John G. Reif, *Youth, University, and Canadian Society: Essays in the Social History of Higher Education* (Montreal, QC: McGill-Queen's University Press, 1989).

Baker, Melvin, 'The establishment of Social & Economic Research in 1961. *Newfoundland Quarterly* 92 (3) (1999): 21-25.

Barry, Garrett, 'A decade on, workers—and town—still mourn loss of Grand Falls-Windsor mill,' CBC News (17 February 2019), <https://www.cbc.ca/news/canada/newfoundland-labrador/mill-closure-anniversary-grand-falls-windsor-1.5020839>

Baumol, William J., Robert E. Litan and Carl J. Schramm, *Good Capitalism, Bad Capitalism and the Economics of Growth and Prosperity* (New Haven: Yale University Press, 2007).

Bernard, J. T., *The Canadian Equalization Program: Main elements, achievements and challenges* (The Federal Idea: A Quebec Think Tank on Federalism, 2012), <https://ideefederale.ca/documents/Equalization.pdf>

Bird, Lindsay, 'Internet, cell service frustrations still rule in rural NL, despite promises to fix it,' CBC News (2 September 2021), <https://www.cbc.ca/news/canada/newfoundland-labrador/broadband-cell-service-workarounds-rural-canada-federal-election-1.6161285>

_____, 'A low-carbon future means a big demand for key minerals. Can NL's mines cash in?' CBC News (6 December 2020), <https://www.cbc.ca/news/canada/newfoundland-labrador/newfoundland-labrador-mining-green-technology-sector-1.5822115>.

Bivens, Josh, 'Updated employment multipliers for the US economy,' Economic Policy Institute (23 January 2019), <https://www.epi.org/publication/updated-employment-multipliers-for-the-u-s-economy/>

BP, *Statistical Review of World Energy* (2021), <https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2021-full-report.pdf>

Bragg, Brad, '5 things to know about homes for sale in St. John's housing market 2020,' NL Home Finder (29 January 2020), <https://www.nlhomefinder.ca/blog/5-things-to-know-about-the-homes-for-sale-in-st-johns-housing-market/>

Breen, Katie, 'NL tech startups had a wildly successful 2019. Can they keep it up?' CBC News (25 December 2019), <https://www.cbc.ca/news/canada/newfoundland-labrador/tech-startups-2019-nl-1.5401391>

Breznitz, Dan, *Innovation in Real Places* (Oxford: Oxford University Press, 2021).

Cain, Timothy, 'Driving by numbers: Province by province pandemic auto sales,' *Driving* (14 April 2021), <https://driving.ca/column/driving-by-numbers/driving-by-numbers-province-by-province-pandemic-auto-sales>

Canadian Institute for Health Information, 'National health expenditure trends,' (November 2021), <https://www.cihi.ca/sites/default/files/document/health-expenditure-data-in-brief-en.pdf>

_____, 'Long-term care homes in Canada: How many and who owns them?' (24 September 2020), <https://www.cihi.ca/en/long-term-care-homes-in-canada-how-many-and-who-owns-them>

Carter, Ken, Heather Hall, and Rob Greenwood, 'Newfoundland & Labrador: Missed opportunities but glimmers of hope,' in P. W. B. Phillips and D. Castle (eds.), *Ideas, Institutions, and Interests: The Drivers of Canadian Provincial Science, Technology, and Innovation Policy* (Toronto: University of Toronto Press, 2022), pp. 113-40.

CBC News, 'Vale signs deal with Tesla to provide Voisey's Bay nickel for electric vehicles,' CBC News (6 May 2022), <https://www.cbc.ca/news/canada/newfoundland-labrador/vale-tesla-nickel-deal-1.6368459>.

