Arctic Development Futures:

Perspectives on Arctic Marine Development in the Canadian Arctic

By

Erling Paul Rolseth

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ABSTRACT

The Canadian Arctic is warming at a rate that could soon attract increased traffic within and the region from Canadian and foreign vessels. Any sharp increase in traffic could pose a threat to Arctic peoples, the environment, and Canada's regime and sovereignty in the North. Canada currently leads the world in Polar Code compliance and regulation. Additionally, it was the first state to publish legislation discriminating the Arctic from other maritime legal regimes, directly leading to Article 234 of the United Nations Convention on the Law of the Sea. As the Arctic warms and ice patterns change, Canada could have to again take up the mantle of leadership in Arctic waters. Canada's

Arctic is already seeing an uptake in transit passages through the Northwest Passage, and it has so far adhered to Canada's regulatory practice. However, even at a low volume, groundings and regulatory breaches occur; without the proper institutional development, incidents could arise with greater frequency and lead to large consequences. This study used industry and policy worker interviews to generate development scenarios for the Canadian Arctic from their perspectives. The goal is to understand policy scenarios and potential development in Canada's Arctic marine industries and government sectors. Two scenarios were developed using the Oxford Scenario Planning Approach and enabled the author to create policy recommendations to identify and address deficiencies in Canada's Arctic regime. A divergence was noted surrounding the strength of Canada's existing Arctic regime, but all data pointed to the requirements of an increase in proactive investment in the region. A briefing note is attached with the report summarizing policy recommendations.

CHAPTER I: INTRODUCTION

Changes in sea ice patters[1,2,3] and economic and political incentives[4,5] in the Canadian Arctic Archipelago (Canadian Archipelago) are increasing the complexity of Canada's role in the Arctic. An increase of transit traffic –between the Atlantic and Pacific Oceans – and destination traffic – voyages to a point in the Canadian Arctic from an Arctic or non-Arctic point of origin – as a result of increased seasonal navigability set on by climate change.[6,7] However, sea ice accumulation in choke points around the Northwest Passage (NWP) – a seaborn route transiting the Arctic Ocean in part through the Canadian Arctic Archipelago – is increasing due to the crumbling of nearby multi-year ice sheets.[8] This decreases the reliability and efficiency of the NWP while increasing collision risks for vessels. This is a potential stressor for environmental and search and rescue (SAR) infrastructure in Canada. Canada must use the time at hand to generate policy solutions to mitigate negative impacts on the Canadian Arctic's environment and peoples and generate infrastructure and institutions to keep vessels safe and sustainable – environmentally and culturally – as they navigate the waterways.

Erling Rolseth is a prospective Master of Marine Management with Dalhousie University under the faculties of science and graduate studies. This project was conducted under the supervision of Prof. Floris Goerlandt, Dalhousie Industrial Engineering.

[1] Huntington, Henry, and Gunter Weller. 'Arctic Climate Impact Assessment'. New York: Cambridge University Press, 2005.
[2] Pizzolato, Larissa, Stephen E. L. Howell, Chris Derksen, Jackie Dawson, and Luke Copland. 'Changing Sea Ice Conditions and Marine Transportation Activity in Canadian Arctic Waters between 1990 and 2012'. *Climatic Change* 123, no. 2 (1 March 2014): 161–73. https://doi.org/10.1007/s10584-013-1038-3.
[3] Pizzolato, Larissa, Stephen E. L. Howell, Jackie Dawson, Frédéric Laliberté, and Luke Copland. 'The Influence of Declining Sea Ice on Shipping Activity in the Canadian Arctic'. *Geophysical Research Letters* 43, no. 23 (2016): 12,146-12,154. https://doi.org/10.1002/2016GL071489.
[4] Laurence C. Smith, *The New North, The World in 2050* (Great Britain: Profile Books Ltd., 2011).
[5] Elizabeth Francis, 'Arctic Governance and China's Claim of Near Arctic State', December 2020.
[6] Headland, R.K. 'Northwest Passage Transits to End of the 2023 Navigation Season'. Cambridge, UK: Scott Polar Research Institute, 26 January 2024. https://www.spri.cam.ac.uk/resources/infosheets/northwestpassage.pdf.
[7] Lawrence R. Mudryk et al., 'Impact of 1, 2 and 4 °C of Global Warming on Ship Navigation in the Canadian Arctic', *Nature Climate Change* 11, no. 8 (August 2021): 673–79, https://doi.org/10.1038/s41558-021-01087-6.
[8] Alison J. Cook et al., 'Sea Ice Choke Points Reduce the Length of the Shipping Season in the Northwest Passage', *Communications Earth & Environment* 5, no. 1 (11 July 2024): 1–11, https://doi.org/10.1038/s43247-024-01477-6.

To ensure the safety of Arctic peoples, ecosystems, and mariners in the Canadian Arctic, Canada must generate institutions and infrastructure in the Arctic. Through a scoping study consisting of interviews with ten experts in Arctic policy, navigation, education, and sealift, the researcher generated development scenarios for the Canadian Arctic and its maritime policy. Analysis followed the Oxford Scenario Planning Approach to create and assess implications of these scenarios and form resultant policy recommendations.

Understanding industry and government perspectives on marine transits in the NWP in the present and future will generate an image of what experts believe Canada to be doing right and wrong when preparing for increased traffic in the Canadian Archipelago. Predictions on Arctic marine traffic in the Canadian Arctic Archipelago were summarized to distill the perceived scenarios. This understanding can be used as a basis to start conversations, generate policy, and inspire further research on resultant questions. While Inuit are naturally a consideration in operations and legislation in the region, this study is cognizant of the fact that implementation of any recommendations in the Canadian Arctic will require not only input but assent from Inuit communities affected. Further research using a similar framework and Inuit consultation is recommended in the future.

The paper consists of five sections: background, methodology, results, discussion and conclusions. Section 1 provides introduction and background for Canada's Arctic regime. It will detail the historical, legal, environmental, and economic background of the region. Section 2 covers the methods used, and introduces the Oxford Scenario Planning Approach (OSPA), the scenario development method used for this study. Selection of participants as well as data handling and de-identification can be found here in accordance with the Tri-Council Policy Statement 2.0 on research ethics[9]. Results of interviews, along with their analysis using the OSPA, can be found in Section 3. Section

[9] Government of Canada, Interagency Advisory Panel on Research Ethics. 'Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans – TCPS 2 (2022)', 11 January 2023. https://ethics.gc.ca/eng/policy-politique_tcps2-eptc2_2022.html.

4 interprets the results and summarizes study limitations. Section 5 concludes with the author's recommendations for further research and a brief summary of the paper. In tandem, the author has created a policy briefing note with distilled recommendations from the results: this includes further research possibilities and will be available to policy-makers in Canada's Arctic departments.

Section 1: Background

Canadian sovereignty in the Arctic has been questioned repeatedly since the outset of the Cold War, but contestation may be at an all-time high as world powers are shifting once again.[10] The Canadian Arctic is rich with mineral and hydrocarbon deposits, and the warming of Climate Change will make the waters of the Canadian Archipelago increasingly accessible. Climate Change is warming the global Arctic at a rate four-times greater than the rest of the planet, with some scholars predicting an ice-free Arctic season regularly by the 2030s.[11] The effect on traffic of changing ice patterns is debated[12], but as of 2023 traffic has increased dramatically since the turn of the century in transit sails alone.[13] Warming both decreases the stability of terrestrial transportation and construction while improving prospects for marine industry, especially transit through and within the region, indicating a high likelihood that Arctic waterways will only grow in importance into the future.[14]

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[10] Aldo Chircop, 'Regulatory Challenges for International Arctic Navigation and Shipping in an Evolving Governance Environment', *Ocean Yearbook* 28, no. 1 (2014): 269–90, https://doi.org/10.1163/9789004270589_011.

[11] Wang, Muyin, and James E. Overland. 'A Sea Ice Free Summer Arctic within 30 Years: An Update from CMIP5 Models'. *Geophysical Research Letters* 39, no. 18 (2012). https://doi.org/10.1029/2012GL052868.

[12] Pizzolato, Larissa, Stephen E. L. Howell, Chris Derksen, Jackie Dawson, and Luke Copland. 'Changing Sea Ice Conditions and Marine Transportation Activity in Canadian Arctic Waters between 1990 and 2012'. *Climatic Change* 123, no. 2 (1 March 2014): 161–73. https://doi.org/10.1007/s10584-013-1038-3.

[13] Headland, R.K. 'Northwest Passage Transits to End of the 2023 Navigation Season'. Cambridge, UK: Scott Polar Research Institute, 26 January 2024. https://www.spri.cam.ac.uk/resources/infosheets/northwestpassage.pdf.

[14] Smith, Laurence C. *The New North, The World in 2050*. Great Britain: Profile Books Ltd., 2011.

This is not news for Canadians. From the Archipelago's earliest inhabitants on its 36,563 islands, seaways have been the primary routes for transportation.[15] Inuit still depend on the waters, ice, and marine natural resources for survival and economic activity.[16] This in turn serves as Canada's justification by historic of the Arctic Archipelago.[17] Private firms and government operations are now populating those same waterways. Sealift delivers critical resources for communities and industrial operations such as mining. Tourism through cruise and pleasure craft is increasing, and so are incidents as vessels push to the edges of the increasingly accessible Arctic waterways.

Canada does not currently possess the security forces required to control access to the Archipelago or Northwest Passage as a backup for non-military measures like legal approaches, policy, and the Canadian Coast Guard. Canada could choose to address this through military asset procurement. Canada has taken a step in the direction of the defence and security option with its construction of six Harry DeWolf class Arctic and Offshore Patrol Vessels (AOPVs) and probing industry for the purchase of up to twelve Arctic-capable diesel-electric submarines, early warning systems, and air-defence measures.[18] The AOPVs will be delivered by the end of 2024, while timelines were not given for the remaining technologies.[19] Canada is more likely to lean toward institutional development and infrastructure construction, as well as engagement with Northern communities, to be able to address possible future issues, and is therefore the target of this project.

To regulate modern activities in the Arctic, Canada sponsors a leading regime in Arctic marine regulation and compliance rooted in international and domestic law and

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[15] Lajeunesse, Adam. *Lock, Stock, and Icebergs: A History of Canada's Arctic Maritime Sovereignty*. Vancouver, BC:
UBC Press, 2016.

[16] Mary Simon, 'Inuit and the Canadian Arctic: Sovereignty Begins at Home', *Journal of Canadian Studies* 43, no. 2 (February 2009): 250–60, https://doi.org/10.3138/jcs.43.2.250.

[17]

[18] Department of National Defence. 'Our North Strong and Free: A Renewed Vision for Canada's Defence'. Government of Canada, 3 May 2024.

[19] Department of National Defence.

institutions.[20] Increasing traffic puts stress on Canada's regulatory bodies and personnel, as well as cultural stress on Northern Communities and the ecosystems they rely on through increases in traffic and cruise interaction with communities. If transit traffic was to balloon rapidly, there is a possibility that Canada could find its regulatory and response infrastructure swamped and stretched thin by the volume of vessels to admit, monitor, and possibly respond to. Since 1993, vessel transits through the Canadian Arctic have increased from 3 to 41 annual voyages - with a notable increase in the most recent decade – a 14-fold increase over 30 years in through-traffic alone. This is conducted by a variety of vessels, including passenger vessels, commercial freighters, research icebreakers, and warships.[21] As of 2023, 393 transits of the Northwest Passage – over various routes – have been conducted since 1906; 318 have been made since the turn of the 21st century, the vast majority completed by non-Canadian-flagged vessels.[22] Canada is able to handle the 20-40 annual transits of the NWP, but groundings, ice-strikes, and illegal transits[23] still occur.[24]

Collaboration between industry, Indigenous peoples, and the federal government will augment Canada's ability to keep up with Arctic traffic and development. Policy forums like the Canadian Marine Advisory Council (CMAC) Prairies and Northern Region, an engagement opportunity put on annually by Transport Canada, is the intersection for high level discussions about Canadian Arctic Policy.[25] Notably, CMAC is

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[20] Kristin Bartenstein, Roman Dremliuga, and Natalia Prisekina, 'Regulation of Arctic Shipping in Canada and Russia', *Arctic Review on Law and Politics* 13 (2022): 338–60.
[21] Headland, R.K. 'Northwest Passage Transits to End of the 2023 Navigation Season'. Cambridge, UK: Scott Polar Research Institute, 26 January 2024. https://www.spri.cam.ac.uk/resources/infosheets/northwestpassage.pdf.
[22] Headland.
[23] John Last, 'New Zealander Sails through Arctic on Custom Yacht in Violation of COVID-19 Restrictions', *CBC News*, 26 August 2020, https://www.cbc.ca/news/canada/north/new-zealand-yacht-cambridge-bay-nunavut-1.5698347.
[24] Transportation Safety Board of Canada, 'Marine Transportation Safety Investigations and Reports - Transportation Safety Board of Canada', Database, Transportation Safety Board of Canada, 27 October 2023, https://www.tsb.gc.ca/eng/rapports-reports/marine/index.html.
[25] Transport Canada. 'Canadian Marine Advisory Council (CMAC) Engagement Opportunity: Marine Safety and Security Regulations'. AMSRP 13371538. AMSRP, 24 September 2024.

responsible for the Canada Gazette's Marine Regulations publications. CMAC meetings are open to the general public.

