

THE ECONOMY OF THE NORTH

ECONOR 2020

FINAL REPORT 20 MAY 2021

SOLVEIG GLOMSRØD,
GÉRARD DUHAIME AND
IULIE ASLAKSEN (EDS.)



ARCTIC COUNCIL



Sustainable
Development
Working
Group

°CICERO



Statistisk sentralbyrå
Statistics Norway



UNIVERSITÉ
LAVAL



Nordic
Co-operation

THE ECONOMY OF THE NORTH – ECONOR 2020

This document exists in 2 versions
ISBN 978-82-587-1275-3 – A4, digital (PDF)
ISBN 978-82-587-1274-6 – A4, print

© Arctic Council Secretariat, 2021

This document is available as an electronic document from the Arctic Council's open access repository: oaarchive.arctic-council.org

This document is licensed under the Creative Commons Attribution-NonCommercial 4.0 International License. To view a copy of the license, visit <http://creativecommons.org/licenses/by-nc/4.0>

Suggested citation

Glomsrød, S., G. Duhaime and I. Aslaksen (eds.). 2021. *The Economy of the North – ECONOR 2020*.

Authors

Solveig Glomsrød, Gérard Duhaime and Iulie Aslaksen (eds.)

Published by

Arctic Council Secretariat

Cover photograph

Knut Espen Solberg

Funding and support

This project was funded by Norwegian Ministry of Foreign Affairs and Nordic Council of Ministers, and the Government of Canada's Department of Crown-Indigenous Relations and Northern Affairs Canada provided funding to Laval University towards the Canadian contribution to the report as well as for preliminary workshops where ECONOR IV scoping discussions took place.

This project was co-led by Canada, the United States, and Saami Council.

Disclaimers

Disclaimer by the Arctic Council: The ECONOR IV project was undertaken as an endorsed project of the Arctic Council Sustainable Development Working Group. The project report was prepared by a project team and does not necessarily reflect the policy or positions of any Arctic State, Permanent Participant, or Observer of the Arctic Council.

Disclaimer by Statistics Norway: Since data are compiled from different sources in several countries, Statistics Norway has not followed standard quality assurance, and a disclaimer applies, where it is emphasized that data and interpretations are the responsibility of the respective authors and not of Statistics Norway or the cooperating institutions or the funding agencies.

Printed by

Statistics Norway

Layout and technical production

Photo Editor: Siri Boquist. Layout: Marit Vågda

Acknowledgements

Acknowledgements are given to all the individuals, institutions and organizations having provided support, funding, data, analysis, texts, illustrations, and scientific and statistical advice for *The Economy of the North – ECONOR 2020*, to the circumpolar ECONOR network, as well as to the representatives of the Arctic States and Permanent Participants of the Arctic Council's Sustainable Development for their reviews enhancing the quality final report.

Solveig Glomsrød, Gérard Duhaime and
Iulie Aslaksen (eds.)

The Economy of the North

ECONOR 2020

Statistiske analyser

(Norwegian)

I denne serien publiseres analyser av statistikk om sosiale, demografiske og økonomiske forhold til en bredere leserkrets. Fremstillingsformen er slik at publikasjonene kan leses også av personer uten spesialkunnskaper om statistikk eller bearbeidingsmetoder.

Statistical Analyses

In this series, Statistics Norway publishes analyses of social, demographic and economic statistics, aimed at a wider circle of readers. These publications can be read without any special knowledge of statistics and statistical methods.

When using material from this publication, please give reference to individual chapters or to the publication in this form:

Glomsrød, S., G. Duhaime and I. Aslaksen (eds.) (2021): *The Economy of the North – ECONOR 2020*. Statistical Analyses 167.

Statistics Norway.

Published 20 May 2021

Corrected 8 September 2021: Figure 5.2-5.5 (page 104 and 106)

ISBN 978-82-587-1274-6 (print)

ISBN 978-82-587-1275-3 (electronic)

ISSN 0804-3221

Design/cover: Siri E. Boquist

Cover photo: Knut Espen Solberg

Print: Statistics Norway

Standard symbols in the tables**Symbol**

Category not applicable

Figures do not exist at this time, because the category was not in use when the figures were collected.

.

Not available

Figures have not been entered into our databases or are too unreliable to be published.

..

Confidential

Figures are not published so as to avoid identifying persons or companies.

:

Preface

The objective of *The Economy of the North – ECONOR 2020* is to present a comprehensive overview of the economy of the circumpolar Arctic, including the traditional production activities of the Indigenous Peoples. The report has been produced as part of the ECONOR IV project, undertaken under the Sustainable Development Working Group (SDWG) in the Arctic Council. The ECONOR IV project was carried out with Norway as lead country, Canada and the United States as co-leads among the Arctic states, and the Saami Council as co-lead among the Permanent Participants.

The ECONOR IV project was funded by Norwegian Ministry of Foreign Affairs and Nordic Council of Ministers, and the Government of Canada's Department of Crown-Indigenous Relations and Northern Affairs Canada provided funding to Laval University towards the Canadian contribution to the report as well as for preliminary workshops where ECONOR IV scoping discussions took place. Additional financial support is provided by institutions participating in the ECONOR network of representatives of national statistical offices, academic researchers and other experts.

The Economy of the North – ECONOR 2020 is the result of contributions from the ECONOR network of experts and researchers from national statistical offices and academic institutions located across the Arctic, and data have been compiled from many sources. Without the expertise and contributions from the ECONOR network, and their access to data sources, this report could not have been produced. While the report is the result of contributions from the entire ECONOR network, the individual chapters bear the names of the authors. Statistics Norway has hosted the editorial group that compiled and edited the contributions from the project network.

Several sections in Statistics Norway have contributed to the ECONOR IV report with data and statistical advice. The National accounts section has provided data, including data on value creation in marine areas, the Business cycle statistics and Structural business statistics sections have provided the presentation of Svalbard statistics, and the Population statistics section has provided the presentation of Sámi statistics.

The Economy of the North – ECONOR 2020 updates the time series of the previous ECONOR reports. The present report is a pioneering work in the sense that the path outlined in the first three ECONOR reports *The Economy of the North*, *The Economy of the North 2008* and *The Economy of the North 2015* is still relatively unexplored, with challenges of statistical and conceptual nature, and with a need to develop partnerships. *The Economy of the North – ECONOR 2020* was edited by Solveig Glomsrød (chief editor) of CICERO Center for International Climate Research, Gérard Duhaime (co-editor) of Université Laval, Quebec, and Iulie Aslaksen (co-editor and project leader) of the Research Department of Statistics Norway. Lars Lindholt of the Research Department of Statistics Norway also participated in the editorial group. Marit Vågdal of Statistics Norway did the technical editing, and Siri E. Boquist of Statistics Norway was the photo editor. *The Economy of the North – ECONOR 2020* and previous ECONOR reports are available at www.ssb.no. Statistics Norway thanks all the individuals, institutions and organizations having provided support, funding, data, analysis, texts, illustrations, and scientific and statistical advice for *The Economy of the North – ECONOR 2020*.

The following two disclaimers apply, by the Arctic Council and by Statistics Norway. The ECONOR IV project was undertaken as an endorsed project of the Arctic Council Sustainable Development Working Group. The project report was prepared by a project team and does not necessarily reflect the policy or positions of any Arctic State, Permanent Participant, or Observer of the Arctic Council. Since data are compiled from different sources in several countries, Statistics Norway has not followed standard quality assurance, and a disclaimer applies, where it is emphasized that data and interpretations are the responsibility of the respective authors and not of Statistics Norway or the cooperating institutions or the funding agencies.

The Economy of the North – ECONOR 2020 is submitted to the Arctic Council for approval to become deliverable to the 2021 Ministerial Meeting of the Arctic Council.

Statistics Norway, 21 April 2021
Linda Nøstbakken



Nuuk, Greenland. Photo: Tom Nicolaysen

Contents

Preface	3
1. The Economy of the North – ECONOR 2020: An introduction	7
<i>Solveig Glomsrød, Gérard Duhaime and Iulie Aslaksen</i>	
2. Social and economic conditions and inequalities in the circumpolar Arctic	13
<i>Gérard Duhaime, Karen Everett, Sébastien Lévesque, Taoyuan Wei, Marileine Baribeau and Andrée Caron</i>	
Box I: The use of Purchasing Power Parities in this report.....	34
<i>Taoyuan Wei and Solveig Glomsrød</i>	
Box II: Sámi statistics in Norway.....	36
<i>Anders Sønstebø</i>	
3. Comparative analysis of Arctic economies from a macro level perspective	39
<i>Solveig Glomsrød and Taoyuan Wei</i>	
Box III: Considerations When Evaluating Gross Domestic Product Estimates for Arctic Regions.....	48
<i>Scott Goldsmith</i>	
4. Arctic economies within the Arctic nations	51
<i>Solveig Glomsrød, Taoyuan Wei, Ryan Macdonald, Lars Lindholt, Scott Goldsmith and Þórólfur Matthíasson</i>	
Box IV: The value of having the exclusive right to exploit a natural resource	93
<i>Lars Lindholt</i>	
Box V: Svalbard – coal, tourism and research	94
<i>Jan Henrik Wang, Jakob Kalko, Mikael Sandberg and Hege Raaberg Bekkevold</i>	
Box VI: Economic values from ocean management by Norway in the Barents Sea and Lofoten.....	98
<i>Edita Zahirovic</i>	
5. Arctic petroleum extraction with increased rates of return	101
<i>Lars Lindholt and Solveig Glomsrød</i>	
Box VII: Mineral extraction in the Arctic	110
<i>Lars Lindholt</i>	
Box VIII: Benefit sharing in Arctic Extractive Industries.....	114
<i>Andrey N. Petrov and Maria S. Tysiachniouk</i>	
Box IX: Social dimensions of mining in Yukon Territory.....	116
<i>Gertrude Saxinger</i>	
6. Interdependency of subsistence and market economies in the Arctic	119
<i>Inuit Circumpolar Council, Gwich'in Council International, Davin Holen (coordinating author), Hannah L. Harrison, David Natcher, Ryan Macdonald, Alexander Pilyasov, Valeriy Kibenko, Ravdna Biret Marja E. Sara, Ellen Inga Turi, Risten MN Buljo, Anders Oskal, Svein Disch Mathiesen, Iulie Aslaksen, MarieKathrine Poppel, Birger Poppel and Susanna Gartler</i>	
7. Tourism in the Arctic	155
<i>Derek J. Clark, Mikko Moilanen and Stein Østbye</i>	
8. Transportation, infrastructure and permafrost degradation in the Arctic	171
<i>Nadezhda Zamyatina, Ryan Macdonald, Alexander Pilyasov, Dmitry Streletskiy and Luis Suter</i>	
Box X: Change in biodiversity and the loss of reindeer pastureland in Finnmark, Norway. An example of the use of GLOBIO3 as a decision support tool in the Arctic	184
<i>Wilbert van Rooij, Iulie Aslaksen, Philip Burgess, Per Arild Garnåsjordet and Svein D. Mathiesen</i>	
Box XI: Sustainability in the Barents region measured with indicators from the United Nations Sustainable Development Goals (SDG) framework.....	186
<i>Alexandra Middleton, Andrey Mineev, Erlend Bullvåg and Sissel Ovesen</i>	
9. Concluding remarks	191
<i>Solveig Glomsrød, Gérard Duhaime and Iulie Aslaksen</i>	
List of authors and other contributors	193
List of figures	195
List of tables	198

1. The Economy of the North – ECONOR 2020: An introduction

Solveig Glomsrød, Gérard Duhaime and Iulie Aslaksen

The Arctic regions belong to different national regimes, and information on social and economic issues has been dispersed and not been easily available at the circumpolar level. A central task of the ECONOR IV project has been to contribute to filling this gap by presenting a comprehensive overview of the scale and structure of the circumpolar Arctic economy. Among several good reasons for compiling an overview of the circumpolar Arctic economy is a need for an information platform from where to assess the sustainability of the Arctic communities in terms of natural wealth management and vulnerability towards climate change and global policies and trends.

While waiting for the upcoming 6th IPCC report, we refer to the 2019 IPCC Special Report on the Ocean and Cryosphere in a Changing Climate, highlighting the increasing climate change: “Feedbacks from the loss of summer sea ice and spring snow cover on

land have contributed to amplified warming in the Arctic (high confidence) where surface air temperature likely increased by more than twice the global average over the last two decades”.¹

The Paris agreement and the 2030 Agenda for Sustainable development are overarching initiatives with significant implications for the Arctic. Climate change and climate policies have large impacts on the economy of the Arctic, many of them dealt with in the ECONOR IV report, while the global focus on the 2030 Agenda for Sustainable Development offers hope for new advances to sustainable development of the Arctic.

The Economy of the North – ECONOR 2020 report finalizes the ECONOR IV project which has been headed by Statistics Norway, CICERO Center for International Climate Research, and Université Laval, Quebec, Canada, in cooperation with a





Family Fishing in Tyonek – A father teaches his sons to pick fish nets outside Tyonek in West Cook Inlet. Although a sometimes tenuous relationship, the oil and gas industry has provided jobs and income to residents of Tyonek for over 50 years. Photo: Davin Holen

circumpolar network of statisticians, academics, and contributors from Indigenous Peoples organizations that hold Permanent Participant status in the Arctic Council. The purpose of this fourth report has been to update the economic statistics of the previous versions, *The Economy of the North*, published in 2006, *The Economy of the North 2008*, and *The Economy of the North 2015*, and to include a wider set of socioeconomic variables to more clearly depict the livelihood of Arctic people.² Other objectives have been to shed light on the value of natural resources in the Arctic and to bring forward knowledge about how Indigenous Peoples manoeuvre between subsistence activities and the market economy.

The Arctic Region as referred to in this report is depicted in the map in Figure 3.1. It covers Northern Russia with the Republics of Karelia and Komi, the Murmansk and Arkhangelsk Oblasts, the Yamal-Nenets and Khanty-Mansii Autonomous Okrugs, the Republic of Sakha, the Magadan Oblast, and the Chukchi Autonomous Okrug (Chukotka). The North American Arctic includes Alaska and the Northern territories of Canada (Northwest Territories, Yukon, Nunavut). The European Arctic consists of Green-

land, Faroe Islands, Iceland and Arctic Norway (including the Svalbard Archipelago and Jan Mayen), Arctic Sweden and Arctic Finland.

Following changes in Russia's federal legislation, the statistical definitions of Arctic Russia – the Arctic Zone – have been changed. In the new definition, Karelia, Khanty-Mansii and Magadan do not belong to the Arctic Zone, while several regions of Krasnoyarskiy Krai and the entire Nenets Autonomous Okrug do. Previously included regions – Evenkiyskiy Autonomous Okrug and Taymirskiy Autonomous Okrug – have become parts of Krasnoyarskiy Krai and Nenets Autonomous Okrug, not included in this report. In *The Economy of the North – ECONOR 2020* we present data for the regions previously defined as Arctic Russia, in order to retain time series and achieve statistical comparability.

The homelands of the six Arctic Indigenous organizations that hold Permanent Participant status in the Arctic Council extend across national borders, as depicted in the map in Figure 6.1. They are the Aleut International Association, Arctic Athabaskan Council, Gwich'in Council International, Inuit

Circumpolar Council, Russian Association of Indigenous Peoples of the North, and the Saami Council. These Indigenous Peoples Organizations represent approximately 500 000 inhabitants of the Arctic in total. The Unangan (Aleut People) live in Alaska and on the Commander Islands in Russia. The Athabaskan Peoples have their territories in Alaska, and Yukon and Northwest Territories in Canada. Gwich'in territory is bisected by the Canada-USA border, and extends across Alaska, the Yukon, and the Northwest Territories. The Inuit have their homeland in Alaska, Canada, Greenland and Chukotka. In the Arctic Russia, there are 40 Indigenous Peoples. The Sámi people have their homeland in Finland, Russia, Norway and Sweden.

Since the publication of *The Economy of the North 2015*, the backdrop of this statistical work has shifted considerably. This updated report reflects a period with resource prices falling dramatically before approaching pre-crisis levels around 2018, which is the most recent year we cover on a broad basis. As resource income in several regions partly is transferred to owners outside the Arctic regions, falling resource prices will also be felt outside the Arctic. Regionally, the local tax revenues, royalties and wage income will decline.

Chapter 2 presents in telling figures how the development affects core elements in human welfare in Arctic regions. The composition of the population, the life expectancy and rate of infant mortality are all observations that convey crucial information on living conditions, which gross regional product (GRP) for Arctic regions cannot convey: A quick glance at GRP would not bring us close to the reality concerning the basis for livelihood, because distribution of income and public services matter to quality of life.

Chapter 3 looks at the Arctic from a bird's eye perspective and presents macro level data of land area, population, GRP per capita and disposable income of households per capita by region. Regional data are depicted in relation to data on the non-Arctic part of their corresponding Arctic states, and to the circumpolar level.

It is important to have in mind that the data in this report on revenues in resource extraction include the wealth component of natural resources. In resource rich communities like the Arctic regions

the sustainability of wealth management is particularly important. Non-renewable resources that have been extracted from the ground represent a loss in wealth that conceptually should not be counted as income. However, by national account conventions they are still included in income. Because the natural wealth is not explicitly accounted for, resource revenues can easily be consumed contrary to principles of long-term sustainability. To avoid myopic behaviour, revenues from petroleum production have in some cases partly been invested in financial funds. An alternative or supplement could be investment in human capital. As the Arctic economies generate a substantial share of their income from resource extraction, it would have been useful to have data for genuine income generation in addition to the value of straightforward resource depletion. The Arctic region has higher extraction costs than in other regions and consequently the wealth loss component of reported income tends to be lower. As this report illustrates, however, the shares in GRP of extractive industries in several Arctic regions are high, and it therefore remains a relevant question for the Arctic regions if wealth management is sustainable from their perspective. A decomposition of resource income into return to production factors and the wealth component is indicated for Norway in Box IV in this report.

On the other hand, the scarcity of pristine nature implies that the wealth component of nature is increasing. The nature value of Arctic wilderness, northern lights, rich biological resources, and traditional living shows up indirectly in income data for tourism and harvesting of renewable resources. The increased demand for other nature values has sharpened conflicts over land use between mineral industries and the renewable nature based industries, not the least for traditional living, with hunting, fishing and herding by Indigenous Peoples. In some regions these conflicts have reached the political arena at Arctic state level, in particular with respect to petroleum, other mineral extraction and wind power. These aspects are to some extent captured in Chapter 4, looking more closely into the regional economic activities.

Chapter 4 on Arctic Economies within the Arctic Nations leaves the circumpolar perspective and looks closer at the role of each regional economy in the national context. The core tables in this chapter



are compiled to present a consistent set of data across regions, when possible at the same level of detail by industry in order to show economic structure in comparable categories.

Petroleum in the Arctic is the topic of chapter 5. One of the large uncertainties confronting the investors in the Arctic is the future price of petroleum, as well as the uncertainty about impacts of future climate and environmental policies. The Stated Preferences Scenario of IEA expects the price of crude oil (in 2012 USD) to be USD 70 in 2025, rising to USD 90 by 2040.³ Current trends indicate that the petroleum industry now perceives higher risk and require an increasing return on investments. Chapter 5 presents a model based analysis of the impact of changes in required rates of return on the prospects for gas and oil activities in Arctic regions towards 2050.

This report has a strong focus on the commercial activity in the Arctic. For several of the Arctic regions, employment and revenues from mineral extraction may be the pillar of the economy. However, the Arctic has a rich wildlife that provides substantial nutritional and cultural values to Arctic communities. Fishing and hunting for own consumption and sharing is a major source of subsistence livelihood for Indigenous Peoples

and other Arctic residents.⁴ This source of income and consumption may at first glance seem to be decoupled from the shifting performance of the global economy - but even this local and mostly unregistered production feels the change, because cash income from employment and sales, or government transfers, are important for being able to purchase equipment and means of transportation for hunting, fishing and herding. In Alaska, dividends from the Alaska Permanent Fund are an important source of funding for the subsistence activities. Hence, subsistence activities and the cash economy are mutually dependent on each other for providing consumption possibilities in the Arctic today, and are at the same time part of a way of life that represents continuity, sharing and connection to nature.

Chapter 6 on the interdependence of subsistence and market economies in the Arctic aims to give an overview of the importance of subsistence activities in different Arctic regions. The chapter presents an Inuit way of looking at the Arctic economy and a Gwich'in perspective on the caribou economy. With some notable exceptions, as in Alaska, subsistence activities are mostly invisible in official statistics. Chapter 6 provides information on subsistence activities in Alaska, Northern Canada, Northern Russia and Greenland, and on the econ-

omy of Sámi reindeer husbandry in Norway. Some results from the SLiCA - Survey of Living Conditions in the Arctic - project are reported.⁵ The economies of Arctic Indigenous Peoples are varied and complex and much has been left out of this report. Future ECONOR reports will attempt to address these gaps by developing partnerships with Indigenous Peoples to further develop this chapter from Indigenous perspectives.

A circumpolar study of the economic importance of tourism is presented in Chapter 7. Chapter 8 presents some characteristics of transportation and infrastructure, particularly in Arctic Russia, and some results from studies on the impacts and costs of melting permafrost. Climate change impacts on the economies of the Arctic regions, which at the time of the first ECONOR project were in their initial phase, are now happening at a large scale. What was previously projected to take place in the distant future is now occurring. The sea ice is at its lowest level. Coastal areas erode, the process of thawing permafrost is running, and wildlife is disturbed. These effects are already affecting the Arctic economies, however, in a macro level overview like ECONOR climate effects are still over-shadowed by other changes and turbulence in resource rich and small economies.

Presenting an economic overview of the Arctic regions in comparable terms offers some particular challenges that go beyond the question of quality and coverage. To add up or compare income accounted for in different countries it is necessary to transform the numbers to a common currency. The USD is frequently used for this purpose, and most people have an understanding of how much a dollar can buy in the world market. However, a translation of income based on a straightforward use of market exchange rates will normally lose some of the information about the true capacity to consume in the domestic market of a specific region. To adjust for price differences in domestic markets purchasing power parity (PPP) indicators have been established as an attempt to harmonize income measures across regions. However, the PPP transformation may sometimes lead to biased assessment of income in different regions. This problem is further discussed in Box I. Some Arctic regions are regions within states, and it is a general phenomenon that regional economic statistics has been less developed and is less complete than the

The circumpolar ECONOR network consists of the following persons and institutions:

Alexander Pilyasov, Lomonosov Moscow state university, Russia. Contact persons in the Federal State Statistical Service, Russia: **Irina Dmitrievna Masakova**, **Tatarinov Andrei Anatolievich**, and **Levit Svetlana Rafailovna**

Gérard Duhaime, Université Laval, Québec, Canada (ECONOR Co-editor)

Karen Everett, Université Laval, Québec, Canada

Ryan Macdonald, Statistics Canada

Jukka Muukkonen, Statistics Finland

Birger Poppel, Ilisimatusarfik, University of Greenland

Anders Blaabjerg, Statistics Greenland

Gilli Wardum, Statistics Faroe Islands

Thórólfur Matthíasson, University of Iceland

Björn R. Gudmundsson, Statistics Iceland

Dolan Haddad/Josefine Rossheim, Statistics Sweden

Scott Goldsmith, Institute of Social and Economic Research (ISER), University of Alaska at Anchorage, USA

Davin Holen, University of Alaska at Fairbanks, USA

Andrey Petrov, University of Northern Iowa, USA

Ellen Inga Turi/Ravdna Biret Marja E. Sara, University of the Arctic EALÁT Institute

Devlin Fernandes, Gwich'in Council International

Magnus Helliessen/Edita Zahirovic, Statistics Norway

Lars Lindholt, Statistics Norway

Wei Taoyuan, CICERO Center for International Climate Research, Oslo

Solveig Glomsrød, CICERO Center for International Climate Research, Oslo (ECONOR Chief editor)

Iulie Aslaksen, Statistics Norway (ECONOR Co-editor, Project leader)

The editorial group at Statistics Norway and CICERO has consisted of:

Solveig Glomsrød, CICERO (Chief editor)

Iulie Aslaksen, Statistics Norway (Co-editor)

Lars Lindholt, Statistics Norway (Researcher)

Siri E. Boquist, Statistics Norway (Photo editor)

Marit Vågdal, Statistics Norway (Lay-out editor)

The editorial group at Université Laval, Québec, Canada, has consisted of:

Gérard Duhaime, Université Laval (Co-editor)

Box 1.1. Defining the Arctic region and the size of the Arctic population

According to the Arctic Human Development Report (AHDR) the population of the Arctic is about 4 million, in contrast to about 10 million according to the ECONOR definition. AHDR takes as its point of departure the definition of the Arctic from the Arctic Monitoring and Assessment Programme (AMAP), however, due to location of administrative boundaries and availability of data, the area covered in AHDR and AMAP differs in some respects:

“Thus, the AHDR Arctic encompasses all of Alaska, Canada North of 60° together with northern Quebec and Labrador, all of Greenland, the Faroe Islands, and Iceland, and the northernmost counties of Norway, Sweden and Finland. The situation in Russia is harder to describe in simple terms. The areas included, as demarcated by our demographers, encompasses the Murmansk Oblast, the Nenets, Yamalo-Nenets, Taimyr and Chukotka autonomous okrugs, Vorkuta City in the Komi Republic, Norilsk and Igarka in Krasnoyarsky Krai, and those parts of the Sakha Republic whose boundaries lie closest to the Arctic Circle. This, then is the AHDR Arctic. It encompasses an area of over 40 million square kilometers or about 8% of the surface of the Earth, a sizeable domain by any standards (AMAP 2002, Armstrong et al. 1978). But the human residents of this vast area number only about 4 million, of whom almost half are located within the Russian federation (AMAP 2002)” (AHDR 2004, p. 17-18).

In contrast, the ECONOR definition of the Arctic covers: Northern Russia with the Republics of Karelia and Komi, the Murmansk and Arkhangelsk Oblasts, the Yamal-Nenets and Khanty-Mansii Autonomous Okrugs, the Taimyr and Evenkia former Autonomous Okrugs,

the Republic of Sakha, the Magadan Oblast, and the Chukchi and Koryak Autonomous Okrugs. The American Arctic includes Alaska and the Northern territories of Canada (Northwest Territories, Yukon, Nunavut). The European Arctic consists of Greenland, Faroe Islands, Iceland and Arctic Norway (including the Svalbard Archipelago and Jan Mayen), Arctic Sweden and Arctic Finland.

Following changes in the Russian Federation legislation, the statistical definitions of Arctic Russia have been changed. “The Economy of the North 2015” presents data for regions previously defined as Arctic Russia, in order to retain time series. In the new definition, Karelia, Khanty-Mansii and Magadan are no longer included in the Arctic Zone, while Nenets and several regions of Krasnoyarsky Krai are included. Previously included regions - Evenk autonomous okrug and Taymir autonomous okrug - have become parts of Krasnoyarsky Krai and Nenets autonomous okrug.

The main reason for the large difference in the population figures between the Arctic Human Development Report and The Economy of the North (ECONOR) is that due to the economic focus of ECONOR, its delineation of the Arctic includes Khanty-Mansii which is the largest Russian oil producing region, adjacent to oil and gas producing Yamal-Nenets. Moreover, due to availability of statistical data, all of the Republic of Sakha- Yakutia is included.

Sources: AMAP (2002). Arctic Monitoring and Assessment Programme (AMAP): Arctic Pollution 2002. AMAP. Oslo. AHDR 2004. *Arctic Human Development Report*. Arctic Council’s Sustainable Development Working Group.

one at the national level. It may also occur that regional data are unavailable at detailed level due to confidentiality reasons as the number of enterprises involved is too low. Further, some Arctic regions are nations or autonomous regions with small populations and limited capacity for economic statistics and national accounts. The major challenges associated with production of regional statistics are outlined in Box III. Due to the diversity in the statistical material, the data and interpretations in this report should be read with care.

The data have been given a common format facilitating comparison of income, production and economic structures among the individual Arctic regions. This represents a major improvement on earlier available material and may work as a building block in a further process towards a harmonized database on arctic economic issues. The path

outlined in the ECONOR reports is still relatively unexplored.

It is our hope that the present overview of the Arctic economy will inspire work to further strengthen the information basis from where to assess the sustainability of the Arctic communities in terms of livelihoods, natural wealth management and environmental challenges.

Notes

¹ Pörtner, H.-O., D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegria, M. Nicolai, A. Okem, J. Petzold, B. Rama, N.M. Weyer (eds.) (2019): IPCC Special Report on the Ocean and Cryosphere in a Changing Climate. IPCC.

² Glomsrød, S. and I. Aslaksen (2006): The Economy of the North. Statistics Norway, SA 84. Glomsrød, S. and I. Aslaksen (2009): The Economy of the North 2008. Statistics Norway, SA 112. Glomsrød, S., G. Duhaime and I. Aslaksen (2017): The Economy of the North 2015. Statistics Norway, SA 151.

³ IEA-International Energy Agency (2019): World energy outlook, OECD/IEA, Paris.

⁴ AHDR (Arctic Human Development Report) I and II. Arctic Council’s Sustainable Development Working Group.

⁵ SLiCA- Survey of Living Conditions in the Arctic.

2. Social and economic conditions and inequalities in the circumpolar Arctic

Gérard Duhaime, Karen Everett, Sébastien Lévesque, Taoyuan Wei, Marileine Baribeau and Andrée Caron

Introduction

In the Arctic, regional economies often prioritize the development of the extractive industries. While these industries can certainly be profitable, questions remain about the benefit of such industries to nature and human development, especially considering the volatility of world markets and the fairness in distribution of natural wealth.¹ The creation of conditions favourable to human development include more than just the economy; other social and political structures also have a role to play. Therefore, an in-depth understanding of multiple indicators is required to obtain a broader understanding of the socio-economic situation across the circumpolar Arctic.²

Comprehensive studies, such as the Arctic Human Development Report (AHDR),³ have sought to identify inequalities in the circumpolar Arctic, while indicators of inequality have been identified, developed, and operationalized as part of the Arctic Social Indicators (ASI) report.⁴ The ECONOR reports, *The Economy of the North*, contribute to these important efforts to identify and understand inequality, particularly from a socio-economic perspective. This chapter builds on our previous efforts to measure specific socio-economic indicators across the circumpolar Arctic and presents the data within their larger contexts.



The Faroe Islands. Photo: Åsne Vigran

In our previous comparative study, *The Economy of the North 2015*, we presented an update of the comparative analysis of socio-economic conditions in the regions of the circumpolar Arctic. Our findings showed some divergence from the main pattern within the three geographic regions, North America, the Nordic countries, and the Russian Federation. However, we concluded that the most important general characteristics were the overall persistence of a major gap between the geographical regions, a modest convergence between them, and less pronounced internal inequalities in the Arctic regions of the Nordic countries than elsewhere, due to the substantial extent of public provision of health and education in the Nordic countries.

This chapter updates and extends the previous comparative study of socio-economic and social conditions across the circumpolar Arctic, by comparing the situation in 2018 and 2012. Comparing the indicators over time allows us to verify whether the socio-economic models of the three geographical groups are still relevant. The socio-economic models are shaped by different factors, including political structures, emphasis on different economic industries, and transportation systems. The updated results continue to indicate that differences between the three geographical groups are shrinking, although there are increasing internal inequalities in some regions.

Methodology

This chapter examines the demographic, health, and economic situation in the circumpolar Arctic. In order to compare with the previous ECONOR report, we revised and harmonized the indicators, we have included the Gini coefficient, and updated indicators to 2018, the most recent year for which data were available. We collected 2012 and 2018 data for the following indicators: 1) population growth, 2) female rate (proportion of women in the total population), 3) youth rate (proportion of

Box 2.1. Converting social and economic indicators to a common scale

Since the indicators are of different units, each indicator has been converted into an index on a scale of 1 to 10. The indices were calculated by min-max normalization, where 1 represents the lowest (or least desirable) observed value among the regions and 10 represents the highest (or most desirable) value.

Each index, for each indicator for each Arctic region (see Table 2.1) has been calculated in the following way, by this formula:

$$Index = 1 + \frac{(x - \min(x))(10 - 1)}{\max(x) - \min(x)}$$

For example, the life expectancy in Alaska is calculated by first subtracting the lowest observed life expectancy (among all Arctic regions) from the life expectancy in Alaska, then multiplying by 9, (indicated as 10-1 in the formula to explicitly recall the range of conversion) and then dividing by the difference between the highest and lowest observed life expectancy (among all Arctic regions). Then 1 is added to this result, to obtain the index value. From Table 2.1 we see that life expectancy in Alaska is 78.8 years. The region with lowest observed life expectancy is Chukotka, with 63.6 years, and the region with highest observed life expectancy is Iceland with 82.9 years. With the calculation described, we find that the index value for life expectancy in Alaska is $1 + (78.8 - 63.6) * 9 / (82.9 - 63.6) = 8.1$.

For the following indicators, the maximum and minimum values have been inverted in the formula to express that low values are beneficial: infant mortality, economic dependency, demographic dependency, and Gini coefficient. In the case of the female proportion, the maximum and minimum values have also been inverted in the formula, and the calculation was based on the difference, converted in absolute values, between the proportion of women in the region and the global average proportion of women.

The replacement rate was calculated based on a ratio between children (age 0-14) and women (age 15-54 years) as a proxy measure for the total fertility rate, which is not available for all Arctic regions. We calculated the distance of this fertility rate proxy to the minimal replacement rate used in developed countries (defined as 2.1 children per woman). We then calculated the distance between the fertility rate proxy and the replacement rate of 2.1.

A composite index for each region was also calculated based on the average of the scaled indices (Table 2.1, last column), allowing us to produce a comparative ranking of the regions (see Table 2.1 and Annex 2.1). Selected indices are also used to create the radar diagrams (Figures 2.1 to 2.8). All indices, except for tertiary education, for lack of comparable data, were used to create the composite index.

children and youth 0-14 years in the total population), 4) replacement rate (defined in Box 2.1), 5) demographic dependency (proportion of children and elders to adults), 6) life expectancy at birth, 7) infant mortality rate, 8) tertiary education attainment, 9) economic dependency ratio (proportion of non-employed persons to employed persons), 10) household (personal) disposable income per capita⁵ 11) gross regional product (GRP) per capita (GRP is gross domestic product (GDP) at regional level), and 12) Gini coefficient. In addition, population data are presented. As in the previous ECONOR report, we do not include the proportion of Indigenous Peoples in the total population due to a lack of systematic data in most northern regions.

Data for the following Arctic regions are analyzed: Alaska (USA); Northwest Territories, Nunavut, and Yukon (Canada); Faroe Islands and Greenland (Denmark); Lapland, Northern Ostrobothnia, and Kainuu (Finland); Iceland; Finnmark, Nordland, and Troms (Norway); Norrbotten and Västerbotten (Sweden); and Arkhangelsk, Chukotka, Karelia, Khanty-Mansii, Komi, Magadan, Murmansk, Sakha, and Yamal-Nenets (Russian Federation). Similar to the previous study, The Economy of the North 2015, we could not include Evenk and Taimyr (Dolgan-Nenets) as their official data are included in Krasnoyarsk, which extends quite far south, and separate data could not be extracted.⁶

The data are presented in several ways, in tables, graphs, and maps. For the radar diagrams (Figures 2.1 to 2.8), the indicators were transformed to a



Leftovers, Nunavut. Photo: Mary Stapleton



Learning about Chinook Salmon in Tyonek. Photo: Davin Holen



Picking blueberries. Photo: Davin Holen

common format, presented as an index on a scale from 1 to 10, where 1 represents the least favourable condition and 10 the most favourable condition for human development⁷ (see Box 2.1). Note that the radar diagrams present GRP and disposable income per capita.

The data for this study were collected from the national statistical agencies of the Arctic countries, and from other sources, including the Centre for Disease Control and Prevention (USA: life expectancy, infant mortality), Finnish Institute for Health and Welfare (Finland: infant mortality), Swedish Register of Education (Sweden: tertiary education), World Bank Development Indicators (Iceland: life expectancy), and the World Bank (global female population). Data were collected near the end of 2020, and where data for 2018 were not available, we used data from the most recent year available (see note 8).

There were some challenges to data collection at the regional level, particularly for regions with smaller populations.⁸ For example, for life expectancy, the reference period is usually presented for a multiple year range rather than for single years, and we used the data that aligned best with 2012 and 2018 (see note 8). Data at the regional level are often updated on a different schedule than data at the national level and some data for 2018 have been estimated (see note 8). There are also methodological differences in the approaches of the statistical agencies, for example, in the calculation of the Gini coefficient. When available, we have presented the Gini coefficient for the equivalized household disposable income per capita (see note 8).

Considering the differences in data, efforts were made to ensure valid comparisons. In some cases, we had to make compromises, with slight differences, in concepts or data used, as for the Gini coefficient, while in other cases, as for education, we concluded that a circumpolar comparison was not possible for this update (see note 8).

These limitations notwithstanding, we were able to analyse the data and achieve a picture of the socio-economic situation in the circumpolar Arctic.

The socio-economic situation of the circumpolar Arctic in 2018

Table 2.1 provides a portrait of the socio-economic situation in the circumpolar Arctic in 2018 according to our selected indicators, with actual values for each indicator for each of the Arctic regions. Notes on definitions are included in Table 2.1, while additional information on the data are found at the end of the chapter.