_____, 'Feds pledge \$930k to expand high-speed internet access in Labrador,' CBC News (4 February 2022), <https://www.cbc.ca/news/canada/newfoundland-labrador/labrador-high-speed-internet-funding-1.6339856>

_____, 'Students, union slam Greene report's proposed post-secondary education cuts,' CBC News (7 May 2021), <https://www.cbc.ca/news/canada/newfoundland-labrador/greene-report-reaction-education-memorial-university-1.6017588>

_____, 'Will fishing shrimp be worth it this year? Maybe not, say harvesters,' CBC News (1 May 2021), <https://www.cbc.ca/news/canada/newfoundland-labrador/shrimp-prices-concerns-broadcast-1.6010541>

_____, 'MUN creates Labrador campus to grant university degrees in Happy Valley-Goose Bay,' CBC News (24 July 2020), <https://www.cbc.ca/news/canada/newfoundland-labrador/mun-labrador-campus-1.5660361>

_____, 'Q&A: The wonky world of equalization payments,' CBC News (22 November 2016), <https://www.cbc.ca/news/canada/calgary/equalization-payments-frequent-questions-answers-1.3862482>

CBC/Radio Canada, 'Life support of \$41.5m given to West White Rose, but no guarantee oil project will restart,' CBC News (3 December 2020), <https://www.cbc.ca/news/canada/newfoundland-labrador/west-white-rose-1.5826436>

Colborne, B., 'St. John's ocean technology cluster: can government make it so?' *Canadian Public Administration*, 49 (1) (2006): 46-59.

Coldwell Banker Richard Ellis (CBRE), *Scoring Canadian tech talent*, 2019
<https://researchgateway.cbre.com/Layouts/GKCSearch/DownloadPublicUrl.ashx>

Cooke, Gord B., Jimmy Donaghey, and Isik U. Zeytinoglu, 'The nuanced nature of work quality: evidence from rural Newfoundland and Ireland,' *Human Relations* 66 (4) (2013): 503-527.

DBRS Morningstar, 'DBRS Morningstar confirms the Province of Newfoundland and Labrador's ratings at A (low), Negative Trend,' DBRS Morningstar (2 December 2020).

Dean-Simmons, B., 'Will Newfoundland offshore oil industry reboot with rising oil prices? SaltWire (8 July 2021), <https://www.saltwire.com/atlantic-canada/business/will-newfoundland-offshore-oil-industry-reboot-with-rising-oil-prices-100609490/>

Department of Finance, Newfoundland and Labrador, <https://www.gov.nl.ca/fin/economics/eb-population/>

Department of Fisheries and Oceans (DFO) Canada, 'Marine sector in Canada summary tables,' <https://www.dfo-mpo.gc.ca/stats/maritime-eng.htm> (2022)

Department of Natural Resources, *Bay du Nord Framework Agreement – Technical Briefing* (St. John's, NL: Government of Newfoundland and Labrador, 2018)

Doloreux, David, and S. Dionne, 'Is regional innovation system development possible in peripheral regions? Some evidence from the case of La Pocatière, Canada,' *Entrepreneurship and Regional Development* 20 (3) (2008): 259-283.

Doloreux, David, and Richard Shearmur, 'Moving maritime clusters to the next level: Canada's Ocean Supercluster initiative,' *Marine Policy* 98 (2018): 33-36.

Eder, J., 'Innovation in the periphery: A critical survey and research agenda,' *International Regional Science Review*, 42(2) (2019): 119-146.

Esau, Iain, 'Industry fury as Premier Furey breaks promise to continue funding seismic work offshore Canada,' *Upstream* (7 January 2022), <https://www.upstreamonline.com/exploration/industry-fury-as-premier-furey-breaks-promise-to-continue-funding-seismic-work-offshore-canada/2-1-1141138>

Ferreras, Jesse, 'Unemployment in Newfoundland and Labrador could reach almost 20% in 3 years,' *The Huffington Post Canada* (15 November 2016), https://www.huffpost.com/archive/ca/entry/newfoundland-unemployment_n_12998174

Fitzpatrick, Ashley, 'Bay du Nord decision will speak to NL's oil role in energy future,' *Atlantic Business* (24 March 2022), <https://atlanticbusinessmagazine.ca/web-exclusives/bay-du-nord-decision-will-speak-to-n-l-oils-role-in-energy-future/>

Florida, Richard, *Is Oil the New Cod? Resource Redux in Newfoundland and Labrador* (Toronto: Martin Prosperity Institute, University of Toronto, 2011).