Legal Background

International use of the Northwest Passage is required by the United Nations Convention on the Law of the Sea (UNCLOS) Article 38 on Transit Passage.[26] However, Canada enjoys uniquely increased jurisdictional powers over its Arctic waters due to UNCLOS Article 234 on unilateral protection of ice-covered waters in a nation's exclusive economic zone[27], raising questions of how much power Canada can exercise over the route[28]. Canada claims a maritime baseline that encompasses the Canadian Archipelago, meaning that the right to innocent passage and Canada's coastal, contiguous, and exclusive economic zones begin *outside* of Canada's islands and connecting waterways. Scholars, international law, and foreign governments frequently disagree on this case[29]. This poses an inherent risk to Canada's historical dependence on domestic policy and collaborative diplomacy, and may require re-examination as the situation evolves in the future.[30]

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https://tc.canada.ca/en/marine/canadian-marine-advisory-council-cmac-engagement-opportunity-marine-safety-security-regulations.

[26] Article 38. United Nations. United Nations Convention on the Law of the Sea (1982). https://www.un.org/depts/los/convention_agreements/texts/unclos/unclos_e.pdf.

[27] Article 234. United Nations. United Nations Convention on the Law of the Sea (1982). https://www.un.org/depts/los/convention_agreements/texts/unclos/unclos_e.pdf.

[28] Viatcheslav Gavrilov, Roman Dremliuga, and Rustambek Nurimbetov, 'Article 234 of the 1982 United Nations Convention on the Law of the Sea and Reduction of Ice Cover in the Arctic Ocean', *Marine Policy* 106 (1 August 2019): 103518, https://doi.org/10.1016/j.marpol.2019.103518.

[29] Gavrilov *et al.*

[30] Andrea Charron, 'The Recasting of the Arctic Sovereignty Theme: Assessing Harper's Arctic Foreign Policy', in *Harper's World: The Politicization of Canadian Foreign Policy, 2006-2015*, ed. Peter McKenna (Toronto, Ont.: University of Toronto Press, 2022), 211–34.

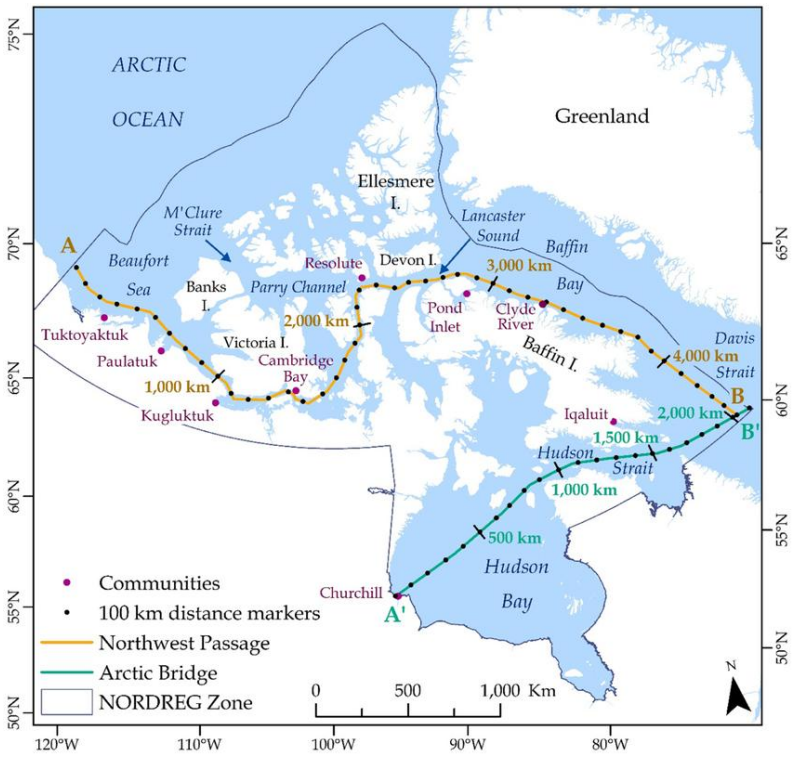

Figure 1: Map of the Canadian Archipelago and the NORDREG regulatory zone. Also included are the Arctic Bridge and Southern Northwest Passage shipping routes (Copland et al., 2016).

In 1970, Canada became the first nation to form Arctic-specific legislation governing its rights over the entirety of the water column following the trans-Arctic voyage of the American *SS Manhattan* in 1969.[31] Canada desired to consolidate its ability to control the passage of vessels through its sensitive Arctic waterways. Additional preventative measures were instated following the controversial 1985 voyage of the *USCGC Polar Sea* through the Canadian Arctic, even being initially led by Inuit.[32] The reality of large-scale oil spills and other ship-born environmental disasters were revealed to the world off the Cornish coast two years prior in 1967 when the *MV Torrey Canyon* discharged 15% of her crude oil cargo into British coastal waters.[33] Under these

[31] Mark Killas, 'THE LEGALITY OF CANADA'S CLAIMS TO THE WATERS OF ITS ARCTIC ARCHIPELAGO' 19 (n.d.).
[32] Briggs, Philip J. 'The Polar Sea Voyage and the Northwest Passage Dispute'. *Armed Forces & Society* 16, no. 3 (1 April 1990): 437–52. https://doi.org/10.1177/0095327X9001600308.
[33] Sheail, John. '"Torrey Canyon": The Political Dimension'. *Journal of Contemporary History* 42, no. 3 (2007): 485–504.

circumstances, Canada passed the unprecedented Arctic Waters Pollution Prevention Act (AWPPA)[34]. Under the AWPPA, Canada not only expanded its maritime jurisdiction from the customary maximum of 3 to 12 nautical miles (nm), but widened the scope of its jurisdiction at this range to encompass the entire surface, seafloor, and water column.[35] This was the springboard that generated UNCLOS Article 234 at the third UN Convention on the Law of the Sea (UNCLOS III), passed in 1982.[36] Article 234 allows states to enact unique legislation over the entirety of their ice-covered waters in the pursuit of pollution prevention, and without Canada's leadership, it may never have been penned.[37] The AWPPA was updated multiple times after 1970 to accommodate amendments in international and domestic law, most recently in 2018 to accommodate the mandatory adoption of the International Maritime Organization's (IMO) international code of safety for ships operating in polar waters (Polar Code) of 2017.

The current iteration of the AWPPA is the Arctic Shipping Safety and Pollution Prevention Regulations (ASSPPR), representing the incorporation of the Polar Code into Canadian law. The Polar Code is a combination of the IMO's Safety of Life at Sea (SOLAS) and International Convention for the Prevention of Pollution from Ships (MARPOL) that outlines certification requirements for vessels and mariners operating in Arctic and Antarctic waters and entered into force in 2017.[38] The Polar Code covers requirements of pollution prevention, emergency response, ship design, and onboard equipment. Ships in Polar waters must be Polar Code certified, as well as their masters,

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[34] Legislative Services Branch. Arctic Waters Pollution Prevention Act, A-12 R.S.C. § (1970). https://laws-lois.justice.gc.ca/eng/acts/a-12/.
[35] Killas, Mark. 'THE LEGALITY OF CANADA'S CLAIMS TO THE WATERS OF ITS ARCTIC ARCHIPELAGO' 19 (n.d.).
[36] Bartenstein, Kristin, Roman Dremliuga, and Natalia Prisekina. 'Regulation of Arctic Shipping in Canada and Russia'. *Arctic Review on Law and Politics* 13 (2022): 338–60.
[37] D.M. McRae, 'The Negotiation of Article 234', in *Politics of the Northwest Passage* (McGill-Queen's University Press, 1987), 98–114.
[38] International Maritime Organization, 'International Code for Ships Operating in Polar Waters', accessed 5 April 2024, https://www.imo.org/en/ourwork/safety/pages/polar-code.aspx.

chief mates, and navigational officers.[39] Canada has played a large role in the Polar Code's development, education, and enforcement since its inception.[40]

Marine safety in the Canadian Arctic is augmented by ice navigators: specialized navigational officers trained in sailing in ice-infested waters. Under the Pilotage Act[41], Canada does not require pilots in Arctic ports with the exception of Churchill, Manitoba, in the Hudson Bay. While the Pacific, Atlantic, and Great Lakes all have pilotage authorities that would oversee these operations, no such authority exists in Canada. Ice navigators, however, are required on board ships in polar waters under the ASSPPR.[42] The Pilotage Act was reviewed in 2018[43], and additional measures to increase navigational safety in the Canadian Arctic as climate change causes an increase in marine traffic, including the generation of an Arctic pilotage regime, and the Low-Impact Shipping Corridors Project[44].

Environmental Considerations

What is known about the physical and biological characteristics of the Canadian Arctic is attributable largely to the Canadian Hydrographic Service (CHS), Canadian Ice Service (CIS), and the Canadian Coast Guard (CCG). A lack of hydrographic survey data coupled with a variable navigational environment due to sea ice has led to several

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[39] International Maritime Organization.
[40] Fraser, Drummond. 'A Change in the Ice Regime: Polar Code Implementation in Canada'. In *Governance of Arctic Shipping: Rethinking Risk, Human Impacts and Regulation*, edited by Aldo Chircop, Floris Goerlandt, Claudio Aporta, and Ronald Pelot, 285–300. Cham: Springer International Publishing, 2020. https://doi.org/10.1007/978-3-030-44975-9_15.
[41] Legislative Services Branch, 'Pilotage Act', P-14 § (2023), https://lois-laws.justice.gc.ca/eng/acts/P-14/.
[42] Canada Legislative Services Branch, 'Arctic Shipping Safety and Pollution Prevention Regulations', 2017–286 SOR § (2023), https://laws.justice.gc.ca/eng/regulations/SOR-2017-286/FullText.html.
[43] Transport Canada. 'Pilotage Act Review'. Legislative Review. Ottawa, ON: AEAD, April 2018. https://tc.canada.ca/en/legislative-reviews/pilotage-act-bill-c-97/pilotage-act-review-final-report-april-2018.
[44] Transport Canada. 'Northern Low-Impact Shipping Corridors Initiative'. Transport Canada. Accessed 22 November 2024. https://tc.canada.ca/en/campaigns/protecting-our-coasts-oceans-protection-plan/stronger-partnerships-indigenous-coastal-communities/northern-low-impact-shipping-corridors-initiative.

instances of vessel groundings, entrapments, and even sinkings.[45,] Eight bottom contacts, ice strikes, groundings, and sinkings have been investigated in the Canadian Arctic since 1994, three resulted in pollution or loss of the ship: *QASAOQ* (1994)[46], *Clipper Adventurer* (2010)[47], and *Akademik Ioffe* (2018)[48]. Two of these incidents and one additional were caused in some way due to poor surveying data: *Clipper Adventurer* (2010), *Akademik Ioffe* (2018), and *Kivalliq W.* (2022)[49]. All of these incidents have been attributed to some lack of attentiveness to instruments and planning and taking undue risks on the water.

The environmental impacts of vessel traffic through climate change, spills, noise pollution, cultural degradation, emissions, discharge, and disturbance of wildlife and ecosystems is a large concern for the future of Arctic marine operations.[50] Ice strikes are especially a concern in the Northwest Passage due to the persistence of multi-year ice in the confined waterways of the Canadian Archipelago.[51] Rapid climatic warming is leading to the expedited disintegration of the Greenland Ice Sheet into Canadian Arctic waters, *increasing* the prevalence of smaller sea ice rather than melting it completely.[52] These navigational hazards are coupled with extreme weather events, complex waterways

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[45] Transportation Safety Board of Canada. 'Marine Transportation Safety Investigations and Reports - Transportation Safety Board of Canada'. Database, 27 October 2023. https://www.tsb.gc.ca/eng/rapports-reports/marine/index.html.

[46] Transportation Safety Board of Canada. 'Marine Investigation Report M94H0002'. Transportation Safety Board of Canada, 29 October 1994. https://www.tsb.gc.ca/eng/rapports-reports/marine/1994/m94h0002/m94h0002.html.

[47] Transportation Safety Board of Canada. 'Marine Investigation Report M10H0006'. Transportation Safety Board of Canada, 27 August 2010. https://www.tsb.gc.ca/eng/rapports-reports/marine/2010/m10h0006/m10h0006.html.