The results of eight key indicators are displayed in radar diagrams (Figures 2.1 to 2.8), where more area coverage within the lines of the diagram indicates a more favourable situation for human development. The comparison of the obtained diagrams allows us to identify a recurrent pattern in each geographical region, which is called the “main pattern”. Similarly, in each geographical region, one or a few diagrams differ from the main pattern and are called “variations” (Table 2.2).

In comparison to the previous ECONOR, the following analysis does not include tertiary education, for lack of comparable data. The most current data from the Russian regions on tertiary education attainment is from the 2010 census and

Table 2.1. Selected social and economic indicators¹ and composite index². Arctic regions. 2018

Regions	Popula- tion	Popula- tion growth rate 2012- 2018	Female rate	Youth rate	Re- place- ment rate	Demographic dependency	Life expect- ancy	Infant mortal- ity	Tertiary edu- cation	Eco- nomic depen- dency	Dis- posable income	GRP	Gini coeffi- cient	Com- posite index
	N	Per cent			Ratio		Years	Per 1 000 live births	Per cent	Ratio	USD-PPP per cap	Ratio	n	
Alaska	735 139	0.1	47.8	20.9	1.3	0.49	78.8	5.9	34.3	0.6	55 735	74 454	0.432	6.15
Northwest Territories	44 956	0.5	48.6	20.3	1.4	0.39	77.0	9.6	22.1	0.7	32 810	87 799	0.328	6.11
Nunavut	38 139	1.6	48.6	32.0	1.0	0.56	71.6	24.2	11.4	1.3	23 189	74 852	0.379	5.43
Yukon	40 612	1.9	49.1	16.8	1.5	0.40	79.0	6.8	27.3	0.8	33 006	62 588	0.295	6.27
Faroe Islands	50 475	0.8	48.5	21.1	1.2	0.63	82.4	0.0	..	0.9	21 449	57 554	0.227	6.38
Lapland	178 522	-0.4	50.0	15.1	1.4	0.66	80.5	2.9	26.7	1.2	22 314	45 542	0.243	4.86
Northern Ostrobothnia	412 161	0.3	49.5	19.6	1.3	0.63	81.6	2.4	29.8	1.3	21 315	40 573	0.263	5.41
Kainuu	73 061	-1.0	49.7	14.1	1.4	0.71	80.3	4.1	24.9	1.1	22 455	38 840	0.241	4.63
Greenland	55 877	-0.3	47.2	21.0	1.3	0.41	70.8	7.3	12.3	1.1	15 543	50 901	0.354	4.56
Iceland	348 450	1.4	49.0	19.3	1.4	0.50	82.9	1.7	35.1	0.8	21 358	59 467	0.234	6.66
Finnmark	76 167	0.5	48.5	16.5	1.4	0.52	79.8	5.0	28.0	0.9	24 323	46 138	0.224	5.68
Nordland	243 335	0.3	49.3	16.5	1.4	0.57	81.1	3.0	26.8	1.0	23 536	45 241	0.217	5.66
Troms	166 499	0.8	49.1	16.8	1.4	0.52	81.7	1.8	32.9	0.8	25 375	47 623	0.222	6.18
Norrbotten	250 497	0.1	48.8	15.4	1.4	0.65	81.1	2.9	27.8	1.0	22 889	55 888	0.253	5.21
Västerbotten	270 154	0.6	49.3	16.8	1.4	0.61	82.0	2.7	23.5	1.0	21 717	46 908	0.264	5.51
Arkhangelsk	1 155 028	-0.8	53.1	17.9	1.4	0.48	72.1	4.8	2.0	1.2	15 358	28 630	0.382	3.66
Chukotka	49 348	-0.5	49.2	21.6	1.3	0.36	63.6	12.7	0.5	0.7	34 941	63 919	0.405	5.15
Karelia	622 484	-0.5	54.4	17.3	1.4	0.48	70.6	5.6	2.2	1.2	12 541	18 157	0.341	3.39
Khanty-Mansii	1 655 074	1.0	51.3	22.0	1.4	0.39	74.3	2.9	1.8	0.9	20 872	108 468	0.398	5.77
Komi	840 873	-0.9	52.8	19.2	1.4	0.44	71.1	4.5	2.3	1.1	14 014	31 958	0.382	3.91
Magadan	144 091	-1.2	51.6	17.8	1.5	0.39	69.6	3.5	2.6	0.7	25 466	47 826	0.388	4.60
Murmansk	753 557	-0.7	52.0	17.6	1.4	0.41	71.7	5.6	1.3	0.9	17 102	25 848	0.356	4.32
Sakha	964 330	0.1	51.5	23.5	1.3	0.46	72.7	5.0	3.3	1.1	18 819	45 397	0.405	4.88
Yamal-Nenets	538 547	0.1	50.4	22.8	1.4	0.35	74.1	5.6	0.2	0.7	34 144	231 116	0.435	6.40

¹ Population growth: average annual per cent; female rate: per cent of women in total population (as compared to global average at 49.58 in 2018, from World Bank); replacement rate: distance of the ratio of children (0-14 years) and women (15-54 years) from the replacement rate of 2.1; youth rate: per cent of 0-14 years in the total population; demographic dependency: (0-14) + (65+) / (15-64); infant mortality: per 1 000 live births; tertiary education: per cent of tertiary level graduates in total population; economic dependency: (non-employed/employed person in total population); disposable income: personal disposable income in 2018 USD-PPP; GRP: gross regional product in 2018 USD-PPP.

² The composite index calculation is based on all indicators with the exception of the total population and tertiary education. See Box 2.1 for further explanation.

Table 2.2. Arctic regions distribution by socio-economic model. 2018

Model	Main pattern	Variation
North America Model Figures 2.1 and 2.5	Alaska Northwest Territories Yukon	Nunavut
Nordic Country Model Figures 2.2, 2.3, and 2.6	Faroe Islands Lapland Northern Ostrobothnia Kainuu Iceland Finnmark Nordland Troms Norrbotten Västerbotten	Greenland
Russian Federation Model Figures 2.4, 2.7, and 2.8	Arkhangelsk Karelia Komi Magadan Murmansk	Chukotka Khanty-Mansii Sakha Yamal-Nenets

was presented in the previous ECONOR report. In this updated study, education data for Russia encompass the percentage “of students studying under the bachelor’s, specialist’s and master’s degree programs”,⁹ while data for the North American and Nordic regions reflect the percentage of the population with a tertiary degree, thus making it impossible to compare data for the education indicator across all Arctic regions.

Our analysis demonstrates continued differences between the three geographical regions, North America, the Nordic countries, and the Russian Federation (Figures 2.1 to 2.8). The results also find that some regions continue to vary from the main pattern within a given socio-economic model (Table 2.2).



Longyearbyen, Svalbard, the world's northernmost city. Photo: Crestock

However, when comparing disposable income per capita, and above all, GRP per capita, across the Arctic regions, the circumpolar comparison is heavily influenced by the high resource revenues of some of the Arctic Russian regions. As made visible by comparison of GRP per capita across regions in the following diagrams, the level of GRP per capita for other regions are dwarfed especially by the high GRP per capita of Yamal-Nenets due to the high resource revenues of this region.

Overall, the North American regions demonstrate favourable conditions for human development. They have the highest disposable income per capita, the highest population growth, and the largest share of youths. The indicators for female rate, life expectancy, and Gini coefficient are average, while infant mortality is the highest in the circumpolar Arctic (Figure 2.1). Although the North American regions have a high level of GRP per capita, compared to most other Arctic regions, in relative terms their GRP per capita is dwarfed by the high level of GRP per capita of Yamal-Nenets, as mentioned above.

The Nordic regions also have favourable conditions for human development, although with a different pattern than in North America. In particular, the Nordic countries have the lowest Gini coefficient, meaning they have the lowest income inequality within their populations. Moreover, the female rate

is the closest to the global average, they have the longest life expectancy, and the lowest infant mortality rates. However, population growth is slower, and disposable income per capita and GRP per capita are much lower than in the North American regions. The Nordic regions also have the lowest share of youths among the three geographical regions (Figures 2.2 and 2.3).

The situation in the Arctic Russian regions is in contrast to what is observed in the North American and Nordic regions. The main pattern shows the youth rate is higher than in the Nordic countries but lower than in North America. The infant mortality rate is lower than in North America, although not as low as in the Nordic regions. Moreover, the population in the Russian Arctic has generally been in decline (Annex 2.1). The female rate is the furthest away from the global average, and all regions but one have a female rate of 50 per cent or above (Table 2.1). Life expectancy, disposable income per capita, and GRP per capita are the lowest, and the Gini coefficient is the highest (Figure 2.4). Some of the Russian regions have the least favourable conditions for human development for several indicators.

As previously mentioned, the regional geographical groups are not homogenous and they each have variations from the main patterns. In North America, Nunavut has a different pattern than the other

Figure 2.1. North America model, main pattern. 2018

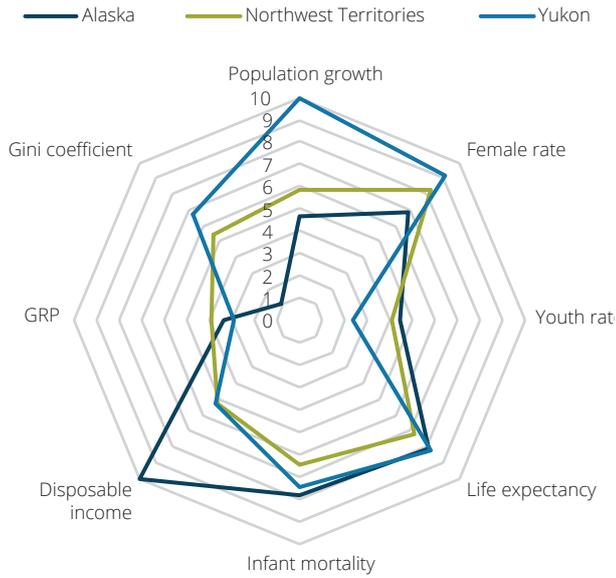


Figure 2.4. Russian Federation model, main pattern. 2018

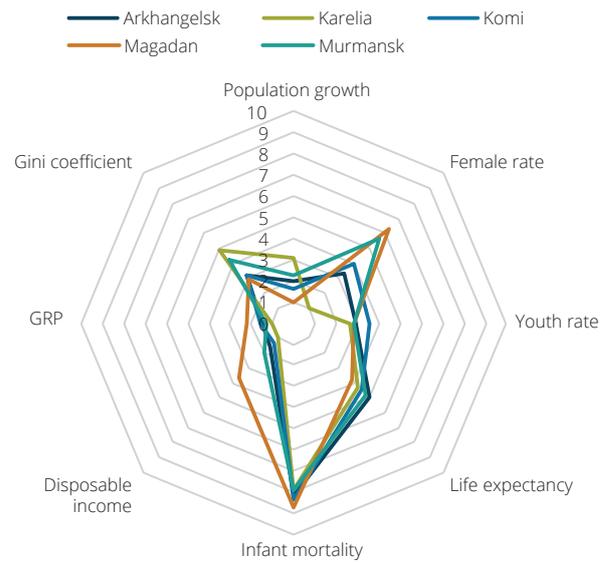


Figure 2.2. Nordic model, main pattern. 2018

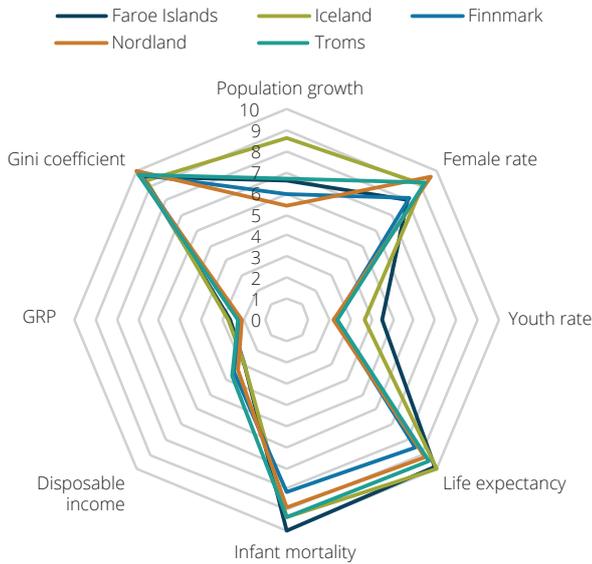


Figure 2.5. North America model, variation. 2018

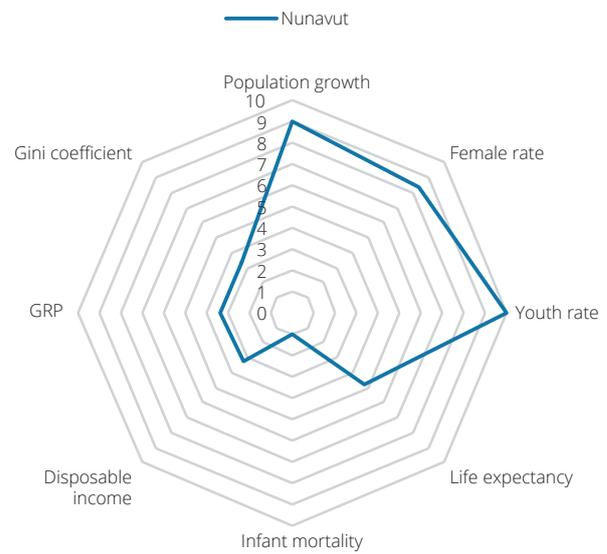


Figure 2.3. Nordic model, main pattern. 2018 (cont.)

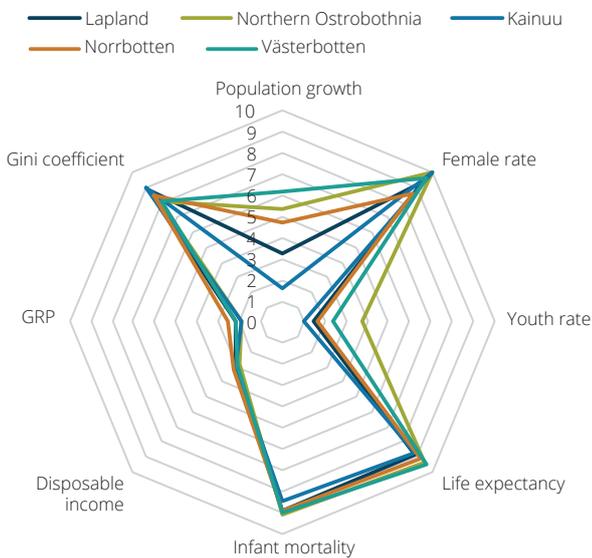


Figure 2.6. Nordic model, variation. 2018

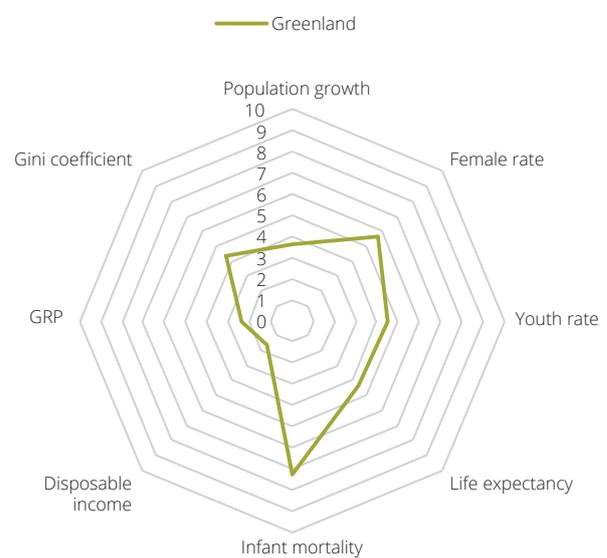


Figure 2.7. Russian Federation model, variation. 2018

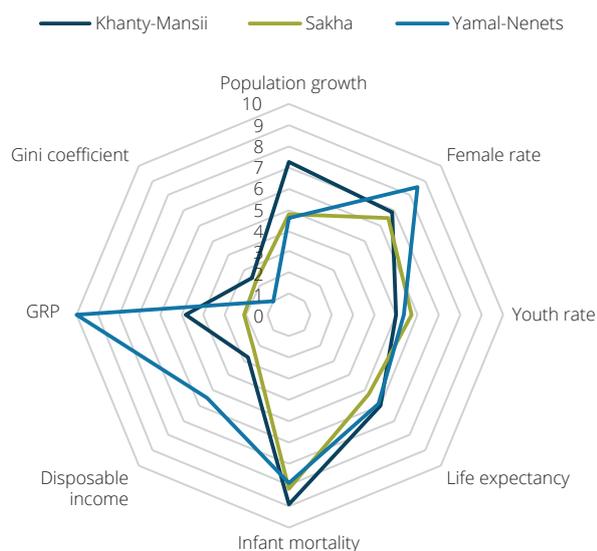
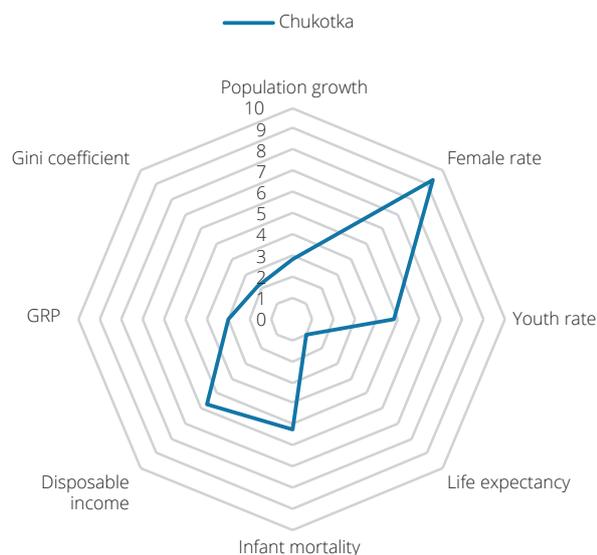


Figure 2.8. Russian Federation model, variation. 2018 (cont.)



regions. For example, life expectancy is lower, as is the disposable income per capita. The region also has the largest share of youths, but also a substantially higher rate of infant mortality (Figure 2.5).

Greenland has a similar GRP per capita in relation to the other Nordic regions and a relatively high youth rate, but differs for many indicators. In particular, the region has lower values than their Nordic neighbours for female rate, life expectancy, and disposable income per capita. Moreover, Greenland also has a high infant mortality rate, and a high level of economic inequality as indicated by the Gini coefficient (Figure 2.6).

There are two variation models of the socio-economic situation in the Russian Federation. The first variation includes Khanty-Mansii, Sakha, and Yamal-Nenets. In relation to the main Russian model, these regions are the only regions to experience population growth, and they have the highest youth rates. Khanty-Mansii and Yamal-Nenets also have the highest GRP per capita in Arctic Russia and the circumpolar Arctic, while Yamal-Nenets has the second highest disposable income per capita in Arctic Russia (Figure 2.7).

The second variation model is for Chukotka. The region falls just behind the other variation model with regards to youth rate. It also has the highest disposable income per capita in Arctic Russia, and the third highest GRP per capita behind Khanty-Mansii and Yamal-Nenets. Despite these relatively positive economic indicators, it also has the lowest life expectancy and highest infant mortality rate (Figure 2.8).

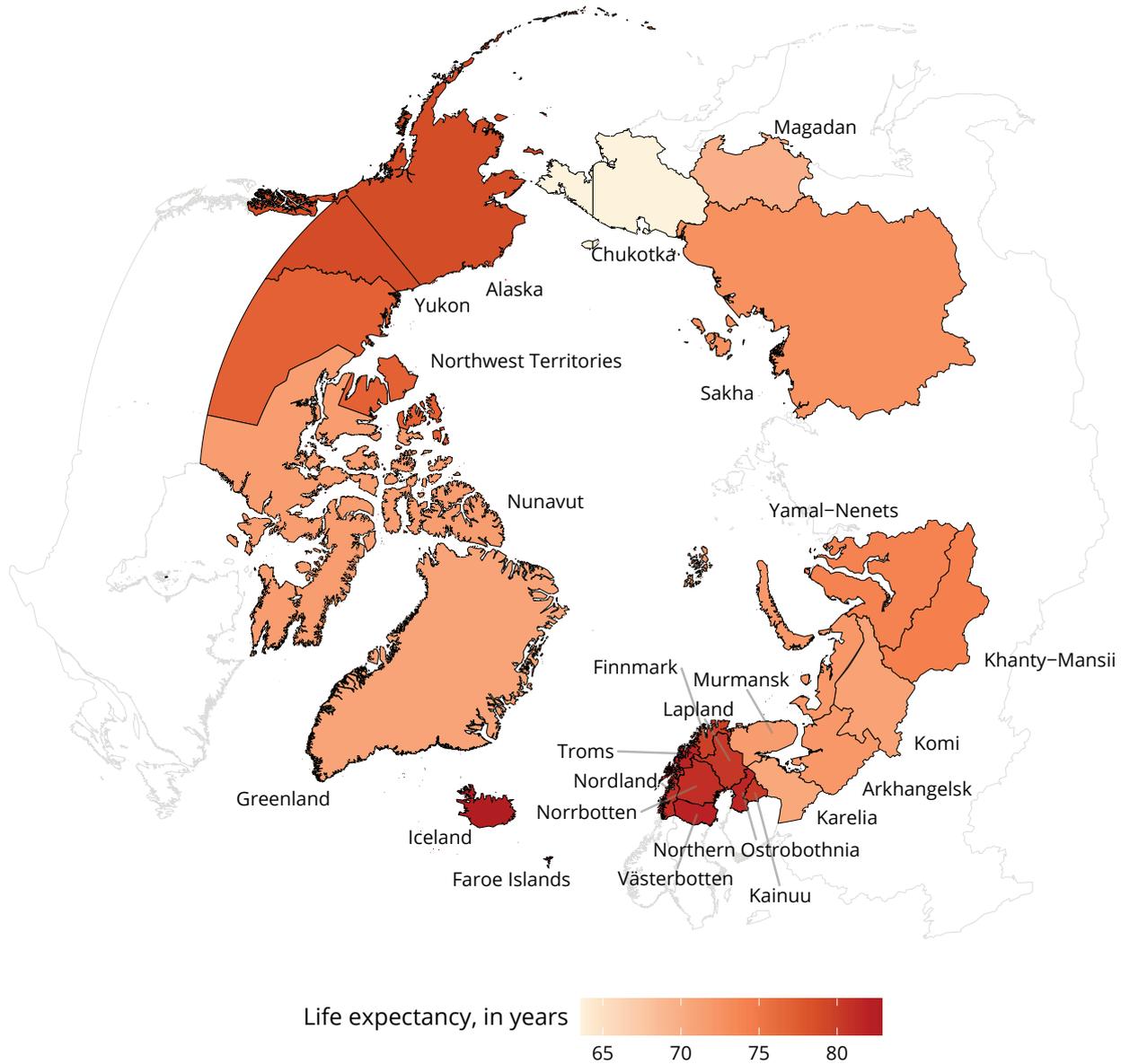
The analysis of key socio-economic indicators for 2018 demonstrates consistency in the existence of regional models for North America, the Nordic countries, and the Russian Federation. At the same time, the analysis also shows that variations are still found within each model, further confirming that inequalities exist both between and within regions.

Maps are used to visualize the differences between the regions for three indicators: life expectancy, infant mortality, and Gini coefficient (Figures 2.9 to 2.11). Figure 2.9 shows that the highest life expectancy is found in the Nordic regions and North America. Figure 2.10 shows that the highest infant mortality is found in Nunavut. Figure 2.11 shows that inequality, measured by the Gini coefficient, is highest in Yamal-Nenets and Alaska, and lowest in the Nordic Arctic regions.

Circumpolar Changes

Finally, we provide a synthesis of the circumpolar changes from 2012 to 2018. The change between 2012 and 2018 was calculated for each of the indicators (see Annex 2.1), and selected indicators are illustrated in a series of bar graphs (Figures 2.12 to 2.19), presenting the changes observed from 2012 to 2018 (2012 being the year of observations in the previous ECONOR report). The selected key indicators are: population growth,

Figure 2.9. Map of circumpolar Arctic life expectancy, in years. 2018¹



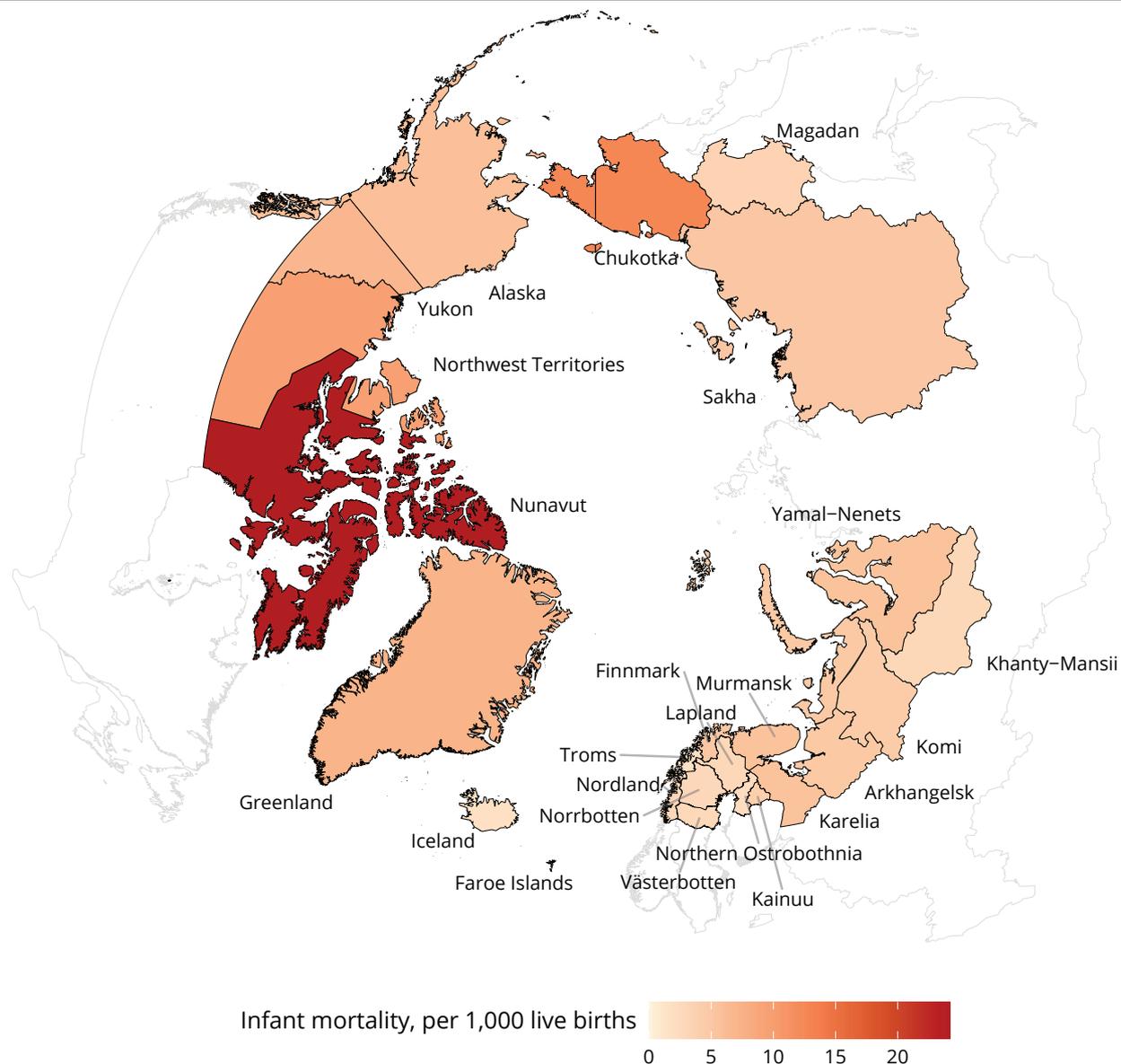
¹ Data for life expectancy in different regions are the most recent available data, see notes at the end of the chapter.

youth rate, life expectancy, infant mortality, female rate, disposable income per capita, GRP per capita, and the Gini coefficient. Compared to the previous ECONOR report, we now include infant mortality and the Gini coefficient, while we are not able to include tertiary education, for lack of data.

On average, the population growth in the Arctic in 2018 compared to 2012 seems very low. In reality, this result masks contrasting changes between the geographical groups: while there is a growth of 13 849 inhabitants in North America and 56 860 in the Nordic countries, this increase is almost completely cancelled out in the total for the Arctic by the population decrease in the Russian regions by 66 795 inhabitants. The Canadian regions of Yukon

and Nunavut show the highest relative growth, followed by Iceland in the Nordic countries. Of the three regions in Russia with population growth, Khanty-Mansii is the only region where growth is substantial. However, population decline is seen in six of the nine Russian regions, as well as in Lapland, Kainuu, and Greenland in the Nordic countries. North America is the only group of regions that did not experience a decline in 2018 as compared to 2012 (Figure 2.12).

The change in the youth rate also presents contrasts that tend to follow the contours of the geographical regions. Notably, there is a larger growth in the youth rate in the Russian North than in other regions. The only regions outside Russia

Figure 2.10. Map of circumpolar Arctic infant mortality, per 1 000 live births. 2018¹

¹ Data for infant mortality in different regions are the most recent available data, see notes at the end of the chapter.

where there have been slight increases in the youth rate are in northern Sweden and in Nunavut (Figure 2.13).

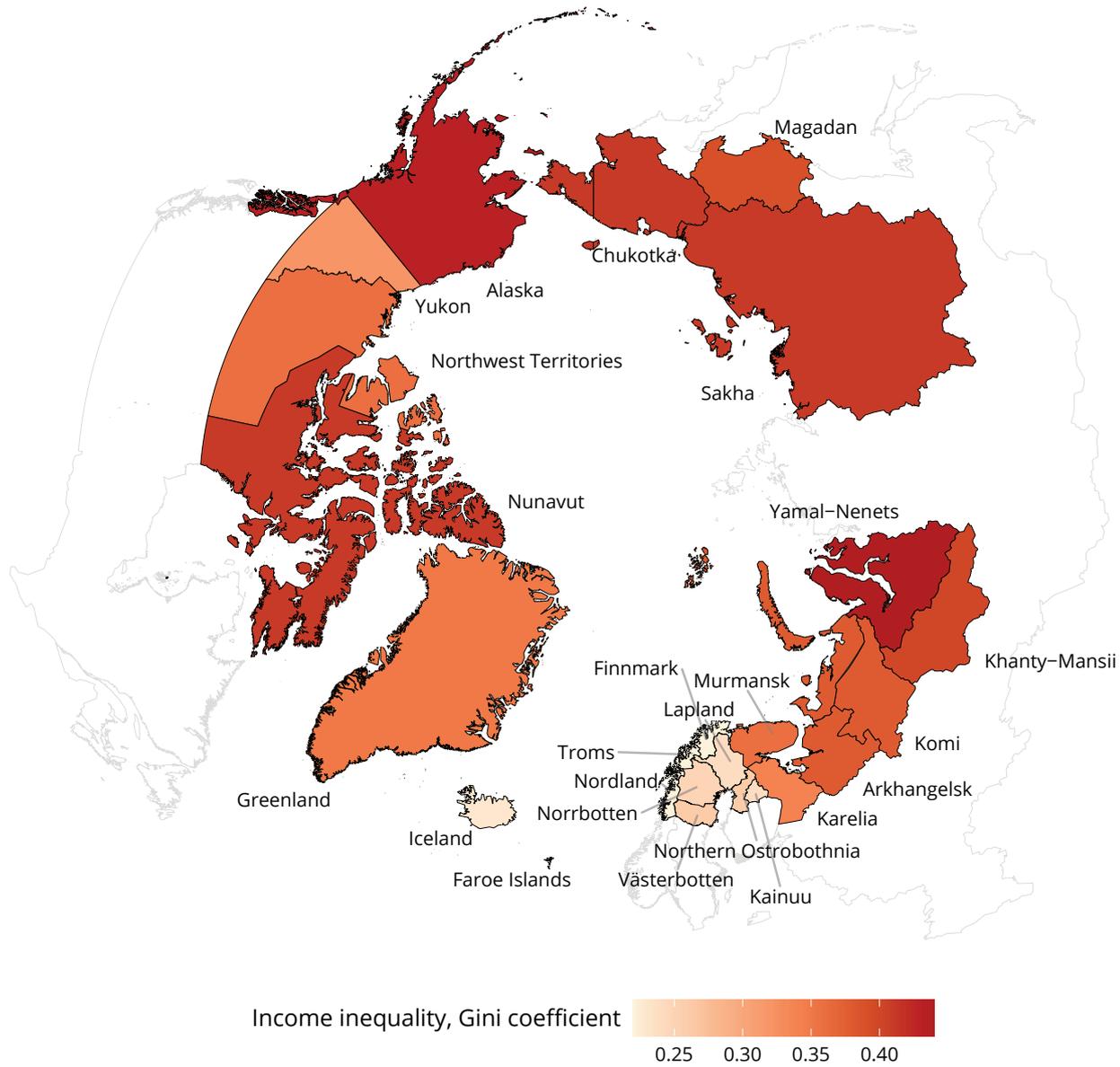
With the exception of Murmansk, all Russian regions show an increase in life expectancy of more than two years (see notes at the end of the chapter), while the variations in the rest of the Arctic are generally quite small. Nevertheless, an increase in life expectancy of about one, to one and a half years is observed for the regions of Greenland, the Faroe Islands, Kainuu, and Troms (Figure 2.14).

The Russian regions experienced a decline in infant mortality, while the North American re-

gions experienced a small increase. In the Nordic countries, generally small variations are recorded, except for Faroe Islands (Figure 2.15). It is important to note, however, that the infant mortality rate for the Faroe Islands can substantially vary from year to year, and is sometimes zero. This was the case in 2018 (see Table 2.1). Changes to the female rate are relatively small across the circumpolar Arctic. The largest decrease is in Iceland while the largest increase is in Yamal-Nenets (Figure 2.16).

In all Nordic regions, both economic indicators, GRP and disposable income, improved in 2018 compared to 2012. The range of growth between regions, however, is considerable. The Faroe Islands and Iceland, for example, show a

Figure 2.11. Map of circumpolar Arctic income inequality measured by the Gini coefficient. 2018¹



¹ Data for the Gini coefficient is based on equivalized household disposable income in different regions, where possible, and the most recent data available are used. See notes at the end of the chapter.

substantial increase in both disposable income per capita and GRP per capita, while the northern regions of Sweden show a smaller increase in gross regional product per capita than in disposable income per capita. In North America, the observed variations for both these economic indicators are generally less substantial than in other regions, with the exception of Nunavut. Nunavut saw its GRP per capita grow substantially in 2018 compared to 2012, and also experienced a decline in disposable income per capita.

The Russian regions present a more contrasted picture. Some regions saw both GRP per capita and disposable income per capita increase, including

Chukotka, Magadan and Yamal-Nenets. In contrast, Komi and Khanty-Mansi have experienced a decline in GRP per capita and have the largest declines in disposable income per capita (Figures 2.17 and 2.18).

Variations in income inequality are rather small, but they show some generally homogeneous trends across the geographical regions. Inequality has decreased slightly in most of the Russian regions, while it has increased slightly in some of the Nordic regions. Nevertheless, these variations remain small, and are marginal in several regions, particularly in North America (Figure 2.19).