_____, *The rise of the creative class and how it's transforming work, leisure, community and everyday life* (New York: Basic Books, 2002).

Gien, Lan, and Rebecca Law, *Attracting and Retaining Immigrants to Newfoundland and Labrador: Voices from the Newcomers and International Students* (St. John's, NL: Harris Centre Regional Analytics Laboratory, Memorial University, 2016), <https://research.library.mun.ca/8155/>.

Government of Newfoundland and Labrador, 'New talent strategy to prepare workers for careers in growing tech sector,' Government of Newfoundland and Labrador (14 January 2021).

_____, 'Provincial Government Provides Update on Status of Terra Nova Project,' Government of Newfoundland and Labrador (14 January 2021).

_____, 'Provincial Government Announces Support for Hibernia,' Government of Newfoundland and Labrador (23 December 2020).

_____, 'Oil and Gas Industry Recovery Task Force Focuses on Immediate Actions,' Government of Newfoundland and Labrador (25 September 2020).

_____, *The Way Forward on Climate Change in Newfoundland and Labrador* (St. John's, NL: Government of Newfoundland and Labrador, 2019).

_____, *Advance 2030: A Plan for Growth in the Newfoundland and Labrador Oil and Gas Industry* (St John's, NL: Government of Newfoundland and Labrador, 2019).

_____, *The Way Forward: A Multi-Year Plan for Infrastructure Investment* (St. John's, NL: Government of Newfoundland and Labrador, 2019).

_____, *The Way Forward on Oil and Gas – Advance 2030: A Plan for Growth in the Newfoundland and Labrador Oil and Gas Industry* (St John's, NL: Government of Newfoundland and Labrador, 2018).

_____, *The Way Forward: A Vision for Sustainability in Newfoundland and Labrador* (St. John's, NL: Government of Newfoundland and Labrador, 2017).

_____, *The Way Forward on Business Innovation* (St. John's, NL: Government of Newfoundland and Labrador, 2017).

_____, *The Way Forward on Immigration in Newfoundland and Labrador* (St. John's, NL: Government of Newfoundland and Labrador, 2017).

_____, *A Population Growth Strategy for Newfoundland and Labrador, 2015-2025* (St. John's, NL: Government of Newfoundland and Labrador, 2015), <https://www.gov.nl.ca/populationgrowth/>

Green, Jeff, "Innovation to market": Program focusing on training PhDs, post-doctoral scholars to become corporate innovators,' Memorial University, <https://www.mun.ca/research/news.php?id=13703&type=news>

Greenwood, Rob, 'Demographics as destiny? Regional development, population, and productivity in NL,' presentation to the Bank of Canada Board of Directors (St. John's, NL: The Harris Centre Memorial University, 12 June 2019), <https://research.library.mun.ca/13984/>

Hall, Heather M., and Kelly Vodden, 'Family and community impacts on mobility for work,' Memorial Presents (St. John's, NL: 5 December 2017).

Hall, Heather, Jacqueline Walsh, Kelly Vodden and Rob Greenwood, *Challenges, opportunities and strategies for advancing innovation in Newfoundland and Labrador* (St. John's, NL: The Harris Centre, Memorial University, February 2014).

Hall, Heather M., Kelly Vodden and Rob Greenwood, 'From dysfunctional to destitute: the governance of regional economic development in Newfoundland and Labrador,' *International Planning Studies* 22 (2) (2017): 49-67.

Hanniman, Kyle, 'COVID-19, Fiscal Federalism and Provincial Debt: Have we reached a critical juncture?' *Canadian Journal of Political Science* 53, (2020): 279-285.

Health Accord NL, *Our Province, Our Health. Our Future. A 10-Year Health Transformation: The Report* (2022), <https://www.gov.nl.ca/hcs/files/Health-Accord-NL-Report.pdf>

Hirschman, Albert, *The Strategy of Economic Development* (New Haven, CT: Yale University Press, 1958).