[48] Transportation Safety Board of Canada. 'Marine Transportation Safety Investigation M18C0225'. Transportation Safety Board of Canada, 24 August 2018. https://www.tsb.gc.ca/eng/enquetes-investigations/marine/2018/m18c0225/m18c0225.html.

[49] Transportation Safety Board of Canada. 'Marine Transportation Safety Investigation Report M22C0338'. Transportation Safety Board of Canada, 18 October 2022. https://www.tsb.gc.ca/eng/rapports-reports/marine/2022/m22c0338/m22c0338.html.

[50] Henry P. Huntington et al., 'Effects of Arctic Commercial Shipping on Environments and Communities: Context, Governance, Priorities', *Transportation Research Part D: Transport and Environment* 118 (1 May 2023): 103731, https://doi.org/10.1016/j.trd.2023.103731.

[51] Huntington et al.

[52] Smith, Laurence C. *The New North, The World in 2050*. Great Britain: Profile Books Ltd., 2011.

through the Canadian Arctic Archipelago, and periods of prolonged darkness in winter when the sun may not rise for months, and heaving sea ice can cover and displace navigational aids, decreasing their reliability.[53]

Canada is subject to legislation like the ASSPPR, Polar Code, and Canada Shipping Act[54] that regulate industry interactions with Arctic ecosystems. Notable measures include no-dumping bans[55], Pollution Prevention Officers[56], Heavy Fuel Oil (HFO) bans[57], and the NORDREG Monitoring Scheme[58]. Through Transport Canada, Communities can request changes to traffic to preserve over-ice routes and sensitive areas. Combined with scientific, bathymetric, and ice data, this information is used to generate future Norther Low-Impact Shipping Corridors.[59]

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[53] Transportation Safety Board of Canada. 'Marine Investigation Report M96H0016'. Transportation Safety Board of Canada, 29 August 1996. https://www.tsb.gc.ca/eng/rapports-reports/marine/1996/m96h0016/m96h0016.html.

[54] Legislative Services Branch. Canada Shipping Act (2023). https://laws-lois.justice.gc.ca/eng/acts/C-10.15/.

[55] Canada Legislative Services Branch. Arctic Shipping Safety and Pollution Prevention Regulations, 2017–286 SOR § (2023). https://laws.justice.gc.ca/eng/regulations/SOR-2017-286/FullText.html.

[56] *Ibid*.

[57] Transport Canada. 'Minister of Transport Announces a Domestic Ban on the Use and Carriage of Heavy Fuel Oil in the Arctic'. News releases, 28 June 2024. https://www.canada.ca/en/transport-canada/news/2024/06/minister-of-transport-announces-a-domestic-ban-on-the-use-and-carriage-of-heavy-fuel-oil-in-the-arctic.html.

[58] Legislative Services Branch. Northern Canada Vessel Traffic Services Zone Regulations (2010). https://laws-lois.justice.gc.ca/eng/regulations/SOR-2010-127/FullText.html.

[59] Transport Canada. 'Northern Low-Impact Shipping Corridors Initiative'. Transport Canada. Accessed 22 November 2024. https://tc.canada.ca/en/campaigns/protecting-our-coasts-oceans-protection-plan/stronger-partnerships-indigenous-coastal-communities/northern-low-impact-shipping-corridors-initiative.

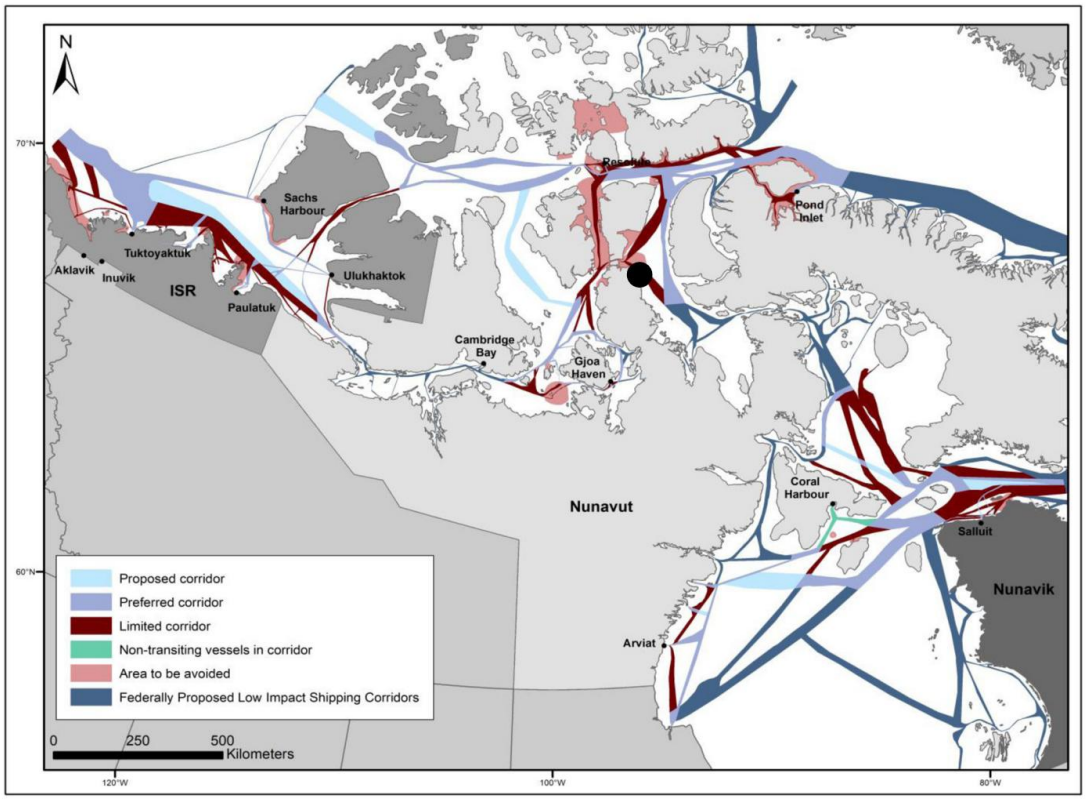

Figure 2: Data compiled for the creation of Low-Impact Shipping Corridors in the Canadian Arctic (Dawson et al., *2020)*[60]

Economic Prospects

Currently, the largest enterprises in Canada's Arctic are mining operations, services such as tourism, and traffic enter the Arctic from abroad.[61] Sealift firms for community resupply also contribute to business and traffic in the Canadian Archipelago.[62] Private sealift firms such as Nunavut Eastern Arctic Shipping Inc. (NEAS), Desgagnés Transarctik Inc. (DTI)/Nunavut Sealift and Supply Inc.

[60] Dawson, Jackie, Natalie Carter, Nicolien Luijk, Colleen Parker, Melissa Weber, Alison Cook, Kayla Grey, and Jennifer Provencher. 'Infusing Inuit and Local Knowledge into the Low Impact Shipping Corridors: An Adaptation to Increased Shipping Activity and Climate Change in Arctic Canada'. *Environmental Science & Policy* 105 (6 January 2020): 19–36. https://doi.org/10.1016/j.envsci.2019.11.013.

[61] Arctic Institute. 'Canada Facts & Figures'. Encyclopedia. The Arctic Institute - Center for Circumpolar Security Studies. Accessed 18 October 2024. https://www.thearcticinstitute.org/country-backgrounders/canada/.

[62] Pomerleau, Jason Pomerleau. 'NEAS'. Accessed 22 November 2024. https://neas.ca/.

(NSSI)/Taqramut Transport Inc. (TTI)[63], and Northern Transportation Company Ltd. (NTCL)[64] operate the majority of sealift routes in the Canadian Arctic. Indefinite moratoriums on deep sea mining and oil and gas extraction in Canada[65] and abroad[66] suspend hydrocarbon prospects[67] for the present. However, in 2023, increased jurisdiction over offshore hydrocarbons was given to the governing bodies of Inuvialuit, Yukon, and the Northwest Territories.[68]

Presently, most traffic within the Canadian Arctic is destination traffic, vessels travelling to a location within the region, rather than transit traffic which passes through the region.[69] However, more concerning is an increase of transit traffic, especially the precedent under which they could be conducted by foreign vessels and Canada's ability to regulate such traffic. For example, in 2020, the sailing vessel *Kiwi Roa* illegally transited the NWP while it was closed during the COVID-19 pandemic, highlighting the controversy and difficulty of a future where Canada regulates the Passage more stringently.[70]

Federally, the Canadian government has undertaken a number of programs and possible development plans through the Oceans Protection Plan (OPP), an investment of

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[63] Desgagnes Transarctik Inc. 'Desgagnes Transarctic Inc.' arcticsealift.com. Accessed 22 November 2024. https://arcticsealift.com/index.

[64] Alvarez & Marshal Canada Inc. 'Northern Transportation Company Ltd.' Alvarez & Marsal | Management Consulting | Professional Services, 3 January 2017. https://www.alvarezandmarsal.com/NTCL.

[65] Crown-Indigenous Relations and Northern Affairs Canada. 'Arctic Offshore Oil and Gas'. Fact sheet, 29 August 2018. https://www.rcaanc-cirnac.gc.ca/eng/1535571547022/1538586415269#chp2.

[66] Global Affairs Canada. 'Canada's Position on Seabed Mining in Areas beyond National Jurisdiction'. Statements, 10 July 2023. https://www.canada.ca/en/global-affairs/news/2023/07/canadas-position-on-seabed-mining-in-areas-beyond-national-jurisdiction.html.

[67] K E Dewing et al., 'Hydrocarbon-Potential Map of the Canadian Arctic Archipelago and Northern Offshore Areas', 2022, https://doi.org/10.4095/329968.

[68] Crown-Indigenous Relations and Northern Affairs Canada. 'Accord between the Government of Canada, the Inuvialuit Regional Corporation, the Government of the Northwest Territories, and the Government of Yukon for the Shared Management and Regulation of Petroleum Resources in the Western Arctic - Tariuq (Offshore)'. Government of Canada, 10 August 2023. https://www.rcaanc-cirnac.gc.ca/eng/1691671328097/1691671355311.

[69] Huntington et al., 'Effects of Arctic Commercial Shipping on Environments and Communities'.

[70] Last, John. 'New Zealander Sails through Arctic on Custom Yacht in Violation of COVID-19 Restrictions'. *CBC News*, 26 August 2020. https://www.cbc.ca/news/canada/north/new-zealand-yacht-cambridge-bay-nunavut-1.5698347.

$1.5 billion CAD in marine development.[71] Programs include the Marine Training Program (MTP), which funds Indigenous and female Canadians to earn marine certifications and increase their participation in marine industries like shipping and fishing.[72] This has led to the funding of Canada's two Arctic marine training centres: Nunavut Fisheries and Marine Training Consortium (NFMTC)[73] in Iqaluit and the Western Arctic Marine Training Centre (WAMTC)[74] in Hay River.

CHAPTER II: METHODOLOGY

Section 1: Overview

This study consulted experienced individuals from across Canada's Arctic marine sector to explore how Canadian institutions perceive ongoing changes in the Arctic, predict and develop scenarios, and recommend next steps to respond to these scenarios at the government and university levels. Findings will be used to inform policy makers and researchers on industry perspectives surrounding the future of the Canadian Arctic's marine operations.

Interviews were conducted with experts who specialized in marine training, ice navigation, policy development, consulting, and sealift in Canada's Arctic. These participants will not be identifiable through their quotes and have been provided a supplementary title and ID number to supply context without revealing their specific position. The interview guide used was developed to develop scenarios in tandem between the interviewer and interviewee by using the Oxford Scenario Planning

[71] Transport Canada. 'Oceans Protection Plan'. AE 18058692. AE, 1 February 2024. https://tc.canada.ca/en/campaigns/protecting-our-coasts-oceans-protection-plan.
[72] Transport Canada, 'Marine Training Program', AE 13742452 (AE, 8 January 2024), https://tc.canada.ca/en/campaigns/protecting-our-coasts-oceans-protection-plan/stronger-partnerships-indigenous-coastal-communities/marine-training-program.
[73] Nunavut Fisheries and Marine Training Consortium. 'Nunavut Fisheries and Marine Training Consortium'. Accessed 23 November 2024. https://nfmtc.ca/.
[74] Western Arctic Marine Training Centre, 'WAMTC', WAMTC, accessed 23 November 2024, https://wamtc.ca/.

Approach (OSPA)[75]. Scenario discussions were used to understand the state of Canada's Arctic, where it's going, what is lacking, and what it will take to respond effectively to future increases in marine traffic. Scenarios are outlined and described in Section 3.