Figure 2.12. Population by Arctic regions, relative changes 2012-2018. Per cent

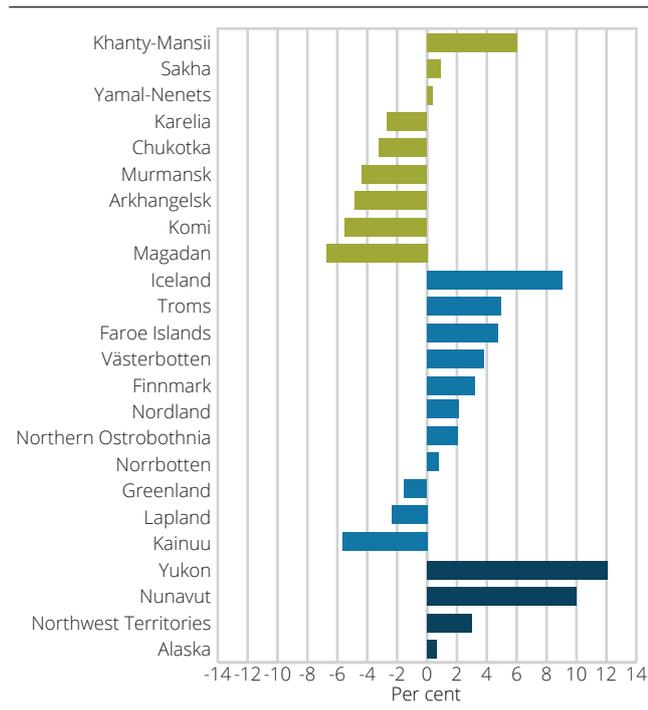


Figure 2.14. Life expectancy by Arctic regions, absolute changes 2012-2018. Years

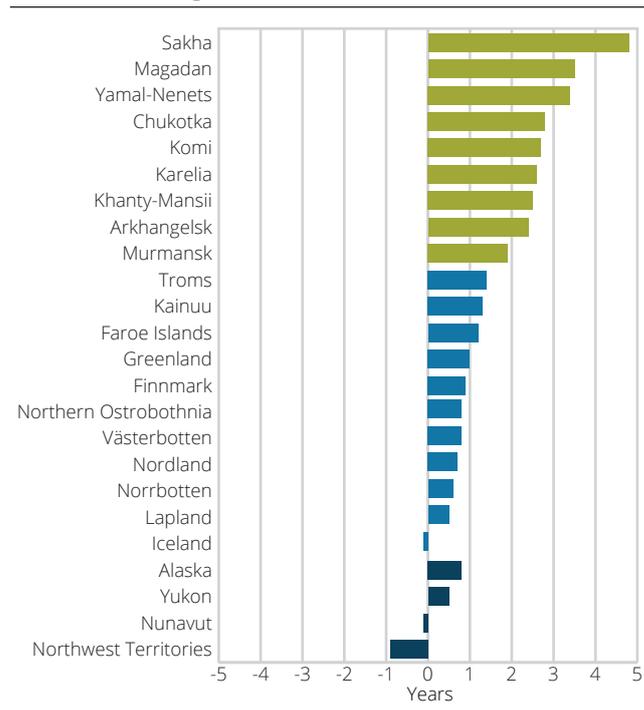
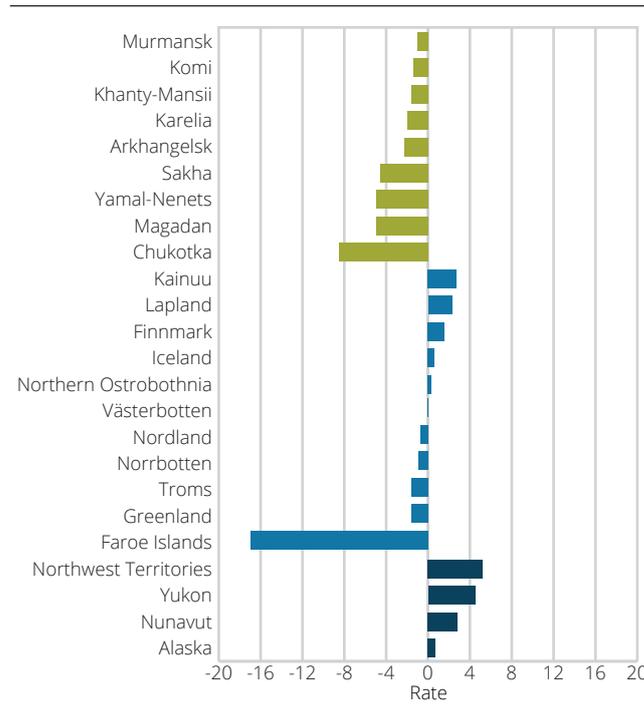


Figure 2.13. Youth rate by Arctic regions, absolute changes 2012-2018. Percentage point



Figure 2.15. Infant mortality by Arctic regions, absolute changes 2012-2018. Per 1 000 live births



Main findings

The findings comparing the situation in 2018 with 2012 raise questions about what is retained in 2018 from the situation in 2012, and what conclusions we can draw from the changes. Our study finds that the socio-economic situations in the three geographical regions follow different patterns of change. These similarities and

differences can be explained by factors related to political systems and regional economic trends.

Similar to the previous study, Russia’s Arctic regions continued to see improvement; in addition to a growing GRP per capita, these regions overall saw a substantial increase in the youth rate, an

Figure 2.16. Female rate by Arctic regions, absolute changes 2012-2018. Percentage point

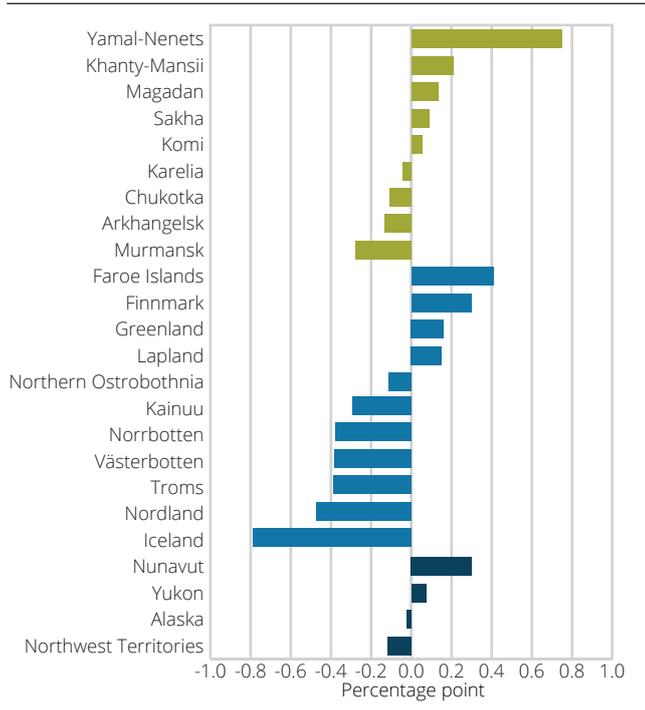


Figure 2.18. Gross regional product in 2018 USD-PPP per capita by Arctic regions, relative changes 2012-2018. Per cent

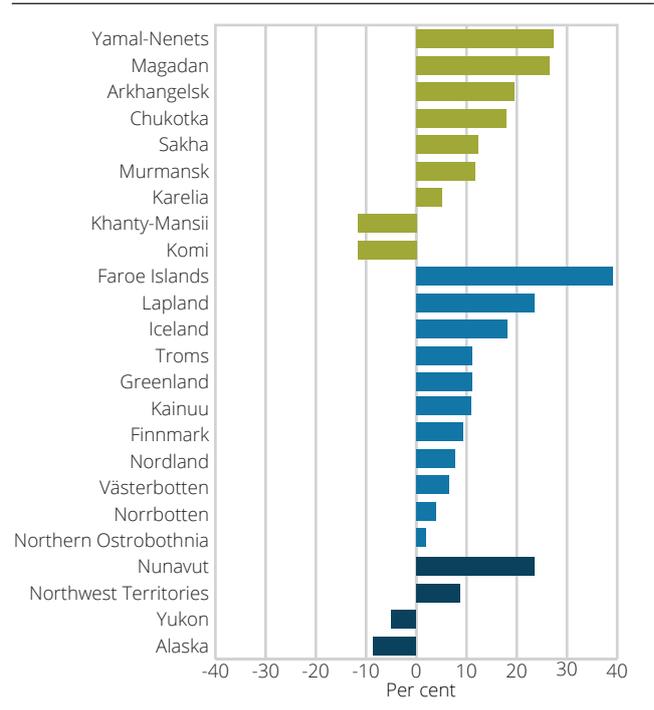


Figure 2.17. Disposable income in 2018 USD-PPP per capita by Arctic regions, relative changes 2012-2018. Per cent

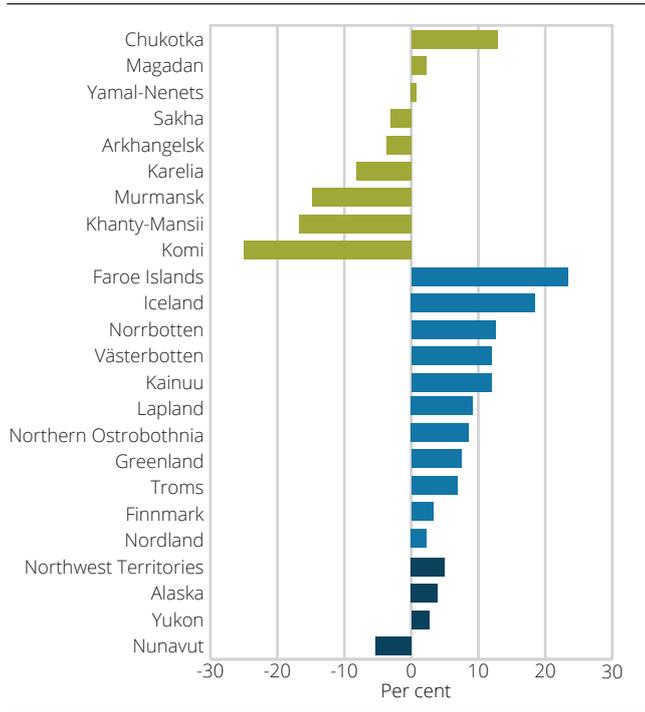
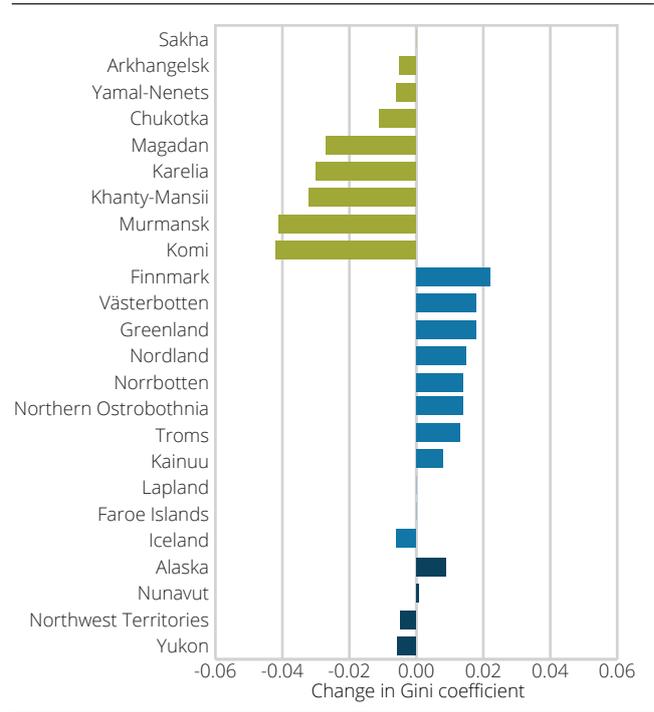


Figure 2.19. Income inequality measured by Gini coefficient by Arctic regions, absolute changes 2012-2018



increase in life expectancy, and a reduction of income inequality. The socio-economic situation of the Nordic regions also improved, with the exception of the Gini coefficient as there was a slight increase in income inequality, except for Iceland. Overall, the North American Arctic regions also experienced improvements in life expectancy, disposable income per capita, and GRP per capita.

The following examines each of the three geographical groups.

North America

When looking at the changes observed in 2018 compared to 2012, we can see improvement, with the exception of the youth rate and infant mortality. This, however, does not mean that



Tyonek Fish Camp – A fish camp in Tyonek on the shore of West Cook Inlet, Southcentral Alaska in June 2004. Photo: Davin Holen

economic growth is substantial. For example, increases in disposable income per capita and GRP per capita are rather modest when compared to the Nordic regions, and in some regions, these indicators are in decline, such as the disposable income per capita in Nunavut and the GRP per capita in Alaska and Yukon. Differences in change also exist in other indicators, such as the Gini coefficient where the changes are too small to lead to a clear conclusion on changes to income inequality.

The differences between the regions have an impact on the main pattern in 2018 for Alaska, the Northwest Territories, and Yukon. The area covered by these regions on the radar diagram is different, particularly for the disposable income per capita in Alaska and the population growth in Yukon. Yet, despite these differences, these three regions remain more similar together than when they are compared with Nunavut, which varies substantially with regards to disposable income, infant mortality, youth rate, life expectancy, and Gini coefficient. This, in part, may be explained by higher costs of living, and that Nunavut does not benefit

substantially from the mining industry, despite the Nunavut Agreement.¹⁰ This could also be explained more broadly by the general socio-economic condition of the Inuit in Nunavut. Even though they form the majority of the population in Nunavut, they are disadvantaged compared to non-aboriginals in the territory, and compared to Canadian standards, in terms of health, education and economic conditions.¹¹

Certain factors contribute to both the similarities and differences within the North American North. First, the federal political systems in the United States and Canada, and the transfer of responsibilities to territorial governments (devolution) in the Canadian territories, provide state and territorial governments with an increased ability to make decisions,¹² in comparison to regions in other parts of the circumpolar Arctic with centralized government structure.

Second, the regional primary economic activities are dominated by the extractive resource sector, public administration and defence.¹³ There are, however, some consequences to reliance on

Box 2.2 Nunavik and other regions with undocumented socio-economic conditions

Some Arctic regions are not explicitly included in this circumpolar comparison because there is not a sufficient statistical data set to be able to describe their socio-economic conditions in a meaningful way. There are several reasons that explain these situations. First, some regions are not systematically covered by national statistical agencies because of their status. In Canada, this is the case for Nunavik, Nunatsiavut, and the Inuvialuit region, as they are Inuit regions that are administratively attached to provinces. In Alaska, this is the case for all sub-state regions such as boroughs. Second, regions that were previously treated as self-governing can no longer be so treated due to administrative changes, with their inclusion in new, larger administrative regions. In Russia, this is the case of the Evenkiyskiy Autonomous Okrug, the Taimyr Peninsula inhabited by the Dolgan-Nenets, which are now included in the Krasnoyarsk region, and the Koryak region now included in the Kamchatka region.

Data on these regions exist, but their creation, extraction and analysis are generally the responsibility of initiatives outside national statistical agencies. For example, in Nunavik, the Kativik Regional Government has set up an autonomous statistics program. The program is called Nunivaat, which in Inuktitut means “our harvest,” a metaphor by which statistics are likened to wild berries harvested by hand.¹ Nunivaat maintains an open-access portal with all available socio-economic statistics. Moreover, it conducts studies to fill in the gaps. For example, several studies have shown the disparity in consumer prices and have led to the implementation of a permanent cost-of-living reduction program;² others follow the evolution of the regional economy over the long term.³ There are other similar initiatives in other regions.⁴ To integrate these realities into the circumpolar comparison, an inventory and analysis of the content produced could be a valuable addition to an upcoming report on the Economy of the North.



¹ www.nunivaat.org

² Robitaille, J., E. Guénard, S. Lévesque and G. Duhaime, The Cost of Living in Nunavik in 2016. Research Report Revised and Expanded Version. 2018. Chaire de recherche du Canada sur la condition autochtone compare: Québec. 22 pages + 10 app.

³ Robichaud, V. and G. Duhaime, Nunavik Economic Portrait 2012. Final Report on the Construction of a Social Accounting Matrix for Nunavik. Research Report. 2015.

⁴ For instance : <http://www.north-slope.org/your-government/nsb-2015-economic-profile-census-report>; <http://www.north-slope.org/your-government/comprehensive-plan>; Petrov, A., Inuvialuit Settlement Region Baseline Social Indicators: A Pilot Study by ResDA. 2014. Lakehead University & Yukon Research Centre. p. 41. <http://yukonresearch.yukoncollege.yk.ca/resda/projects/research-projects/theme-2-sustainable-communities/inuvialuit-indicators-project/>

certain sectors, such as public administration. According to political scientist Heather Exner-Pirot, these jobs have “driven up the cost of wages, which has inflated the cost of all other goods, resulting in an extremely high cost of living”¹⁴ as in the case of Northern Canada.

Nordic countries

The changes observed in 2018, when compared to 2012, show an overall improvement, with the exception of youth rate and Gini coefficient. The most substantial growth occurred for the disposable income per capita, while modest improvements are observed for life expectancy and GRP

per capita. Certain indicators, such as population growth and infant mortality, demonstrate improvement for some regions and a decline in others.

Nevertheless, the overall portrait of the Nordic regions continues to remain similar, as demonstrated in the main patterns for 2018. There is considerable similarity in life expectancy, disposable income per capita, GRP per capita, Gini coefficient, and to a lesser extent infant mortality.

The extent to which conditions are similar in the main pattern highlights the differences found in

Box 2.3. Wealth of the Arctic Group of Experts (WAGE)

The WAGE Circumpolar Partnership is supported by the Government of Canada's Department of Crown-Indigenous Relations and Northern Affairs, which financially supports the development and pilot phase of its work.

Despite its size and vitality, the Arctic economy is not spared by inequalities. This is suggested by evidence from recent work that identifies income inequalities between Indigenous and non-Indigenous Peoples;¹ between women and men;² between rural and urban areas;³ between regions with different industrial structures and those with different levels of economic activity;⁴ between regions with different levels of health, education and training.⁵ While recent knowledge has provided a glimpse of the phenomenon, its systematic understanding is still only at an exploratory stage, despite the importance that inequalities have taken on as an object of social science and as an issue for political decision-making.

The WAGE Circumpolar Partnership (Wealth of the Arctic Group of Experts) focuses on the economic and social inequalities in the Arctic and circumpolar North. It intends to respond to calls at the Arctic Council for states to address inequalities particularly affecting Indigenous Peoples and to initiate a fundamental transformation in the distribution of wealth produced in the Arctic. It echoes the Government of Canada's Arctic and Northern Policy Framework, which identifies addressing inequalities as a priority for action and research

and international collaboration as a means to inform public policy decisions.

WAGE has its origins in the ECONOR network, with which it is associated. It brings together more than 35 members from all Arctic countries; from the policy and practice community, including representatives of Indigenous organizations, NPOs and governments; and from the research community, universities, research centers, and statistical agencies. The WAGE Circumpolar Partnership is supported by the Government of Canada, which financially supports the development and pilot phase of its work. It is directed by Université Laval in Canada.

¹ Duhaime, G. and R. Édouard, Monetary poverty in Inuit Nunangat. Arctic. 2015. 68(2):223-32.; Lévesque, S. and G. Duhaime, Inequality and social processes in Inuit Nunangat. The Polar Journal. 2016. 6(1): 69-86.

² Oddsdóttir, E. E., A. M. Sigurðsson and S. Svandal, Conference Report Gender Equality in the Arctic: Current Realities, Future Challenges. 2015. Iceland Ministry for Foreign Affairs: Reykjavik.

³ Rasmussen, R. O. Megatrends. 2011. Nordic Council of Ministers: Copenhagen.

⁴ Nordic Council of Ministers, Arctic Social Indicators: ASI II: Implementation. 2015. Nordic Council of Ministers: Copenhagen.

⁵ Rautio, A., B. Poppel and K. Young, Human health and well-being. in Arctic Human Development Report: Regional Processes and Global Linkages, J.N. Larsen and G. Fondahl, Editors. 2014. Nordic Council of Ministers: Copenhagen. pp. 299-348.; Hirshberg, D. and A. N. Petrov, Education and human capital, in Arctic Human Development Report: Regional Processes and Global Linkages, J.N. Larsen and G. Fondahl, Editors. 2014. Nordic Council of Ministers: Copenhagen. pp. 349-99.

Greenland, which takes a very different shape in the radar diagrams. In particular, the youth rate and GRP per capita are higher, while the outcomes of remaining indicators are behind many of the other regions. Statistics Greenland points out that "income inequality in Greenland is higher than the Nordic average".¹⁵ As well, Greenland is similar to Nunavut in that it also experiences disadvantaged health outcomes.¹⁶

In contrast to North America, the government structure in the Nordic countries is generally centralized at the federal level,¹⁷ while municipalities have "the right to decide what tasks they want to manage to strengthen the welfare of their residents", although the extent of federal control and municipal authority varies from one country to another.¹⁸ Regardless of these differences, the Nordic Welfare Model ensures equitable access to social and public services, and is likely the main contributor to the similar situation across the region. However, there has been a general shift from preventative to reactive measures,¹⁹ thus potential-

ly altering the outcomes for individuals. Research has shown that household income inequality is increasing across the Nordic regions,²⁰ and this is demonstrated in our study as the Gini coefficient has increased in all regions but Iceland.

Another consideration that differentiates the Nordic regions from North America is the extent of the transportation infrastructure system. In particular, Iceland, Norway, Sweden, and Finland have a relatively comprehensive road network, connecting most of the communities throughout the region, while many but not all communities in Alaska, Yukon, and the Northwest Territories are connected by road. In contrast, intercommunity road networks in Nunavut and Greenland are non-existent.²¹

Russian Federation

In the regions forming the main socio-economic pattern of the Arctic regions of the Russian Federation, the improvements of social conditions that are documented are in line with the observations

made when comparing the data for 2006 and 2012 in the previous ECONOR reports. The decrease in infant mortality and the increase in life expectancy may be associated with the relative decrease in income inequality, observed earlier in the Arctic.²² These changes may be associated with improved employment conditions and quality of life in the High North regions.²³ Above all, they may be linked to national policies, with a major objective of recent Russian policy to re-establish basic social guarantees, particularly in the field of health, after the destabilization that followed the end of the Soviet regime.²⁴

As far as economic indicators are concerned, two main characteristics emerged. While GRP per capita has increased almost everywhere, personal disposable income per capita has decreased in most of the regions. The growth of the GRP per capita would generally be explained by an increase in petroleum production,²⁵ as well as minerals (see Chapter 4). There is also growth in construction (see Chapter 8) and other production, to some extent linked to an increase in local production to counter the effects of the American and European sanctions adopted in 2014.²⁶ The observed decline in personal disposable income (adjusted in terms of purchasing power) may also reflect the weakening of purchasing power resulting from the same sanctions, as imported goods became more expensive.²⁷

In Russia, the variations of socio-economic patterns identify very different situations. The increase in oil and gas production has led to different results for the regional economies: in Yamal-Nenets, the huge growth in production led to a corresponding increase in GRP per capita; but in Khanty-Mansii, the reduction in oil prices between 2013 and 2017, the weakening of the ruble, and the increase in population resulted in a decrease in GRP per capita, when converted to USD-PPP²⁸. In these two regions, unlike almost all the others, the population has grown and the cities have continued to develop.²⁹ In Chukotka, the highest disposable income per capita in Arctic Russia, and second highest in the circumpolar Arctic, have been made possible by large extractive industries.

The socio-economic conditions in the three geographical groups are shaped by different factors, such as political structures, emphasis on certain

economic industries, and transportation systems, for example. In line with the results presented in previous ECONOR reports, we continue to see that differences between the three geographical groups are shrinking, although there are increasing internal inequalities in some regions.

Summary

Our capacity to understand the socio-economic situation in the circumpolar Arctic has been limited by data availability. Some statistics that were available for the previous ECONOR report were not available for the current study. This was the case with the frequency at which the data is updated, e.g. when censuses are only completed every 10 years. Moreover, some statistics are not available, as is the situation when knowledge about the demographic situation on Indigenous Peoples is limited. There are challenges in obtaining population data for Indigenous Peoples,³⁰ while regional statistics are provided for the entire population. Finally, there are conceptual differences between definitions used by the different statistical agencies.

Comparing 2012 and 2018, the statistical challenges are no less today. Changes have occurred in some regional boundaries, resulting in loss in statistical coverage. It remains difficult to infer significant trends from small and very large changes, especially in regions where population size is small. It is difficult to elucidate local situations in the context of a broad comparison. For most regions, it remains impossible to obtain statistical information that is sufficiently recent and systematic to adequately describe the situation of Indigenous Peoples.

In addition to these challenges, there are also knowledge gaps in factors that have a direct impact on the wellbeing of northerners. For example, what is the real purchasing power across and within regions, and what is the basket of public services that are offered for free to residents? Moreover, not all statistical agencies provide data on the distribution of wealth within regions, making it more difficult to have a deeper understanding of income inequality.

Despite the statistical challenges, our analysis confirms three dominant features of the socio-economic portrait of the circumpolar Arctic. First,

a major gap continues to exist between the three geographical regions. Second, a modest convergence between them can be seen when we consider the diminishing income inequalities and the increasing life expectancy in Russia. Finally, the internal differences within the major geographical groups, that continue to have main and variation patterns of socio-economic conditions, have not changed since an overall picture was first presented in *The Economy of the North 2008*.

There are some phenomena that are important in explaining these differences, such as the population structure and dynamics, each region's role in the national and global economies, and redistribution of income and provision of public services to populations of the Arctic regions, both to Indigenous Peoples and other Arctic residents. In future research and statistical work, including ECONOR reports and the recent initiative of the Wealth of the Arctic Group of Experts (WAGE) (Box 2.3), it is important to continue to improve the knowledge basis for exploring the social and economic conditions and inequalities in the circumpolar Arctic.

Acknowledgements

We would like to thank the following experts at the different statistical agencies and organizations that took the time to answer our questions and help us find the relevant data:

Centre for Disease Control and Prevention (U.S.): CDC Info Response

Statistics Canada: Ryan Macdonald, Laurent Martel

Statistics Faroe Islands: Jógvan Bærentsen, Høgni P. Vilhelm

Statistics Finland: Joni Rantakari

Statistics Greenland: Emil Malta-Møller, Lars Pedersen

Statistics Iceland: Þóra Kristín Þórsdóttir

Statistics Norway: Elisabeth Løyland Omholt, Anders Sønstebo

Statistics Sweden: Dolan Haddad, Tomas Johansson, Johan Lindberg, Tomas Westling

Rosstat: Gregory Oksenoyt

Université Laval: Louise LeBlanc, Gaston Quirion

U.S. Census Bureau: U.S. Census Bureau Customer Support

Notes

- ¹ Larsen, J.N. and L. Huskey, *The Arctic economy in a global context.*, in *The New Arctic*, B. Evengård, J.N. Larsen and Ø. Paasche, Editors. 2015. Springer. pp. 159-174.
- ² Duhaime, G. and A. Caron, *Economic and social conditions of Arctic regions*, in *The Economy of the North*, S. Glomsrød and I. Aslaksen, Editors. 2009. Statistics Norway: Oslo-Kongsvinger. p. 12.
- ³ Larsen, J.N. and G. Fondahl, *Arctic Human Development Report II. Regional Processes and Global Linkages*. 2014. Nordic Council of Ministers: Copenhagen.
- ⁴ Larsen, J.N., P. Schweitzer and A. Petrov, *Arctic Social Indicators. ASI II: Implementation*. 2014. Nordic Council of Ministers: Copenhagen.
- ⁵ Personal disposable income per capita is calculated by dividing the total household disposable income (in millions of dollars) by the total population. Chapter 3 uses a similar method to calculate household disposable income per capita.
- ⁶ Duhaime, G. et al., *Social and economic inequalities in the circumpolar Arctic*, in *The Economy of the North 2015*, S. Glomsrød, G. Duhaime and I. Aslaksen, Editors. 2017. Statistics Norway: Oslo-Kongsvinger. p. 13.
- ⁷ Sen, A. K., *Development as Freedom*. 1999, Oxford: Oxford University Press. United Nations Development Programme, *Human development report*. 1990. p. 189. Wilkinson, R. and K. Pickett, *L'égalité c'est mieux. Pourquoi les écarts de richesses ruinent nos sociétés*. 2013. Montréal: Ecosociété. 379.
- ⁸ Additional data information for Table 2.1: Data is for the year 2018 with some exceptions, including Canada: Yukon infant mortality is from 2016, tertiary education is from the 2016 census data, Gini coefficient is from the 2016 census data; Norway: Infant mortality is for the range 2011-2015, disposable income is estimated following the growth rate of 2016; Russia: disposable income is estimated based on the average growth of 2016 and 2017. As well, life expectancy can be difficult to calculate when there are smaller populations and many of the national statistical agencies present this data in time blocks to account for this. The data presented here is for: Alaska 2010-2015; Yukon 2014-2016; NWT, Nunavut, and Finland 2016-2018, Faroe Islands and Greenland 2017-2018, Iceland and Russia 2018, Norway 2011-2015, and Sweden 2014-2018. Values for Norway and Sweden are weighted averages calculated by the research team as the official data is presented for male and female separately. It should also be noted that although the 2018 infant mortality rate for the Faroe Islands was 0 in 2018, it was 8.8 in 2017. As for tertiary education, this includes all university degrees (short and long). Data for the Faroe Islands is missing because Statistics Faroe Islands does not have current data on this indicator. The most current educational attainment data for Russia is the 2010 census, therefore, the data presented in the table is the per cent of the population enrolled in tertiary education at the bachelor, specialist, or master's level. Therefore, Russian data cannot be compared with data from other regions. Finally, the Gini coefficient is a measure of income inequality within a given population. The coefficient varies between 0 and 1, where 0 signifies perfect equality, and 1 corresponds to complete inequality, i.e. where a single person has the entire income of the economy. Where possible, data for the Gini coefficient was collected based on equalized disposable income, however, there were some exceptions: USA: Gini coefficient is officially calculated on gross household income and is not equalized; Canada: Gini co-

efficients are not available through Statistics Canada and were calculated on 2016 census data by the research team; Russia: Gini coefficients are calculated from total pre-tax income divided by household size.

- ⁹ This is a translation of the original text (Численность студентов, обучающихся по программам бакалавриата, специалитета, магистратуры, тыс. Человек) which is an indicator used for each region in: РЕГИОНЫ РОССИИ. ОСНОВНЫЕ ХАРАКТЕРИСТИКИ СУБЪЕКТОВ РОССИЙСКОЙ ФЕДЕРАЦИИ 2019 СТАТИСТИЧЕСКИЙ СБОРНИК. 2019, Москва: Росстат. [Regions of Russia. Main characteristics of the subjects of the Russian Federation 2019 statistical digest. 2019. Moscow: Rosstat.]
- ¹⁰ Bernauer, W., The limits to extraction: mining and colonialism in Nunavut. *Canadian Journal of Development Studies / Revue canadienne d'études du développement*, DOI: 10.1080/02255189.2019.1629883
- ¹¹ Southcott, C., Socio-economic trends in the Canadian North: Comparing the Provincial and Territorial Norths. *Northern Review*, [S.I.], 38, mar. 2015. ISSN 1929-6657. Available at: <https://thenorthernreview.ca/nr/index.php/nr/article/view/330>.; Lévesque, S. and G. Duhaime, Inequality and social processes in Inuit Nunangat. *The Polar Journal*. 2016. 6(1): p. 69-86. Larsen, J.N., and G. Fondahl, Arctic Human Development Report. 2014. Nordic Council of Ministers, TemaNord: Copenhagen.; Duhaime, G. and R. Édouard, Monetary poverty in Inuit Nunangat. *Arctic, Arctic Institute of North America*. 2015. 68(2): 223-232. <http://dx.doi.org/10.14430/arctic4481>.
- ¹² Poelzer G. and G.N. Wilson, Governance in the Arctic: Political systems and geopolitics, in *Arctic Human Development Report: Regional Processes and Global Linkages*, J.N. Larsen and G. Fondahl, Editors. 2014. Nordic Council of Ministers: Copenhagen. p. 189-190.
- ¹³ Glomsrød, S. et al., Arctic economies within the Arctic nations, in *The Economy of the North 2015*, S. Glomsrød, G. Duhaime and I. Aslaksen, Editors. 2017. Statistics Norway: Oslo-Kongsvinger. p. 38, 44.
- ¹⁴ Exner-Pirot, H., Canada's northern economic development paradigm and its failures, in *Canada's Arctic Agenda: Into the Vortex*, J. Higginbotham and J. Spence, Editors. 2019. Centre for International Governance Innovation: Waterloo. p. 17.
- ¹⁵ Vahl, B. and N. Kleemann (Editors), *Greenland in Figures 2019*, Statistics Greenland. 2019. p. 31.
- ¹⁶ Rautio, A., B. Poppel and K. Young, Human health and well-being. in *Arctic Human Development Report: Regional Processes and Global Linkages*, J.N. Larsen and G. Fondahl, Editors. 2014. Nordic Council of Ministers: Copenhagen. p. 302.
- ¹⁷ Poelzer G. and G.N. Wilson, Governance in the Arctic: Political systems and geopolitics, in *Arctic Human Development Report: Regional Processes and Global Linkages*, J.N. Larsen and G. Fondahl, Editors. 2014. Nordic Council of Ministers: Copenhagen. p. 191.
- ¹⁸ Mäkinen, E., Controlling Nordic municipalities. *Public Law*. 2017. 23(1): p. 123, 142.
- ¹⁹ Melin, H., The Nordic Model and social inequalities, in *Welfare State at Risk: Rising Inequality in Europe*, D. Eißel, W. Rokicka and J. Leaman, Editors. 2014. Springer. See p. 114-118.
- ²⁰ Grunfelder, J., Increasing income inequality, in *State of the Nordic Region 2020*, J. Grunfelder, G. Norlén, L. Randall, N. Sánchez Gassen, Editors. 2020. Nordic Council of Ministers: Copenhagen. p. 101.
- ²¹ Turunen, E., Road Accessibility of Arctic Settlements. 2019. Nordregio. Map available at: <https://nordregio.org/maps/road-accessibility-of-arctic-settlements/>
- ²² Duhaime G. and S. Lévesque, Arctic social inequities in the global economy, in *Transitions in Everyday Life in the Arctic*, M. Tenberg, A. Espiritu et al., Editors. In Press. Routledge: London.; Wilkinson, R. and K. Pickett, *L'égalité c'est mieux*. 2013. Écosociété: Montreal. p. 378.; Milanovic, B., *Inégalités mondiales*. 2016. La Découverte: Paris. P. 285.
- ²³ Giltman, M., Impact of wages on employment and migration in High North of Russia, in *The Interconnected Arctic — UArctic Congress 2016*, In K. Latola and H. Savela, Editors. 2017. Springer Polar Sciences. DOI 10.1007/978-3-319-57532-2_18
- ²⁴ Raviot, J-R., La fabrique des élites en Russie, in *Regards de l'Observatoire franco-russe 2019*, A. Dubien, Editor. 2019. L'Inventaire: Paris. p. 119-133.; Petoukhov, V., Dynamique des tendances sociales en Russie et naissance d'une demande de changements. In *Regards de l'Observatoire franco-russe 2019*, A. Dubien, Editor. 2019. L'Inventaire: Paris. p. 137-148.
- ²⁵ Simonov, K., Le secteur pétrogazier en 2018. In *Regards de l'Observatoire franco-russe 2019*, A. Dubien, Editor. 2019. L'Inventaire: Paris. p. 235-251.
- ²⁶ Raviot, op.cit.; Shapovalova, D., E. Galimullin and E. Grush-evenko, Russian offshore petroleum governance: The effects of Western sanctions and outlook for Northern development. *Energy Policy*, 2020. 146: p. 1-8.
- ²⁷ Simonov, K., Le secteur pétrogazier en 2018. In *Regards de l'Observatoire franco-russe 2019*, A. Dubien, Editor. 2019. L'Inventaire: Paris. p. 235-251.
- ²⁸ Simonov (2019), op. cit.
- ²⁹ Laruelle, M., Le réajustement des politiques arctiques de la Russie dans le contexte de l'après-2014. In *Regards de l'Observatoire franco-russe 2019*, A. Dubien, Editor. 2019. L'Inventaire: Paris. p. 316.
- ³⁰ For example: Young, T.K. and P. Bierregaard, Towards estimating the Indigenous population in the circumpolar regions. *International Journal of Circumpolar Health*, 2019. 78(1).

Annex 2.1. Changes in selected social and economic indicators¹ and composite index. Arctic regions, changes between 2012 and 2018²

Regions	Popula- tion	Female rate	Youth rate	Re- place- ment rate	Demo- graphic depend- ency	Life expec- tancy	Infant mor- tality	Tertiary edu- cation	Eco- nomic depend- ency	Dis- pos- able income	GRP	Gini coeffi- cient	Com- posite index
	N	Per cent		Ratio		Years	Per 1 000 live births	Per cent	Ratio	USD-PPP per cap		Ratio	n
Alaska	4 696	0.0	-0.7	0.0	0.1	0.80	0.7	2.6	0.0	2 119	-6 939	0.009	-0.50
Northwest Territories	1 308	-0.1	-0.5	0.0	0.0	-0.90	5.2	2.5	0.1	1 562	7 020	-0.005	-0.25
Nunavut	3 467	0.3	0.4	0.0	0.0	-0.10	2.8	1.0	-0.1	-1 294	14 229	0.001	0.15
Yukon	4 378	0.1	0.0	0.0	0.1	0.50	4.5	2.4	0.0	854	-3 287	-0.006	-0.13
Faroe Islands	2 271	0.4	-0.4	0.0	0.0	1.20	-16.9	..	-0.2	4 061	16 163	0.000	1.33
Lapland	-4 322	0.2	-0.4	0.0	0.1	0.45	2.3	3.0	-0.1	1 882	8 695	0.000	-0.08
Northern Ostrobothnia	8 241	-0.1	-0.8	0.0	0.1	0.81	0.3	2.8	-0.1	1 687	744	0.014	-0.12
Kainuu	-4 374	-0.3	-0.6	0.0	0.1	1.31	2.7	2.7	-0.1	2 395	3 826	0.008	-0.08
Greenland	-872	0.2	-1.0	0.0	0.0	1.04	-1.6	1.9	-0.1	1 084	5 084	0.018	0.10
Iceland	28 875	-0.8	-1.4	0.0	0.0	-0.06	0.6	7.8	-0.1	3 330	9 158	-0.006	0.26
Finmark	2 380	0.3	-1.8	0.1	0.0	0.93	1.6	3.5	0.0	763	3 903	0.022	-0.03
Nordland	5 015	-0.5	-1.1	0.0	0.0	0.68	-0.7	3.8	0.0	525	3 225	0.015	0.06
Troms	7 849	-0.4	-1.3	0.0	0.0	1.42	-1.6	4.5	-0.1	1 622	4 791	0.013	0.23
Norrbottnen	1 860	-0.4	0.4	0.0	0.1	0.57	-0.9	3.2	-0.1	2 553	2 085	0.014	0.19
Västerbotten	9 937	-0.4	0.9	-0.1	0.1	0.81	-0.1	2.4	-0.1	2 326	2 834	0.018	0.28
Arkhangelsk	-58 505	-0.1	1.8	-0.1	0.1	2.45	-2.3	-1.3	0.1	-595	4 656	-0.005	0.08
Chukotka	-1 640	-0.1	0.7	-0.1	0.0	2.79	-8.5	0.3	0.1	3 978	9 677	-0.011	0.42
Karelia	-17 197	0.0	1.9	-0.1	0.1	2.56	-2.0	-1.4	0.1	-1 123	885	-0.030	0.29
Khanty-Mansii	93 836	0.2	2.2	-0.1	0.1	2.49	-1.6	-1.3	0.0	-4 212	-14 291	-0.032	0.06
Komi	-48 964	0.1	2.1	-0.2	0.1	2.73	-1.4	-1.8	0.1	-4 674	-4 220	-0.042	0.12
Magadan	-10 394	0.1	1.6	-0.1	0.1	3.47	-4.9	-3.9	0.1	549	10 015	-0.027	0.28
Murmansk	-34 391	-0.3	2.0	-0.1	0.1	1.87	-1.0	-2.6	0.1	-2 982	2 725	-0.041	0.25
Sakha	8 471	0.1	1.5	-0.1	0.1	4.79	-4.6	-1.8	0.0	-590	4 951	0.000	0.37
Yamal-Nenets	1 989	0.7	2.3	-0.1	0.1	3.41	-4.9	-1.8	0.1	261	49 630	-0.006	0.14

¹ Population growth: average annual per cent; female rate: per cent of women in total population (as compared to global average at 49.58 in 2018, from World Bank); replacement rate: distance of the ratio of children (0-14 years) and women (15-54 years) from the replacement rate of 2.1; youth rate: per cent of 0-14 years in the total population; demographic dependency: (0-14) + (65+) / (15-64); infant mortality: per 1 000 live births; tertiary education: per cent of tertiary level graduates in total population; economic dependency: (non-employed/employed person in total population); disposable income: personal disposable income in 2018 USD-PPP; GRP: gross regional product in 2018 USD-PPP.