'Holyrood Marine Base,' <http://holyrood.ca/business/oceans-holyrood-initiative/holyrood-marine-base/>

Innovation, Science and Economic Development (ISED) Canada, 'Canada's Ocean Supercluster,' Government of Canada, <https://oceansupercluster.ca/about/>

Innovation, Science and Economic Development (ISED) Canada, 'Canada's Ocean Supercluster' (22 June 2021), <https://oceansupercluster.ca/>

Isaken, A., and J. Karlsen, 'Innovation in Peripheral Regions,' in R. Shearmur et al. (eds.), *Handbook on the Geographies of Innovation* (Cheltenham, UK: Edward Elgar, 2016), pp. 277-85.

Kean, Gary, 'Summit in Corner Brook highlights the need to squeeze more value out of forestry sector,' Saltwire, (28 January 2019), <https://www.saltwire.com/newfoundland-labrador/news/summit-in-corner-brook-highlights-need-to-squeeze-more-value-out-of-forestry-sector-279658/>

Kennedy, Alex, 'Birth numbers in NL stagnant in 2021, a trend "almost impossible" to reverse,' say expert,' CBC News (24 January 2022), <https://www.cbc.ca/news/canada/newfoundland-labrador/nl-births-and-deaths-2021-1.6318466>

Knubley, J., 'Building Superclusters for Canada Institute,' Brookfield Institute for Innovation and Entrepreneurship (April 2021), https://www.brookfieldinstitute.ca/wp-content/uploads/Superclusters_Final2.pdf

Lepawsky, Josh, Chrystal Phan and Rob Greenwood, 'Metropolis on the margin: Talent attraction and retention to the St. John's city-region,' *The Canadian Geographer*, 54 (3) (2010): 324-46.

Lepawsky, Josh, Heather Hall and Betsy Donald, 'Kingston and St. John's: The role of relative location in talent attraction and retention,' in J. Grant (ed.), *Seeking Talent for Creative Cities* (Toronto: University of Toronto Press, 2018), pp. 201-18.

'Letter: No reason to ban catch and release salmon fishing in NL,' (28 March 2022), <https://www.saltwire.com/atlantic-canada/opinion/letter-no-reason-to-ban-catch-and-release-salmon-fishing-in-nl-100711460/>.

Locke, Wade, 'An overview of Newfoundland and Labrador's Oil and Gas Sector: Structure, Royalties, Issues, Challenges and Future Directions (2020).

Locke, Wade, and Doug May, 'Newfoundland and Labrador's debt management strategy: kicking the can down the road while waiting for a saviour,' A Presentation to the CARE Speaker Series (Memorial University of Newfoundland, 2019).

Lundy, Matt, 'In Newfoundland and Labrador, a demographic crisis gets worse,' *The Globe & Mail* (23 February 2020), <https://www.theglobeandmail.com/business/economy/article-in-newfoundland-and-labrador-a-demographic-crisis-puts-the-economy-at/>

Macdonald, Christopher Hewitt, Michael Haan, and Barbara Neis, *Interprovincial Employees from Newfoundland and Labrador, 2005-2014, On the Move Partnership*, 2018, <http://www.onthemovepartnership.ca/wp-content/uploads/2019/01/NL-IPE-Final-web.pdf>

Marine Institute, 'About us,' <https://www.mi.mun.ca/aboutus/>

McKnight, Scott, and Peter Warrian, 'Innovating in the oil and gas supply chain: The case of Newfoundland and Labrador,' presentation to the Innovation Policy Lab, Munk School of Global Affairs, University of Toronto (1 October 2021).

McNally, Robert, *Crude Volatility: The history and the future of boom-bust oil prices* (New York: Columbia University Press, 2017).