Analytical Framework: Oxford Scenario Planning Approach

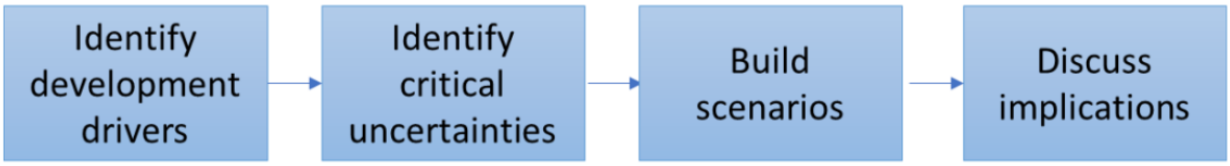

Figure 3: Scenario Process Diagram (Middleton et al., *2021)*[76]

Interviews and analysis stemmed from the OSPA as adapted by Middleton et al. (2021)[77]. The OSPA identifies development drivers and critical uncertainties to generate plausible scenarios in dynamic environments. Scenarios are designed to dissect probable shifts within a wider change.[78] In the Canadian Arctic, that shift is climate change. The study used ten interviews with a diverse range of Canadian Arctic Industry members – spanning government, policy advising, ship operators, marine trainers, and academics – to identify development drivers in the Arctic as perceived from their sectors. Drivers are then used to determine their underlying uncertainties: these are the factors that are out of the control of the industry participants or exist at a higher level of management. Two critical uncertainties are selected for pertinence in the specific context, then used to generate scenarios along a two-by-two grid. Scenarios and limitations are then discussed and reflected upon between the interviewer and interviewee. In a departure from Middleton et al., however, this project utilized the interview phase to develop plausible

[75] Ramírez, Rafael, and Angela Wilkinson. *Strategic Reframing: The Oxford Scenario Planning Approach*. Oxford University Press, 2016. https://doi.org/10.1093/acprof:oso/9780198745693.001.0001.

[76]

[77] Alexandra Middleton et al., 'Scenarios for Sustainable Development in the Arctic until 2050', *Arctic Yearbook*, 2021.

[78] Middleton et al.

scenarios and interpret them relative to the critical uncertainties. This method is more in line with Ramirez and Wilkinson's 2016 OSPA methodology[79] in this respect.

Where other scenario development studies in the Arctic will use uncertainties as axes on which to independently generate scenarios, this study discussed and developed scenarios with interviewees. This practice is aligned with the OSPA's original intent to serve as a framework for planning and development workshops, allowing participants to chart a course to their desired outcome by first understanding how it is derived.[80] Additionally, implausible scenarios from the viewpoints of industry and policy workers could be avoided.

Section 2: Data Collection

Ethics

Interviews were digitally transcribed using Microsoft Teams Transcription Software when possible. Transcripts were then de-identified prior to analysis and publication. Interviews were semi-structured, and responses are de-identified so as not to make quotes attributable to the participants. Scenario planning, especially in this model, requires trust and mutual understanding[81] between the interviewer and interviewee. In order to allow participants to speak freely and retain their voice, they were assured of their anonymity through the researcher's completion of a Research Ethics Board. The Ethics file can be found under Dalhousie University MAPERSC File No. 2024-006 (file since closed). If requested, quotes were sent to the participant for review prior to the final publication of the project. The only characteristics of the participant are what are seen in excerpts of transcripts, the participants identification number, and an identifying title related to the individual's activity in the Canadian Arctic (see Figure 4).

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[79] Rafael Ramírez and Angela Wilkinson, *Strategic Reframing: The Oxford Scenario Planning Approach* (Oxford University Press, 2016), https://doi.org/10.1093/acprof:oso/9780198745693.001.0001.
[80] Ramírez and Wilkinson.
[81] Middleton et al.

Participants

Twelve participants were selected via snowball sampling from marine education, government departments, policy advisors, sealift firms, and ice navigators. During the process of data collection, however, two participants were unable to submit responses. The original ID numbers assigned were not edited, and the two non-participants were removed from Figure 4. All participants were self-identified as having extensive experience in their respective roles and the Canadian Arctic in general. Participant names that arose during the study were subsequently contacted if they represented a role, department, or firm not yet interviewed. Due to the preliminary nature of this study, roles, departments, and firms were not repeated to allow equal weight of response for all participants.

Participants 1 (Arctic Sealift and Icebreaking Firm Spokesperson) and 3 (Arctic Sealift Firm Spokesperson) are representatives of corporate structures in the Arctic. Their firms are a part of the infrastructure that makes delivery of vital solid and liquid goods to Northern communities possible. Both are based out of Montreal, Quebec. Participants 4 (Canadian Coast Guard Officer), 5 (Canadian Government Arctic Policy Advisor), 6 (Graduate of Dalhousie University's Interdisciplinary PhD), and 12 (Arctic Marine Operations and Policy Consultant) are involved in Canada's Arctic marine policy development in some capacity. Finally, Participants 7 (Arctic Marine Training Advisor), 9 (Arctic Marine Consultant), 10 (Ice Pilot), and 11 (Arctic Vessel Pilot) are operators currently active in the Canadian Arctic with varying influence on policy development.

ID Number	Participant Title
1	Icebreaker/Ice-Navigation Firm Spokesperson
3	Arctic Sealift Firm Spokesperson
4	Canadian Coast Guard Officer
5	Canadian Government Arctic Policy Advisor
6	Dalhousie University Interdisciplinary PhD
7	Arctic Marine Training Superintendent
9	Arctic Marine Consultant
10	Ice Navigator
11	Arctic Pilot
12	Arctic Marine Operations and Policy Consultant

Figure 4: Participant ID-Title Table

Interview Guide

An interview guide was designed to allow the researcher to understand the participants' professional and personal views and predictions on development in the Canadian Arctic. Interviews were not inherently linked to the member's current employment, but rather attempted to tap into opinions and perspectives as individuals tenured in the Canadian Arctic's marine activities. Six questions were drafted for the participants (see Appendix B), and interviews were semi-structured.

Question 1 requests the current employment and relevant experience of the participant. While this provided context for the remainder of the interview and some preliminary questions, it was not quoted for use in this paper to avoid identifiable statements, but did provide identifying information for participant titles and interpretation of results.

Question 2 requests that the participants predict what the Arctic will look like once we reach a reliable ice-free shipping season along our current trajectory. Question 3 initiated scenario development and asked about development plans and scenarios at the institutional level to the best of the participant's knowledge. This question was asked in the context of their profession or department. Questions 2 and 3 are used to understand development drivers in the region by identifying policy areas targeted by experts to effect change. Policy areas that were not addressed, or could not be addressed by the expert, were labeled critical uncertainties. These inputs, used for in the OSPA analysis later, were clarified with the participants in follow-up questions.

Questions 4 and 5 revolve around Indigenous inclusion and engagement by the participants' industries and departments, both as it stands and how it may change in the future. Question 4 focuses specifically on the current reality of Inuit inclusion and participation in the participant's department and experience and includes follow-ups on current best-practices. Question 5, like Question 3, projects the future scenario of Inuit inclusion and engagement and allowed the participant to speak to the value held in (increased) participation from Indigenous populations, especially as it pertains to the unique setting of the Canadian Arctic. These questions were included to specifically understand how industry interacts with Canadian Inuit, and how they predict that

evolving as Canadian Arctic marine industries develop. These responses were not used as a proxy for Indigenous data.

The OSPA framework is concluded in Question 6, which seeks to understand the limitations and implications of the scenarios predicted above. The participants are given follow-up questions about pertinent topics and recurring themes. Participants are then asked to sum their ideas if possible and relay their closing thoughts. These scenarios were later expounded upon by the researcher using the OSPA.

Interviews

Responses were collected between September and November of 2024, with ten conducted in total. Interviews were conducted and transcribed using Microsoft Teams, and were scheduled to last 60 minutes. Following a recorded verbal affirmation of consent by the interviewee and an introductory brief by the interviewer, interviews followed according to the interview guide. Participants consisted of policymakers, ice pilots, Arctic shipping firms, and Arctic marine education. These groups were selected due to their role in preparing Canada for future possibilities in the Arctic: training mariners, developing policy, providing for communities, and generating best practices. In the future, a wider collection of operational sectors and government departments should be drawn upon to enhance findings, including those who may not yet have a role in the region, like hydrocarbon and deep sea mining firms.

Section 3: Briefing Note

A briefing note is available in Appendix A of this report outlining the findings and recommendations. The briefing note will be distributed to all participants as well as relevant government departments following the paper's online publication after February 2025. The briefing note follows the standard Government of Canada structure. In point form, background and recommendations are included to summarize findings and next steps for readers.

CHAPTER III: RESULTS

Section 1: Data

In total, ten interviews were conducted. Despite communicating that interviews would last one hour, two participants exceeded this time by twenty minutes, and another by two hours. Two participants – 3 and 11 – were only able to send in written responses to the interview guide (Appendix B). This was a result of their operational schedules not lining up with the researcher's needs. Participant 3 was experiencing their peak operational season, making a live interview impossible due to scheduling difficulties. Participant 11 was working on ship, and due to connectivity issues, preferred to send written responses. The researcher did not follow up on the responses provided from either participant.

For the remaining eight participants, the interviews were transcribed digitally, and analysis was conducted using the transcript. Video recordings were used to verify the transcript prior to quoting where possible.

Three participants had issues with their video call recordings. Participant 9's recording was mostly lost, only leaving the last seventeen minutes of the interview. The full transcript, however, remained intact. Participant 5's video call failed to be recorded, but the audio recording from the researcher's personal laptop was transcribed through Otter.AI and fully verified using the audio. Participant 4's recording and transcript were unable to be downloaded from MS Teams, and was therefore unavailable for analysis. Participant 4, however, provided responses to the interview guide in text format following their interview.

Below, development drivers, critical uncertainties, scenarios and their implications are described. Sections are worked through along the OSPA framework, and quotes from interviews wherever possible. Quotes from transcripts as opposed to written statements are not discriminated in their citation, and all quotes are referenced using the participant's ID number (see Figure 4).

Section 2: Development Drivers

According to the experts consulted, six key drivers steer development in Canada's Arctic. Economic incentives, infrastructure and technology, climate change, political will, regulatory environment, and the Northern population. Drivers are broad themes identified throughout the interview process that are noted to have development implications for broader change. In this study, drivers are used to provide targets and mechanisms for future Canadian policy in the Arctic in response to increasing traffic.

Economic Incentives

The environment of the Canadian Arctic makes development difficult. The combination of harsh weather conditions, periods of prolonged darkness, and engineering around thawing permafrost on land and sea ice in the water inherently increases cost and risk.[82] Therefore, economic incentives must be high for an actor to begin or alter their behavior in the Arctic. Additionally, cost of entry is higher than other regions. This is proven by the lack of economic competition and market diversity in Canadian Arctic marine industries. Should barriers to entry decrease in the future, Canada will need to decide whether or not an open market is beneficial to the region.

High input prices on fuel, emissions, vessels, and labour are often transferred onto the Arctic consumer, as are regulatory costs. Due to the price inelasticity of demand for essential goods like food and gasoline, rising prices can increase with little effect on quantity consumed.

> "[I]t's very costly to do business [in the Arctic] …and there's a lot of red tape"
>
> -Participant 1

However, despite high costs, one expert was certain that development would continue in the North due to its history and potential for economic growth outside of essential services.

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[82] Smith, *The New North*.

> "The whole goal of folks trying to find a Northwest Passage was only one thing. It was all about the money, and that's still the case today. They can say it was about the sense of adventure. They could say it's about the sense of discovery. In the end, whether they were looking to get spice that they could trade for something in the 15th century, to whether they're going to be able to get coal through an across or iron ore through comes down to economics."
>
> -Participant 5

Experts did not hesitate to outline that economic exploitation of the Northwest Passage would not occur until reliability and revenue along sea routes increased for firms. Therefore, participants were hesitant to say that through-traffic on the Northwest Passage would materialize in the near future:

> "From a business perspective…there's no real benefit given that industry, you know, it's not like a ship just goes from port A to port B and then back to A and back to B. You know? There's a series of ports that they hit along the way to make that voyage worthwhile. There aren't [in the Arctic]. Even if there were ports at every community across the Northwest territories and Nunavut, there's no industry up there that would make that [worthwhile]…like there's nothing to deliver, there's nothing to pick up outside of minerals."
>
> -Participant 6

The high barriers to entry and operating costs lends itself well to vertically integrated firms. Sealift companies are increasingly reliant on their own capability to deliver goods, monitor ice patterns, and break ice. An additional consequence is the creation of limited-competition markets, which was a concern for some participants.