² The data from Table 2.1 is compared to the following years: Life expectancy: Canada 2010-2012; Finland and Greenland 2011-2012; Iceland and Russia 2012; Finland and Alaska 2012 (ECONOR); Norway 2006-2010; Sweden 2008-2012; Infant mortality: Norway 2006-2010; Tertiary education: Canada 2011 census data; Gini: Canada 2011 census data. In order to compare Disposable Income and GRP per capita across time, the values for 2012 were converted into 2018 USD PPP. 2012; Finland and Alaska 2012 (ECONOR); Norway 2006-2010; Sweden 2008-2012; Infant mortality: Norway 2006-2010; Tertiary education: Canada 2011 census data; Gini: Canada 2011 census data. In order to compare Disposable Income and GRP per capita across time, the values for 2012 were converted into 2018 USD PPP.

Annex 2.2: ArcticStat Circumpolar Databank

As a result of multiple sources, finding the relevant socio-economic data for the Arctic regions has long been a highly time-consuming process.

ArcticStat was created to overcome this difficulty and to increase research capacity by taking advantage of already existing data. This databank aims to facilitate research by importing, stocking, and organizing, in a user-friendly way, socio-economic data covering some 30 Arctic regions belonging to 8 countries.

The data in ArcticStat covers dwellings, population, language, health, education, migration, economy, employment, and other social and economic realities. It is an open-access web-based databank that links

users directly to the relevant tables on the original websites, when possible; moreover, the portal offers a PDF and an EXCEL copy of these tables.

ArcticStat was launched in 2007, and it has been kept up to date by monitoring updates on the relevant statistical agency websites. It gives access to more than 11 800 tables through 8 indicators and some 77 sub-indicators. ArcticStat is an independent databank created at Université Laval by the Canada Research Chair on Comparative Aboriginal Condition. It was considered as a major Canadian contribution to the International Polar Year. It can be found at www.arcticstat.org

Appendix: Data sources for Chapter 2

Alaska

Bureau of Economic Analysis (BEA). SAGDP1 Gross Domestic Product (GDP) summary, annual by state
<https://apps.bea.gov/iTable/iTable.cfm?acrdn=6&isuri=1&reqid=70&step=1#reqid=70&step=1&isuri=1>

Bureau of Economic Analysis (BEA). SAINC4 Personal Income and Employment by Major Component
<https://apps.bea.gov/iTable/iTable.cfm?reqid=70&step=1&isuri=1>

Bureau of Economic Analysis (BEA). SAINC5 Personal Income by Major Component and Earnings by Industry
<https://apps.bea.gov/iTable/iTable.cfm?acrdn=6&isuri=1&reqid=70&step=1#reqid=70&step=1&isuri=1>

Centre for Disease Control and Prevention (National Centre for Health Statistics). Life Expectancy at Birth for U.S. States and Census Tracts, 2010-2015
<https://data.cdc.gov/api/views/5h56-n989/rows.csv?accessType=DOWNLOAD&bom=true&format=true>

Centre for Disease Control and Prevention (CDC Wonder). About Underlying Cause of Death, 1999-2019
<https://wonder.cdc.gov/controller/saved/D76/D93F116>

U.S. Census Bureau. Annual Estimates of the Resident Population for Selected Age Groups by Sex for Alaska: April 1, 2010 to July 1, 2019
<https://www2.census.gov/programs-surveys/popest/tables/2010-2019/state/detail/sc-est2019-agesex-02.xlsx>

U.S. Census Bureau. Educational Attainment
<https://data.census.gov/cedsci/table?q=Education&g=0400000US02&y=2018&tid=ACSST1Y2018.S1501&hidePreview=true>

U.S. Census Bureau. Gini index of income inequality
<https://data.census.gov/cedsci/table?q=gini&g=0400000US02&y=2018&tid=ACSST1Y2018.B19083&hidePreview=true>

Canada

Statistics Canada. Census Profile. 2016 Census. Statistics Canada Catalogue no. 98-316-X2016001. Ottawa. Released November 29 2017
<http://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E>

Statistics Canada. National Household Survey Profile. 2011 National Household Survey. Statistics Canada Catalogue no. 99-004-XWE. Ottawa. Released June 26 2013
<http://www12.statcan.gc.ca/nhs-enm/2011/dp-pd/prof/index.cfm?Lang=E>

Statistics Canada. Table 13-10-0140-01 Life expectancy and other elements of the life table, Prince Edward Island and the territories
<https://doi.org/10.25318/1310014001-eng>

Statistics Canada. Table 36-10-0222-01 Gross domestic product, expenditure-based, provincial and territorial, annual (x 1,000,000)
<https://doi.org/10.25318/3610022201-eng>

Statistics Canada. Table 36-10-0224-01 Household sector, current accounts, provincial and territorial, annual
<https://doi.org/10.25318/3610022401-eng>

Statistics Canada. Table 13-10-0713-01 Infant deaths and mortality rates, by age group
<https://doi.org/10.25318/1310071301-eng>

Statistics Canada. Table 14-10-0202-01 Employment by industry, annual
<https://doi.org/10.25318/1410020201-eng>

Statistics Canada. Table 17-10-0005-01 Population estimates on July 1st, by age and sex
<https://doi.org/10.25318/1710000501-eng>

Faroe Islands

Statistics Faroe Islands. AM03030 Employees by industry, region, sex, age and month (1985-2020)
https://statbank.hagstova.fo/pxweb/en/H2/H2_AM_AM03/lonv_kaoamd.px/

Statistics Faroe Islands. B01030 Population by sex, age and village/city, 1st January (1985-2020)
https://statbank.hagstova.fo/pxweb/en/H2/H2_IB_IB01/fo_aldbygd.px/

Statistics Faroe Islands. IB02050 Life expectancy by age and sex (1966-2019)
https://statbank.hagstova.fo/pxweb/en/H2/H2_IB_IB02/fd_livsavi.px/

Statistics Faroe Islands. IB02070 Mortality rate (per 1,000) by age and sex (1985-2019)
https://statbank.hagstova.fo/pxweb/en/H2/H2_IB_IB02/fd_deydkvot.px/

Statistics Faroe Islands. IP01010 Gini and Hoover indexes and income quantile ratios by age, sex, type of household and region (2009-2018)
https://statbank.hagstova.fo/pxweb/en/H2/H2_IP_IP01/innt_ginfin.px

Statistics Faroe Islands. IP01035 Income and taxes by municipality, deciles and average (2009-2018)
https://statbank.hagstova.fo/pxweb/en/H2/H2_IP_IP01/des_kom.px/

Statistics Faroe Islands. TB02010 Gross domestic product at current prices (1998-2018)
https://statbank.hagstova.fo/pxweb/en/H2/H2_TB_TB02/tb_btu.px

Finland

Finnish Institute for Health and Welfare. Select indicators
https://sotkanet.fi/sotkanet/en/haku?indicator=s_YtBgA=®ion=szYpTsTbSMwQA&year=sy6rsjbs0zUEAA==&gender=t

Statistics Finland. 11ra -- Key figures on population by region, 1990-2019
http://pxnet2.stat.fi/PXWeb/pxweb/en/StatFin/StatFin_vrm_vaerak/statfin_vaerak_pxt_11ra.px/

Statistics Finland. 11re -- Population according to age (1-year) and sex by area, 1972-2019
http://pxnet2.stat.fi/PXWeb/pxweb/en/StatFin/StatFin_vrm_vaerak/statfin_vaerak_pxt_11re.px/

Statistics Finland. 12bd -- Income and production by area, annually, 2000-2019*
http://pxnet2.stat.fi/PXWeb/pxweb/en/StatFin/StatFin_kan_altp/statfin_altp_pxt_12bd.px/

Statistics Finland. 12bf -- Household income and expenditure by area, annually, 2000-2018
http://pxnet2.stat.fi/PXWeb/pxweb/en/StatFin/StatFin_kan_altp/statfin_altp_pxt_12bf.px/

Statistics Finland. 12bg -- Employment and hours worked by area, annually, 2000-2019*
http://pxnet2.stat.fi/PXWeb/pxweb/en/StatFin/StatFin_kan_altp/statfin_altp_pxt_12bg.px/

Statistics Finland. 12bs -- Population aged 15 or over by level of education, municipality, region, gender and age, 2007-2019
http://pxnet2.stat.fi/PXWeb/pxweb/en/StatFin/StatFin_kou_vkour/statfin_vkour_pxt_12bs.px/

Statistics Finland. 127r -- Income differences and equalising impact of current transfers on income differences in dwelling population by region, 1995-2018
http://pxnet2.stat.fi/PXWeb/pxweb/en/StatFin/StatFin_tul_tjt_henkiloiden/statfin_tjt_pxt_127r.px/

Statistics Finland. Appendix table 1. Life expectancy at birth by region in the period 2016 to 2018
http://tilastokeskus.fi/til/kuol/2018/01/kuol_2018_01_2019-10-24_tau_001_en.html

Statistics Finland. Appendix table 1. Life expectancy at birth by region in the period 2015 to 2017
http://tilastokeskus.fi/til/kuol/2017/01/kuol_2017_01_2018-10-26_tau_001_en.html

Statistics Finland. Appendix table 1. Life expectancy at birth by region in the period 2014 to 2016
http://tilastokeskus.fi/til/kuol/2016/01/kuol_2016_01_2017-10-27_tau_001_en.html

Greenland

Statistics Greenland. Disposable income for persons (14 years +) by municipality (2002-2019) [INEPI201]
https://bank.stat.gl/pxweb/en/Greenland/Greenland_IN_IN20/INXPI201.px/

Statistics Greenland. Educational attainment (16-74 years) i pct., 2002-2019 [UDEISCPROH]
https://bank.stat.gl/pxweb/en/Greenland/Greenland_UD_UD40_UD4020/UDXISCPROH.px/?rxid=UDXISCPROH09-11-2020%2011%3A30%3A12

Statistics Greenland. Income distribution [INEF1]
https://bank.stat.gl/pxweb/en/Greenland/Greenland_IN_IN99/IN40/INXF1.px/

Statistics Greenland. Life Expectancy 2-year basis [BEEDT2A]
https://bank.stat.gl/pxweb/en/Greenland/Greenland_BE_BE10_BE20/BEXDT2A.px?rxid=9f179859-94a3-4e93-9138-4e917bbee157

Statistics Greenland. Main employment for permanent residents by time, industry, gender, age, place of birth and place of residence [AREBFB1]
https://bank.stat.gl/pxweb/en/Greenland/Greenland_AR_AR30/ARX-BFB1.px?rxid=995b81ad-5d5a-4937-a320-6054c709fddd

Statistics Greenland. Population Account (Greenland) 1994- [BEECALC]
https://bank.stat.gl/pxweb/en/Greenland/Greenland_BE_BE80/BEX-CALC.PX/

Statistics Greenland. Population January 1st 1977-2020 [BEEST1]
https://bank.stat.gl/pxweb/en/Greenland/Greenland_BE_BE01/BEX-SAT1.PX?rxid=9f179859-94a3-4e93-9138-4e917bbee157

Statistics Greenland. Trends in GDP [NRE10]
https://bank.stat.gl/pxweb/en/Greenland/Greenland_NR/NRX10.px?rxid=9f179859-94a3-4e93-9138-4e917bbee157

Iceland

Statistics Iceland. Educational attainment of the population according to ISCED 2011 2003-2019, percentage distribution
https://px.hagstofa.is/pxen/pxweb/en/Samfelag/Samfelag_skolamal_5_menntunarstada/SK000002.px

Statistics Iceland. Gini-index and quintile share ratio 2004-2018
https://px.hagstofa.is/pxen/pxweb/en/Samfelag/Samfelag_launog-tekjur_3_tekjur_2_tekjur_silc/LIF01110.px

Statistics Iceland. Gross domestic product and Gross national income 1995-2019
https://px.hagstofa.is/pxen/pxweb/en/Efnahagur/Efnahagur_thjodhag-sreikningar_landsframl_1_landsframleidsla/THJ01102.px

Statistics Iceland. Infant mortality and late fetal deaths 1951-2019
https://px.hagstofa.is/pxen/pxweb/en/lbuar/lbuar_Faeldirdanir_danir_danir/MAN05321.px

Statistics Iceland. Non-financial Institutional Sector Accounts 2000-2018
https://px.hagstofa.is/pxen/pxweb/en/Efnahagur/Efnahagur_thjodhag-sreikningar_tekjuskipting/THJ06021e.px?rxid=9500208e-db6c-4add-97bb-15068de245d4

Statistics Iceland. Population - key figures 1703-2020
https://px.hagstofa.is/pxen/pxweb/en/lbuar/lbuar_mannfjoldi_1_yfirlit_yfirlit_mannfjolda/MAN00000.px

Statistics Iceland. Population by sex and age 1841-2020
https://px.hagstofa.is/pxen/pxweb/en/lbuar/lbuar_mannfjoldi_1_yfirlit_yfirlit_mannfjolda/MAN00101.px?rxid=c3acc3b8-16e2-4e51-9dea-69974c60e0e7

Statistics Iceland. Population by status and year 2003-2019
https://px.hagstofa.is/pxen/pxweb/en/Samfelag/Samfelag_vinumarkadur_vinumarkadsrannsokn_3_arstolur/VIN00901.px?rxid=25c3ccc8-0c1a-4b7b-80cb-93e8ee466525

World Bank. World Development Indicators (for life expectancy)
<https://databank.worldbank.org/reports.aspx?source=world-development-indicators#>

Norway

Statistics Norway. 05378: Infant mortality (C) 1966-1970 - 2011-2015
<https://www.ssb.no/en/statbank/table/05378/>

Statistics Norway. 05797: Expectation of lifetime, by sex and selected age (C) 1971-1975 - 2011-2015
<https://www.ssb.no/en/statbank/table/05797/>

Statistics Norway. 07459: Population, by sex and one-year age groups (M) 1986 - 2020
<https://www.ssb.no/en/statbank/table/07459/>

Statistics Norway. 09114: Measures of income dispersion. Household equivalent income (EU-scale) between persons (M) (UD) 2004 - 2018
<https://www.ssb.no/en/statbank/table/09114>

Statistics Norway. 09429: Educational attainment, by municipality and sex (M) 1970 - 2019
<https://www.ssb.no/en/statbank/table/09429/>

Statistics Norway. 11713: Regional accounts, by industry (C) 2008 - 2018
<https://www.ssb.no/en/statbank/table/11713>

Statistics Norway. 12815: Households' income (C) (closed series) 2011 - 2016
<https://www.ssb.no/en/statbank/table/12815/>

Sweden

Statistics Sweden. Deaths by region, age (during the year) and sex. Year 1968 - 2019
https://www.statistikdatabasen.scb.se/pxweb/en/ssd/START_BE_BE0101_BE0101/DodaHandelseK/#

Statistics Sweden. Disposable income of households (ESA2010) by region (NUTS1-3) and transaction item. Year 2000 - 2018
https://www.statistikdatabasen.scb.se/pxweb/en/ssd/START_NR_NR0105_NR0105A/NR0105ENS2010T02A/

Statistics Sweden. Gross Regional Domestic Product (GRDP), number of employed and wages and salaries (ESA2010) by region (NUTS1-3). Year 2000 - 2018
https://www.statistikdatabasen.scb.se/pxweb/en/ssd/START_NR_NR0105_NR0105A/NR0105ENS2010T01A/#

Statistics Sweden. Income inequality indicators by region. Year 2011 - 2018
https://www.statistikdatabasen.scb.se/pxweb/en/ssd/START_HE_HE0110_HE0110F/Tab1DisplnK/#

Statistics Sweden. Live births by region, mother's age and child's sex. Year 1968 - 2019
https://www.statistikdatabasen.scb.se/pxweb/en/ssd/START_BE_BE0101_BE0101H/FoddaK/

Statistics Sweden. Population by region, marital status, age and sex. Year 1968 - 2019
https://www.statistikdatabasen.scb.se/pxweb/en/ssd/START_BE_BE0101_BE0101A/BefolkningNy/#

Swedish Register of Education. Number of persons (16+) with a tertiary education concluded with a degree in Västerbotten and Norrbotten county 2012-2018. Data obtained through Statistics Sweden.

Russia

Fed Stat. Коэффициент Джини (индекс концентрации доходов) (January-December) [Gini Coefficient (income concentration index) (January-December)]
<https://www.fedstat.ru/indicator/31165>

Fed Stat. Младенческая смертность (на 1 тыс. родившихся живыми) (ppm (0.1 percent), значение показателя за год) [Infant mortality (per 1,000 live births) (ppm (0.1 percent), value per year)]
<https://www.fedstat.ru/indicator/55376>

Fed Stat. Ожидаемая продолжительность жизни при рождении (year, indicator value for the year) [Life expectancy at birth (year, indicator value for the year)]
<https://www.fedstat.ru/indicator/55386>

Fed Stat. Численность постоянного населения - мужчин по возрасту на 1 января (man) [Number of resident population - males by age as of January 1 (man)]
<https://www.fedstat.ru/indicator/31548>

Fed Stat. Численность постоянного населения - женщин по возрасту на 1 января (человек) [Number of resident population - women by age as of January 1 (people)]
<https://www.fedstat.ru/indicator/33459>

Rosstat. РЕГИОНЫ РОССИИ. ОСНОВНЫЕ ХАРАКТЕРИСТИКИ СУБЪЕКТОВ РОССИЙСКОЙ ФЕДЕРАЦИИ 2019 СТАТИСТИЧЕСКИЙ СБОРНИК. 2019, Москва: Росстат. [Regions of Russia. Main characteristics of the subjects of the Russian Federation 2019 statistical digest. 2019. Moscow: Rosstat.]

Rosstat. Численность занятых в возрасте 15-72 лет по субъектам Российской Федерации [Number of employees aged 15-72 years by regions of the Russian Federation]
https://rosstat.gov.ru/storage/mediabank/aBHzrZ2j/trud2_15-72.xls

Statistics Showcase. 22111200200050200001 Общий объем денежных доходов населения (до 1998г. - в млрд. руб.) [Total cash incomes of the population (until 1998 - in million rubles)] <https://showdata.gks.ru>

Statistics Showcase. 21220000200080200002 Валовой региональный продукт [Gross regional product] <https://showdata.gks.ru>

World Bank

World Bank. Population, female (% of total population) <https://data.worldbank.org/indicator/SP.POP.TOTL.FE.ZS?end=2018&start=2018>

OECD

OECD. 4. PPPs and exchange rates https://stats.oecd.org/viewhtml.aspx?datasetcode=SNA_TABLE4&lang=en#

Box I. The use of Purchasing Power Parities in this report¹

The main purpose of this report is to provide an overview over economic activity in the Arctic regions. A major challenge has therefore been to compare and add up value of production in terms of income of industries of regions in different countries. A conversion of income data based on a straightforward use of market exchange rates (MER) will normally not appropriately reflect the income levels of the different regions. To adjust for price level differences across regional markets Purchasing Power Parity (PPP) indicators have been applied. However, also PPP conversion may sometimes lead to a biased assessment of production and income levels.



Fishing in Qeqertarsuatsiaat, Greenland. Photo: Hunter T. Snyder

Chapter 3 provides an overview of the economic activity in the circumpolar region. Based on PPP-conversions it is estimated that gross product of the circumpolar Arctic in 2018 was 615 billion USD-PPP corresponding to 0.7 percent of the world economy. The Arctic regions of Russia alone accounted for 449 billion USD-PPP, or 73 percent.

PPP-converted gross products (value added) are proxies for income in terms of capacity to consume. In that respect income levels in the Arctic vary from a low of 42 000 USD-PPP per capita in Northern Finland to a high of 75 000 USD-PPP per capita in Alaska (see Figure 3.8).

It is interesting to note the differences between income in arctic versus non-arctic regions within the Arctic states. For example, per capita income of Russia outside the Arctic is around 21 000 USD-PPP while it is as high as 67 000 USD-PPP in the Russian Arctic. In Norway the pattern is reversed: While per capita income outside the Arctic is 62 000 USD-PPP, the income level of Arctic Norway is 46 000 USD-PPP. A major factor behind these differences is that the income from petroleum in Norway is registered outside the arctic region, in Russia this is not the case.

As noted, the data for the different countries have originally been reported in national currencies but have in this report been converted into a common currency using purchasing power parities. Alternatively, the national currency data could have been converted into a common currency by use of the market exchange rates (MER). The Russian share of the Arctic gross product would, for example, then have been estimated to 50 per cent, instead of 69 per cent (see also Figure 2).

In most studies comparing income of different countries, PPP-conversion is preferred to market exchange rates. We have followed this tradition and have applied PPP-converters developed by the International Comparison Program and the OECD-Eurostat PPP-program.

The advantage of PPP-conversion is taking into account that price levels vary considerably between countries. A frequently applied illustration of the variation in price levels is the price of a Big Mac in different countries. Using market exchange rates, the average price of a Big Mac in Sweden was 6.37 USD in January 2021, whereas the price in Russia at the same time was 1.81 USD. This illustrates that almost identical products are priced quite differently if we use market exchange rates as the basis for price comparisons. Consequently MER-conversion of income levels might give seriously misleading numbers as far as production and consumption potentials are concerned.

¹ Bjart Holtsmark, Statistics Norway, contributed this text for the first ECONOR report, now with updated data.

When practicing PPP-conversion we would have preferred to use PPP-factors specific for the Arctic regions in each country, but Arctic-regional PPP-factors have not been developed. Instead, we have applied PPP-factors for the national economies.

It is difficult to judge to what extent the use of national PPP-measures is misleading. If the economies of the Arctic regions simply were downscaled versions of the economies of the respective nations and products were priced uniformly across regions, the national PPP-converters would not have been a source of error. However, the Arctic regions are quite different from their respective national economies, as discussed in chapter 4. Moreover, the general price levels are different between different regions within the individual countries. A Big Mac is, for instance, more expensive in Anchorage than in New York. Hence, just as the use of MER-based numbers would represent a source of error, using national PPP-based numbers is also a source of error.

There are indications that the price level in arctic regions might be somewhat higher than in the rest of the respective Arctic states due to extended transport distances as well as more limited infrastructure. Further, the arctic economies tend to be more involved in mineral extraction and public services provision than the south, both activities with relatively high wage rates. If this is the case, the PPP adjustment of income level of the arctic region would be biased upwards.

The Russian Arctic region is more dominated by oil and gas production than the rest of the Russian economy. Oil and gas are internationally tradable goods and the relatively high average income level of the Russian Arctic is largely due to the export of oil and gas traded in USD. The dominance of the petroleum industry in the Russian Arctic indicates that the use of a PPP-converter calculated for the Russian economy will probably imply a downwards bias when it is applied to the Russian Arctic regions. However, a higher price level in the Russian Arctic would tend to modify that bias.

Figure 1 illustrates how sensitive the estimates of regional GDP per capita are to the choice between PPP and MER. When PPP-factors are applied, regional GDP per capita in Russian Arctic is higher than in the Arctic regions of the Scandinavian countries. However, as MER-factors are applied, the income levels in Arctic Russia appear to be much lower.

It should be noted that we have reported data on regional GDP, not gross regional incomes. Regional GDP represents regionally generated income and does not include transfers in and out of the regions. Hence, regional GDP per capita does not constitute a precise representation of income levels in the different regions.

Figure 1. GDP per capita by Arctic region 2018. 1 000 USD at 2018 prices

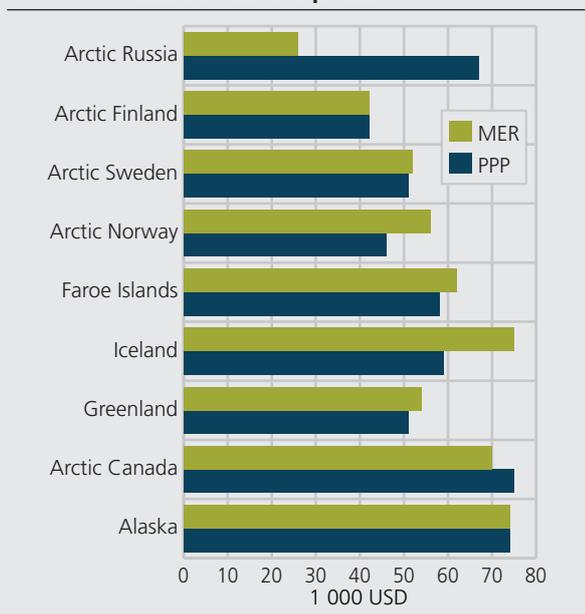
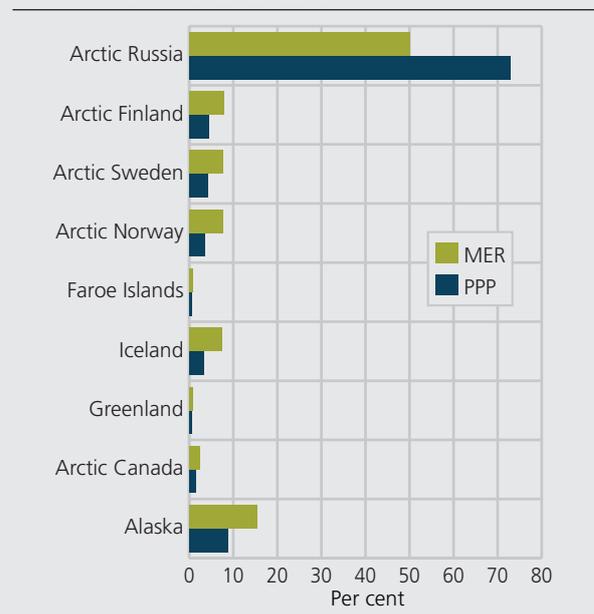


Figure 2. Arctic Region share of total circumpolar GDP 2018. Per cent



Box II. Sámi statistics in Norway

The Sámi traditional settlement area is in the north of Norway, Sweden and Finland, and at the Kola Peninsula in Russia. The national statistical offices of the Nordic countries publish population statistics based on census and population registers. However, ethnicity is not included as a dimension in the census, neither for Sámi nor for any other ethnic groups. It is therefore not possible to produce statistics for the Sámi population from the population registers.

From 1845 to 1930 the census in Norway included estimates of the number of Sámi and kvener (people of Finnish descent in Northern Norway). The 1950 census provided estimates of the use of Sámi and Kven language in some villages in the northern counties in Norway. The 1970 census was the last time when questions about Sámi language and ethnical background were included, in a supplementary questionnaire to selected municipalities and local communities in the northern counties.

It is difficult to assess the number of Sámi in Norway based on previous census data. The reason is partly that the censuses used different basis for defining who is Sámi, according to ancestry, language or self-reporting, and partly that not all Sámi were reached by the census as the supplementary questionnaire about Sámi identity only was used in selected municipalities. The census had registered a Sámi population of about 15 000 from 1845 to 1875, and the number increased to about 20 000 from 1890 to 1930. In 1950 the number was 8 778, a number that was considered far too low. In 1970 the number was slightly below 10 000.

Table 1. Income account for households. All of Norway, STN-area, and north of Saltfjellet. Average for households that have the income category. NOK. 2017

	All of Norway	STN-area ¹	Other areas in North Norway ²
Income from work	717 400	596 100	672 600
Employee income	692 000	560 600	644 600
Net income from self-employment	276 400	266 100	297 300
Property income	45 600	16 000	28 600
Taxable transfers	290 200	300 600	289 600
Social security benefits	302 600	299 500	302 700
Unemployment benefit	96 600	81 800	81 100
Compensation for illness leave	61 600	69 900	67 500
Tax-free transfers	37 500	37 300	37 000
Child allowances	21 400	22 000	21 400
Dwelling support	20 200	12 300	16 200
Social assistance	53 000	31 300	43 400
Total income	814 200	707 300	775 700
Total assessed taxes and negative transfers	215 400	156 500	193 600
After-tax income	606 400	559 400	588 600

¹ The STN-area is defined as the areas that qualify for support from the Sámi Parliament to business development.

² Those areas north of Saltfjellet not defined as STN-area.

Source: Statistics Norway

The last decades have seen a distinct change in policies and attitudes towards Sámi people in Norway. Assimilation into the Norwegian society was a clearly stated policy for a long period, lasting long into the post world war II period. Sámi were expected to give up their language and adopt the way of life of the majority population. Starting around 1980, considerable efforts have been made to reverse the consequences of assimilation policies and to secure the rights of the Sámi people. A Sámi Parliament has been established, with its first election in 1989.

There has, however, been a lack of statistical information basis to describe Sámi society and evaluate to what extent political objectives have been achieved. In 2003 the Sámi Parliament commissioned a project with cooperation between Statistics Norway and Sámi Instituhtta (Nordic Sámi Institute) to develop a permanent framework for development, production and dissemination of Sámi statistics. Since the central population register does not include information on individual ethnicity, as explained, other approaches must be taken. The solution chosen so far is to produce statistics for areas defined as Sámi settlement areas. In practice, this was operationalized by selecting those areas that qualify for support to business development from the Sámi Parliament, the STN area.¹ The geographical area for support has been extended several times, most recently in 2012.

The main argument for choosing this geographical approach is that the selected area encompasses local communities whose viability is seen as crucial for sustaining and further developing Sámi culture and local businesses, at the same time as the Sámi Parliament has support schemes applicable to this area. In order to plan the use and evaluate the effect of these policy instruments, the Sámi Parliament needs data that can illustrate current status and development over time.

This geographical approach to Sámi statistics, based on the STN area, has obvious shortcomings. Many of the inhabitants in these areas are not Sámi, and many Sámi live outside these areas. The entire STN area lies north of the Arctic Circle, and none of the large towns of Northern Norway are within the STN area. To a large extent, the difference between Sámi and non-Sámi areas observed in the statistics therefore reflects the difference between urban and rural areas, and to some extent the difference between north and south. A statistical approach that would have allowed comparison of Sámi and non-Sámi, independently of place of residence, might have been better.

Statistics Norway has explored the possibilities to produce Sámi statistics for individuals, by combining existing registers where individuals directly or indirectly have declared themselves as Sámi, such as the 1970 census, the register of the Norwegian Agriculture Agency, of persons affiliated with reindeer herding, and the electoral register of the Sámi Parliament.² The results from this work was not followed up, partly due to difficulties to achieve permission to use and combine the registers, and uncertainty about the representativity of the sample of the Sámi population.



Sámi reindeer herding, Finnmark. Photo: Tom Nicolaysen.

Statistics Norway continues to produce geographically based Sámi statistics. As long as the Sámi Parliament continues to provide support to particular geographical areas, regardless of whether the applicant is Sámi or not, it will be important to closely follow the development in these areas. The first of these bi-annual publications *Samisk statistikk/Sámi statistihkka 2006* was launched in 2006 on the Day of the Sámi People on 6 February. The topics cover elections to the Sámi Parliament, population, education, including use of Sámi language in schools and kindergartens, income and personal economy, labor market, reindeer herding and agriculture, and fishing and hunting.

A Government appointed expert group, where Statistics Norway is represented, has been assigned the mandate of compiling an annual report on the situation and trends in the Sámi community. The report, *Samiske tall forteller* (Sámi statistics speak), is used in annual budgeting and consultations between the government and the Sámi Parliament. An English translation of selected articles was published in 2018 as *Sami Statistics Speak*.

Population data for the current STN areas have been calculated back to 1990. The population in these areas has in recent years been about 55 000 persons, now declining after a stable level from 2011 to 2017, following a continuous decline since 1990, when population was 10 000 persons higher. There is no population

growth observed in the STN area from 2010 to 2020, although population in Norway has increased with almost 510 000 persons, or 10.5 per cent, over the same period.

Table 1 shows the income account for households in the STN area in 2017, compared to other areas of northern Norway (north of Saltfjellet) and average for Norway. Average total household income (before tax) for the STN area was about 9 per cent lower than for other northern areas and about 13 per cent below the average for Norway. Average income from employment and from property was considerably lower in the STN area than the average for other northern areas and for Norway. Taxable transfers were higher in the STN area. Average unemployment benefit in the STN area is almost equal as in other northern areas, but lower than average for Norway. Child allowance is the only tax-free income type that is higher on average for recipients in the STN area. Average after-tax (disposable) household income for the STN area was 5 per cent lower than average for other northern areas and about 8 per cent lower than the average for Norway.

¹ The Norwegian term for support from the Sámi Parliament to business development is «Sametingets tilskuddsordninger for næringsutvikling» (STN).

² Holth, B. A. & Lillegård, M. 2017. Statistikk over samiske språkbrukere i Norge. En kartlegging av eksisterende datakilder og vurdering av fremgangsmåter for statistikk. SSB/Statistics Norway, Notater 34:2017.



Arctic catfish sold at local marketplace, Nuuk, Greenland. Photo: Tom Nicolaysen

3. Comparative analysis of Arctic economies from a macro level perspective

Solveig Glomsrød and Taoyuan Wei

The population of the Circumpolar Arctic counts about 9.7 million people, less than the 10 million threshold, which qualifies cities to be called a megacity according to UN definition.¹ There are 33 megacities in the world. In contrast to these urban crowds, the arctic inhabitants roam on 8 per cent of the global land area, which is partly sovereign, partly managed by the respective Arctic states.

The outsiders view on this land area as remote and uninhabitable is gradually modified. People around the world have come closer to the Arctic as tourists and trading partners whereas the arctic peoples reaches the rest of the world through better communications and opening up of northern sea routes. The Arctic is under rapid change from new economic opportunities but also from opportunities lost through climate change.

For the Arctic, the term global warming is an understatement, as the temperature rise in the Arctic is more than twice the rate of temperature increase globally.² The reason for rapid warming is that the ice cover disappears, replacing strong heat reflection from ice and snow with absorbed heat by the dark open ocean. The nature is affected and so are the Arctic societies, both directly by climate change

and via stricter climate policies, as fossil energy has been an important export commodity for several regions.

Variations in the regional endowments of natural resources lead to considerable variation in income across the circumpolar Arctic. However, transfers within Arctic states tend to modify the gaps in disposable income per capita between Arctic regions and their non-Arctic counterparts. This chapter takes a broader look at the Arctic economies from a macro level perspective, providing a circumpolar outlook as well as comparing the Arctic regions with their non-Arctic counterparts within the Arctic states.

The Arctic economies are generally confined to regions that are encompassed or traversed by the Arctic Circle. In many contexts, however, regions in Europe that are situated somewhat to the south of the Arctic Circle but participate in the cooperation of the Barents Euro-Arctic Council³ are included among the Arctic economies. The Arctic regions of the ECONOR project largely comply with this definition, however the Canadian region of Nunavik is left out because Nunavik is part of Quebec and lacks official regional accounts⁴ (Figure 3.1).

Box 3.1. The harmonisation of economic values across regions

In the national statistics the figures of gross regional product (GRP) and disposable income of households (DIH) are expressed in national currencies. Converting income in different regions and countries to a single currency will not adequately represent the purchasing power of income by country (see Box I). Thus GRP and DIH are converted to unified purchasing power parity (PPP) values and expressed in USD 2018 prices. The PPP conversion factors have been taken from OECD Statistics. The role of the PPP conversion factors is to adjust for differences in regional purchasing power, thus providing a better indicator of the capacity to consume based on regional price levels while at the

same time achieving a unified valuation. However, national PPP conversion factors reflecting national price levels have been used, causing some bias in the GRP and DIH values, because the price levels in Arctic regions may differ from the country average price levels.