Memorial University, 'About Memorial: Newfoundland and Labrador's university,' (29 September 2021), <https://www.mun.ca/main/about/>

_____, 'Campuses,' <https://www.mun.ca/main/campuses/>

_____, 'Canada Research Chairs,' <https://www.mun.ca/research/explore/chairs/crc.php>

_____, 'Core Sciences Facility,' <https://www.mun.ca/csf/>

_____, 'Engaged research: Sustainable solutions to marine biomass innovations,' News releases (12 January 2022), <https://grenfell.mun.ca/campus-services/Pages/News-Description.aspx?NewsID=545>

_____, 'Fact Book 2021', https://www.mun.ca/ciap/media/production/ciap/media-library/factbook/fb2021/38_Table_R3.pdf.

_____, 'Harris Centre Priorities, 2014-2015,' https://www.mun.ca/harriscentre/HC_2014-15_final-plan_CW.pdf.

_____, 'The Public Engagement Framework,' Memorial University, <https://www.mun.ca/publicengagement/memorial/framework/>.

Memorial University Integrated Planning Committee, 'What We Recommend: Maintaining Excellence in a Time of Reduced Public Funding. Memorial University Integrated Planning Committee, 2020 Memorial University Integrated Planning Committee. Operating Budget Report. Memorial University Integrated Planning Committee, 2019).

Memorial University of Newfoundland, *Timeline: History of Memorial University*, <https://www.mun.ca/main/history/timeline/>.

Mercer, Nicholas, 'TRU Precious Metals making headway in central Newfoundland gold properties,' *The Telegram* (8 March 2021), <http://thetelegram.newspaperdirect.com/epaper/viewer.aspx>

Minister of Innovation Science and Economic Development, Government of Canada, 'About Canada's Innovation Superclusters initiative,' Innovation Superclusters Initiative (22 June 2021), <https://www.ic.gc.ca/eic/site/093.nsf/eng/00016.html>

Minister of Innovation Science and Economic Development (ISED), Government of Canada, *About Canada's Innovation Superclusters initiative* (Innovation Superclusters Initiative, June 2021), <https://www.ic.gc.ca/eic/site/093.nsf/eng/00016.html>

Mintz, Jack M., 'Fairness for Newfoundland and Labrador starts with equalization,' *Toronto Star* (9 October 2019), <https://www.thestar.com/opinion/contributors/2019/10/09/fairness-for-newfoundland-and-labrador-starts-with-equalization.html>

Mullin, Malone, 'The rest of Canada is booming. Why is NL's population falling behind?' *CBC News* (20 September 2019), <https://www.cbc.ca/news/canada/newfoundland-labrador/nl-population-projection-1.5289419>

Municipal and Provincial Affairs, Government of Newfoundland and Labrador, 'Joint Working Group on Regionalization: Report and Recommendations,' (2 February 2022), <https://www.gov.nl.ca/mpa/files/Regionalization-Report-and-Recommendations.pdf>

Nalcor Energy, 'Independent resource assessment identifies significant potential in the West Orphan Basin offshore Newfoundland and Labrador,' Nalcor Energy (24 August 2016).

Newfoundland and Labrador Association of Technical Industries, *2020 Facts and figures*, <https://www.nati.net/facts-and-figures/>

Newfoundland and Labrador Statistics Agency, Department of Finance, https://stats.gov.nl.ca/Statistics/Topics/population/PDF/PopAgeSex_M.PDF

Nordal, Kaitlynn, 'Don't expect the hot housing market to cool down any time soon, says St. John's realtor,' *Saltwire* (29 March 2022), <https://www.saltwire.com/atlantic-canada/lifestyles/dont-expect-the-hot-housing-market-to-cool-down-any-time-soon-says-st-johns-realtor-100712063/>

Ocean Frontier Institute, 'About us,' <https://www.ofi.ca/about>

Ocean Startup Project, 'Lab2Market Oceans,' <https://oceanstartupproject.ca/lab2market-oceans/>

Organization of Economic Cooperation and Development (OECD), 'Defining Innovation,' <https://www.oecd.org/site/innovationstrategy/defininginnovation.htm>

Putnam, Robert, *Making Democracy Work* (Princeton, NJ: Princeton University Press, 1993).