> "It's not like being down South…where you've you know you can, you're in the Port of Montreal, you're in the port of Halifax or Saint Johns and you got a whole variety of competition [that] works up and down the eastern seaboard: that's just not the case."
>
> -Participant 7

> "[On] the dry side [of sealift] you have NEAS and Desgagnés. And then on the wet side, on the liquid side, you have Woodwards and the Desgagnés tanker side, which is PetroNav. So, you know, duopolies in both domains."
>
> -Participant 10

A lack of competition could pose a long-term risk for the economic health and growth of the Artic, according to this expert. However, one participant spoke excitedly about the low density of Arctic operators in Canada. This allows new firms to join the

market more easily, and to do so with an incentive to collaborate with northern communities.

> "If you look at somewhere like the port of Vancouver…you have to undo a lot before you can try to rebuild a new relationship. In the Arctic, there hasn't really been an industry; the industry serves the community….For the most [part] there's a very different relationship [in the Arctic]. And so what was very exciting was the idea that we could build it the right way the first time."
>
> -Participant 6

This willingness to collaborate with communities was strong even in large firms as well, underscoring the culture of Arctic industry. This is elaborated on in the following sub-section.

The Northern Population

Industry collaboration with Northern Canadians, and more specifically with Indigenous Northern Canadians, was a common theme in every interview. Participants regularly spoke highly about the positive engagement networks that many firms, departments, and industries have with Northern communities in the Canadian Arctic, seen as a necessary condition for conducting business in the Arctic. Currently, the state of engagement in the North is strong, and will have to remain that way as Arctic industries expand and traffic increases.

The cruise industry, which relies on tourism and community visits, is known for its compliance with all community requests.

> "…[C]ruise ships and community resupply depend so heavily on the communities or their business they will abide by just about any non-mandatory requirement you put out there because they have a very positive relationship, and they want to maintain it because their business depends on it."
>
> -Participant 6

Navigational safety, regulatory and policy work, however, did not receive praise from the same Participant:

> "There was an unsettling number of accounts of [Northern Canadians] reporting things and never hearing back, reporting an oil spill, reporting a suspicious vessel, reporting something and never hearing back from anybody. Not ever having a

> human that they could report it to. They just, you know, like, leave a voicemail and that was it."
>
> -Participant 6

Though proposals for an immediate increase in direct communication between Northerners and government is not without its critics. Marine operations, like any technical sphere, are difficult to understand for those who do not operate in it. One participant with experience in Arctic sailing and policy development said the following on the subject:

> "It's a delicate diplomatic role, you know, to be there and have someone from a community come up with a, you know, a second-hand story about a ship that they said did something and it, well, it didn't do [it]; or it did something…but for different reasons. Communities in in the north love that they've got a voice and love that they have the power – and they should have the power – but their power may be inappropriately wielded based on a lack of understanding."
>
> -Participant 12

What is highlighted above is an education problem. For generations in Canada, the bast majority of Indigenous peoples have remained outside of the marine industry. Despite a history of working and living off the waters of the Canadian Arctic, shipping and other industries represent an entirely new field of understanding. However, the Marine Training Program through the OPP have begun to fund increased Indigenous participation in marine sector training.

> "So the objective of all this really is to, yes, bring young people, new people, into the marine industry: create a northern workforce where little exists. Supply expertise, training: recurring…not only initial training but again, like I say, recurring training. Watch keeping mate…supervisor oil transfer operations, small vessel proficiency, all over the place, and all marine. And the idea, really, here, is to have a more people: more people making a living in the North as professionals and more people supplying…Arctic operations in general."
>
> -Participant 7

The two schools currently operated in the Arctic – the Nunavut Fisheries and Marine Training Consortium (NFMTC) and the Western Arctic Marine Training Centre (WAMTC) – aim to provide financially and geographically accessible training for Indigenous Northern Canadians.

> "We look to provide this training to places where people…really aren't in a position to go to Vancouver or Halifax, but we can go to them. And then going to them, we make it easier for them and we help."
>
> -Participant 7

> "[If] you're able to do a watch keeping mate certificate. In the north or in your hometown in the north, which even better then that certainly gives you a good basis for furthering your studies."
>
> -Participant 9

The influence of these accessible programs targeted at developing Indigenous opportunities in growing Arctic marine sectors is felt by firms. Indigenous marine training and hiring, as well as benefit sharing and co-management, is quickly becoming a priority for ice navigators…

> "As we enter partnerships with peoples of the North – i.e., Inuit, Innu or Indigenous – I believe it's paramount that we have shared agreements in place for the resources we seek... Arctic development plans must have three things in mind in order to succeed. 1. A buy-in from the local Innu or Innuit… 2. Employment for northern people… 3. A balance between industry objectives and traditional hunting and fishing practices of the local people…There will always be limitations on implementation of development involving local habitat and industry expectations…However, if we are to seek more development and exploitation in the Canadian North, then further dialogue is crucial between the Canadian Government, Local Territories, local Innu governments and industry."
>
> -Participant 11

…sealift firms…

> …[W]e're operating in [Inuit] territory, like, they should be a part of it…We're in their water, so why not have them on board as well? I just think it's a cool opportunity to share it: share the experience. And also…there's a shortage of seafarers…so why not tap into this market and offer this training? And I think it's just also opening doors for them: more opportunities where they don't have to come down South for a job, you know, like, they can still operate [in the Arctic] and work in their backyard…"
>
> -Participant 1

…and the Canadian Coast Guard.

> "One of CCG Arctic Region's priorities is to provide *services In the North, for the North, and by the North.* This means that we are committed to hiring a

> [N]orthern-based workforce, increasing opportunities for [N]ortherners…Through the [Marine] Training Program, we are looking to increase northern representation in fleet and reduce barriers for [N]orthern applicants."
>
> -Participant 4

Accessing Indigenous and Northern Canadians through education, employment, and exposure was a commonly referenced idea. While an untapped segment of the Canadian workforce is naturally an appealing prospect for firms, Indigenous collaboration and co-management was never referenced without a discussion of partnership. Not only was true and meaningful partnership between Indigenous and non-Indigenous Canadians desired by experts in the Arctic, but it was a necessary condition for project success.

> "We were there to co-develop, co-implement, and then co-manage various projects and make sure that where our Inuit partners wanted to take the lead, they took the lead, and the government of Canada supported, and where Inuit partners didn't want any involvement in a specific initiative, we didn't push it. We respected what our new partners wanted."
>
> -Participant 5

> "On some projects, the people working on them within the federal government were great partners. They called [the Inuit], they talked to them, they emailed them. They were inclusive…They made them feel like partners. Others, what do you know, they'd send a very formal request to engage, they would have their engagement, and then they would disappear into the depths of the department for years and never say anything back. It's that human element…[I]n terms of moving into the international realm, I think Canada absolutely has a role as a leader. No questions asked."
>
> -Participant 6

Indigenous and Northern Canadians undoubtedly have a vital role to play in the future of the Canadian Arctic, as Canada has a vital role in the future of the wider Arctic. As operators, advisors, and leaders. Engaging Northerners would allow Canada to gain a better understanding of its Arctic territory and develop best practices for future endeavours in the region. Experts understand that there is still work to be done.

> "I think there's a lot of roles that could be fulfilled by local community members that would actually support the federal mandate role in [Arctic] shipping governance. For example, when it comes to monitoring, you have people on the

> ground. You've actually already paid for them to have a boat for monitoring; it just sits there. Why not have them go out and look themselves? ...I do not think Someone in Ottawa…or even really Winnipeg, can fully understand all the potential impacts of shipping…every risk analysis has an inherent or subconscious weighting exercise put into it, and I think it's in that weighting exercise that indigenous partners are not currently being engaged."
>
> -Participant 6

In one instance, Transport Canada was specifically referenced for its recent ban of more-affordable HFO in the Canadian Arctic. Now required to use other, more expensive fuels on Arctic voyages, including sealift, the prices of goods, including food, were predicted by one expert to increase.

> "None of the people who made those [fuel pricing] decisions, have a, you know, have a food supply downstream that they depend on for the for, for subsistence, for their family. That's this skin in the game part…they have a lowest bidder system."
>
> -Participant 10

Industry, possibly even more rapidly than government, is coming to understand the necessity of engagement with Northern Canadians while developing Canadian Arctic marine ventures. Continued investment in engagement programs and opportunities will be necessary to facilitate sustainable relationships and operations in the Canadian Arctic. However, there are areas requiring improvement, notably communication and representation at the decision-making level. Continuing to cultivate relationships with Northerners by government and operators in the North will allow Canada to ensure best practices are being developed and implemented *before* climate change and marine traffic lead to serious incidents in the region.

Infrastructure and Technology

A marine venture is inherently capital-heavy. Vessels are relied upon to provide services and conduct specialized tasks. Specialized emergency and navigational equipment and infrastructure is required to ensure safety on the water. Ports, berths, and the subsequent machinery allow integration between ashore and afloat industries. In the Arctic, equipment must be further specialized to handle harsh environmental conditions, most notably a need for ice-strengthened hulls and icebreaker services.

> "Like just having to invest in infrastructure in the North to be able to train people to be, to be able to work there… It's a lot of work…but the fact that everything just costs more because you're so far north, and because you have to adapt everything to be able to withstand, like +20 to -60 [degrees Celsius]. So, like a lot of equipment isn't made for it."
>
> -Participant 1

Infrastructure and technology was targeted as a development driver in two respects. First, an increased Canadian presence in the North through new and existing and future would allow for increased and more rapid future development on top of it. Second, a strong foundation of structures, systems, and capabilities in the Canadian Arctic will signal to other actors that moving into the market is feasible and lucrative.

> "What will it take? We need infrastructure and, you know, if you build it, they will come. You have to reach a certain critical mass of infrastructure…if the federal government of the population sees a need for maintaining sovereignty and positioning strategic infrastructure without an economic case, then the private sector is not going to do that. The government of the Northwest [Territories]? Not on their own volition. The Government of Canada is going to have to put money aside to hire the private sector to build the strategic infrastructure that we need…"
>
> -Participant 7

The cost of these projects was unclear in the Arctic's future, given the still-unpredictable market and environmental conditions. The second uncertainty was the political will to spend the time and money to engage in new activities in the Arctic. Two participants did have updates on projects that signal change driven by Canada on the federal side…

> "In the long run, [icebreaker construction and operation] will create many jobs in the marine sector including with the CCG. With their enhanced capabilities, these larger, more powerful Polar icebreakers will enable the Coast Guard to conduct year-round operations in Canada's Arctic. Their greater endurance will ensure they can operate at higher latitudes for longer periods, and will allow the fleet to better support Inuit, First Nations, Métis and northerners, strengthen Arctic sovereignty, advance high Arctic science, and better respond to maritime emergencies."
>
> -Participant 4

…and in the form of private innovation.

> "We have…[proprietary] technology onboard our ships and it allows like the crew to be able to like pinpoint say different icebergs on the radar screen and then you're able to track them and follow them to make sure…you avoid them."
>
> -Participant 1

Maintaining a state of constant adaptation is necessary to operate in an environment as volatile as the Arctic. This understanding was coupled by some experts with a fear of the pace of population and settlement growth in the Arctic.

> "The northern population is young and developing rapidly… The demographics are growing and it's the largest young population in Canada. If we don't change something there will be very important issues, adding infrastructure and communication are major medical and educational needs and supply service a fundamental element."
>
> – Participant 3

While this refers largely to shore-based infrastructure, if programs like the Marine Training Program are successful in the long-run, infrastructure may require augmentation to accommodate the increasing number of skilled mariners in the Arctic. The form that these adaptations may take did not come up in the data.

Climate Change

Climate change was an underlying theme in all interviews. In the long run, the navigable season in the Northwest Passage will lengthen, allowing for increased traffic and an expanded breadth of operations that can occur in the Canadian Arctic.

> "We have a confidence that we expect the activity to increase due to climatic change. We've seen it. I've seen a person myself in the past 15 years, the lengthening of the navigation season. We have seen in the past five or six years, the increase in just pure commercial transits…"
>
> -Participant 5

However, it was rarely spoken of in a negative context. The tone of climate change was neutral: it's happening. Operators were already focusing on how to respond to its effects in the Arctic.

> "The Arctic is warming nearly four times faster than the rest of the world. Due to climate change and melting sea-ice, the Arctic and the Northwest Passage is

> becoming more accessible. We are seeing an increase in vessel traffic in the Arctic which increases the risk of marine incidents… This increased traffic impacts Inuit, First Nations, and Métis communities in the North who rely on the land, sea, and ice for subsistence or for their livelihood. CCG is committed to helping protect the marine environment and to support our Northern communities."
>
> -Participant 4

A common theme amongst interviewees was that the warmer future may be beneficial for sailing through Arctic waters. Less ice and longer ice-free periods entail more time to move goods to, from, and through the Arctic Archipelago's waterways. When this will occur, however, is an uncertainty, and are spoken about in detail below. Global warming may also force Arctic industries to rely on marine supply chains and services an increasing amount in the future due to thawing permafrost.[83] Inhibiting the reliability of land-based construction, rail- and road-based supply chains and services are likely to be interrupted by 2050. As the waterways of the Canadian Archipelago become more accessible, however, communities may be reached by water more reliably and safely than other methods of delivery.[84]

Political Will

Unanimously, participants voiced that without political support for Arctic programs, infrastructure, and operations, they would not happen. Costs are too great, the Northern population too small, and the consequences of neglecting the Arctic too far in the future to be politically significant.