Regional accounts for Norway, Sweden, Russia, Greenland and Faroe Islands are available only at current prices. To get the volume growth of the regional economy the GRP of the years 2012-2018 are converted into USD 2018 prices by using the implicit price index of the national GDP series.

Figure 3.1. Administrative areas of the circumpolar Arctic



Source: Compiled by Winfried K. Dallmann.

Eight countries have regions belonging to the Arctic economies: United States, Canada, Denmark, Iceland, Norway, Sweden, Finland and Russia. Greenland and Faroe Islands are represented in the table alongside Arctic states corresponding to their extensive Self-Governance Rule within the Realm of Denmark. Greenland and Faroe Islands have Self-Governance in most policy areas, including management of natural resources. However, foreign policy and security issues are a Danish competence area.

The overview presented below illustrates regional indicators on land, population and economic

activity in terms of Gross Regional Product (GRP). Further, Disposable income of households (DIH) per capita is included to indicate economic welfare of the populations living in the arctic regions.

While GRP indicates the total value of goods and services, household disposable income represents the value of private household's incomes from wages, net interest and dividends, plus net transfers from other sectors. The majority of transfers to households from other sectors are payments from governments as pensions and social security. Transfers from households to other sectors are essentially taxes paid to governments.

Figure 3.2. Arctic surface area, population and GRP of Arctic states as share of the Arctic total. 2018. Per cent

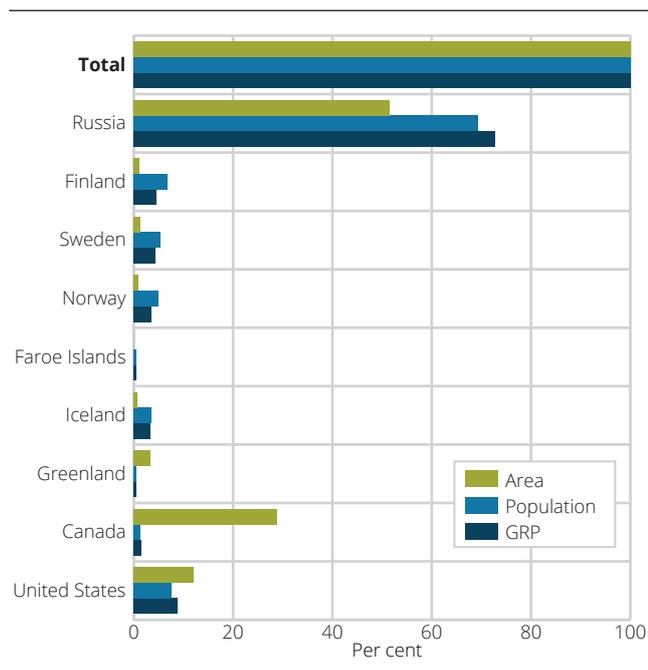
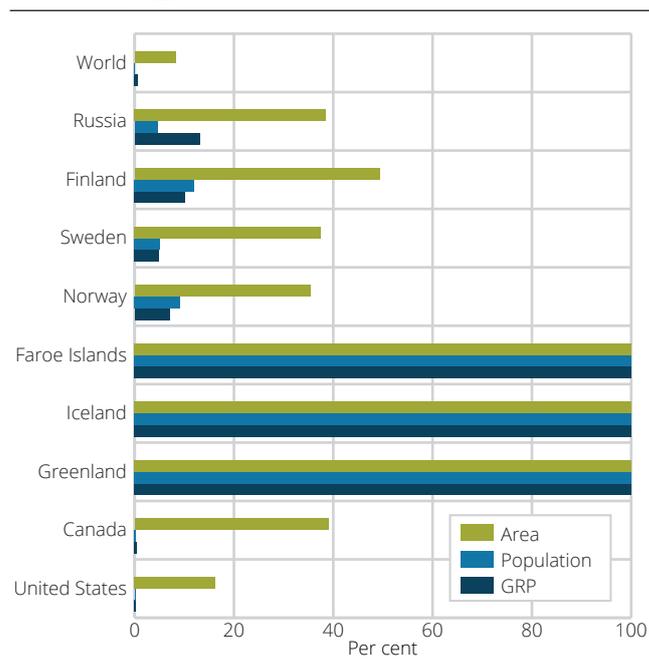


Figure 3.3. Arctic region share of surface area, population and GRP of corresponding country. 2018. Per cent



The people in the Arctic have strong traditions and rich opportunities for living off the land. However, the value of hunting, fishing and harvesting for own consumption is neither included in GRP nor in household disposable income due to lack of data. This might represent a bias in the comparison between arctic and non-arctic regions within arctic states

Note that provision of public services might add further to livelihood and welfare but differ among the Arctic regions. Governments provide substantial services in education and health care, and total value of consumption by households can exceed the conventional estimate of household disposable income. In a pilot assessment for Northern Canada, the disposable income of households including these services are estimated (see Box 4.2).

The data used in this analysis are based mainly on the regional accounts of the statistical offices of the Arctic countries.

The regional data are converted from local currencies to USD in purchasing power parities (PPP). Box 3.1 explains the reason for using PPP rather than market exchange rates when comparing across regions and countries and illustrates some of the steps that have to be taken when harmonizing the valuation of economic data across regions.

An overview of Arctic economies

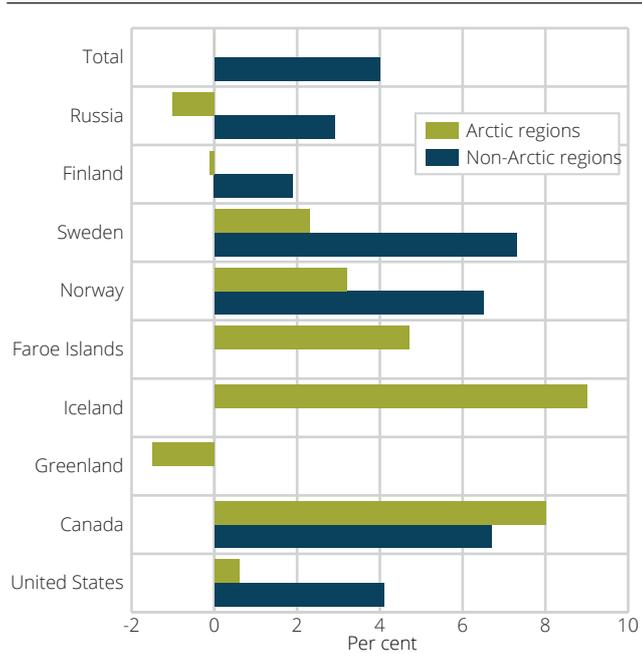
At circumpolar level the Arctic regions with 0.1 per cent of the world population generated as much as 0.7 per cent of global gross domestic product (GDP) in 2018. The Arctic covers as much as 8 per cent of the global surface area.

Figure 3.2 illustrates the role of the Arctic states within the entire Arctic region. Russia’s Arctic area covers slightly more than half of the total Arctic land area. In 2018 the Arctic Russian income (GRP) amounts to 73 per cent of the total Arctic economy and the population share of the Arctic is similarly high (69 per cent). Canada has the second largest share of the Arctic surface area (29 per cent) but has disproportionally low population and a share in the economy of the Arctic at 2 per cent.

The second largest economy is Alaska with somewhat less than 10 per cent of the Arctic GRP. Only minor shares of arctic land are left for the other regions, with Greenland as the largest, covering 3 per cent of arctic land with its ice-free area. Iceland and the Arctic regions in Norway, Sweden and Finland all have small shares of the arctic territory but their shares of arctic population and GRP are relatively larger.

Russia, Fenno-Scandinavia and Iceland have higher shares of Arctic population than of land

Figure 3.4. Population growth. Arctic and non-Arctic regions by country. 2012-2018. Per cent



area. Russia has a slightly higher share of Arctic GRP than of population, whereas Arctic regions of Fenno-Scandinavia and Iceland all have lower shares of Arctic GRP than of population. Arctic Canada is so sparsely populated that its shares in Arctic population and GDP are dwarfed when compared with the share of Arctic Canada’s territory.

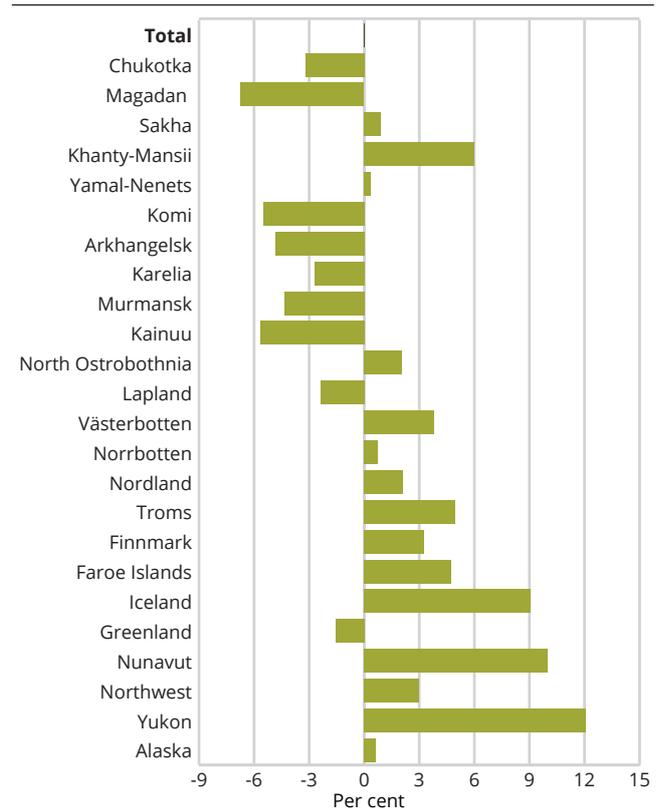
Figure 3.3 looks into the position of arctic regions within their respective Arctic state. The Arctic regions Greenland and Faroe Islands are represented in the table alongside Arctic states corresponding to their extensive Self-Governance Rule within the Realm of Denmark. Greenland and Faroe Islands have Self-Governance in most policy areas, including management of natural resources. However, foreign policy and security issues are a Danish competence area.

The Russian Arctic has a higher share of Russia’s GDP than of population, whereas Northern Finland and Arctic Norway generate smaller shares of national GDP than their shares in populations. In Sweden the arctic shares of national population and GDP are fairly equal. For Canada and the United States the non-Arctic economies and populations are totally dominating.

Population

During 2012-2018 the Arctic population as a whole has remained stable (Figure 3.4). The Russian Arctic with by far the largest population among Arctic

Figure 3.5. Population growth by Arctic region. 2012-2018. Per cent

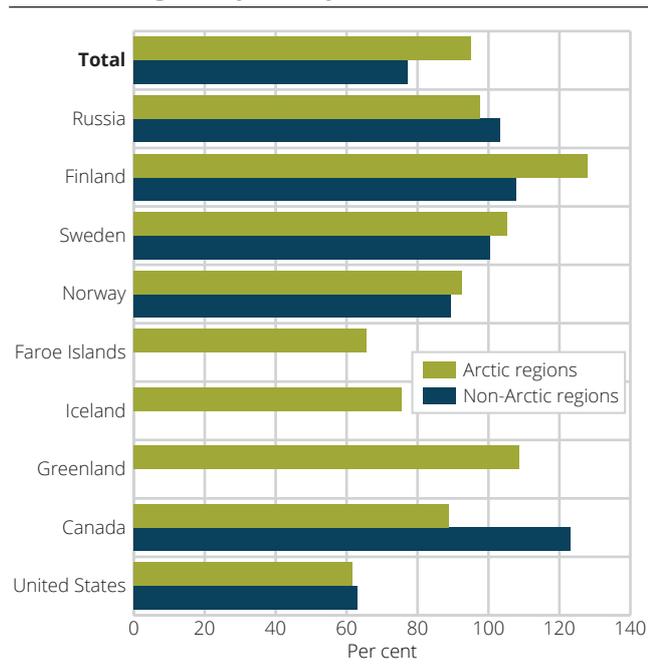


regions had a decline of about 0.6 per cent. Greenland was the only other region with population decline (1.5 per cent). Their declines were balanced over the Arctic by the increase in population in all other Arctic regions. Behind Iceland with 9 per cent growth, Northern Canada followed suit with 8 per cent growth during 2012-2018. In Arctic Sweden the population increased by 2 per cent whereas Alaska showed minor population growth of 0.6 per cent over the period.

The largest population increase of 9 per cent in Iceland is a result of generous policy towards families with children. In European context, Iceland had a relatively high total fertility rate of 1.7 in 2018. However, the trend is falling after a relatively stable period 1990-2010.⁵ Total fertility rate, or the number of children per woman in childbearing age, continued a declining trend only interrupted by an increase at the time of the financial crisis, of 2.2 in 2009. The share of women employed was nearly 80 per cent in 2016, and almost all children are in day-care (90 per cent).

Arctic Norway, supposed to have similar day-care and employment opportunities for women has a

Figure 3.6. Dependency ratio in Arctic and non-Arctic regions, by country. 2018. Per cent



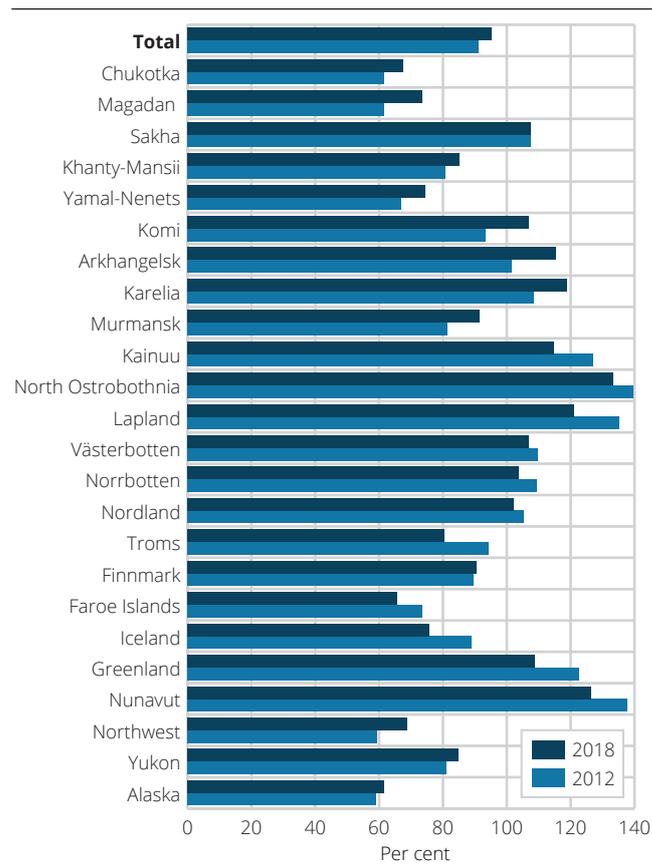
much lower population growth than Iceland. This indicates that there is still limited opportunities for jobs and day-care in the Arctic region as the population in Northern Norway is spread along the coast and in smaller inland communities, imposing high costs on services. In contrast, in Iceland the majority of the population lives in or around the capital of Reykjavik and can benefit from the centralized services.

Among Arctic states, all had higher population growth in non-Arctic regions, except Canada.

Figure 3.5 shows population growth during 2012-2018 by Arctic sub-region, revealing substantial variation in population development within Arctic regions. In Arctic Russia the only sub-regions with population growth were the petroleum-rich region of Khanty-Mansii (6 per cent) and to a much smaller extent, in Sakha and Yamal-Nenets. Other Arctic Russian sub-regions faced population decline of 2.7-6.7 per cent, with the largest decline in Magadan.

Most Arctic regions in Western Europe had increasing populations. In Finland, however, only Northern Ostrobothnia, housing the knowledge center Oulu, had population growth, in contrast to declines in Lapland and above all, in Kainuu (5.6 per cent). Other Fenno-Scandinavian sub-regions

Figure 3.7. Dependency ratio, by Arctic sub-region. 2012 and 2018. Per cent



had population growth in the range of 2.1-4.9 per cent, except Norrbotten in Sweden with a marginal growth of 0.7 per cent.

Dependency ratio

A useful socio-economic indicator is the economic dependency ratio, which is the number of persons unemployed or outside the labour force per employed person. The persons outside the labour force include children, elderly, disabled, students, unemployed, and, especially relevant in the Arctic, people involved in the informal subsistence economy.

Factors that increase the dependency ratio can be high population growth, with many children to support, or low population growth with an ageing population. Unemployment also increases the dependency ratio. A large migrant workforce, for instance temporarily or seasonally employed in resource extraction with their families outside the region, tends to reduce the dependency ratio.

Figure 3.6 shows that in USA, Canada and Russia the Arctic regions have lower dependency ratios than their non-Arctic regions. The use of seasonal

and migrant labour in petroleum and mining industries may explain the low dependency ratios of these regions. The difference between arctic and non-arctic regions is particularly large in Northern Canada. Arctic regions of Finland, Sweden and Norway all have higher dependency ratios in arctic regions than in non-Arctic parts of the countries. However, the differences for Norway and Sweden are less pronounced than for Finland, which has the highest dependency ratio among all arctic and non-arctic regions, followed by Greenland.

The dependency ratios in 2012 and 2018 in Arctic sub-regions are shown in Figure 3.7. For understanding the factors behind the differences of dependency ratios, more detailed statistics on the population age structure etc. would be needed.

The main petroleum producing regions Alaska, Khanty-Mansii and Yamal-Nenets, have fairly low dependency ratios, indicating use of seasonal/temporary labour. So is the case with the Northwest Territories of Canada with diamond production. However, in all these sub-regions, the dependency ratio has been increasing during 2012-2018.

In 2018 the highest dependency ratio is found in Northern Ostrobothnia, with 1.3 additional persons to support for every employed person. Then follows Nunavut, Lapland, Karelia, Arkhangelsk and Komi, the latter at par with Greenland. For the Arctic as a whole, there is a small increase in dependency ratio from 2012 to 2018. There is a marked increase in all Arctic Russian sub-regions, with the exception of Sakha, where there is a negligible change. The trend in Finland, Sweden, Norway, Iceland, Faroe Islands and Greenland is the opposite, all reducing their dependency ratios. Nunavut is the only North American arctic region which reduced its dependency ratio.

The economies of the Arctic

Figure 3.8 shows GRP per capita of Arctic regions and non-Arctic counterparts in 2018. For the Arctic as a whole GRP per capita is larger in arctic than in the non-arctic regions. This aspect is clearly visible in the mineral exporting arctic regions of Russia, Canada and the USA. In Northern Russia with its huge petroleum and other mineral production the GRP per capita is more than three times that of the non-Arctic level in 2018. Canada has the highest GRP per capita among the Arctic regions, closely

Figure 3.8. Gross regional product (GRP) per capita, by Arctic region. 2018. 1 000 USD-PPP

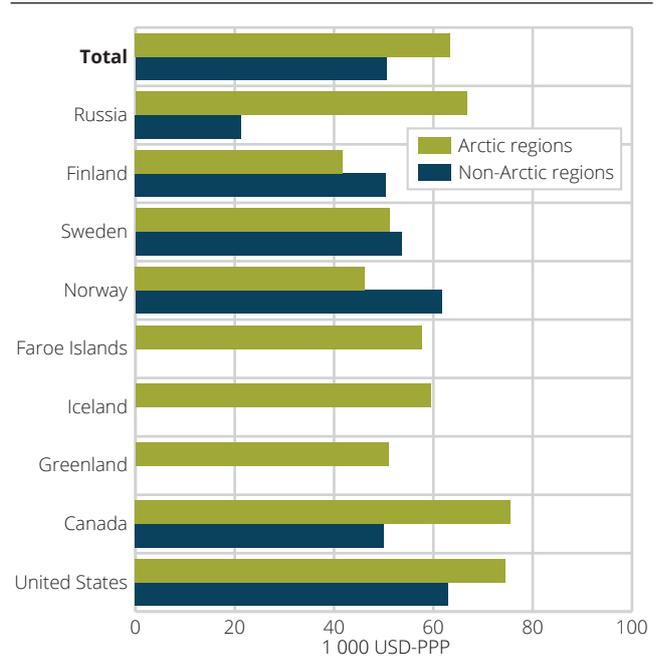
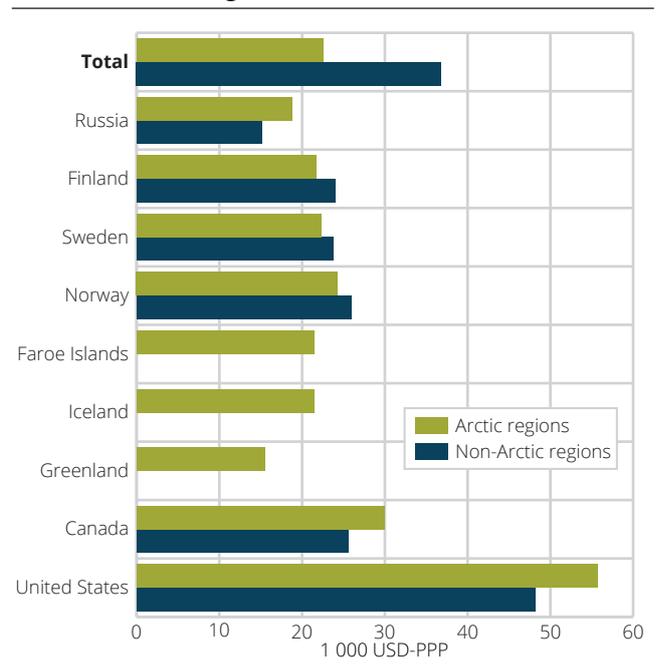
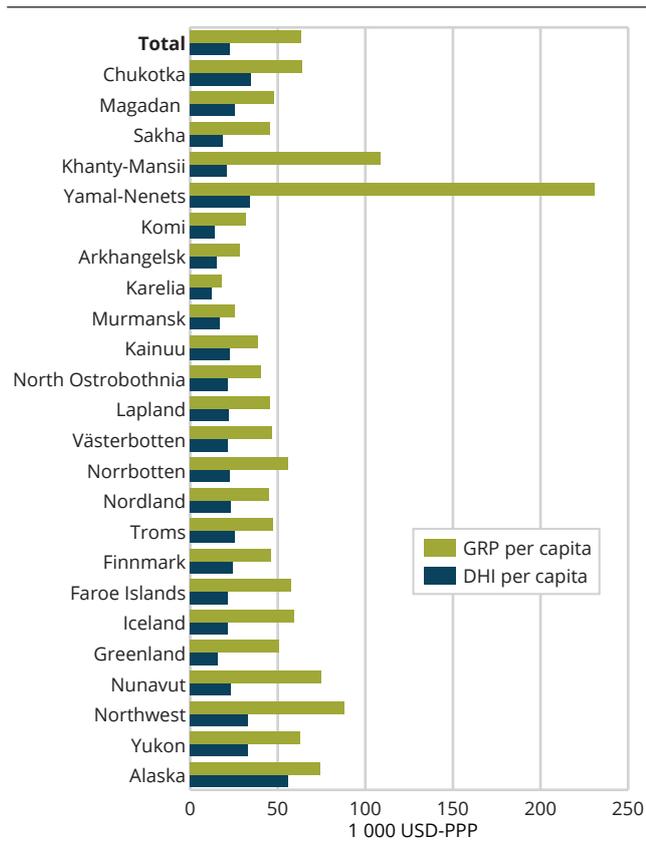


Figure 3.9. Disposable income of households per capita, by Arctic region. 2018. 1 000 USD-PPP



followed by Alaska and Northern Russia. Iceland and Faroe Islands achieve levels of GRP per capita at about the average of the Arctic, with fisheries as an important industry. Arctic Norway generates less value added per capita than these fish based economies and less than the non-arctic part of Norway. Norway has a substantial petroleum production but mainly in non-Arctic regions. Although there is petroleum production in the arctic region,

Figure 3.10. Gross regional product (GRP) per capita and disposable income of households (DIH) per capita, by Arctic sub-regions. 2018. 1 000 USD-PPP



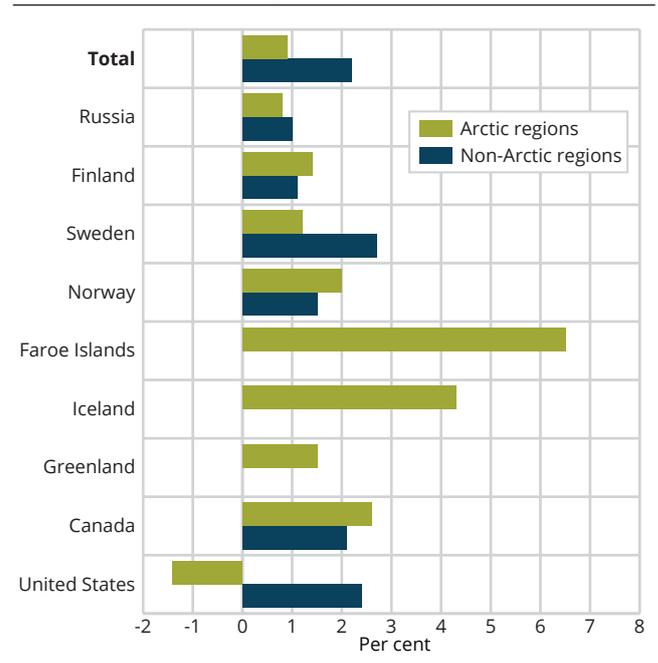
this extraction takes place offshore and the income is by statistical convention assigned to a virtual “region”.

Figure 3.9 shifts the focus from GRP or value generation at regional level to the actual income of people living in the Arctic, as indicated by the disposable income of households (DIH) per capita, which represents per capita income adjusted for taxes and transfers.

On average for the Arctic, DIH is substantially higher in non-Arctic regions. In contrast, the three dominating mineral producers – Alaska, Canada and Russia – have higher DIH per capita in Arctic than in non-Arctic regions. Note that Alaska’s DIH per capita is supported by the annual per capita contributions from the Alaska Permanent Fund (see Box 4.2). Greenland has the lowest disposable income level among arctic regions.

Figure 3.10 compares GRP per capita and DIH per capita, in Arctic sub-regions. Alaska has the highest DIH per capita followed by Chukotka, Yamal-Nenets, Yukon and Northwest Territories. Arctic

Figure 3.11. Average annual economic growth of Arctic and non-Arctic regions, by country. 2012-2018. Per cent



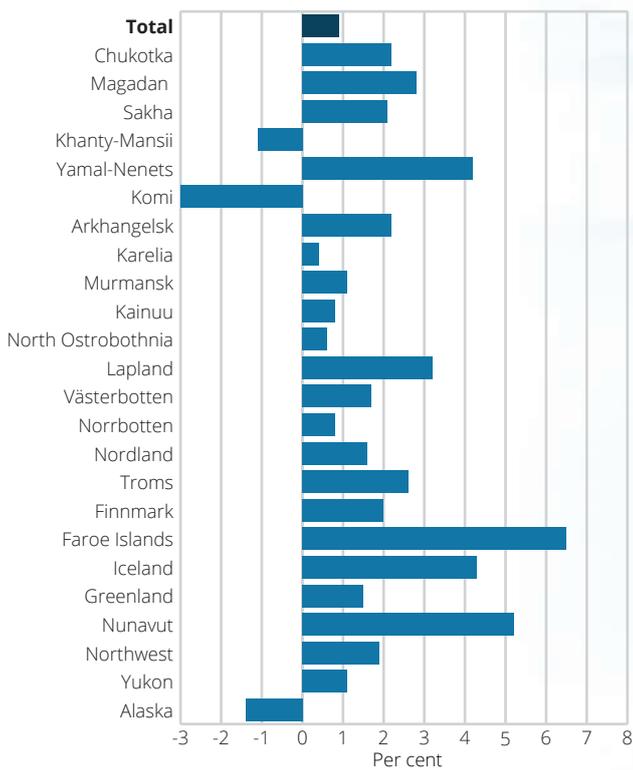
Finland, Sweden and Norway all have about similar levels of DIH per capita. The overview clearly shows how GRP per capita differentials are not directly reflected in DIH per capita which are much more evenly distributed although wide differences in mineral based income occur.

Figure 3.11 gives an overview of real economic growth by regions, in terms of average yearly percentage growth in GRP measured in purchasing power parities (GRP-PPP). At circumpolar level the growth rate of Arctic regions (0.8 per cent) has been markedly lower than in the non-Arctic regions of the Arctic states (2.2 per cent). The highest growth occurred in Faroe Islands and Iceland with 6.5 and 4.3 per cent annual growth, respectively, both benefiting from increasing fish prices. Canada had the highest arctic growth rate after Faroe Islands and Iceland. Northern Canada, Arctic Norway and Arctic Finland had stronger growth in Arctic than non-Arctic regions.

Arctic Sweden grew less than half the rate of non-arctic Sweden. Except in fisheries intensive regions of Faroe Islands and Iceland, the regions roughly had 1-2 per cent annual growth. Alaska was the only region with a yearly decline of 1.3 per cent.

At sub-regional level, Khanty-Mansii and Alaska both experienced annual average reductions in

Figure 3.12. Average annual economic growth, by Arctic sub-region. 2012-2018. Per cent



GRP by 1.1 and 1.4 per cent respectively (Figure 3.12). This is mainly due to the decline in oil prices around 2015. Komi had an even more rapid decline (3 per cent) whereas all other regions had positive growth rate, with Nunavut at 5 per cent annual growth, second highest growth rate after Faroe Islands.

The growth in Northern Canada was unevenly allocated among sub-regions, with high growth above all in Nunavut with Northwest Territories and Yukon markedly below. In Arctic Finland, Lapland showed relatively strong growth of about 3.2 per cent per year, whereas the region of Northern Ostrobothnia kept an annual growth of only 0.6 per cent, surpassed by Kainuu with a growth rate of 0.8 per cent.

Notes

¹ UN Department of Economic and Social Affairs, Population Dynamics, World Urbanization Prospects 2018. [the_worlds_cities_in_2018_data_booklet.pdf](https://www.un.org/en/development/desa/pubs/2018/08/2018-population-prospects-2018-edition/) (un.org)

² Pörtner, H.-O., D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegria, M. Nicolai, A. Okem, J. Petzold, B. Rama, N.M. Weyer (eds.) (2019): *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate*. IPCC.

³ <https://www.veac.st>

⁴ Regional accounts for Nunavik have, however been compiled for 1938, 1991, 1998 and 2003, and are available at Nunivaat.org or <http://www.nunivaat.org/TableViewer.aspx?U=http://www.chaireconditionautochtone.fss.ulaval.ca/extranet/doc/152.pdf>. See also Duhaime, G, and V. Robichaud, 2007. *Economic Portrait of Nunavik 2004*. Québec, Canada Research Chair on Comparative Aboriginal Condition, 66p.

⁵ World Bank: Fertility rate, total (births per woman) - Iceland | Data (worldbank.org)





Box III. Considerations When Evaluating Gross Domestic Product Estimates for Arctic Regions

Gross Domestic Product (GDP) is the total value of final goods and services¹ produced within a region during a specified time period. It is one of the important measures of the level of economic activity in a region, along with employment and personal income.

GDP is a measure of how much output a region produces as well as how much income it generates from that production. For this reason GDP is equivalent to Value Added (VA), defined as the economic contribution to goods and services production at each step in the production process by the factors of production—mostly labor and capital. Since the sum of value added equals both the value of output and the income to factors of production, total income equals total output.

The international standard for measuring GDP is established in the System of National Accounts (SNA93) prepared by representatives of the International Monetary Fund, European Union, Organization for Economic Cooperation and Development, United Nations, and World Bank. The rules and measures for the measurement of national accounts are designed to be flexible, to allow for differences in local statistical needs and conditions.² GDP statistics are available for most countries and are commonly used to track and compare economic performance.

GDP is generally measured in the local currency, and so to compare the economic activity or performance between different countries requires that the GDP in each country be converted to a common base, typically using either the currency exchange rate or the purchasing power parity exchange rate. The choice depends on the objective of the comparison. The former compares the international purchasing power of different economies. The latter is a better measure of the domestic purchasing power of the average producer or consumer within the countries. Some implications of this choice with relevance for The Economy of the North are discussed in Box I.

Analysts using GDP as a measure of economic performance for a country need to keep in mind that it has a number of well-known shortcomings including:

1. Non-market transactions (child rearing, homemaker production, etc.) are generally excluded.
2. Measurement does not distinguish between what are considered economic “goods” and “bads”. For example the response after an environmental disaster would increase GDP.
3. The value of leisure and other aspects of the quality of life are excluded.
4. The sustainability of production is ignored.
5. The distribution of income across the population is not measured.

In many countries GDP is also calculated at a regional level, allowing comparisons between regions within a country as well as between regions in different countries. These comparisons need to recognize certain features of regional GDP calculations, particularly when the regions are small and remote.

1. **Residency**—GDP is a measure of the value of production within a region, regardless of the residence of the labor or the residence of the owner of the capital used in production. A companion measure at the national level, Gross National Product (GNP), measures the value of production by the residence of the owners of the labor and capital used in production, wherever that production takes place, but there is no comparable figure at the regional level, at least in the United States.

This can be a problem when using GDP as a measure of the income of a small and remote regional economy. A significant share of the work force could consist of commuters or seasonal workers who live outside the region. A large share of the capital could be owned by non-residents and the profits from production could leave the region. Under these conditions the income accruing to the residents of the regional economy would be less than the value of production measured by GDP.

The opposite is also possible. The state of Alaska controls a large investment fund, the Alaska Permanent Fund, with a portfolio of investments almost entirely outside the state. Each year the Fund generates several billion dollars of income that is not included in Alaska GDP because the production associated with those investments occurs outside the state.

2. **Federal Assistance**—A remote rural region of a national economy may be dependent upon assistance from the central government to pay for and provide public services, over and above the level that taxes from the region to the central government can provide. In such a case the GDP, which generally includes all public sector spending in the region, will be an overestimate of the productive capacity of the region itself by the amount of the «subsidy». For example, an increase in central government spending in the region would increase GDP, even though it would not represent an increase in productive capacity of the resources in the region.
3. **Location of Production**—When production of some output involves inputs located in more than one region it can be difficult to allocate the share of value added attributable to each region. For example, oil production on Alaska’s North Slope depends on the inputs physically located in Alaska, but also on capital and labor inputs located in the headquarters offices of the oil companies outside the state. Allocating economic rents (the value of output in excess of that required to compensate capital and labor) between regions in this case will be somewhat arbitrary.

Production may occur in one region and be reported in another. A share of the seafood harvested in the ocean adjacent to Alaska is done by boats headquartered outside the state. The value of that harvest is reported in the GDP of other regions.

4. **Valuing Subsistence Activities**—A share of the population in many remote rural regional economies engages in productive activities outside normal economic markets, such as the subsistence activities of Indigenous Peoples. The valuation of these subsistence activities can be handled in several different ways in the GDP accounts. They may be excluded altogether as is the case in the United States. If they are included, there may be differences in the types of activities included. Placing a value on subsistence activities can be done in different ways. For example, the value of output of subsistence activities can be determined by comparison to similar items that have market prices (replacement value), by valuing the outputs at the cost of the inputs used in subsistence, or by imputing a value using a “willingness to pay” measure.
5. **Price Variation**—Small remote regional economies may be dominated by a limited number of primary commodity producing industries. The value added in the production of those commodities can be quite volatile from year to year because of volatility in their market prices. The Alaska GDP is heavily influenced by oil production, and much of the change in GDP from year to year is a result of the annual change in the price of oil rather than any change in its physical output.

This volatility means that comparisons with other regions are sensitive to the year in which the comparison is made. A comparison when the price of oil is high will indicate a larger Alaska economy relative to other locations than would be the case of a comparison when the price of oil is low.

6. **Data Collection Difficulties**—The small size of regional economies results in less precision in estimates of GDP based on sampling (due to sampling error). Remoteness can also contribute to imprecision due to the challenges of data collection associated with travel, weather, and other variables.

¹ Including exports.

² Countries may differ in the types of non-market activities they chose to include in GDP. They also may differ in which prices they use to present output figures. Among the alternatives are market prices (including any sales, property, and excise taxes) or factor costs (market prices net of taxes which are not a return to a factor of production). This measure is also known as GDP in basic prices.



Iceberg, Icefjord north of Nuuk, Greenland. Photo: Tom Nicolaysen

4. Arctic economies within the Arctic nations

Solveig Glomsrød, Taoyuan Wei, Ryan Macdonald, Lars Lindholt, Scott Goldsmith and Thórólfur Matthíasson

At a first glance the Arctic seems frozen and firm but recent years have shown that the climate as well as the economies are in a dynamic mode. There is damage to infrastructure as permafrost is thawing but also prospects of harvesting potential for renewable energy and better communication. International markets want high quality seafood from clean waters and emerging energy intensive industry knocks on the doors of cool regions. Climate change and climate policy have started to change the Arctic.

This chapter focuses on the economic structure and development within the arctic regions. Most of the economies are based on resource export. When looking at the price indices of fish, minerals, and energy in Figures 4.1 and 4.2 there is reason to reflect on how these world market conditions have affected the arctic regions during the last years. However, new activities have increased their footprint in the economic statistics, e.g. wind energy and datacenters.