Reid, Jenna, 'Change is in the air for Memorial University,' *The Muse* (25 April 2022), <https://themuse.ca/change-is-in-the-air-for-memorial-university/>

Rendell, Mark, and Sean Silcoff, 'Nasdaq to buy Verafin for US\$2.75-billion in biggest Canadian software takeover since 2007,' *The Globe & Mail* (19 November 2020), <https://www.theglobeandmail.com/business/article-nasdaq-to-buy-canadas-verafin-for-us275-billion/>.

Roberts, Terry, 'Cenovus to decide on West White Rose "in the coming weeks," says CEO,' *CBC News* (27 April 2022), <https://www.cbc.ca/news/canada/newfoundland-labrador/cenovus-argentina-white-rose-1.6432691>

_____, 'Amid hype over Bay du Nord, NL forecasts declining oil production and royalties,' *CBC News* (7 April 2022), <https://www.cbc.ca/news/canada/newfoundland-labrador/budget-mining-oil-1.6411747>

_____, 'Last year was the worst year in history for births in Newfoundland and Labrador,' CBC News (22 January 2019), <https://www.cbc.ca/news/canada/newfoundland-labrador/births-low-population-1.4980724>

_____, 'Vale, province celebrate first production at new nickel plant in Long Harbour,' CBC News (19 November 2014), <https://www.cbc.ca/news/canada/newfoundland-labrador/vale-province-celebrate-first-production-at-new-nickel-plant-in-long-harbour-1.2840691>

Ross, Michael, *The Oil Curse: How Petroleum Wealth Shapes the Development of Nations* (Princeton, NJ: Princeton University Press, 2012).

SaltWire Network, 'Banner year for mineral exploration activity in Newfoundland and Labrador,' Saltwire (11 January 11 2021), <https://www.saltwire.com/nova-scotia/business/banner-year-for-mineral-exploration-activity-in-newfoundland-and-labrador-539616/>

Saxenian, Anna Lee, *Regional Advantage* (Cambridge, MA: Harvard University Press, 1994).

Schultz, Heiner, 'Political Institutions and Foreign Direct Investment in Developing Countries: Does the Sector Matter?' SSRN (13 May 2009), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1403983

Sheppard, Robert, 'Letter: Ban catch and release salmon fishing in Newfoundland in 2019,' *The Telegram* (30 March 2019).

Short, Larry, 'Grudge Match in the Oilpatch: Decarbonizers versus Double-Downers,' CBC News (9 November 2019), <https://www.cbc.ca/news/canada/newfoundland-labrador/decarbonize-vs-double-down-1.5352989>

Simms, Alvin, and Jamie Ward, *Regional population projections for Newfoundland and Labrador 2016-2036* (St. John's, NL: Harris Centre Regional Analytics Laboratory, Memorial University, 2016), https://www.mun.ca/harriscentre/PopulationProject/Population_Projections_for_NL.pdf

Simms, Alvin, and Robert Greenwood, 'Newfoundland and Labrador,' *State of Rural Canada Report* (2015), <https://sorc.crrf.ca/nl/>.

'Six Amendment to Voisey's Bay Development Agreement' (19 December 2014), <https://www.gov.nl.ca/iet/files/royalties-amendment-4-redacted.pdf>

Slawinski, Neralie E. K., Blair Winsor, Mark Stoddart, Diane Hodgins, John Schouten, and Wendy Smith, 'Building Resilient Rural Communities through Social Entrepreneurship: Lessons from the Shorefast Foundation on Fogo Island, Newfoundland and Labrador' (St. John's, NL: Memorial University of Newfoundland, 2018).

Smellie, Sarah, 'Atlantic provinces will have highest proportion of seniors over 85: census,' CBC, <https://www.cbc.ca/news/canada/newfoundland-labrador/cp-atlantic-provinces-seniors-2043-1.6432892>

Standard and Poor Global, 'Province of Newfoundland and Labrador outlook revised to negative on Impact of COVID-19 and low oil prices,' Standard and Poor Global (28 May 2020).