> "I think Canada has to start looking at the political capital and courage, to start making the investments to put in place and build from what is a very strong and effective regime, some type of structural organization…First, there has to be the interest from a from a government point of view and from a political point of view that, yeah, this is something we want to focus…it has to be a priority."
>
> -Participant 5

[83] Smith.
[84] Smith.

A lack of awareness of the Arctic by Southern Canadians was commonly cited. Unfortunately, unless the Canadians who make up the nation's cultural, economic, and legislative hubs are aware of the opportunities in the Arctic – or the risks of an unmanaged Arctic – development will not occur.

> "The Arctic is really, for the vast majority Canadians, not a priority. It's going to take somebody with a vision to sit down and say, 'You know what? This isn't a priority today, but this is something we have to start preparing for in the future.'"
>
> -Participant 5

> "In the major cities, they don't even know we exist up here for the most part… So what needs to happen? There needs to be a whole recognition and interest by the common Canadian person, championed by the federal government and others, to recognise, and not just recognise and give lip service to the idea of Canada as an Arctic nation, but truly, truly be that Arctic nation; through investment in Arctic infrastructure, an Arctic fleet, Coast Guard, navaids, charting, everything…"
>
> -Participant 7

One expert cited Canada's history in the Arctic during the Cold War, when military threats to North America fueled rapid development in the Arctic. They saw this historical example as proof that Canada could once again become an "Arctic nation."

> "…[A]t one point we were a lot more involved in the Arctic, we were an Arctic power technologically and militarily. We were much more robust, and I think that with strong leadership federally and a national narrative: a national narrative that supports that and recognises those potential threats, and also the potential [of the Arctic]. Rather than just focusing on the threats; just the great opportunities.
>
> -Participant 7

Regulatory Environment

Necessary for sustainable and responsible development in the Canadian Arctic is the presence of a robust regulatory environment. Seven federal departments operate in the Canadian Arctic directly: Transport Canada, Fisheries and Oceans Canada, Environment and Climate Change Canada, Global Affairs Canada, Crown-Indigenous and Northern Affairs Canada, Canadian Northern Economic Development Agency, and Indigenous Services Canada. These departments, along with territorial governments and other departments that may be involved in specific projects in the Canadian Arctic, administer the services that render the Canadian Arctic prepared for modern operations like cruise

lines and sealift. The administrative burden that this plurality of governance puts on operators in the Arctic is commented on here:

> "As an example, you're a cruise ship operator, you might have to get 50 to 60 different permits from four or five, six different organizations…How do you advance [development]? So, like anything, before you go outside of your house to start promoting your house and need to get your house in order."
>
> -Participant 5

In addition to the administrative strain put on Arctic operations, some experts fear that the governance of the Canadian Arctic has lost its perspective. This loss of bureaucratic culture was discussed determinedly by one participant.

> "I think culture [in] bureaucracy right now is [the issue]. It's the huge piece, sadly. And then [repairing it is] gonna be hard to do, but I know it is doable because…we had a culture before. And it's just a matter of getting the right people in and, you know, getting a focus back…We need to close that gap [between bureaucrats and operators] one way or the other. Transport Canada has to get their head out of their butt and accept that looking at a regulation on a purely regulatory black and white framework is it's not good enough…It's causing other risks to come up because we're getting people focused on responding to, quite frankly, stupid requests"
>
> -Participant 12

The "right people" discussed above refers to personnel with relevant operational experience. The participant goes on to discuss the difficulty of dealing with departments like the Canadian Ice Service (CIS) who have never sailed in or seen sea ice. Handing too much governing power to personnel who lack and understanding of the practical dimension was a serious point of concern; often feeling robbed of agency and the ability to make quick and safe decisions on the water in the face of government overextension.

Section 3: Critical Uncertainties

Uncertainties were distilled from interview results at points where experts' opinions diverged or concrete statements were avoided, and are used to extrapolate how drivers will interact with the system in question, the Canadian Arctic's marine industries. Two broad critical uncertainties surrounding Canada's Arctic development were identified from interviews: Pace of Growth and Government Intervention. Uncertainties

were identified to be associated with the above drivers in the following alignment. Pace of growth: Economic Incentives, and Climate Change. Government Intervention: The Northern Population, Infrastructure and Technology, Political Will, and the Regulatory Environment. Uncertainty is a critical part of scenario analysis, as predictions require making assumptions without complete information about the future. The two critical uncertainties utilized for this analysis, in line with the OSPA, form the axes used to understand how scenarios relate to one another in Section 4.

Pace of Growth

Pace of Growth refers to the rate and fashion in which traffic and extractive activities will increase in the Canadian Arctic. This can refer to changes in types of marine traffic, increases in Arctic marine traffic volume, expansion of activities like mining and surveying, and new industries and firms moving into the Canadian Arctic. The limitation of how an when Canada's Arctic marine industrial environment will expand is uncertain due to two interrelated factors: sea ice and market access. Even in the absence of a market for production, extraction, or exchange in the Canadian Arctic, a reduction in sea ice and the ensuing transit increase was predicted to bolster the required administrative, navigational, and safety services regardless. When this critical point in the length of the shipping season will occur, however, is unclear.

> "Can we predict when it's going to be fully open? No. Do we have an indication when it may be? Yes, but it's only fools and arrogant people who can come in and predict the future precisely."
>
> -Participant 5

Reduced sea ice, especially multi-year ice, has been linked to having a direct influence on the volume of traffic seen in the Arctic due to the threat that it poses to vessels.[85] Therefore, it is justified that experts also predicted a negative correlation between ice and vessel traffic. Until Canada sees seasons where there is no ice in the

[85] Pizzolato, Larissa, Stephen E. L. Howell, Jackie Dawson, Frédéric Laliberté, and Luke Copland. 'The Influence of Declining Sea Ice on Shipping Activity in the Canadian Arctic'. *Geophysical Research Letters* 43, no. 23 (2016): 12,146-12,154. https://doi.org/10.1002/2016GL071489.

Canadian Archipelago, there exists a risk of ice-related incidents. Participants saw it to be likely that vessel traffic would increase faster than ice recedes, presenting the risk of high-volume, high-risk traffic through the Northwest Passage.

> "I think the traffic is… going to increase substantially, but I also think that…pleasure crafts will increase as well substantially. So, then, the resources for like say, Canadian Coast Guard search and rescue, will be fully utilised for search and rescue, for probably smaller vessels. And yes, this season is longer, but it also means there's a lot more old ice and icebergs…that are trickling down…"
>
> -Participant 1

The understanding of climate change's warming effects on sea ice is, on the large scale, that it will increase waterway accessibility in the Canadian Archipelago.[86] Until then, the narrow waterways of the Canadian Archipelago makes future ice patterns and behaviour unpredictable. The ice navigators who were interviewed especially believed that this unpredictability will increase in the near future.

> "The July date, the break up date isn't changing As rapidly, it's not coming as much earlier. the freeze update is much later than it ever was…. Next year, it's gonna be totally different. You know, we are losing ice [overall], but we're also gaining ice at the same time this year."
>
> -Participant 12
>
> "I would say that yes, interseason variability has really increased and that makes planning advanced planning more challenging. But it is not true that the window is narrowed. Yes, we have seen multiyear ice in places that we didn't used to see it, but, you know…it's not a consistent pattern. So…the overall window is…wider. The edges are more variable."
>
> -Participant 10

Experts observed a pattern of longer ice-free seasons annually, but the variability between shipping seasons has implications on planning. Without proper planning, revenue is difficult to guarantee. And without guaranteed revenue, firms are less likely to expand into the Canadian Arctic. Due to how cruises, tourism, and pleasure craft cater to

[86] Pizzolato et al.

advertising Arctic experiences, some experts predicted that they would be the first to respond to decreased ice risk.

> "I think you will see increasing cruise and marine tourism, especially the private yachts…with reducing risk of navigation because of reducing sea ice..."
>
> -Participant 6

But this behaviour may pose risks of its own.

> "So, there's less ice, which makes people maybe less prudent, and which and I think they should [be]. So…I feel like there might be more instances where there are occurrences [of] potentially hitting old ice or icebergs, and more traffic with small vessels getting in the way"
>
> -Participant 1

Experts were not able to give clear answers about how ice patterns would shift and how various industries – cruise, shipping, and others – would respond. Sequences of events were offered, but these varied depending on the expert's industry.

Government Intervention

The second uncertainty is government intervention. Frustration with the Canadian government's capacity and willingness to intervene in the Arctic was multiplied by concerns of foreign influence in the Canada's Arctic territory; notably from Russia, China, and the United States. Uncertainty about enforcement stemmed both from *what agenda* Canada would be pushing in the Arctic and *how* it intends to do so, if at all. The need for a strong regulatory system was best described here:

> "Having regulatory frameworks in place as to types of vessels calling at northern ports is crucial by the Canadian Coast Guard and TC. Without these frameworks in place, a typical wild west scenario can quickly develop."
>
> -Participant 11

This "wild west scenario" however, would be an extreme case, and was not agreed upon by others. For the most part, Canada's existing Arctic legislation in the region is strong. Experts even referenced it as standing out from international cases of similar policies.

> "The Arctic Waters Pollution Prevention Act is probably one of the strictest and one of the strongest regimes [in the Arctic], it is truly a no-go regime, where if you don't meet what we have for requirements, we won't allow you to go in, or if you're in there and something happens where you're not in compliance, we can direct you wherever."
>
> -Participant 5

Uncertainty surrounding *if* and *how* the Canadian government would invest in infrastructure and improved regulatory structures in the Arctic was present in six interviews at different levels of operations: pleasure craft, shipping, and foreign influence. Shipping policy and infrastructure was discussed with the greatest certainty due to Canada's robust enforcement structure for the Polar Code, NORDREG monitoring, and legislation like the Arctic Shipping Safety and Pollution Prevention Regulations (ASSPPR).

> "Canada is doing a vastly better job of Polar Code enforcement than…Than the Danes and the Americans… I think that there's a, there's a legacy of that sort of oversight in the Canadian Arctic that didn't exist elsewhere."
>
> -Participant 10

This was echoed less-favourably by members of the sealift industry.

> "…It's very costly to do business [in the Arctic]…and there's a lot of red tape."
>
> -Participant 1

Smaller vessels, however, are infrequently bound to marine regulations to the extent of larger industrial ships. While the cruise industry is, as stated above, inclined to cooperate with Northern communities, pleasure craft and small fishing vessels present a different problem.

> "These it's harder to notify these small vessels or pleasure crafts on different like rules and regulations in the Arctic. So how do they abide by these? So I think the government is gonna get a lot of complaint from communities of these vessels going into, like, no go areas, no go zones, like how do they abide by that? And then if we're not calling it, if some people don't believe it's Canadian waters, then who are they to listen to us? Do they have to abide by these rules and regulations if they consider international waters, how can we regulate it if it's technically not considered ours?"
>
> -Participant 1

> "Now we have some gaps on the regime when it comes to smaller pleasure craft and smaller vessels. Yes, and that's something that we have to start addressing longer term."
>
> -Participant 5

The broader issue of Canadian sovereignty over the Arctic is called into question by the doubt introduced by smaller vessels. Is Canada able to regulate them, or will they continue to slip through the cracks as they do at present?[87] The continued incursion of unregulated classes of vessels was even hinted to have international implications by discrediting Canadian authority in the Arctic.

> "[S]hortcomings of the Canadian Government are perceived by foreign nations about our seriousness to protect and defend the Canadian arctic waters and territories year-round."
>
> -Participant 11

The same participant believed that a response through national defence may be required. This sentiment was shared by those also in operational roles such as training and pilotage.

> "Canada's arctic will play a pivotal role with shipping and exploitation demand for precious resources that the Canadian arctic holds. Other nations are well aware of this and are exerting pressure on the Canadian Government with increased presence of foreign vessels and assets that is applying challenges to our existing territorial jurisdiction and maintaining a measure of defense to protect Canadian Sovereignty."
>
> -Participant 11

Section 4: Scenario Building

Experts were asked in their interviews to make predictions about the Canadian Arctic's waterways and marine industry in 25-50 years both barring and including intervention from their sector. The scenarios described would later be placed along the axes of the critical uncertainties. Participants all agreed on four facts. Global warming will lead to a lengthened ice-free season. A longer ice-free season will generate more

[87] Last, 'New Zealander Sails through Arctic on Custom Yacht in Violation of COVID-19 Restrictions'.

traffic and opportunities for activity in the North. An increase in traffic will increase risks to the environment, Northern peoples, and Canadian Sovereignty. And there is a high potential for development in the Arctic through extraction, shipping, training, and development. Using these facts as they were weighted in participants' statements, and transcript analysis following explicit discussion of predictions and possible interventions, two scenarios were developed.