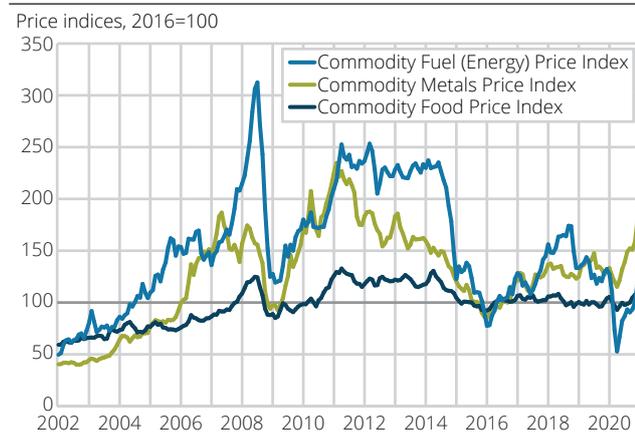
The ECONOR projects have followed the economy from 2002 to 2018, capturing peaks and turbulence in world resource prices. The previous version of this report – The Economy of the North 2015 – covered the years 2008-2012, capturing the turbulence around the financial crisis and the recovery, supported for some time by higher prices on energy and minerals. The current report compares

the situation of 2018 with 2015 levels, the year when the prices for energy and other minerals dropped drastically and only partly recovered over the next years.

Fish prices (Figure 4.2) show some similarities with the development of mineral prices, but enjoyed a less volatile increase. In the following presentation of National Account data and other economic statistics it is useful to keep in mind the recent resource price development when interpreting the results. Note, however, that these world price indices do not precisely reflect prices on arctic resources as there are variation in resource types, species and qualities. Salmon and cod are highly priced in international markets.

For each of the Arctic regions this chapter contains a core table showing gross regional product (GRP or GDP for nations) in current prices (local currency basic prices, i.e. net of taxes and subsidies) and the contribution to GRP by industry. Standardized figures present GRP by main industry category, GRP volume index and real growth rate 2000-2018 (2020) and disposable income of households. GRP per capita and DIH per capita are presented in purchaser price parities (USD PPP) to facilitate comparison among Arctic states. Core tables and figures generally refer to the years 2015 and 2018. The data for the Arctic regions are based on National statistics. Data sources by region are listed in Box 4.4.

Figure 4.1. Price indices of food, metals and energy. 2002-2020



Source: Primary Commodity Price System (PCPS) (01/15/2021)
<https://data.imf.org:443>
<https://data.imf.org/?sk=471DDDF8-D8A7-499A-81BA-5B332C01F8B9>

Figure 4.2. Price indices for fish. 2002-2020



Source: OECD-FAO
<http://stats.oecd.org/viewhtml.aspx?QueryId=71240&vh=0000&vf=0&l=&il=&lang=en#>



Recreation in Alaska. Photo: Davin Holen



Alaska

Alaska has 735 000 inhabitants and about half the population lives within the Anchorage region. The backbone of the economy is the petroleum industry. However, the giant oil field of Prudhoe Bay on the North Slope has long been in the decline phase and new fields have not been able to compensate for that. Real economic growth rate was negative during 2012-2018 and the level of employment decreased.

Table 4.1 shows the industrial structure of the economy in 2015 and 2018. The Oil and gas industry declined by 6.8 per cent over these three years whereas the economy as a whole had 4.7 per cent growth. The Oil and gas industry came out as the second largest single activity with 10.6 per cent of GRP after Public administration and defense at 22.8 per cent of GRP. A major factor behind the decline in Oil and gas is the drastic reduction in exploration drilling and other services to oil and gas production, falling by more than a third over the period. On the other hand, income in Pipeline transportation grew by around 40 per cent, increasing its share in GRP from 6.8 per cent to 8.4 per cent. In 2018 Oil and gas production and Pipeline transportation jointly contributed 19 per cent to total income, slightly above the 18.7 per cent in 2015. It might seem that petroleum sustains its position in terms of income generation. However, these income data are measured in basic prices, net of taxes and subsidies and only expressing the total return to labour and capital. Different components within the petroleum cluster have different tax/subsidy rates and a reallocation among these business components affects the level of tax revenue, which has decreased during 2015-2018.

Table 4.1. Value added¹ by industry. Alaska. 2015 and 2018

	2015		2018	
	Mill. USD	Per cent	Mill. USD	Per cent
Agriculture, forestry, fishing and hunting	316	0.7	264	0.5
Oil, gas and support activities	5 721	11.9	5 330	10.6
Mining (except oil and gas)	1 202	2.5	1 675	3.3
Utilities	697	1.5	719	1.4
Construction	2 118	4.4	1 943	3.9
Wood products	75	0.2	41	0.1
Food, including seafood	897	1.9	739	1.5
Petroleum and coal products	587	1.2	806	1.6
Other manufacturing	223	0.5	232	0.5
Wholesale and retail trade	2 870	6.0	2 897	5.8
Pipeline transportation	3 271	6.8	4 216	8.4
Other transportation	2 298	4.8	2 308	4.6
Accommodation and food services	1 502	3.1	1 528	3.0
Finance and insurance	1 181	2.5	1 348	2.7
Real estate and rental and leasing	4 514	9.4	4 709	9.4
Public administration and defense	10 426	21.8	11 411	22.8
Educational services	188	0.4	199	0.4
Health care and social assistance	3 643	7.6	4 239	8.5
Other service activities	6 145	12.8	5 537	11.0
Total	47 874	100.0	50 139	100.0

¹ At basic prices net of taxes and subsidies.

While Oil and gas declined, Mining (except oil and gas) saw a strong growth of almost 40 per cent, increasing its share in the economy from 2.5 to 3.3 per cent.

The Construction industry declined by 8 per cent, reducing its contribution to GRP to 3.9 per cent. Factors behind this development are reduced investments in oil and gas development and a practically stagnant population limiting the demand for housing. Construction was also lower because of a slowdown in State of Alaska government spending and flat federal spending on construction.

Manufacturing has a modest position in the economy with a share of 3.6 per cent of total income in 2018, about the same as in 2015, after an increase in Petroleum and coal products manufacturing roughly compensated for a decline in Food processing, which to a large extent is fish processing.

Among services, Wholesale and retail trade lagged behind the average economy with a growth of less than 1 per cent during the period.

After Pipeline transportation the largest activity among private services is Real estate activities with 9.4 per cent of GRP, practically sustaining its share over the period.

Figure 4.3. GRP volume index and growth rate. Alaska. 2000-2018

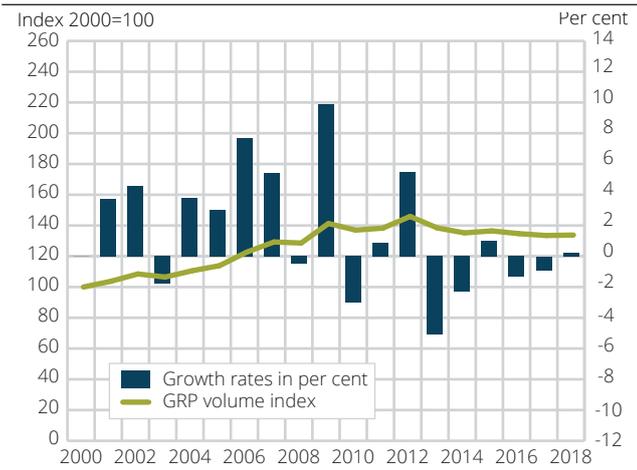
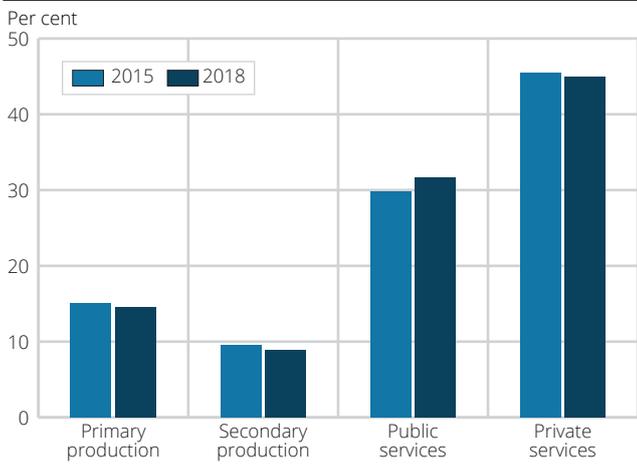


Figure 4.4. Value added by main industry (at current price). Alaska. Per cent of GRP. 2015 and 2018



Other services, containing information services and scientific and administrative services, declined partly due to a drop in business services (legal, accounting, etc.) stemming from the general slowdown of the economy. An increase in tourism prevented a stronger decline in Accommodation and food services from the general slowdown of the economy. On the other hand, Finance and insurance showed three times stronger than average growth.

Public administration increased at twice the rate of the economy at large, mainly due to rising Federal civilian services and State and local services, increasing its share in the economy from 21.8 to 22.8 percent. Education sustained its share of GRP (0.4 per cent), whereas Health care and social services increased markedly by 16 per cent, well above the growth in GRP, as a response to the rising number of seniors 65 years plus and an example of the

economic diversification in the wake of this demographic change.

Economic growth

Population growth can work as a driver of economic growth as well as being a result of a booming economy. These mechanisms related to economic growth now seem to be reversed in Alaska. Exploration at the huge Prudhoe Bay oil field and the construction of the Alaska pipeline generated a large inflow of young working age people and the economic boom sustained population growth. Hence, the population has been young for a while, however, the population has stabilized in recent years and the share of seniors is increasing rapidly. The working age population is in decline in parallel with the falling trend in the oil and gas industry.

As Alaska is relying on the mineral extraction for most of its income, the state is sensitive to shifts in global demand and business cycles in general. As shown in Figure 4.3 the economy was in steady or high growth towards 2009, except in 2003 and 2008. From 2009 real growth was more unstable and a declining trend took over from 2012, involving a yearly reduction of 1.4 per cent on average in real GRP towards 2018. The shift in growth mode points to a structural challenge associated with the oil dependency and limited domestic demand from a zero-growth population with an increasing share of seniors with a relatively high saving rate. A modifying factor is that a rising number of retirees has generated an inflow of pension cash transfers from outside the state. The cash flow into the state from this spending is difficult to estimate but is similar in magnitude to the cash flow from tourist visitors to the state. Retiree expenditures as well as publicly funded health care spending on their behalf has become a significant source of economic diversification.

Figure 4.4 shows only minor shifts between main production sectors. Note that primary production is limited to extraction of natural resources and harvesting, whereas services to extractive industries is part of private services. Public civil services at all levels increased, whereas private services declined. There is also a small decrease in primary production, as higher than average growth in mining did not compensate for the decline in Oil and gas and in Agriculture, forestry, fishing

and hunting. Secondary industries decline mainly due to lower activity in Construction, and to some extent in manufacturing industries.

In 2018 GRP per capita was somewhat higher in Alaska than in non-Arctic states of the USA due to the high shares of petroleum and mining (Figure 4.5). Disposable income of households (DIH) per capita is also somewhat higher in Alaska, partly because there is no state tax on income and partly reflecting the higher cost of living and the higher wage levels in extractive industries. In addition, the Alaska Permanent Fund Dividend program provides annual cash transfers to each citizen, adding to the disposable income level and reducing income differences, as every person including children receives the same amount (see Box 4.1). Alaska is the state within USA with the smallest income differences.

Royalties and taxes from petroleum industry have over the years largely financed the public sector and investments in infrastructure. In addition, revenues have been set aside in the Alaska Permanent Fund. However, with Prudhoe Bay in decline and lower oil prices the petroleum income falls short of covering the state expenditures to the same extent. Foreseeing a situation with less petroleum income, the government established the Alaska Permanent Fund in 1976 to turn petroleum income into a sustained source of income. The fund has received 25 per cent of royalties on petroleum production and ended the fiscal year 2018 with a balance of USD 65 billion, unchanged from a year earlier. In 2018 the dividend was USD 1 600, originally estimated to USD 2 700 but reduced by legislative action.¹ In 2020 it was down to USD 990. The fall in oil prices in 2015 together with smaller oil volumes required additional income sources to balance the budget. Between 2015 and 2018 the additional revenue sources used to balance the state budget came from cash reserves outside the Permanent Fund. From the fiscal year 2018-2019 the Legislature opened up for using fund earnings not only for paying dividends but also as contribution to state government to support public services.² Since then, Permanent Fund earnings not allocated to the dividend have been used to help pay for government expenditures.

The federal government has been another source of income through direct expenditure and trans-

Figure 4.5. Gross regional product (GRP) per capita and Disposable Income for Households (DIH) per capita. United States. 2018. 1 000 USD-PPP

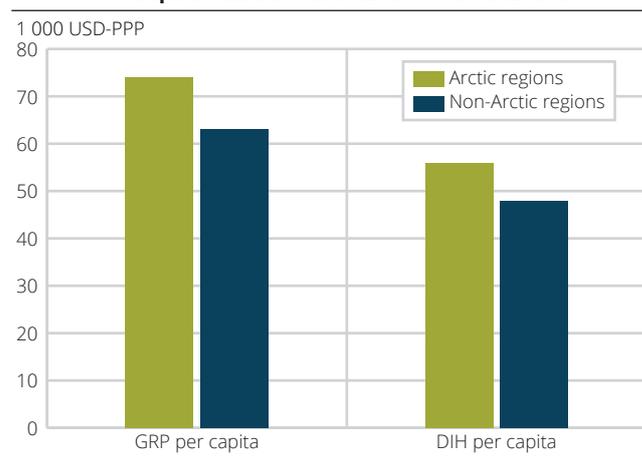
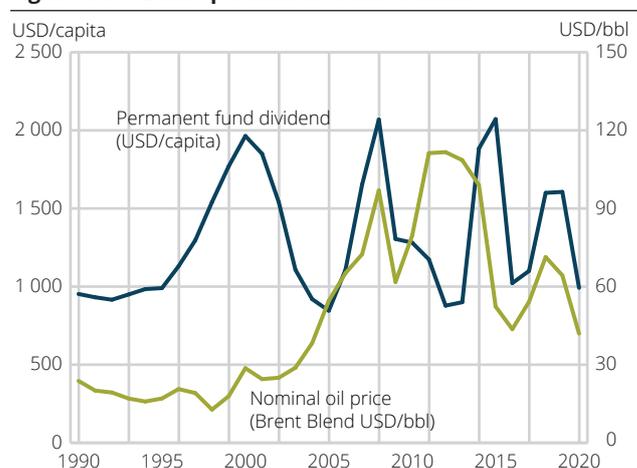


Figure 4.6. Alaska permanent fund dividend

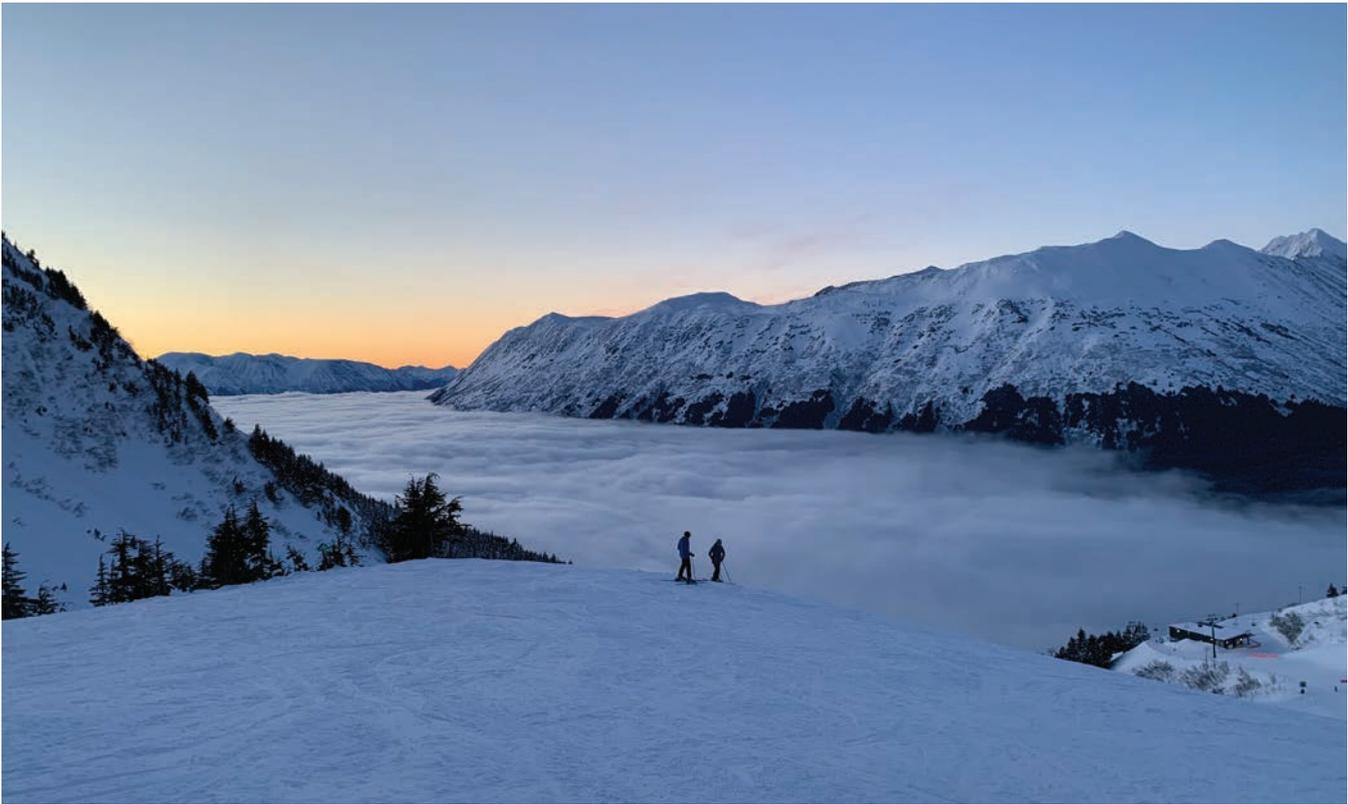


Source: <http://www.apfc.org/home/Content/dividend/dividendamounts.cfm>. Oil price from <https://data.imf.org/?sk=388dfa60-1d26-4ade-b505-a05a558d9a42&slid=1479331931186>

fers to the state government. Direct expenditures to federal activity relate to management of public lands, services to Alaska natives and military activities. Direct federal expenditures to Alaska also include a large number of programs that transfer money to individuals including social security (a retiree pension), Medicare (health care for senior citizens), Medicaid (health care for low income persons), and federal employee pensions.

Petroleum

When including shale oil and shale gas Alaska's share of proven US oil and gas reserves is around 7 and 2 per cent, respectively.³ However, Alaska has huge amounts of undiscovered petroleum resources amounting to 5 188 Mtoe⁴ oil and 5 261 Mtoe gas,⁵ corresponding to around 30 per cent of US undiscovered resources.



Recreation in Alaska. Photo: Davin Holen

Explorations at Prudhoe Bay, the largest oil field in the USA, started in the 1960s and oil came on stream in 1977 when the Alaska pipeline was opened. Prudhoe Bay peaked in 1988 and the decline of this giant field has not been compensated by supply from other fields, reducing the taxes and royalties to the state and federal governments. The pressure for opening-up new reserves is increasing although lower petroleum prices more recently have reduced the incentive to explore, develop, and produce. The state has responded by revising the production tax (2013) to stimulate petroleum activity. At the same time technological advances such as coiled tube pipe, horizontal drilling, multiple completions from a single well, 3d seismic, and advances in computer simulation capabilities have driven down the cost of exploration and production.

Exploration activities outside the Prudhoe Bay area are in three areas controlled by the federal government – Alaska National Wildlife Refuge (ANWR) to the east, National Petroleum Reserve Alaska (NPRA) to the west, and the Outer Continental Shelf (OCS) offshore. Development in all these areas has met resistance from environmental groups. The Native community is divided on questions of development

as some groups have benefited from past development and would stand to gain economically from future development.

The ANWR is the largest remaining wilderness area, rich in wildlife and home to the Porcupine caribou sustaining the livelihood of the Gwich'in and Iñupiat peoples with ancient relations to the land.

After many years of advocacy by the state, the federal government opened a portion of ANWR for exploration and oil leases were auctioned in January 2021. The State of Alaska and two small companies were the only bidders, paying a price barely above the minimum price per acre set by the government and buying only half of the area offered for lease.⁶ As of publication, activity there is unlikely in the foreseeable future. Low interest might reflect a more risk averse attitude in the petroleum industry towards big projects with a long-time horizon (see chapter 5). In the current oil price regime and with serious global climate policy at the gate, oil companies tend to go for fast development of proven reserves in other regions of the USA. Further, several large banks⁷ will not finance drilling in the area, in support of the native peoples and for environmental reasons.

On the other hand, there have been large discoveries in the NPRA by ConocoPhillips and Oil Search that would, if successful, reverse the projected decline in oil production in Alaska for many years. Alaska's oil production in 2019 was less than a quarter of the production in 1988, the year of peak production from Prudhoe Bay.

Currently there is no activity in the Outer Continental Shelf since Shell left. Their departure was partially due to the high cost of exploration and development in such an environmentally challenging region.

Other minerals

The value added in other mining than petroleum increased markedly from 2015 to 2018 (Table 4.1) and the dominant minerals in terms of production value are zinc and gold (Figure 4.7). The production value of zinc increased markedly from 2016 to 2018, whereas the value of gold production declined. The production values of silver and lead are lower and relatively stable. In comparison to gold and zinc the production values of industrial and other minerals are marginal.

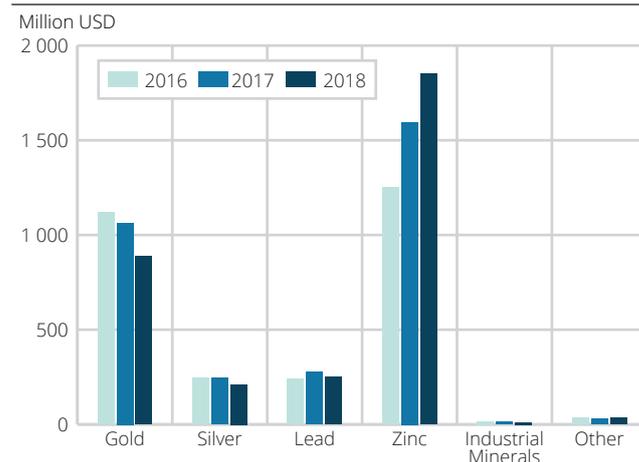
Fisheries

The harvest, primarily of salmon, halibut, shellfish, and groundfish, is taken partially by Alaska residents but also by boats based in other ports along the west coast of the USA. Processing of the harvest occurs both on shore in Alaska and elsewhere and on large processing vessels. The fisheries are managed to sustain their yield over time, primarily by limiting the number of harvesters and their catch. The salmon and shellfish harvests are managed by the state while the halibut and groundfish fisheries are managed by the federal government. Fisheries employment tends to be stable although the value added fluctuates due to price and harvest variation from year to year. A long-term challenge for this industry is competition from farmed fish.

Tourism

As seen from Table 4.1, petroleum, other mining and public services dominate the economy. Other industries play minor roles, however, in this picture it is easy to forget the role of tourism, which is generating income in many industries like transportation, hotels and restaurants etc. Tourism is not an industry in national account context, but satellite

Figure 4.7. Mineral production of Alaska. 2016-2018



Source: Table 11. Athey, J.E., and Werdon, M.B., 2019, Alaska's mineral industry 2018: Alaska Division of Geological & Geophysical Surveys Special Report 74. <http://doi.org/10.14509/30227>

accounts have been developed (see Chapter 7). For Alaska a satellite account was developed for 2004. An update for 2013 indicates that tourism in Alaska contributed 6.9 per cent to GRP, and tourism further increased by about one percentage-point by 2017 (see Chapter 7).

Notes

¹ Alaska Permanent Fund Dividend amounts by year. <https://pfd.alaska.gov/Division-Info/Summary-of-Applications-and-Payments>

² Historical Timeline of the Fund and APFC - Alaska Permanent Fund Corporation

³ BP (2016).

⁴ Million tonnes of oil equivalents

⁵ USGS (2008)

⁶ The Economist January 9th 2021.

⁷ Wall Street backs away from Arctic drilling amid Alaska political heat | Reuters. <https://www.reuters.com/article/us-usa-oil-alaska-idUSKBN20Q0H2>



Bull Moose, Alaska. Photo: Davin Holen

Box 4.1: The Alaska Permanent Fund and the Permanent Fund Dividend

Scott Goldsmith, University of Alaska at Anchorage

The Alaska Permanent Fund is a sovereign wealth fund of the state of Alaska established in 1976 by a vote of the people to preserve the wealth from petroleum production on public lands for future generations. Since its inception about 18 percent of petroleum revenues have been deposited into the fund either as constitutionally required contributions or special legislative appropriations of windfalls. The legislature has also added to the principal to offset the effects of inflation on its value. Today the fund has a balance of USD 65 billion,¹ about USD 85 thousand per capita.

The fund portfolio is invested in a broad range of non Alaskan income producing assets ranging from bonds to real estate. It generates annual income after inflation of more than USD 3.0 billion. These earnings can be spent at the discretion of the legislature, but spending of the principal is prohibited by the constitution.

Since 1982 about half the fund earnings have been used to pay an annual dividend, the Alaska Permanent Fund dividend, to every Alaska resident. In this way all residents have been able to share directly in the petroleum wealth. The dividend has ranged in size from USD 331 to 2072 as the fund has grown. The total amount distributed as dividends each year represents a significant share of household income for many Alaskans. Since its inception the cumulative Permanent Fund dividends have been USD 66 thousand (2020 USD) per person. Fund income not appropriated to the dividend (or inflation proofing) has, until recently, been reinvested.

The Permanent Fund has successfully transformed a portion of state non-sustainable petroleum revenues into a sustainable financial asset that can produce an annual flow of income for future generations of Alaskans. By diverting a portion of current petroleum revenues from the annual budget cycle, it has also helped to constrain the growth of public spending and moderated the economic cycles generated by price sensitive fluctuating oil revenues. The current success of the fund can be attributed to a number of factors.

First, management of the fund is largely independent of the other branches of government. The governing corporation has a clearly defined and narrow purpose which is to manage the portfolio to generate income for the state. It has no role in two challenging political questions—how much revenue to extract from the production of petroleum, and how to spend the earnings the fund produces.

Second, the fund is not a development bank. Alaska has collected more oil revenues than originally anticipated and has taken advantage of the occasions when revenues were high to create programs that have deflected pressure on the fund to take on the role of fostering economic development through capital investments in the state. These programs have included a number of agencies—including the Alaska Renewable Resources Corporation, Alaska Industrial Development and Export

Authority (AIDEA), the Alaska Housing Finance Corporation (AHFC), the Alaska Science and Technology Foundation, the Alaska Energy Authority, and the Alaska Aerospace Development Corporation—designed to promote economic development in the state. Consequently, there has been limited pressure to “put the fund to work” building the Alaska economy.

Third, only about 10 percent of the petroleum revenue stream has been constitutionally dedicated to the fund. This has left 90 percent for the legislature and governor to spend on expanded government programs and reduced taxes for businesses and households.

Fourth, there is a continuing perception that the state wasted its original bonanza—a USD 900 million bonus payment collected from producers in 1968 at a time when the state budget was only USD 150 million. Consequently, there is pressure to deposit any new windfalls into the Permanent Fund, where they will be safe from wasteful spending.

Fifth, the fund has a policy of not investing in Alaska. It looks worldwide to build a portfolio to maximize long term return on investment adjusted for risk. In this way it avoids any political pressure to funnel money into particular investments favored by powerful individuals or groups or to invest in Alaska projects that produce a non-monetary benefit rather than a financial return.

Sixth, the Permanent Fund corporation is probably the most highly respected institution in the state. Operational transparency adds to confidence in the corporation. Board meetings are open to the public and held in communities throughout the state. The corporation publishes a clearly written annual report, produces educational materials for Alaskans, and maintains a speaker's bureau. One can access a current list of portfolio holdings on a daily basis, the value of the fund, and detailed minutes of past board meetings from the corporation web site. It reports annually to the legislature. Finally, because Alaska is a small state, the board members are widely known in their communities.

Second guessing the investment decisions of the corporation is not a popular public pastime even in times when financial markets are down. The attention of the public is concentrated on the issue of how to collect the “fair share” of petroleum wealth from the companies producing oil in the state (a never ending political debate). Once the wealth has been converted to financial assets, the public feels confident that these assets will be professionally managed for their benefit.

And finally, the Permanent Fund dividend has created a constituency protecting the fund. (This constituency is a proxy for future Alaskans whose voices cannot be heard today.) Alaskans have come to expect the annual dividend and react very poorly to any suggestions for changing the way the Permanent Fund is managed. Most Alaskans feel that individuals can benefit more from deciding themselves how to spend at least a

portion of the public wealth rather than allowing the government to decide on their behalf. And many feel that since the oil production is on land owned by the state, they have a right, as individuals, to an annual dividend payment.

Although the Permanent Fund has accumulated an impressive balance over its 40-year life, looking ahead it faces its biggest challenges as Alaska transitions away from a petroleum based economy. Alaska has relied almost entirely on petroleum revenues to fund government (about 90 percent) for 45 years. But now oil production is only 25 percent of its 1989 peak level, and although rising oil prices offset declining production for many years, current oil revenues alone can no longer fund public needs. And since the state economy has not been able to develop an alternative tax base to replace petroleum, earnings of the Permanent Fund will need to begin to help funding government.

This transition from “saving” to “spending” has created two questions that the state has not been able to resolve for several years, but answers to which become more critical as time passes.

The first question is how much to draw from the fund to spend each year. Most residents recognize the need to balance the needs of the current generation with future Alaska residents who also have a right to the public wealth. However, it is easier to see and politically tempting to respond to the needs of the current generation compared to future Alaskans.

A simple spending rule would impose some discipline against the tendency to overspend in the present. Such a rule could be based on a percentage of fund value or it could be a specific amount adjusted over time based on inflation, population, and other variables. But the

rule should recognize that as long as the state is collecting current petroleum revenues it should continue to save a share as it has in the past. So in a transition period until there is no petroleum left to produce, saving should continue in the same fashion as the last 45 years.

The second question is how much of the annual draw to continue to allocate to the dividend and how much to make available to fund government spending. Unfortunately, a large share of dividend recipients feel that the sole purpose of the Permanent Fund is to pay the dividend. For them the fund is not a saving account but rather an income distribution fund. In fact, many Alaskans now incorrectly refer to the fund as the Alaska Dividend Fund.

But maintaining the historical practice of using half the earnings of the fund to pay the annual dividend while leaving half to pay for government programs has led to significant budget shortfalls, covered by drawing down the balances in savings accounts outside the Permanent Fund. Now that those balances have been depleted, the state must decide among significant cuts to public programs, the introduction of new taxes, or a reduction in the size of the annual dividend (or perhaps all three) to balance the budget.

Unfortunately the easiest option politically might be increasing the annual draw from the Permanent Fund above the sustainable level. If that were to happen the transition from “savings” to “spending” would result in the ultimate depletion of the fund with dismal consequences for the ability of the Alaska economy to sustain itself.

¹ 2020 Annual Report, Alaska Permanent Fund Corporation.



Photo: Colorbox



The Canadian North

Northern Canada is comprised of the three Northern Territories, Yukon, Northwest Territories and Nunavut. The population of Northern Canada in 2018 was 124 thousand people, with the population of Northwest Territories being the highest and that of Nunavut the lowest. Traditionally, resource extraction has been the major activity in the Canadian North, but over the period from 2008 to 2017, an important transition took place where the central position of resource extraction was eclipsed by the Public sector, including public administration, health and education. Mining and in particular diamond extraction has continued to have a strong position in the economy, whereas oil and gas production declined to marginal levels in 2017.

Economic structure

The two largest industries in Northern Canada are Mining and quarrying (excluding oil and gas extraction) and Public administration and defense (Table 4.2). These industries were roughly equal in size in 2017, each constituting close to 20 per cent of Northern Canadian GRP. The next three largest industries are Real estate, rental and leasing (10.9 per cent), Construction (9.4 per cent) and Health care and social assistance (7.8 per cent). The contribution of the Oil and gas industry to GRP was marginal in 2017, in contrast to its scale a decade earlier of about 8 per cent of GRP.¹

Resource extraction has been a feature of Canada's northern economy for centuries and has included fishing, hunting and trapping across the north, whaling in Nunavut, the 1898 Klondike Gold Rush, the discovery of oil at Norman Wells in the 1920s, mining for gold, silver, lead, zinc and copper and, recently, the discovery of diamonds in the Northwest Territories in the 1990s. Both the Mining and the Oil and gas industry have been important sources of economic activity for a long time, being major determinants of migration from southern regions and of exports from Northern Canada.

Table 4.2. Value added¹ by industry. Arctic Canada. 2015 and 2017

	2015		2017	
	Mill. CAD	Per cent	Mill. CAD	Per cent
Agriculture, forestry and logging	24.7	0.3	27.2	0.3
Fishing, hunting and trapping	7.9	0.1	25.7	0.3
Oil and gas extraction	143.2	1.5	7.6	0.1
Mining and quarrying	1 601.5	16.8	2 023.8	19.8
Electricity generation, transmission and distribution	156	1.6	151.5	1.5
Natural gas distribution, water	27.3	0.3	29.2	0.3
Construction	969.3	10.2	964.8	9.4
Manufacturing	48.2	0.5	44.8	0.4
Wholesale trade	176.2	1.9	209.6	2.0
Retail trade	428.7	4.5	434.1	4.2
Transportation and warehousing	435.3	4.6	407.5	4.0
Information and cultural industries	235.4	2.5	311	3.0
Finance and insurance	242.4	2.5	244.6	2.4
Real estate and rental and leasing	1 035.3	10.9	1 114.2	10.9
Professional, scientific and technical services	224.8	2.4	208.9	2.0
Management of companies and enterprises	54.3	0.6	32.8	0.3
Administrative and support, waste management	159.9	1.7	155.9	1.5
Educational services	603.9	6.3	626.5	6.1
Health care and social assistance	710.1	7.5	799.7	7.8
Arts, entertainment and recreation	25.8	0.3	31.2	0.3
Accommodation and food services	200.7	2.1	234.2	2.3
Other services (except public administration)	121.1	1.3	132.2	1.3
Public administration	1 887.4	19.8	2 010.6	19.7
Total	9 516.5	100.0	10 224.7	100.0

¹ At basic prices net of taxes and subsidies.

However, resource extraction has declined as a share of economic activity in Northern Canada in recent years. In 2008, during the 2007-2009 global recession, Mining and Oil and gas extraction together constituted 28.8 per cent of Northern Canadian GRP.² At this time, it was the largest source of economic activity in the region. The recession saw rapid declines in commodity prices, particularly for oil and gas. As the global economy and commodity prices recovered, the share of Mining in GRP approached its pre-crisis level by 2017. In contrast, the Oil and gas industry entered a state of steady decline even as the global economy expanded. On top of this, the production was hard hit as an oil pipeline was shut and reduced supply markedly, so that petroleum income contributed negligibly (0.1 per cent) to GRP in 2017. The declining trend reflects both weakness in commodity prices in later years and shrinking production (Figures 4.11-4.13).

Economic growth

Current dollar measures of GRP allow for examinations of the composition of the northern economy across industries and sectors but can present less than ideal measures of economic growth because price changes can obscure changes in scale of production. To account for this, measures of real GRP remove the effect of price changes, allowing for a more appropriate measure of growth in economic volume. However, measures of real GRP are typically not comparable based on their level values and are presented as indexes or growth rates. And, often, real GRP measures are examined over longer periods to help mitigate the effects of year-to-year fluctuations when looking at longer term trends.

Between 2000 and 2019, Northern Canada’s real GRP increased by an average of 2.5 per cent per year with the fastest growth occurring in the early 2000s and in 2007 as a result of rapid increase in the diamond industry (Figure 4.8, Figure 4.11). Consistent with the global recession occurring at the time, the Northern Canadian economy contracted in 2008 and 2009, and also had weak years in 2011, 2015 and 2019. The weak years held back growth so that from 2008 to 2017 the average annual growth rate was 1.3 per cent. This is roughly half the growth rate of the overall period.

Primary or extractive industries increased from 2015 to 2017, mainly driven by a marked increase in Mining (excluding oil and gas), and also supported by Fishing, hunting and trapping, which tripled its modest contribution to regional GRP (Table 4.2, Figure 4.9). Within secondary industries, Construction and Manufacturing both declined somewhat. Construction represents a considerable share of the total economy (9.4 per cent). Manufacturing is, however, a minor industry with only 0.4 per cent of GRP in 2017. The largest single activities in Manufacturing are chemical industry and food processing.

Public services sustained its role in the economy, whereas private services slightly declined. Retail trade and Transportation, in particular pipeline transportation, contributed to this decline.