_____, 'Province of Newfoundland and Labrador "A" ratings affirmed; Outlook remains stable,' Standard and Poor Global (8 August 2019).

Statistics Canada, 'Population and dwelling counts: Canada and population centres,' (9 February 2022), <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=9810001101>

_____, *Canada goes urban* (2020), <https://www150.statcan.gc.ca/n1/pub/11-630-x/11-630-x2015004-eng.htm>

_____, 'Record decline in natural resources real gross domestic product,' (23 September 2020), <https://www150.statcan.gc.ca/n1/daily-quotidien/200923/dq200923a-eng.htm>

_____, 'Population and dwelling count highlight tables, 2011 Census,' <https://www12.statcan.gc.ca/census-recensement/2011/dp-pd/hlt-fst/pd-pl/Table-Tableau.cfm>

_____, 'Population and dwelling counts: Canada, provinces and territories,' <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=9810000101>

_____, <https://publications.gc.ca/Collection/Statcan/96F0030X/96F0030XIE2001002.pdf>

Storey, Keith, 'From "new town" to "no town" to "source", "host" and "hub" communities: The evolution of the resource community in an era of increased labour mobility,' *The Journal of Rural and Community Development* 13 (3) (2018).

_____, *Commuting to Alberta: The mobile workforce in Newfoundland and Labrador*, Report prepared for the Department of Human Resources, Labour and Employment (St. John's, NL: Government of Newfoundland and Labrador, Harris Centre, Memorial University, 2010).

Storey, Keith, and Heather M. Hall, 'Dependence at a distance: The new single-industry community and the implications for policy,' *The Canadian Geographer*, 62(2) (2018): 225-237.

'The Big Reset: The Report of the Premier's Economic Recovery Team' (St. John's, NL: May 2021), <https://thebigresetnl.ca/>

The World Bank, 'Climate-Smart Mining: Minerals for Climate Action,' <https://pubdocs.worldbank.org/en/961711588875536384/Minerals-for-Climate-Action-The-Mineral-Intensity-of-the-Clean-Energy-Transition.pdf>

The World Bank, 'Migration and Remittances Data,' <https://www.worldbank.org/en/topic/migrationremittancesdiasporaissues/brief/migration-remittances-data>.

Thrasher, Jack, 'Newfoundland Generic Royalty Regime,' *Dalhousie Law Journal* 26 (2) (2003): 365-407.

Turner, Chris, *The Patch* (Toronto: Simon & Schuster, 2017).

US Energy Information Administration, 'Frequently asked questions (FAQs): What countries are the top producers and consumers of oil?' US EIA, <https://www.eia.gov/tools/faqs/faq.php?id=709&t=6> (2022).

Walsh, Deatra, Mary-Dan Johnston, and Christine Saulnier, *Great Expectations: Opportunities and Challenges for Young Workers in Newfoundland and Labrador* (Ottawa: Canadian Centre for Policy Alternatives, 2015).

Warrian, Peter, and David Wolfe, 'Research and Technology Transfer at the Marine Institute, Memorial University of Newfoundland,' (Memorial University, April 2017).

Warrian, Peter, and Ray Gosine, 'Degree of Technology Challenge and MNE Knowledge Creation and Sourcing in Host Countries,' Working Paper, Munk School of Global Affairs (August 2021).

Webb, J., 'The Rise and Fall of Memorial University's Extension Service, 1959-91,' *Newfoundland and Labrador Studies* 29 (1) (2014).

Wolfe, David, and Peter Warrian, 'C-Core as networked industrial policy initiative,' (18 July 2016), Memorial University Public Engagement, https://www.mun.ca/wearehere/c-core-study-v5.2-FINAL_1.pdf

Wolfe, David A., and Meric S. Gertler, 'Clusters from the Inside and Out: Local dynamics and global linkages,' *Urban Studies* 41 (5/6) (May 2004): 1071-1093.