Scenario 1 outlines a future in which Canada builds on its current relationships and institutions in the Arctic, coupled with a small amount of investment, to create a prosperous and safe Arctic conducive to a productive marine industrial environment. Scenario 2 highlights the declining relative investment and attention the Canadian Arctic is currently receiving; a trend of the last four decades. While experts readily discussed futures along the uncertainty of government intervention, especially how the federal government would choose to invest and interact in the Canadian Arctic in the future, they did not vary along the uncertainty of pace of development. Discussion surrounding what kind of business the Canadian Arctic would receive and when, the narrative was consistently that small vessel traffic – tourism, cruise, pleasure craft, and fishing - would increase soon, and shipping traffic was dependent on ice patterns and route reliability and require more time.

In the extremes, two scenarios become evident through the inputs above; varying intensities of these predictions are present throughout the data. First is the possibility for a prosperous Canadian Arctic with increased attention and inputs from government and industry. This represents a high pace of growth and increased government intervention. Second is the possibility of the region falling into decline, with some suggestion of it generating a security crisis. This assumed that development would occur regardless of Canadian participation: either outpacing lacking Canadian investment and interest or being foreign driven from the beginning.

Scenario	Characteristics
Scenario 1	- Reactive response to changes in the region - Growth of existing institutions (education, emergency response, monitoring) - Indigenous participation as partners and through land claim agreements - Leaning on existing legal structure (Polar Code, ASSPPR) - International regime based in democratic leadership - Economic or political incentive to utilize NWP - Investment in infrastructure and fleets
Scenario 2	- Steady decline of awareness and spending on the Canadian Arctic - Bureaucratic overcrowding - Overregulation or use of the region for partisan competition - Reactive policy past critical traffic volume - No investment in infrastructure or fleets - Waning private investment interest, or lack of competition - Unsafe navigational conditions (possibly due to institutional shortfalls)

Figure 5: Consolidated table of scenario characteristics

Scenario 1

> "I think Canada has the ability in the future, if things are planned, if things are supported, and if investments are made to provide to the world an international strait of maritime commerce based on Canadian democratic values, reflective of agreements between Canada and its Inuit partners; reflective of a strong democratic country and society where the rule of Law is respected and provide to the world an alternative strait of maritime commerce that is not impacted by geopolitical issues or not impacted by regional tension, I think…given the climactic changes and…the ability to offer a more consistent navigation route…and the potential to have Canada provide that continuity for supply chain in a more consistent, stronger, democratically controlled processes; and in a way that shows Canada's leadership as an international maritime player."
>
> -Participant 5

Scenario 1 was supported by participants 1, 3, 4, 5, 7, and 9. The positive outlook was based in a trust in Canada's current efforts in the Arctic surrounding marine training, community engagement, regulation, and the opportunities for future growth they present. Scenario 1 participants were still aware of Canada's need to invest in the Arctic but felt that the current pace of reactive policy generation would not lead to a crisis scenario.

However, long-term planned investment could lead to a sustainable and prosperous Canadian Arctic akin to the development programs of the late 20th century but driven by 21st century Canadian values.

The strength of Canada's future in the Arctic, as per Scenario 1, lies in its engagement of current and future Inuit and Northern Canadians. According to participant responses Canadian government and private entities seek to work and partner respectfully with Northerners.

> "We have to involve them because they are the future of the communities, we involve them at all levels so, commercial, Trade show, meetings etc. .... Our company has financial partners in Nunavut and Nunavik, and every season we give dividends back to the Inuit associations, which in turn invest in the communities. We decide together on the different needs."
>
> -Participant 3

This includes the increasing presence of Inuit traditional knowledge in Arctic marine training and navigational practices.

> "In many situations, we incorporate Indigenous Traditional Knowledge and Inuit Qaujimajatuqangit (khow-yee-mah-yah-too-kha-neet) or IQ into our programs and services."
>
> -Participant 4

A continuous uptake in inclusion and respect for Inuit in Canada's Arctic marine sectors will result in more resilient and productive institutions and projects in the region. Participants were optimistic that these relationships between Inuit and their partners would strengthen over time. Capability gaps persist today, however, due to staffing, funding, and planning issues, that lead to shortfalls in Inuit engagement like those discussed above.

> "Over the last year, I've seen a lot of improvements, but there's a lot more room for improvement."
>
> -Participant 1

Scenario 1 forecasts that the upward trend in Northwest Passage transits could provide Canada with the momentum necessary to enact beneficial and sustainable initiatives in the Arctic.

> "With use of the Northwest Passage already trending upwards, Canada is in a unique position; one where the foresight and time is available to generate effective and beneficial institutions and infrastructure to support Northerners, industry, and existing institutions."
>
> -Participant 5

Proposed ideas for beneficial projects focused reducing the bureaucracy overseeing the Arctic. A reduction in organizations responsible for Arctic operations would not only reduce costs for government and industry, but the process of working in the Arctic would gain efficiency and likely safety through enhanced oversight with minimal redundancies.

> "I always had this vision of something that I always call the Arctic shipping authority, which would be a governance body set in place to bring all that co-management of shipping activities that occur in Canadian Arctic into one organization…, if you're going to operate your vessel, and Canadian arctic, you go to that authority"
>
> -Participant 5

Other projects that constrain transit passages without greatly constraining the benefits would likely make Arctic operations easier to justify for government and be a good model for future endeavours. This unitarian approach of developing a single Canadian Arctic supervisory regime was not without critiques fearing that this could increase the governance burden on the Canadian Arctic, but this would require further research to form conclusions beyond expert opinions.

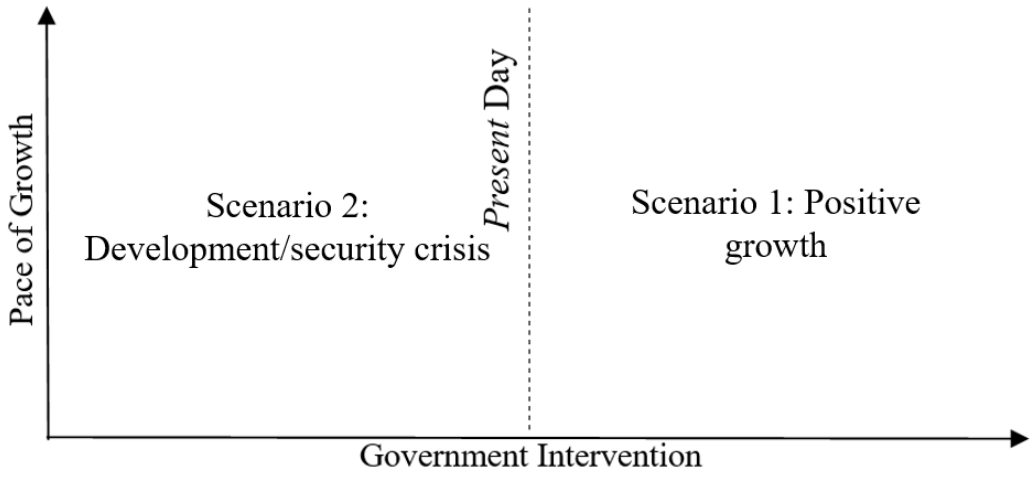

Figure 6: Mapping of Scenarios along Critical Uncertainties. Scenarios were found to not be driven by Pace of Growth in the region, but rather diverged along individual's interpretation of the Canadian Government's willingness to produce change in the region.

Scenario 2

> "So what'll it take [to see change]? I just think it's going to take Canadians recognising that they can't keep this land for free."
>
> -Participant 7

Scenario 2 was heavily focused on a reported decline of spending and development in the Canadian Arctic over the past four decades, and was supported by responses from participants 7, 10, 11, and 12. As a result of the trend of decline until now, experts cited indications of weak and inexperienced governance, a lack of defence and enforcement capability, and a *status quo* that would be easily disrupted by a sudden increase in vessel traffic in the Canadian Arctic independent of ice patterns. The scenario requires that Canada's efforts in the Arctic stay where they are or decline in the near future, with a great enough decline leading to a possible resource or security crisis. Participants were dissatisfied with the lack of communication between government and industry, and had little faith in the government altering their behaviour in the future.

> "if [TC] can't hire the people within the organisation then they should make them do a much better job of actually consulting and listening to the people that are actually doing it."
>
> -Participant 12

Others believed that a lack of defence and enforcement measures will see Canada's administrative ability overwhelmed. This would open the region to environmental and cultural threats, such as spills and major disruptions of Inuit traditional practices.

> "Having regulatory frameworks in place as to types of vessels calling at northern ports is crucial by the Canadian Coast Guard and TC. Without these frameworks in place, a typical wild west scenario can quickly develop."
>
> -Participant 11

Risks were extrapolated to an extreme by one participant, believing that Canada could see the Arctic or its resources seized by a foreign power, causing a worst-case outcome.

> "We have no means of defending. And there doesn't seem to be any national interest or federal government interest nationally. And maybe just because it's not

> a popular thing. People live in Toronto. They live in Vancouver. They live in Calgary. They're not keen on seeing their tax dollars go. And it's expensive: It's expensive to have a big piece of land like this. And, but unless we, unless we can actually say that it's our~ how do we say that it's ours if we don't live there? Defend it? Populate it? I don't know. I think it's an argument. It's not popular to say, but, you know, could you blame someone else for taking it over? What 'cause we painted it pink on the map? I don't know."
>
> -Participant 7

Primarily, considering the high likelihood of population and traffic growth in the Arctic, experts believed that Canada's current resources and efforts would be quickly exhausted. Increased traffic puts strain on regulatory and monitoring networks like Transport Canada, the Canadian Border Services Agency, and NORDREG. Additionally, the risk that vessels bring in of pollution, collisions, and the safety and environmental scenarios that could result would require an increase in spill response and SAR assets.

Section 5: Scenario Implications

The scenarios developed were a direct result of concern over whether Canada invests in the Arctic. Multiple suggestions were made by participants about where investment is most immediately required, and ideas were given about projects and programs that they believed may alleviate current problems in Canada's Arctic administration. If only Scenario 1 would be a desired outcome for a governing body, the overarching implication of this scenario is size and decisiveness of actions. Steps taken, whether they are to increase engagement with Northerners or develop infrastructure and programs, must be large enough to be meaningful, and work on a long-term plan to cement Canada's place in the Arctic.

CHAPTER IV: DISCUSSION

Section 1: Interpretation of Results

This project set out to uncover expert opinions from Canada's Arctic marine industry and produce scenarios for development in these industries and the wider region. After conducting ten interviews, two scenarios were developed. Both lie along a spectrum of government intervention in the Canadian Arctic and were independent of the other

critical uncertainty identified: Pace of Growth. Scenario 1 is a positive outlook on Canada's current relationships and trajectories in the Arctic. Scenario 2 is a negative outlook, concerned with spending and emergency preparedness infrastructure. These scenarios hinged on trust in Canada's existing Arctic institutions and the government's commitment to contribute further to Canada's in the region. The results uncovered in this study stem from a divergence in industry's trust in the social, political, and economic institutions that already exist in the Canadian Arctic. While not fully developed, these institutions could plausibly serve as an excellent foundation in the future. All participants were concerned more with a lack of infrastructure, spending on defence and emergency response, and social and political will to make investments in the region. Scenarios stemmed from differing understandings of how these areas would improve or worsen in the future, and their importance according to the participant.

Participants more critical of Canada's position in the Arctic, leading to the development of Scenario 2, were work currently in marine training, pilotage, and ice navigation. Scenario 1 was supported by members of and government and firms where their roles focused on policy analysis and development. Such a divide is hypothesized to be a symptom of myopia suffered by operators in complex policy environments like the Canadian Arctic.All participants discussed the same federal programs and shortcomings, disproving this hypothesis. There is also a possibility that operators in the North see themselves as the last line of defence in the region in the event of a marine emergency, unprotected by aging military and Coast Guard resources. However, as one participant under Scenario 1 (Participant 9) has a history of working on vessels in the Canadian Arctic, and Participant 12 under Scenario 2 has had a major hand in Canadian and wider Arctic policy development, and their views failed to overlap, this theory also has its flaws.