While GRP indicates the total value of goods and services, household disposable income represents the value of private household’s incomes from

Figure 4.8. GRP volume index and growth rate. Arctic Canada. 2000-2019

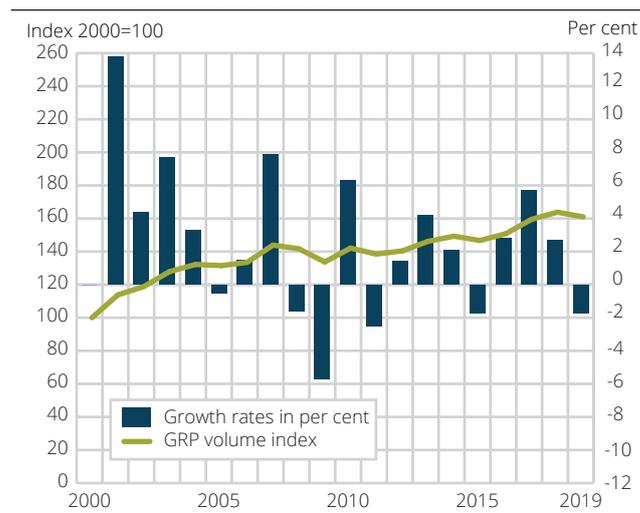


Figure 4.9. Value added by main industry. Arctic Canada. Per cent of GRP. 2015 and 2017

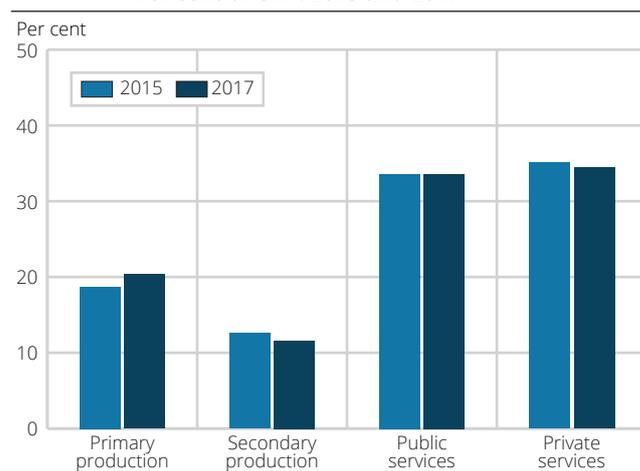
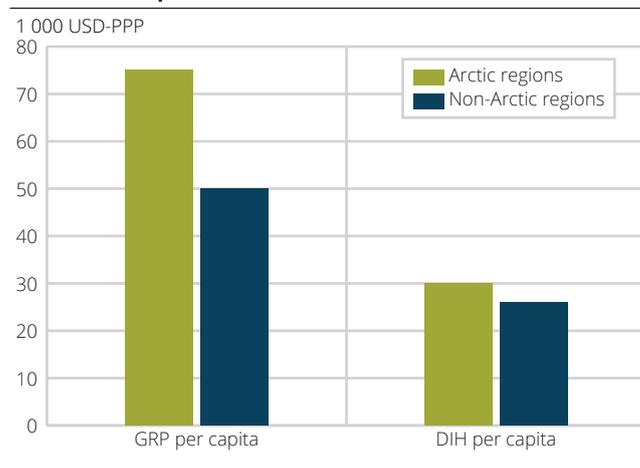


Figure 4.10. Gross regional product (GRP) per capita and Disposable Income of Households (DIH) per capita. Arctic Canada. 2018. 1 000 USD-PPP

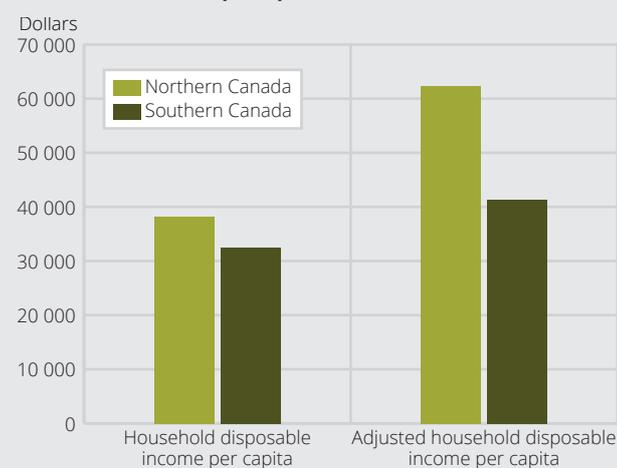


Box 4.2: Adjusting Disposable income for subsistence production and consumption of public services

Household disposable income per capita is often used as an approximate measure of household material well-being because it represents, on average, how much consumption persons within a region can undertake without having to sell assets or take on debt. However, household disposable income measures do not take into account subsistence activities, which can be an important source of food in remote northern communities. And, where governments provide important services, particularly education and health care, the total value of consumption undertaken by households can exceed the privately received disposable income. This occurs either when the taxes used to pay for government provided services such as health and education are raised from businesses, or when transfers from a different jurisdiction are used to support government programs.

Estimates for the value of subsistence activities in Northern Canada are not available, but it is possible to account for the difference in consumption levels due to government provided services. To do so, a measure called adjusted household disposable income that takes into account in-kind transfers from government can be calculated. This raises the value of household income and household consumption equally. On a per-capita basis, adjusted household disposable income was CAD 62 298 in Northern Canada 2017, about 50 per cent higher than the CAD 41 354 adjusted household disposable income in Southern Canada, and similar to the size of the difference in GRP per capita between Northern and Southern Canada

Conventional and adjusted Disposable Income of Households (DIH) per capita. Canada. 2017. Canadian dollars (CAD)



Notes: Gross regional product is measured at market prices to enable consistency with household sector estimates.

Other charts and tables use measures of Gross domestic product at basic prices

employment and self-employment, net interest and dividend income, plus net transfers from other sectors. The majority of transfers from other sectors are payments from governments as pensions and social security. Transfers made to other sectors are essentially taxes paid to governments.

GRP per capita and household disposable income per capita in Northern Canada are both higher than in Southern Canada (Figure 4.10). In 2018, GRP per capita in Northern Canada was 75 000 USD-PPP, which was 50 per cent higher than GRP per capita in Southern Canada. This partly reflects price differentials and partly differences in industry structures. Prices for goods and services in Northern Canada can be higher than in Southern Canada due to extended transport distances as well as more limited infrastructure. This is particularly the case for Nunavut where communities are not connected by all-weather roads. Further, the Northern Canadian economy is also more concentrated in mineral extraction and public services provision than the south, both activities with relatively high wage rates.

Household disposable income at 30 000 USD-PPP in Northern Canada in 2018 was also higher than in the south, but not by the same extent as GRP per capita. In 2018, Northern Canadian household disposable income per capita was 17 per cent higher than in Southern Canada (26 000 USD-PPP). Besides disposable income, households also benefit from public services through education and health. An example of adjusting the DIH for public services is shown for Northern Canada in Box 4.2.

As with GDP per capita, the relatively higher values for Northern Canada result from relatively higher prices as well as a different industry structure from Southern regions.

Petroleum and mining

Canada produces lots of oil and gas, but little in the Arctic. There is however, some oil production in the Northwest Territories

The volume of oil production (Figure 4.12) and natural gas production (Figure 4.13) in Northern Canada have been in decline for most of the 21st century. The declining output volumes mean that for oil and gas extraction to maintain its share of economic activity, the price of oil and gas needs



to increase to offset the reductions in production. During the early years of the 2000s, rising commodity prices buoyed current dollar measures of oil and gas extraction in GDP. However, as the commodity boom ended, and as commodity prices cycled down, the value of oil and gas extraction in Northern Canada declined.

From 2016 to 2018, the Norman Wells Oil Pipeline was shut because of safety concerns, and as a result, production at Norman Wells was suspended and Arctic Canadian oil supply almost came to a halt, as is visible from the marginal level of income in Oil and gas in 2017 (Table 4.2).

In 2016, the federal government announced that Canadian Arctic offshore, including areas offshore of Northwest Territories, is indefinitely off limits to new offshore oil and gas licensing to be reviewed every five years. The first five-year review is due in 2021.³

Despite the value of diamond production not increasing in over a decade (Figure 4.11), diamonds continue to make a major contribution to the economy of the Northern Territories. A majority of the diamonds mined in Canada are produced in the Northwest Territories and the diamond mines currently in production in the Northwest Territories are characterized by high grade deposits which increase their economic viability. Only a few companies are processing diamonds in Northwest Territories and most of the diamonds from the Northwest Territories are exported outside Canada as rough or un-worked diamonds. This trade constitutes the majority of Canada's trade with the Netherlands and is a major determinant of northern export performance.

The diamond industry has had a positive impact on other sectors in the economy of Northern Canada, including exploration, which has been carried out to some extent in Nunavut as well as in Northwest Territories. Foreign investors generally consider Canada, including the Northwest Territories, more attractive from both a geopolitical and investment risk perspective than many other diamond producing countries. However, it is expensive to construct and maintain diamond mines in the Northwest Territories as a number of factors contribute to high construction and maintenance costs including a harsh climate, transportation on ice roads, and environmental commitments.

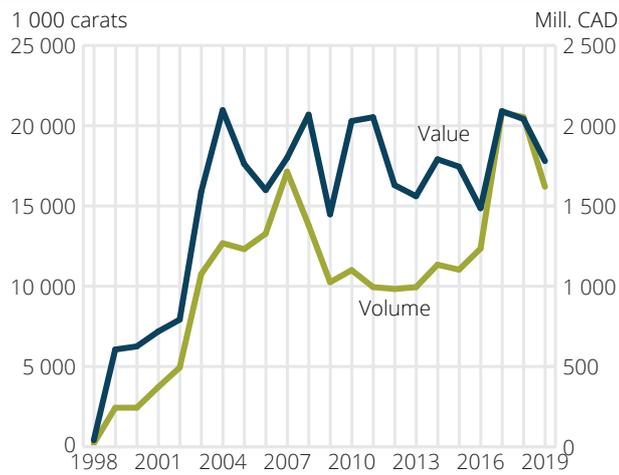
The territories

The three Northern Canadian Territories combined accounted for 0.3 per cent of the total Canadian population and 0.5 per cent of Canadian GRP in 2017. These sparsely populated territories have private sector economies that are smaller than the provinces of Southern Canada and dispersed populations where service delivery is expensive. As a consequence, it is challenging for territorial governments to raise sufficient revenue through taxation to allow for commensurate service levels for territorial residents with their southern compatriots, and transfers from the Federal Government constitute an important source of territorial government revenue. In 2017, transfers from the Federal Government accounted for 88.3 per cent of total public revenues in Nunavut, 80.3 per cent in Yukon and 64.8 per cent in Northwest Territories. These shares are considerably higher than the 21.2 per cent average across the provinces of Canada (Table 4.3).

Table 4.3. Basic Indicators. Northern Canada. 2017

	Yukon	Northwest Territories	Nunavut
Population	39 670	44 890	37 550
GRP at basic prices (Mill. CAD)	2 780	4 480	2 970
Real GRP annual growth rate 2012-2017	0.6	2.2	5.2
Share of Northern Canadian GRP	27.2	43.8	29.0
Percent of territorial government revenue from federal transfers	80.3	64.8	88.3

Figure 4.11. Diamond production. Arctic Canada. 1998-2019



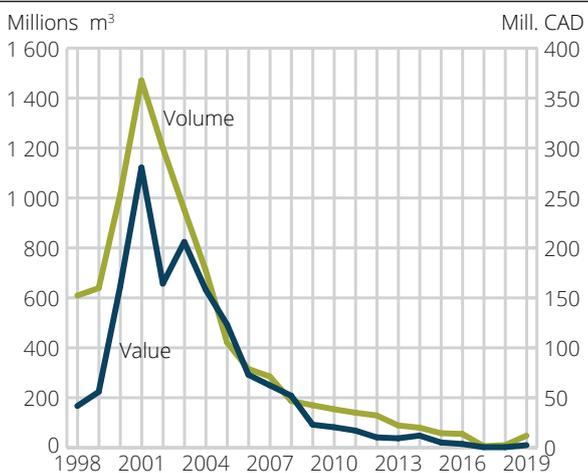
Source: Natural Resources Canada. Annual Statistics of Mineral Production.

Figure 4.12. Oil production. Arctic Canada. 1998-2019



Source: Canadian Association of Petroleum Producers.

Figure 4.13. Natural gas production. Arctic Canada. 1998-2019



Source: Canadian Association of Petroleum Producers.

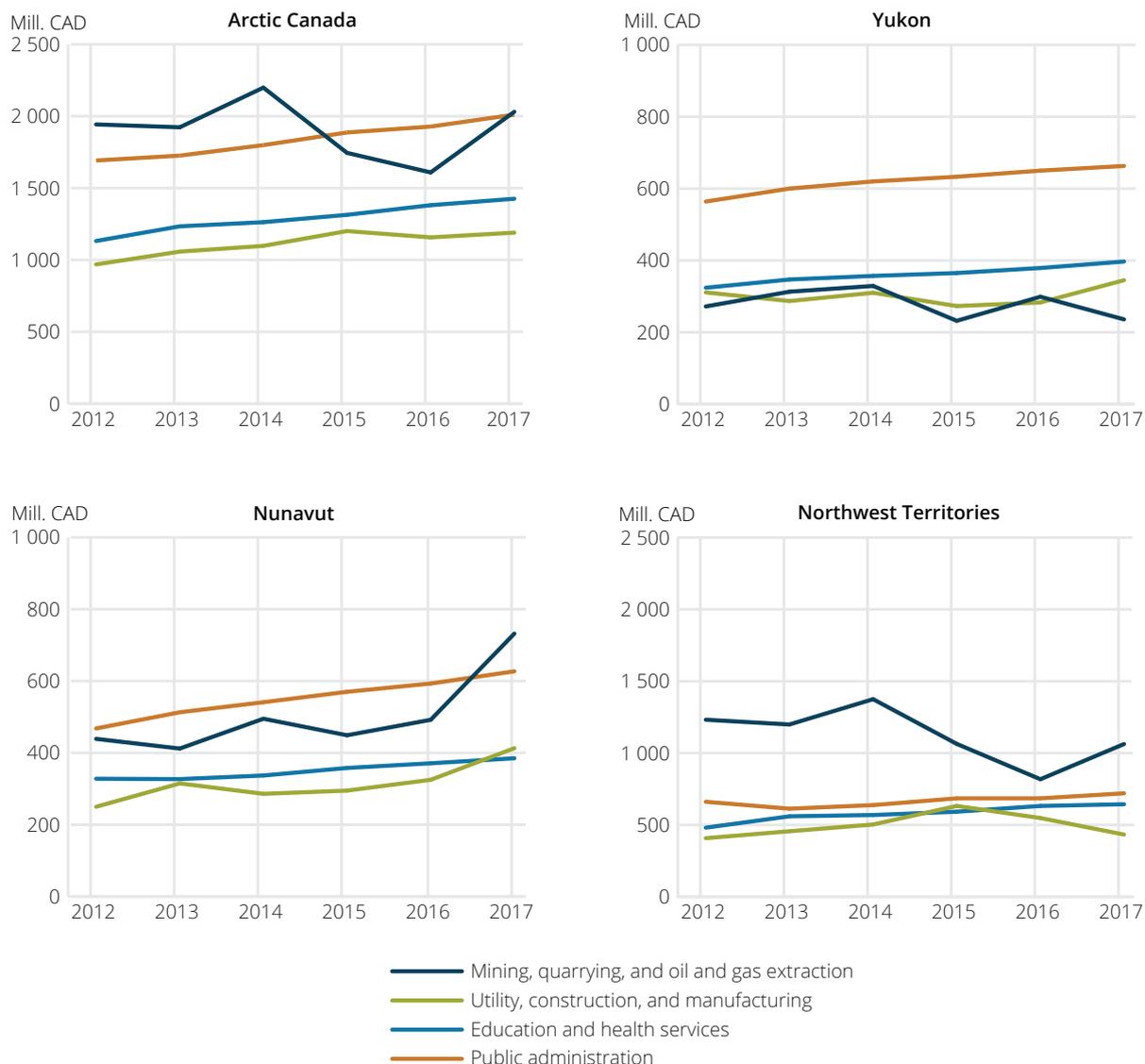
The Northwest Territories has the highest GRP and GRP per capita across the territories while Nunavut had the second highest and Yukon the lowest in 2017. The high GRP of the Northwest Territories reflects the high levels of mining, above all of diamonds, and also its oil and gas industry.

The Public sector has been rising in importance over the past decade and is larger than resource extraction as a source of economic activity in the Northern Canadian economy in 2017. The Public sector is a special aggregation of Public administration and defense as well as the publicly provided portion of economic activity from other industries, such as Education and Health care and social assistance. Together, the Public sector accounted for 33.6 per cent of Northern Canadian GRP in 2017. This makes the Public sector larger than any individual industry and larger than the entire goods producing side of the Northern Canadian economy.

The provision of public sector services increased steadily over time, rising from a share of economic activity roughly equal to Mining, quarrying and oil and gas extraction in 2008 to become the largest source of economic activity in 2017. Between 2008 and 2017, the current Canadian dollar value added in Mining, quarrying, oil and gas extraction declined by an annual average of 1.9 per cent while the value added of Public sector increased by 4.6 per cent per annum. As a result, the contribution of Public sector in Northern Canada’s GRP rose by 6.3 percentage points from 27.3 per cent in 2008 to 33.6 per cent in 2017. Over the same period, the share of GRP from Mining, quarrying and oil and gas extraction declined by 8.9 percentage points to 19.9 per cent in 2017.

The effect of the transition occurring within Northern Canada’s economy is a reorientation of activity away from the Business sector to the Public sector. The transition resulted from a combination of weak growth in Mining, quarrying, oil and gas extraction which held back business sector growth, in parallel with strong Public sector growth. In effect, the Business sector saw moderate growth, but was hindered by weak growth from resource extraction. The public sector expanded at a more rapid rate, and this led to it becoming the central feature of the Northern Canadian economy in 2017.

Figure 4.14. Value added in selected industries. Arctic Canada. 2012-2017. Mill. CAD



The transition from resource extraction to the public sector in Northern Canada is reflected in real terms and in current dollar terms. That the change occurs in real and current dollar terms indicates that the change in the share of activity from Mining, quarrying and oil and gas extraction is not due solely to weak mineral and energy prices, but suggests a more permanent adjustment is taking place.

Across the Northern Canadian economies, Nunavut had the strongest growth between 2012 and 2017, Northwest Territories the second strongest and Yukon the weakest growth (Table 4.3). The industrial growth rates were the strongest on the goods side of Nunavut’s economy. For Northwest Territories,

the largest industrial growth was in the Mining, quarrying and oil and gas extraction combined, while in Yukon, the largest industrial growth rate came from Information and cultural industries. Manufacturing declined in all three territories while Public administration, Education and Health care and social assistance increased (Figure 4.14).

Notes

¹ Glomsrød, S., G. Duhaime and I. Aslaksen (2017): The Economy of the North 2015. Statistics Norway, SA 151

² Glomsrød, S., G. Duhaime and I. Aslaksen (2017): The Economy of the North 2015. Statistics Norway, SA 151

³ Canada Energy Regulator (2020): Provincial and Territorial Energy Profiles – Canada, <https://www.cer-rec.gc.ca/nrg/ntgrtd/mrkt/nrgsstmprfls/cda-eng.html>



Photo: Ásne Vigran

Faroe Islands

Faroe Islands is a self-governing nation within the Kingdom of Denmark. The Government of the Faroe Islands has legislative and administrative responsibility in a wide range of areas mentioned in the Home Rule Act such as the conservation and management of marine resources, protection of the environment, continental shelf resources, external trade relations, financial policy, business regulation, taxation and customs, energy, transport communications, emergency preparedness, social security, culture, education and research.¹

Faroe Islands had 52 080 inhabitants by January 2020 of which 22 000 live in the capital region of Tórshavn. The livelihood has throughout history been based on the ocean and the marine resources. It still is, and Faroe Islands has built up businesses and expertise within fisheries, aquaculture and marine engineering.

Table 4.4 shows GRP or value added by industry in 2015 and 2018. Total income of the economy

Table 4.4. Value added¹ by industry. Faroe Islands. 2015 and 2018

	2015		2018	
	Mill. DKK	Per cent	Mill. DKK	Per cent
Fisheries	1 885	12.5	2 040	11.7
Aquaculture	803	5.3	1 310	7.5
Agriculture, mining and quarrying	36	0.2	53	0.3
Manufacture of food products and beverages	1 083	7.2	1 027	5.9
Other manufacturing	468	3.1	634	3.6
Electricity, gas and water supply	383	2.5	370	2.1
Construction	839	5.6	1 501	8.6
Wholesale and retail trade, hotels and restaurants	1 665	11.1	1 885	10.8
Transportation and storage	1 267	8.4	1 404	8.1
Information and communication	428	2.8	445	2.6
Finance and insurance	553	3.7	538	3.1
Real estate and renting	1 617	10.7	1 541	8.8
Public administration	730	4.8	819	4.7
Education	840	5.6	939	5.4
Health and social work	1 611	10.7	1 906	10.9
Other service activities	847	5.6	1 018	5.8
Total	15 053	100.0	17 429	100.0

¹ At basic prices net of taxes and subsidies.

increased by 16 per cent during this period. Income in Fisheries also increased but only at half that rate, reducing its share of GRP from 12.5 per cent in 2015 to 11.7 per cent in 2018. Fisheries and fish farming generated 19.2 per cent of total income in 2018. In addition to these major contributions to GRP the fisheries cluster creates activity and generate income in Fish processing and marine industry. Other manufacturing industries than Fish processing increased more than twice the average growth in the period.

Fisheries is the largest single industry in Faroe Islands, but two industries are about to challenge its position. Aquaculture is rapidly growing,



Tórshavn. Photo: Ásne Vigran

increasing by 63 percent over the period and with a large potential for further growth, in terms of natural conditions and market potential based on good environmental reputation. The other industry is Construction with the highest growth among all industries (79 per cent) during 2015 to 2018. The high construction activity is to a large extent a result of the largest infrastructure project so far in Faroe Islands. In 2014 the parliament² decided to build subsea tunnels connecting several islands and the first tunnel opened in December 2020, whereas another tunnel is under construction. This infrastructure investment has been a strong driver behind growth in Construction during 2015-2018.

Health and social services increased slightly more than the total economy, raising its share in GRP from 10.7 to 10.9 per cent in 2018. Education and Public Administration increased as well, but somewhat less than the economy at large.

Real growth has been strong in the period 2013-2016 with annual growth rates of 8-9 per cent, followed by a moderate 3 and 1.4 per cent growth respectively in 2017 and 2018 (Figure 4.15).

GRP represents total income generated by the regional economy and by 2018 the GRP per capita was 58 000 USD measured as purchaser price parities (PPP), which indicates the capacity of the whole economy to consume or save. Disposable income of households depicts the share of GRP allocated to private households after taxes and subsidies and represents the maximum level of household consumption that is possible without having to take up loans or sell assets. In 2018 the disposable income of households at 21 000 USD-PPP made up 36 per cent of GRP (see Figure 4.17).

Natural resources

Fisheries are the backbone of the economy. In 2020 export of fish products contributed 92 per cent to the total commodities export value. Figure 4.18 shows development in catches by main species during 2008-2018. In recent years, blue whiting has been the dominating catch in terms of volume. However, catches fell drastically during 2009-2011 and only reached its former catch level towards 2014 before increasing further towards 2017-2018. The dramatic decline was followed up with an agreement between the coastal states of EU, Norway, Iceland and Faroe Islands on a long-term

Figure 4.15. GRP volume index and growth rate. Faroe Islands. 2000-2018

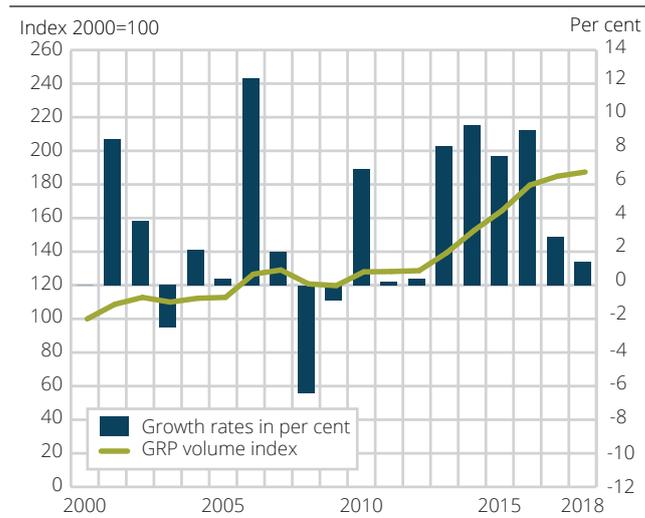


Figure 4.16. Value added by main industry. Faroe Islands. Per cent of GRP. 2015 and 2018

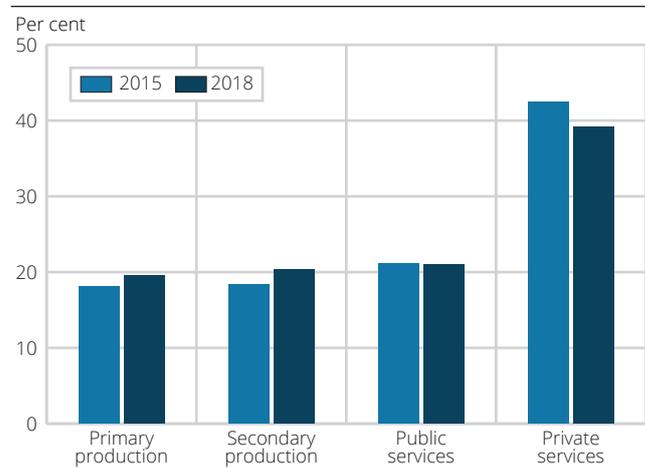
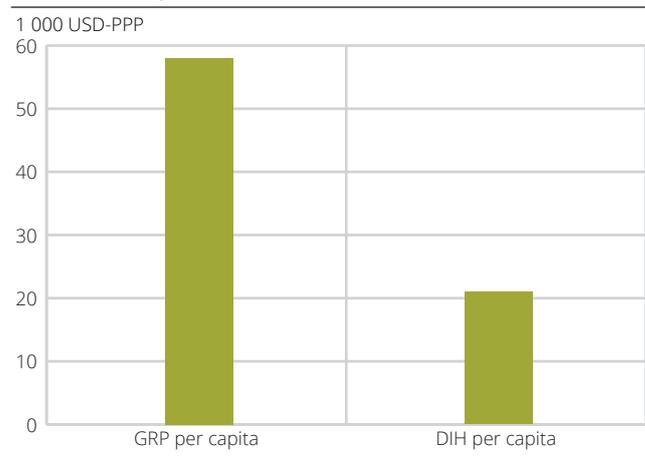


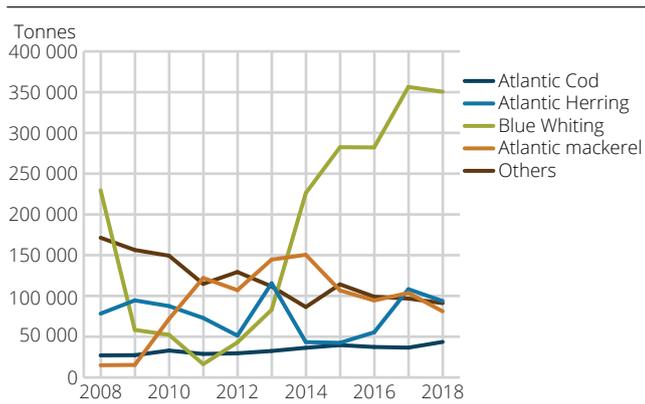
Figure 4.17. Gross regional product (GRP) per capita and Disposable Income for Households (DIH) per capita. Faroe Islands. 2018. 1 000 USD-PPP



plan to increase the recruitment and re-establish a sustainable stock.

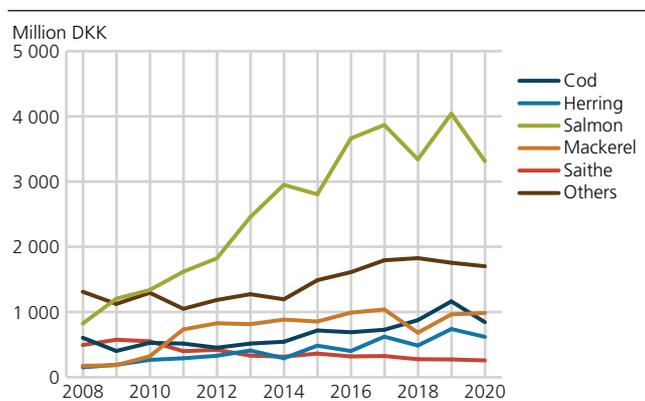
The catch of mackerel was negligible until 2010 when the species migrated further into northern

Figure 4.18. Fish harvest by main species. Faroe Islands. 2008-2018



<https://statbank.hagstova.fo:443/sq/3bffaa16-ea1e-4497-9e2c-07fdce-6438da>
https://statbank.hagstova.fo/pxweb/en/H2/H2_VV_VV01/fv_heild.px/

Figure 4.19. Export of fish products by species. 2008-2020. Million DKK



<https://statbank.hagstova.fo:443/sq/70370487-a411-45c4-83f8-c8a91374664e>
https://statbank.hagstova.fo/pxweb/en/H2/H2_UH_UH01/uh_utfisk.px/

waters due to a substantial rise in the sea temperature. Catches increased and peaked at nearly 150 000 tonnes by 2014, before stabilizing somewhat below that level towards 2019. Figure 4.19 shows the value of fish export by main species during 2008-2019. Blue whiting is dominating in volume and mainly used for fish meal or fish oil, contributing relatively modest to the value of fish export. The processing of blue whiting is less labour intensive than processing of fish for food, and employment in Fish processing industry has remained relatively stable through 2015-2019.

Farmed salmon represents by far the largest export value. Aquaculture is vital in future supply of fish products as the potential for wild fish harvesting is limited on a global basis. Being a natural feeding ground for the stock of Atlantic salmon, the environment of Faroe Islands is well suited for fish farming with clean and temperate sea waters and sheltered fjords. The main species are Atlantic

salmon and Rainbow trout. The export value of salmon has increased almost every year since 2008 and contributed 43 per cent to the total export value of fish products by 2020, far more than any other fish product (figure 4.19).

The energy system is to a large extent fossil based, but the Faroe Islands are developing their potential for renewable energy. In 2019, 59 per cent of electricity was oil based, 27 per cent from hydropower and 14 per cent from onshore wind. Onshore wind was planned to increase further. However, opposition was increasing towards further loss of nature and attractive landscapes. More recently, plans for further investments in onshore wind energy has been reoriented from land based to offshore wind production, near Tórshavn, with capacity to replace 5 onshore wind farms. The dominant producer of electricity is SEV, a company owned by the municipalities in Faroe Islands.

Of total oil consumption the fishing fleet is the largest user with 29 per cent, electricity production uses 17 per cent and road vehicles 12 per cent. The production of wind power increased from 4.2 per cent of total electricity production in 2005 to 14 per cent in 2019. The government has ambitious goals, aiming for 100 per cent green electricity production by 2030. The potential for further renewable capacity growth is large, both for wind and tidal power.

The first licensing round for petroleum exploration in the Faroe Islands was held in 2000. However, so far commercially viable discoveries have not been made. The Faroese economy has, however, benefited from the demand for supply services from mechanical industries and transportation during exploration activity. The Danish parliament decided to halt all new exploration for oil and gas in the North Sea and phase out petroleum production by 2050. Faroe Islands have self-governance in management of natural resources. Faroe Islands has signaled that they will continue exploration. Significant oil and gas fields have been discovered outside the Shetland Islands, only a few kilometers from Faroe Island’s maritime border. Faroe Islands opened a 5th oil and gas licensing round in 2019 in parallel with a UK announcement.

Notes

¹ <https://www.government.fo/en/foreign-relations/constitutional-status/>

² THE PROJECT - P/F Eysturoyar- og Sandoyartunnil (estunlar.fo)



Arctic Finland

Northern Finland consists of the sub-regions Lapland, Kainuu and Northern Ostrobothnia with a total population of 662 000 in 2019. The manufacturing industry is highly developed and integrated in the global economy although the dominance of the electronic industry with the large-scale production of mobile phones is history. From 2015 to 2018 GRP increased by 11 per cent. The highest growth occurred in Mining and quarrying, raising its income by 200 per cent from 2015 to 2018.

Within manufacturing, Metal industry including basic metals and metal products is the most important activity, contributing 10.4 per cent to GRP in 2018 (Table 4.5). However, growth from 2015 to 2018 was as low as 3.5 per cent, far below the average growth of 11 per cent. In contrast, Wood and wood products, Paper and printing and Other manufacturing saw growth around 25-28 per cent during the period. All in all, manufacturing industries generated 17 per cent of total income in 2018, about the level prevailing after the peak level of 26.6 per cent before the drastic decline in the electronics industry (see ECONOR III). Among goods producing activities we find the production of snow mobiles at the factory in Rovaniemi, exporting to Nordic regions and Russia.¹

Construction had a larger than average growth, raising income by 27 per cent and contributing 8.3 per cent to GRP in 2018. Utilities containing production and distribution of electricity, gas and heat and a range of other services increased by 23 per cent, twice the growth of the economy at large.

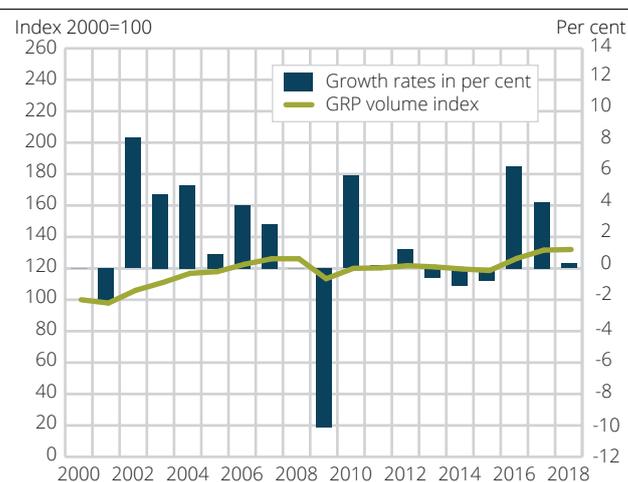
Trade and Transportation had less than average growth, at 6 and 9 per cent respectively. The sector

Table 4.5. Value added¹ by industry. Arctic Finland. 2015 and 2018

	2015		2018	
	Mill. euro	Per cent	Mill. euro	Per cent
Agriculture and hunting activities	190	1.0	165	0.8
Forestry and fishing	638	3.5	692	3.4
Mining and quarrying	194	1.1	584	2.9
Wood and wood products	178	1.0	222	1.1
Paper and printing industries	321	1.8	408	2.0
Metal industry	2036	11.2	2108	10.4
Other manufacturing	556	3.0	712	3.5
Utilities	598	3.3	735	3.6
Construction	1310	7.2	1669	8.3
Wholesale and retail trade	1323	7.3	1406	7.0
Transportation and storage	783	4.3	853	4.2
Accommodation and food service activities	325	1.8	417	2.1
Information and communication	427	2.3	547	2.7
Finance and insurance	322	1.8	340	1.7
Real estate services	278	1.5	291	1.4
Rental and operation of dwellings	2087	11.4	2307	11.4
Professional, scientific and technical services	753	4.1	755	3.7
Administrative and support services	512	2.8	580	2.9
Public administration and defence; compulsory social security	1375	7.5	1324	6.6
Education	1236	6.8	1238	6.1
Health care and social work services	2221	12.2	2199	10.9
Other service activities	582	3.2	632	3.2
Total	18 243	100.0	20 185	100.0

¹ At basic prices net of taxes and subsidies.

Figure 4.20. GRP volume index and growth rate. Arctic Finland. 2000-2018



Other private services generally had lower growth around or below the growth in the economy at large, except Accommodation and food services and Information and communication. The growth in tourism was an important driver behind growth in income of hotels and restaurants (see Chapter 7). There was zero growth in the knowledge-based industry of Professional, scientific and technical services, reducing its share in GRP from 4.1 to 3.7 per cent.

Figure 4.20 shows real growth in GRP during 2000-2018 assuming fixed prices, thus reflecting annual volume growth rates and the real GRP index. After the financial crisis 2008-2009 and the immediate bounce back in 2010, the annual growth rate was marginal or even below zero until activity picked up markedly in 2016 and 2017. The years of low growth in particular reflect the downscaling of the large electronics industry, mainly related to the production of the Nokia mobile phone – the flagship of the manufacturing industry. In 2018 the annual growth rate was positive but marginal. Although the electronics industry collapsed with the mobile phone production, the industry has developed further within electronic network technology, contributing to high growth (28 per cent) in both Information and communication and Other manufacturing.

Figure 4.21 shows structural changes in the economy during 2015-2018. The trend has been a notable increase in primary or extractive industries, above all due to the boost in Mining. The goods producing secondary industries containing Construction and Utilities in addition to manufacturing also increased in importance. Both private and public services reduced their shares in GRP.

Figure 4.22 compares GRP – total regional income – per capita and disposable income of households (DIH) per capita in Northern and Southern Finland. Both these indicators are lower in the Arctic region than in the rest of the country, however, the difference in DIH per capita between Arctic and non-Arctic regions is much smaller than the difference in GRP per capita. Disposable income per capita in Northern Finland in 2018 was 22 000 USD-PPP, corresponding to 52 per cent of GRP per capita generated in the region. In contrast, in 2005 the share of DIH in GRP per capita was as high as 64 per cent (see ECONOR III).