A combination of both possibilities could have led to this dichotomy, and should be investigated further in the future. It is clear, however, that this divide at least exposes a dissatisfaction on behalf of Canada's marine trainers and ice navigators with the direction the Canadian Arctic appears to be heading under the leadership of the Canadian federal government. The strength of the regulatory environment, however cluttered, was

nevertheless always respected by participants. This was abundantly clear when discussing Polar Code enforcement relative to nations like Denmark and the United States. While this could signal that Canada may become easily overcome should traffic rapidly increase, the researcher perceives it to be instead a testimony to Canada's commitment to averting potential disasters, especially given the limited state of domestic response and defence infrastructure.

Typically, the Oxford Scenario Planning Approach, the framework utilized for analysis in this paper, is used to generate four scenarios plotted on a two-by-two grid between both critical uncertainties. However, in this study, of the two uncertainties deduced from the data – Pace of Growth and Government Intervention – only Government Intervention was variable enough to generate distinct scenarios that were supported by responses. Responses from participants never reinforced a possibility other than a future where the Canadian Arctic sees increased traffic and therefore growth and development. The linear scenario result was arrived at over the two-by-two plot method to ensure that the data supported the findings. While other scenarios may be plausible, there was no support for them in the data.

In other scenario analyses conducted across the wider Arctic[88,89,90], four scenarios are always developed. If the OSPA approach had been followed for scenario development without regard for data collected they would have appeared, as follows, along an X-Axis of Government Intervention, and a Y-Axis of the Pace of Growth:

- Bottom-left: Canadian Withdrawal
- Top-left: Security Crisis
- Top-right: Arctic Development
- Bottom-right: The Suburban Arctic

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[88] Middleton et al., 'Scenarios for Sustainable Development in the Arctic until 2050'.
[89] Arctic Council, 'Arctic Marine Shipping Assessment 2009 Report', 2009, https://oaarchive.arctic-council.org/items/b01465f9-413d-4555-af59-07ddc7b7499a.
[90] Smith, *The New North*.

There was minimal testimony for the bottom-right scenario and none for the bottom-right scenario. This indicates that experts consulted were certain that development would occur in the Arctic. Disagreed upon was Canada's willingness to act in the region given the *status quo*. To receive no data regarding an entire scenario could be due to the researcher failing to ask the right questions or sample a wide enough population.

Section 2: Study Limitations

Results did not develop perfectly in line with the OSPA framework, possibly stemming from two structural problems in the study. The most likely possibility is that the interview guide was not structured correctly to extract critical uncertainties for analysis, or the researcher was too reliant on causal pathways to group uncertainties prior to analysis. In Section 3, uncertainties were drawn from direct and supporting quotations and resulted in the selection of Pace of Growth and Government Intervention. Questions may have not been asked thoroughly enough about what enables and propels growth in the region from an industry perspective. The project could have benefitted from additional case studies and comparative analysis of other Arctic maritime nations such as Norway and Greenland. However, this study was intentionally scoped to format a baseline of knowledge derived from and surrounding Canada's Arctic marine industries and policy. Further research, therefore, should include a wider range of sources as well as comparison with other jurisdictions across single variables like ice pilotage and Indigenous engagement.

Only ten experts were engaged for this project, and this was largely due to time allotted for data collection. Through snowball sampling, opinions may have been homogenized, especially considering that Indigenous peoples and some government departments were not sampled from. Furthermore, industry sampling could involve consulting based on firm instead of sector, and sampling from sectors like construction and mining (deep-sea and terrestrial) may provide stronger results. Additionally, follow-ups were not conducted to cover gaps in responses or touch on larger recurring themes after the initial interview. In the future, studies could be conducted that use this research guide (Appendix B) as a foundation for further conversations.

Despite the scope of the study being limited to marine industry perspectives on development in the region, it is impossible to understand the context of any project in the Arctic without the Indigenous peoples who inhabit and depend on the region. The lack of Indigenous participation was not specifically a limitation for the results of this study. However, in order to contextualize the results found above in the wider Canadian Arctic, and before implementing new policy as a result, Indigenous consultation along a similar framework will be required. Decisions made surrounding the Arctic will inevitably have an effect on the Inuit; whether it's through changes in education and employment opportunities, an influx of Canadians to the Arctic to work in the region, or the lands, waters, and foods they depend on. Of the few statements made about Inuit in the data, no analysis was conducted using statements that purported to know what Inuit want, feel, or need in the future.

CHAPTER V: CONCLUSION

This study highlighted the uncertainty surrounding Canada's future in the Arctic. With the importance of the marine sector in the Canadian Arctic being enhanced by climate change, industry members are looking to the federal government to invest in positive change. Uncertainty over future federal actions was a key variable in this analysis. There is a high likelihood that the reduction in multi-year sea ice in the Canadian Archipelago will ensure an increase in small vessel traffic. Small vessels, however, are difficult to regulate historically, and may require new legislation, enforcement, and monitoring powers for authorities in the region.

The data diverged on the strength and reliability of Canada's current Arctic marine regime, especially in the uncertainty of how and when vessel traffic in the Northwest passage will expand beyond the current means of regulation. However, a few points were unanimous throughout the data: Canada should invest in infrastructure and Indigenous peoples in order to ensure sustainable development in the Canadian Arctic. Additionally, without investment in monitoring and enforcement institutions to allow for steady and natural growth, the region could succumb to ship-born environmental, cultural, economic, and possibly security disasters. Currently, certainty about how

Canada will choose to invest in the future of the Canadian Arctic is unclear to members of industry and the interviewed government departments, indicating that decision-making power here is inherently political.

Development in the Canadian Arctic, according to experts in industry and government, is driven by the Northern population, economic incentives, infrastructure, climate change, regulation, and the political will to enable growth. These are the result of Canada's unique position as a wealthy, centralized nation that relies on the rule of law and democratic values to facilitate positive change through policy and legislation. Keeping these drivers and values in mind when producing future regional policy will allow for maximum sustainable benefits. The constant and meaningful partnership between government actors and Northern peoples and communities is an essential quality for future endeavours in the Canadian Arctic. This understanding was shared by every participant interviewed for this study.

It is also possible that heightened government control in the Canadian Arctic, or perhaps over Canadian industry and Indigenous peoples in general, leaves little autonomy for groups seeking to start new ventures in Canadian Arctic waters. Any lack of spending and development in Canada by the federal government could constrain industry members to perceive development on two different timelines. However, once sea ice has decreased enough on a reliable basis to pose less of a threat to infrastructure, vessels, and revenue, activity and therefore growth in the Arctic will increase, possibly even without Canada unless regulations and Canadian Arctic enforcement mechanisms are radically improved in the near future.

Further Research

Previously conducted scenario development studies in the Arctic covered a broad range of interview participants, whereas this study was rooted in industry members. The major limitation of this study was time, but a much larger consultation that includes Indigenous peoples, NGOs, environmental organizations, and academics should be conducted prior to implementing any findings. Input from stakeholders and rightsholders

in the region is necessary to fully understand the required drivers, willingness, and uncertainties to serve as a basis for policy generation. Additionally, the findings of this study highlight an uncertainty from industry and bureaucracy in the federal government's plans for development in the Canadian Arctic. Conducing further research to understand why scenarios were less dynamic than in standard scenario development exercise and only existed along a single axis would be beneficial for future analysis of the Canadian Arctic. Expanding the scope of participants and their numbers for an industry-based study could also provide a greater understanding of the non-political and non-Indigenous programs and predictions in the region.

This study was mistakenly conducted at the end of the Canadian Arctic shipping season due to the time and budget constraints of the academic program it was completed for. interviewing during June and July is nearly impossible for firms and operators due to their workloads and unlikelihood of wi-fi and cell service while at sea, respectively. A similar theme of summer unavailability was noted by the researcher for Inuit peoples due to a need to hunt and gather over summers, in many cases for subsistence. Future research must be mindful of this condition, either by lengthening their window for data collection or by conducting interviews outside of the summer.

Policy recommendations could be generated in the future by analyzing gaps between generated scenarios and reviewed literature. Recommendations could then be plotted along two axes of difficulty and importance, as utilized in the 2022 ARCSAR report[91], to allow the researcher to create normative recommendations for generating the project's resultant policy briefing note without relying on the researcher's subjectivity. This idea was proposed for this study, but could not be conducted due to the manifestation of scenarios that were not mutually-exclusive.

[91] Jones, Dylan, Kevin Willis, Ashraf Labib, Joe Costello, Djamila Ouelhadj, and Asrul Ismail. 'Mapping of Practitioner Needs for Innovation and Knowledge Exchange in the ANA Region'. Study. European Union HORIZON 2020, pg. 64, 30 October 2022.

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APPENDIX A: POLICY BRIEFING NOTE

BACKGROUND: The Canadian Arctic is warming at a higher rate than the rest of the world as a result of climate change. This indicates a rapidly expanding ice-free season that vessels can use to navigate the Canadian Arctic Archipelago. However, variability in ice patterns during the season caused by drifting multi-year ice poses a threat to all vessels, especially in choke points along the Northwest Passage. This unpredictability gives Canada time to begin generating policy and infrastructure to regulate a possible future of substantially-increased Arctic marine traffic. An increased risk profile additionally gives Canada a mandate to respond proactively to avoid potentially-harmful scenarios for the environment, Arctic communities, and Canadian Sovereignty.

REPORT: The accompanying report (Rolseth, 2024) interviewed ten experts from Canada's marine sector in positions to generate policy and infrastructure, as well as train mariners and provide for communities. Participants were drawn from sealift firms, ice navigators, marine training, and government departments. Results were used to create scenarios of possible development pathways in the Canadian Arctic through an industry lens.

- Results of this study should be used to understand more than the broad picture of policy and industry development in the Canadian Arctic.
- Two scenarios were developed, differentiating solely on government intervention in the Canadian Arctic into the future.
- Scenario 1 predicts that with minimal investment, Canada has generated the institutions and relationships in the North sufficient to develop sustainably into the future with a reactive posture.
- Participants believing in Scenario 1 focused on small-vessel traffic, Indigenous engagement, and political, legal, and cultural leadership by Canada to realise the end goal of a prosperous and sustainable Canadian Arctic.
- Scenario 2 predicts that investment in the North at its current or lower levels will result in environmental, cultural, economic, and security crises in the region.
- Participants who predicted Scenario 2 were concerned with institutional spending and proactive action, bureaucratic overcrowding, unsafe navigational environments, and a lack of public *and* private investment in projects in the Canadian Arctic.
- Development in the Arctic was found to be driven by economic incentives, climate change, the northern population, infrastructure and technology, political will, and the regulatory environment.
- Because all participants lacked faith in the federal government's willingness to invest in the Canadian Arctic, meaningful engagement with industry beyond the current annual CMAC Prairies and Northern Region session is required.
- Action should be taken to identify the Arctic as a unique and high-priority region, ungrouping from larger projects like the Oceans Protection Plan.
- Similar research must be conducted with Indigenous rightsholders in the Canadian Arctic to develop scenarios and gauge appropriate approaches, as well as perceived future issues.

APPENDIX B: INTERVIEW GUIDE

Pre-interview: *My name is Erling Rolseth. I am a researcher from Dalhousie University in Halifax, Nova Scotia, researching for my graduate degree in Marine Management. My research seeks to gauge Canada's ability to withstand future pressures of increased Arctic marine traffic. This may entail the creation of specific jobs and regimes that require years of experience in the region due to the unique hazards of Polar sailing. I am interviewing industry members like ice navigators and members of government to generate scenarios that could improve navigational safety and oversight along the coastal Canadian Arctic, specifically the Northwest Passage. The final results will be written into a graduate project and briefing note for government departments in the future. You will receive a copy unless otherwise requested.*

There are no guidelines or assumptions made by the Interviewer, so please speak freely.

The questions you are about to be asked as a part of your interview follow the Oxford Scenario Planning Approach, which relies on workshops proceeding in four phases: Identifying drivers, identifying critical uncertainties, building scenarios, and discussing the implications of those scenarios. Following some simple identification questions about yourself and your knowledge, these phases will be walked through with you.

Are you ready to start the interview?

1. What are your workplace goals/needs/tasks in your current position or your position operating closest to the Canadian Arctic? Please detail your relevant experience.
2. If we change nothing, where do you see Canada's Arctic, and the Northwest Passage, in 25 to 50 years? What role does your industry/department/company plan to play?
3. Describe your Arctic (program) development plans along economic, social, cultural, developmental, and security lines. Your answer does not have to be on any official project, ideas are perfectly fine.
4. How are Inuit included in your department/industry historically and today?
    a. What are your best-practices for engaging with Indigenous Canadians?
5. How are Inuit included in these scenarios? Is traditional and place-based knowledge utilized? Does this hold an inherent value in the region…in your line of work? What are other contributions?

    a. Are there legal/policy frameworks that you must adhere to? If not, please explain.
    b. Do you have plans for increased regional ownership of these projects? Through training? Adapted frameworks?
6. What are the existing limitations to implementing these scenarios? What are their potential benefits?

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