Disposable income of households is total private income adjusted for taxes and transfers/subsidies. However, there is reason to assume that with rich wildlife outside the door the inhabitants in the northern regions have larger income from own produce of food from hunting, fishing and harvesting than in the non-arctic regions. However, these values are difficult to measure and not included in national account data of DIH. Another relevant adjustment of the DIH relates to received value of

Figure 4.21. Value added by main industry. Arctic Finland. Per cent of GRP. 2015 and 2018

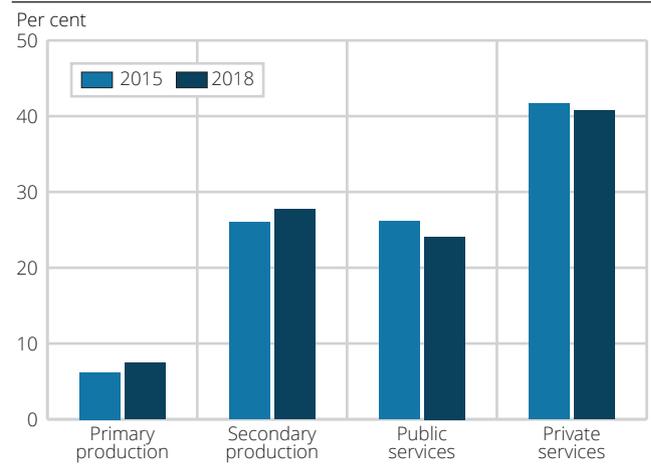
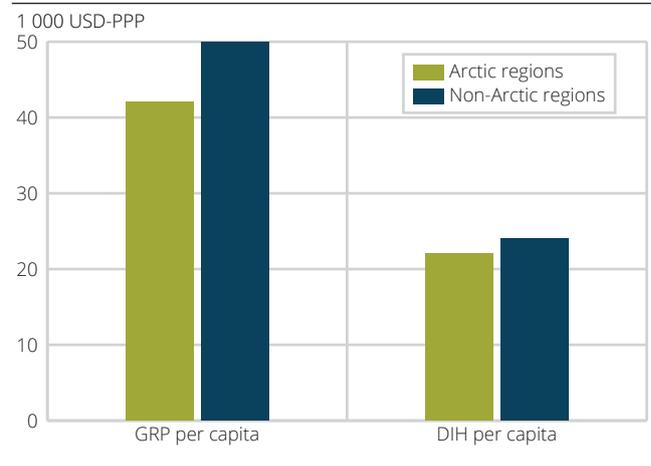


Figure 4.22. Gross regional product (GRP) per capita and Disposable Income of Households (DIH). Arctic Finland. 2018. 1 000 USD-PPP

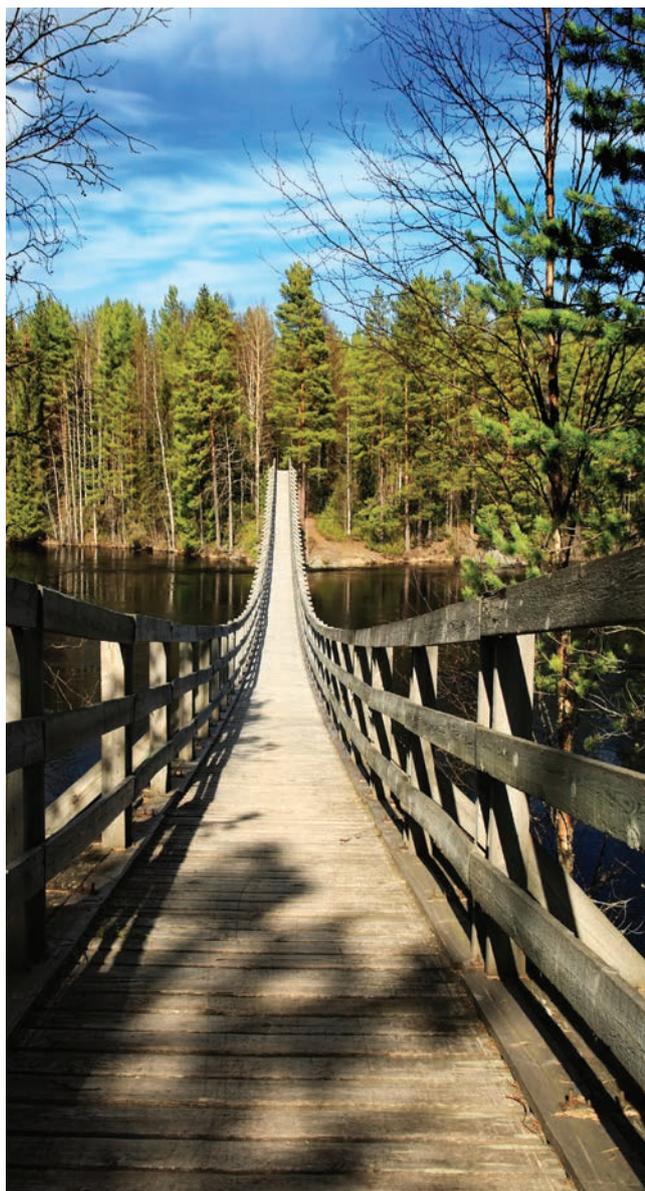


in-kind services, for instance as unpaid education and health services. By convention these are not included either, however, this income flow can be estimated. A pilot example of adjusted DIH per capita with respect to the value of in-kind services like health and education is presented for Northern Canada in Box 4.2.

Minerals²

The mining industries tripled its income from 2015 to 2018 and a driving force in global markets has been demand for metals and minerals used for batteries, fuel cells and electronic devices relevant for the green transition.

Lapland’s Kemi mine is the only cromite mine in the EU. Chromite is used in alloys for hardening and corrosion resistance, practically indispensable in the production of ferrochromium used in stainless steel for construction.



In Lapland there is also some nickel production in the Kevitsa mine. Nickel is used in chemical and aerospace industries and for batteries and fuel cells. The Kevitsa mine also extract copper for use in construction and electrical and electronic industries. The mine also produces a small amount of palladium, mainly used by the car industry for catalytic converters.

There is some gold production in the Kittila Mine in Lapland. Gold is used for jewelry and as monetary reserves, besides being a catalyst in industrial processes. There is a small platinum production in the Suhanko mine in Lapland.

Northern Finland has mineral reserves that are suitable for emerging industries, however, the seemingly empty areas is home to Sámi reindeer herders and the mining adds to the existing

pressure from construction of roads, wind-parks, logging, and tourism.

Energy

In 2018 hydropower dominated electricity supply in Kainuu (53 per cent) and Lapland (66 per cent) whereas in North Ostrobothnia wind power delivered 37 per cent of the regional electricity supply, slightly more than hydro power (34 percent). Thermal power ranged from 18 per cent in each of the Kainuu and Lapland regions to as much as a third in North Ostrobothnia.³

The growth in onshore wind power has been moderate in comparison to in Northern Sweden.⁴ The largest potential is along the west coast and offshore, however there is a moderate potential in most of the arctic region.⁵ Wind power investments have been encouraged with a feed-in tariff. However, subsidies are now being phased out.

In contrast to arctic regions of Sweden and Norway, Northern Finland tends to depend on imports of electricity. However, the Hanhikivi 1 nuclear power plant in Northern Ostrobothnia commissioned for 2028 will change the energy balance in Finland by adding capacity of national electricity supply by 10 per cent.⁶

Tourism

Arctic Finland has specialized in mass tourism at compact resorts, like Levi in North Lapland receiving 750 000 visitors per year, mostly for skiing⁷. There has also been a large increase in visitors in the months leading up to Christmas, reflecting the popularity of the Santa Claus Village in Rovaniemi. (see Chapter 7). Rovaniemi Airport is the third busiest airport in Finland after Helsinki and Oulu airports.

Notes

¹ <https://www.brp.com/en/about-us/our-locations/manufacturing-facilities.html#content-Finland>

² USGS 2015. Mbendi (2019): <https://mbendi.co.za/indy/ming/mingsa.html> Mineral Gallery (2019): http://www.galleries.com/minerals_by_name.

³ Business Index North data compiled from data of Statistics Finland

⁴ bin2017_5_renewable_energy_in_the_north_web.pdf (businessindexnorth.com)

⁵ Finnish Wind Atlas - Maps of power production (tuuliatlas.fi)

⁶ bin2017_5_renewable_energy_in_the_north_web.pdf (businessindexnorth.com)

⁷ <https://www.levi.fi/en/info/general-information.html>



Nuuk, Greenland. Photo: Tom Nicolaysen

Greenland

Greenland is a self-governing nation within the Kingdom of Denmark. The Government of Greenland has sovereignty and administration over the areas mentioned in the Self-Government Act such as education, health, fisheries, environment and climate.¹

The population counted 56 081 in 2020 and population growth has been low or negative after 2000, with falling birth rates and variable but net emigration. However, from 2012 the decline in total fertility is replaced by a relatively stable trend around 2.00 towards 2020.²

The economy of Greenland increased by 13 per cent from 2015 to 2018 (Table 4.6). Fisheries, enjoying favorable prices and good harvests increased by 23 per cent, contributing 17.5 per cent to GRP in 2018. Greenland's open sea fisheries of Northern prawns and halibut are Marine Stewardship Council (MSC)³ certified as sustainable, requiring that politically determined quotas comply with biological advice, a precondition for selling to many of the large buyers of fish and shellfish.

Besides fisheries, Manufacturing, Construction and Transportation had growth rates above average.

Manufacturing including fish processing saw 35 per cent growth, the largest income growth among our industry categories during 2015-2018. Construction grew 32 per cent, reaching a share of 11.1 per cent of GRP in 2018. Income in extraction of raw

Table 4.6. Value added¹ by industry. Greenland. 2015 and 2018

	2015		2018	
	Mill. DKK	Per cent	Mill. DKK	Per cent
Agriculture and hunting	341	2.1	310	1.7
Coastal fisheries	709	4.3	878	4.7
Offshore fisheries	1 486	9.0	1 937	10.5
Other fisheries	334	2.0	418	2.3
Extraction of raw materials	86	0.5	76	0.4
Manufacturing	715	4.4	964	5.2
Utilities	549	3.3	408	2.2
Construction	1 557	9.5	2 051	11.1
Wholesale and retail trade	1 652	10.1	1 601	8.6
Transportation	1 274	7.8	1 529	8.3
Accommodation and food services	277	1.7	298	1.6
Finance and insurance	236	1.4	229	1.2
Real estate and rental services	1 147	7.0	1 229	6.6
Public administration	1 562	9.5	1 731	9.3
Education	989	6.0	1 008	5.4
Health services	743	4.5	832	4.5
Social services	1 144	7.0	1 343	7.3
Other services	1 628	9.9	1 697	9.2
Total	16 430	100.0	18 539	100.0

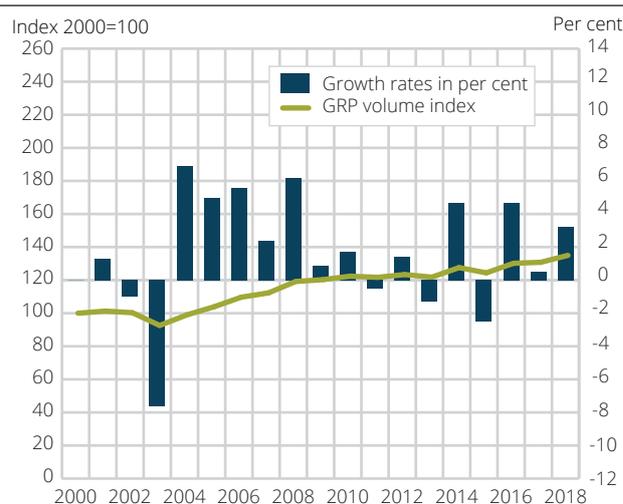
¹ At basic prices net of taxes and subsidies.

Table 4.7. Fisheries in Greenland. Value added¹ 2012-2018. Mill. DKK

	2012	2013	2014	2015	2016	2017	2018
Coastal fisheries	759	685	782	709	865	867	878
Ocean fisheries	1 105	975	1 329	1 486	1 724	2 034	1 937
Other fisheries	257	240	285	334	453	388	418
Total	2 121	1 900	2 396	2 529	3 041	3 288	3 232

¹ At basic prices net of taxes and subsidies.

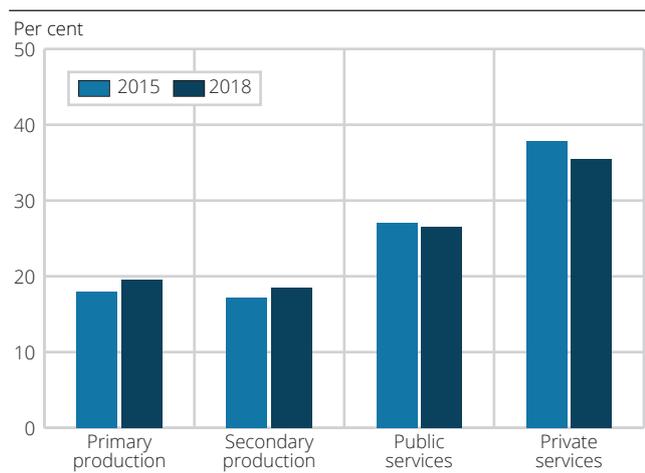
Figure 4.23. GRP volume index and growth rate. Greenland. 2000-2018



materials has been falling further, to only 0.4 per cent of the GRP in 2018.

Figure 4.23 shows real economic growth, that is the volume growth assuming fixed prices of goods

Figure 4.24. Value added by main industry. Greenland. Per cent of GRP. 2015 and 2018

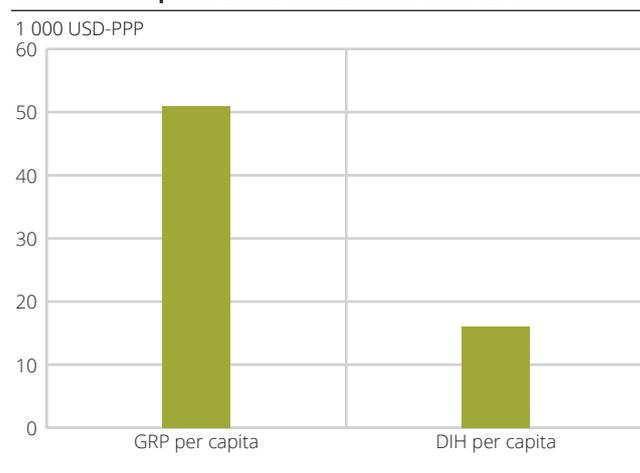


and services. After 2012 there has been a strong growth in several years, although negative or low growth also appear.

Figure 4.24 sums up the economic changes in terms of shifts between main industry categories. Growth in fisheries has lifted primary production, and fish processing and construction raised the share of secondary (goods producing) industries, whereas public and in particular private services both contributed smaller shares of GRP in 2018 than in 2015.

Figure 4.25 compares the GRP per capita with Disposable income of households per capita in

Figure 4.25. Gross regional product (GRP) per capita and Disposable Income for Households (DIH) per capita. Greenland. 2018. 1 000 USD-PPP



2018. Greenland has a GRP per capita more than three times the disposable income per capita, a bigger difference than for other Arctic regions, except Arctic Russia. In comparison, the share of disposable income of households in GRP in Greenland was 45 per cent in 2012 (see ECONOR III). Note, however, that disposable income does not include the in-kind benefits through public health and educational services, which might be considerable. Besides disposable income, households also benefit from public services through education and health services which represent 17 per cent of GRP. A modified approach to calculating disposable income by also including the value of in-kind public services is shown for Northern Canada in Box 4.2.



Greenland. Photo: Colourbox

Fisheries

There has been a favorable trend in fisheries mainly as a result of increasing fish prices, creating a booming economy and labour shortage, reducing unemployment from more than 10 per cent in 2014 to less than 4 per cent in 2019.⁴ Prices increased for the most important fish species Greenland halibut, cod and above all prawns. The large income growth has induced significant investment in new open-seas vessels.⁵ The value of fish export made a jump for cod, halibut and above all prawns in 2019, falling back to the trend in 2020 (Figure 4.27).

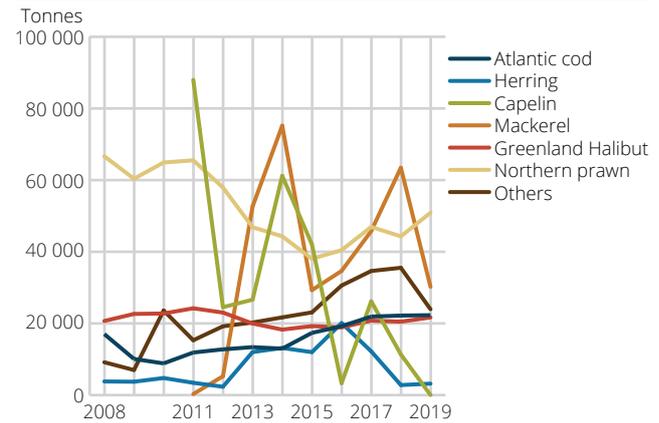
Greenland has introduced a resource tax on their highly profitable fisheries to reflect that profit in fisheries above normal return on capital shall benefit the whole society. The tax rate increases with the market price. In good times the resource tax revenue benefits the whole society, however, in the case of a negative shock the tax revenue will fall markedly, adding to the strain from lower direct and indirect income losses in fisheries. Some petroleum-based economies like Alaska and Norway have built up funds to buffer against price shocks or resource depletion, ensuring a sustainable source of revenue based on the resource extraction (see Box 4.1).

Petroleum

So far there is no petroleum production in Greenland, but according to US Geological Surveys 2008, Greenland has considerable undiscovered resources of 47 billion barrels of oil equivalents (bboe), of which oil is around 25 bboe and gas 22 bboe. However, the location of these resources provides challenges in terms of ice and storms, and the neighborhood of a pristine natural environment. Even if profitable discoveries are made, reserves in Greenland are not expected to be developed in the near future because the time lag between discoveries and production tend to be considerable in the Arctic.

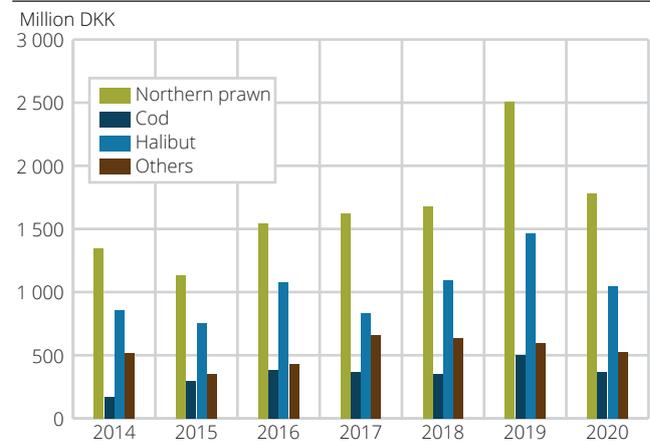
Natural gas has been indicated by seismic surveys, but no findings have proven viable so far. Several petroleum companies have stopped their exploration activities the last couple of years. Currently, oil and gas companies hold 15 licenses to explore in Greenland. While none of them is actively drilling at the moment, the license holders are actively analyzing seismic data in preparation for future

Figure 4.26. Catch of fish and shellfish. Tonnes



Source: https://bank.stat.gl/pxweb/en/Greenland/Greenland_FI_F110/FIX008.px/

Figure 4.27. Export of fish and shellfish. Greenland



Source: https://bank.stat.gl/pxweb/en/Greenland/Greenland_IE/IEEXP.px/px/

drilling. If petroleum companies start to expect higher future prices, Greenland’s oil and gas activity could recover again.⁶

Minerals

Greenland potentially has many different mineral resources, such as coal, copper, gold, lead, precious stones, rare-earth elements, uranium, and zinc.⁷ The Greenland Self-Government Authority has primary sovereignty over mineral resources. However, half of potential mineral revenues above DKK 75 million will be subtracted from the Danish block grant.

The Aappaluttoq ruby and pink sapphire mine started production in May 2017, however, 2019 and 2020 saw considerable deficits, but a surplus is expected in 2021, as the covid-19 pandemic slows. As of 9 April 2021, the large scale zinc mining project at Citronen Fjord is approaching a complete set of permits, the last one will be applied for when

the financial process is successfully concluded. The Citronen Fjord zinc deposit is large, and the mine will be among the six largest producers in the world.⁸

The Kvanefjeld (Kuannersuit) is considered one of the world's major undeveloped deposit of both rare-earth elements and uranium. The prospects for mineral incomes, including from the Kvanefjeld potential, play a role in Greenland's aspirations for independence, which depends on its capacity to sustain the welfare level without receiving the block grants from Denmark. Environmental groups and local inhabitants oppose the planned disposal of waste from Kuannersuit, and there is also local concern about the potential radioactive dust precipitation on the local communities and surrounding grazing lands, and waters. The new coalition government (as of 24 April 2021) following the general elections on 6th April is based upon an agreement that there will be no uranium mining and to stop the Kuannersuit project. Legislative measures will be taken to ban exploitation of minerals containing radioactive materials.⁹

Tourism

Another potential source of increased income and tax revenue is the tourist industry. There is no road network in Greenland, and most visitors arrive

by air. In 2015 the parliament decided to develop three airports, with Denmark contributing finance and guaranties for the two airports in Nuuk and Illulisat.

In recent years the increase in number of visitors has mainly come as cruise arrivals. The number of cruise passengers increased from 24 thousand in 2014 to 45 thousand in 2018, followed by a minor increase towards 2019, see Chapter 7.

Notes

¹ <https://naalakkersuisut.gl/en/About-government-of-greenland/About-Greenland/Politics-in-Greenland>

² Fertility rate, total (births per woman) - Greenland | Data (worldbank.org) <https://data.worldbank.org/indicator/SP.DYN.TFRT.IN>

³ The MSC Fisheries Standard | Marine Stewardship Council

⁴ Danmarks nationalbank: Strong growth, but reforms are required. ANALYSIS_No.21_ The Greenlandic economy.pdf (nationalbanken.dk)

⁵ Danmarks nationalbank: Strong growth, but reforms are required. ANALYSIS_No.21_ The Greenlandic economy.pdf (nationalbanken.dk)

⁶ Geological Survey of Denmark and Greenland (2017): Mineral resources assessment: Geological Survey of Denmark and Greenland.

⁷ Geological Survey of Denmark and Greenland (2017): Mineral resources assessment: Geological Survey of Denmark and Greenland.

⁸ USGS (2016): The Mineral Industries of Denmark, the Faroe Islands, and Greenland, The Minerals Yearbook.

⁹ <https://ia.gl/da/2021/04/16/koalitionsaftale/>



Nuuk apartment blocks, view from above, Greenland. Photo: Colourbox



Iceland

The pillar of the Icelandic economy has been the fishery cluster, with fishing, fish processing and now also fish farming as core elements. However, during most of the time since the financial crisis in 2008 tourism has grown into the role as another pillar of the economy. Over the last decade production and export of basic metals and metal products have emerged, so has an industry of datacenters dealing with computer clouds and digital currency mining. Both metals and datacenters enable Iceland to indirectly export its landlocked surplus of renewable energy and diversify the economy through export of goods and services. However, the impact on the environment is substantial, as clearly expressed in Iceland’s political landscape. The natural landscape of Iceland is highly valued by the population and the main attraction of tourists.

During 2015-2018 the economy of Iceland increased by 22 per cent measured as GRP in current prices. In relative terms the largest growth in income is found in Aquaculture, which tripled its income from 2015 to 2018. Still the industry is small in national context, contributing only 0.3 per cent to GRP in 2018. Then follows Mining and quarrying, which more than doubled, but still represents only 0.2 percent of total income in 2018. The third largest growth and most impacting on the economy is in Construction (76 per cent), raising its share of the economy from 5.4 per cent to 7.8 per cent of GRP.

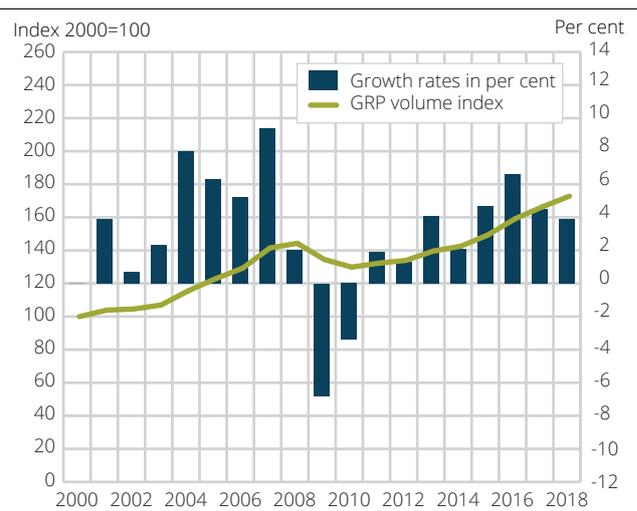
The strong growth in Construction during 2015-2018 is partly driven by further investment in metal producing capacity, in particular as the second

Table 4.8. Value added¹ by industry. Iceland. 2015 and 2018

	2015		2018	
	Mill. ISK	Per cent	Mill. ISK	Per cent
Agriculture and forestry	21 948	1.1	23 924	0.9
Fishing	98 502	4.7	80 203	3.2
Aquaculture	2 152	0.1	6 626	0.3
Mining and quarrying	1 969	0.1	4 817	0.2
Fish processing	66 840	3.2	62 309	2.5
Basic metals	50 714	2.4	32 508	1.3
Metal products	14 312	0.7	19 374	0.8
Other manufacturing	114 499	5.5	128 661	5.1
Electricity, gas, steam and air conditioning supply	86 124	4.1	94 746	3.7
Water supply, sewerage, waste	19 376	0.9	20 897	0.8
Construction	112 663	5.4	197 771	7.8
Wholesale and retail trade	187 114	9.0	230 640	9.1
Transportation and storage	136 213	6.6	176 693	7.0
Accommodation and food service activities	65 905	3.2	96 626	3.8
Information and communication	95 365	4.6	115 822	4.6
Finance and insurance	138 096	6.6	149 178	5.9
Real estate activities	230 375	11.1	288 101	11.4
Scientific, technical and administrative services	170 885	8.2	222 297	8.8
Public administration and defence	112 531	5.4	135 598	5.4
Education	128 165	6.2	154 266	6.1
Human health and social work	165 276	8.0	213 240	8.4
Arts, entertainment and other services	58 739	2.8	75 113	3.0
Total	2 077 762	100	2 529 409	100

¹ At basic prices net of taxes and subsidies.

Figure 4.28. GRP volume index and growth rate. Iceland. 2000-2018



silicon smelter was under construction from 2015, starting production in late 2018.

The Accommodation and food industry serves tourists and mobile labour, in addition to the residents

in general. Increasing demand lead to a 47 per cent growth, more than twice the rate of the total economy. A rising tourist industry (see Chapter 7) might also explain the larger that average growth in Transportation, which also was influenced by the higher activity in Construction.

Income in Fisheries was 19 per cent lower in 2018 than in 2015, while Fish processing was down 6 per cent.

The metal producing industries are attracted to Iceland by the abundant and low-cost supply of renewable energy in terms of hydropower and geothermal energy. The cheap renewable energy more than outweigh the additional transportation costs for raw materials and products. There has been substantial investments in aluminium and silicon smelters. However, income in basic metal production was lower in 2018 than in 2015. On the other hand, income growth in Metal products made up for some of this decline.

The industry of Scientific, technical and administrative services grew markedly more than the average economy, mainly driven by strong growth in administrative services.

After the financial crisis in 2008-2009 positive real growth in Iceland was reestablished already in 2011 and has since then been substantial, with highest growth around 2016, a year of the high investments in metal production capacity (Figure 4.28).

Figure 4.29 shows the industrial activity allocated to main industries. The fisheries are important to the economy, however the relatively low level of income in fisheries left the share of primary or extractive industries as low as 4.6 per cent in 2018, with small contributions from Mining and Agriculture. Iceland's economy is highly diversified with relatively large secondary industries and private services above 50 per cent of GRP, reflecting the high level of education and associated knowledge industries.

As shown in Figure 4.30 the GRP per capita is almost three times larger than disposable income per capita. Besides disposable income, households also benefit from services through education and

Figure 4.29. Value added by main industry (at current price). Iceland. Per cent of GRP. 2015 and 2018

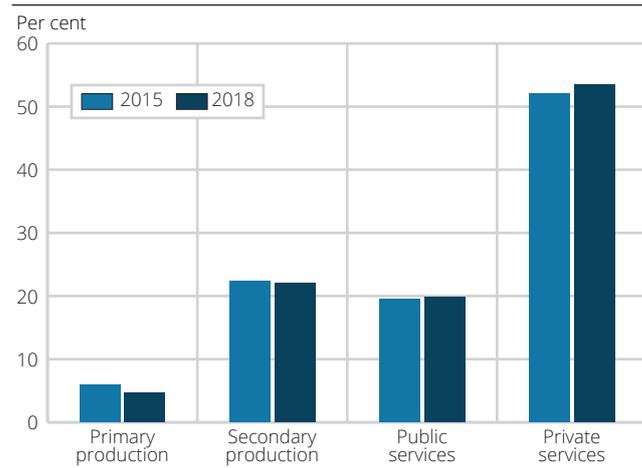
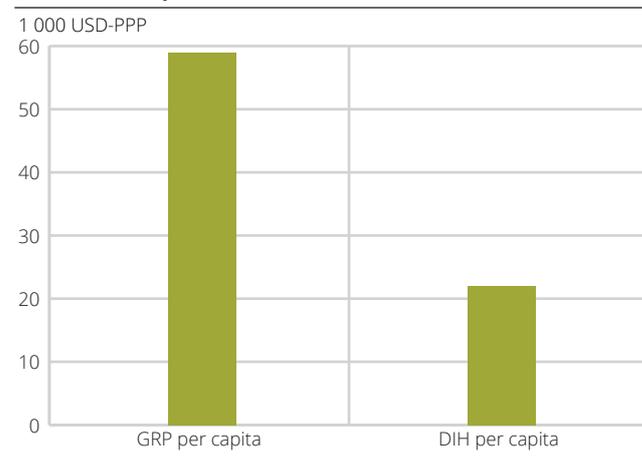


Figure 4.30. Gross regional product (GRP) per capita and Disposable Income for Households (DIH) per capita. Iceland. 2018. 1 000 USD-PPP



health, which together represents 14.5 per cent of GRP in 2018. An example of adjusting the DIH for public services is shown for Northern Canada in Box 4.2.

Tourism

Tourism is the major source of export income, generating almost 40 per cent of total export revenue in 2018 and contributing 8.6 per cent to GRP in 2017.¹ The number of visitors increased by 12 per cent per year on average during 2015-2018, almost reaching 2.5 million in 2018 (see Chapter 7). Among the major attractions of Iceland are spectacular natural sceneries and the opportunities for hiking, trekking, whale watching – activities which also put pressure on fragile ecosystems. In March 2021, the volcano Fagradalsfjall near Reykjavik erupted and added to spectacular views.²



Nesjavellir geothermal power plant in Iceland. Photo: Crestock

As nature is the magnet of visitors there is also a concern that loss of valuable nature through development in energy supply to energy intensive industries is a factor which might interfere with interests of the tourist industry.³ A long-term Tourism Policy Framework 2020-30 with a strong focus on sustainability was launched in 2019 in tandem with an environmental tool for assessing the status of protected areas and natural attractions.

In 2020 during the covid-19 pandemic there was a 70 per cent reduction in number of visitors from the top ten countries⁴ and GRP in 2020 declined by 6.6 per cent in real terms from the previous year.⁵ This illustrates the vulnerability of small arctic economies achieving success in specific industries, a challenge that is not only relevant for mineral extraction.

Energy

Iceland is richly endowed with geothermal energy and hydropower, covering 65 and 18 per cent respectively of primary energy use in 2019. Fossil sources dominated by oil contribute around 15 per cent to primary energy use and is mainly used by the fishing fleet and in road transportation. In electricity production, 69 per cent came from hydropower and 31 per cent from geothermal energy. The supply of geothermal energy in primary energy increased significantly until 2012, when the level remained about constant until 2019. Landsvirkjun generates three fourths of electricity and is one

of the largest producers of renewable energy in Europe. The contribution from wind energy is marginal and did not increase during 2016-2019.

The potential for further supply of renewable energy is huge. However, as direct energy export is impossible, the economy has moved in a direction where energy can be exported indirectly as energy intensive goods and services. The government has opened-up for large scale investments in heavy industries, mainly aluminium and silicon smelters. The strategy for indirect energy export has left a big footprint on the environment. However, the activity has been exposed to close-downs related to low world market prices or environmental regulations.

Providing renewable energy to energy intensive industries make large improvements in the climate



Reykjavik, Iceland. Photo: Colourbox

and environmental footprint of companies and is increasingly requested by investors and governments. Besides production of basic metals, another industry enjoying benefits of cheap renewable energy is the data center business. Data centers are energy intensive activities, and the stable and cool climate of Iceland keeps costs of cooling down. Cryptocurrency mining is consuming about 90 per cent of total energy use by datacenters.⁶

Domestic demand for electricity is expected to increase. The Icelandic government will replace fossil fuels with electricity over the next decades. Among the government's goals is a ban on new gasoline and diesel vehicles by 2030. The government aims to have 30 000 electric cars in Iceland by 2026.⁷

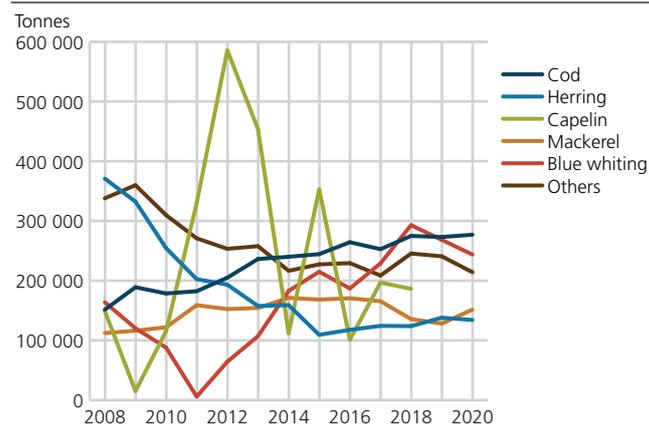
Fisheries

Figure 4.31 shows the catch of main species. Capelin has in periods dominated in terms of landed weight. Capelin is a relatively short-lived and highly dynamic species, in addition, the changing temperature and ocean currents in recent years have made it difficult for researchers to locate and assess the stock, leading to large variability in catches. Traditionally, capelin has been used for fish meal and fish oil and has a lower commercial value than cod, which is by far the most important species in terms of export value (Figure 4.32). Over the last years, however, there has been increasing consumer demand of capelin from Asia.

Cod is the most valuable single species with an export value roughly 5-6 times that of other wild fish species. The export value of farmed salmon has increased to 19 thousand million ISK in 2020, exceeding that of several traditional wild fish species.

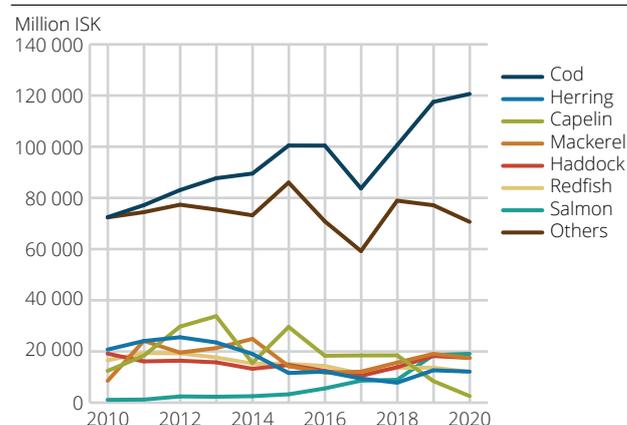
Iceland has managed its fisheries, by introducing harvest quotas by vessel or company at a sustainable level. Increasing demand and prices in recent years have strongly increased income in the industry, which is endowed with the exclusive right to harvest the fish resources of the nation. To secure the society at large a share in the resource rent – the surplus above normal return on investments – a resource tax was introduced in 2012, based on the profit margins of harvesting the different species. The resource rent tax is channeled into the government budget to the common benefit.

Figure 4.31. Catch by species. Iceland. Tonnes



Source: https://px.hagstofa.is/pxen/pxweb/en/Efnahagur/Efnahagur__utanrikisverslun__1_voruvidskipti__01_voruskipti/UTA06101.px/?rxid=0393c417-06ac-43de-850e-8f42864f0418

Figure 4.32. Export of marine products by species. Iceland. Million ISK



Source: https://px.hagstofa.is/pxen/pxweb/en/Efnahagur/Efnahagur__utanrikisverslun__1_voruvidskipti__01_voruskipti/UTA06101.px/?rxid=0393c417-06ac-43de-850e-8f42864f0418

The quota system provides the government with control of the harvest volumes, however, there is concern about distributional aspects of the system as the quotas are transferable and a concentration of quotas might disfavor smaller scale fisheries and local communities (see Box 4.3).

Notes

¹ Iceland | OECD Tourism Trends and Policies 2020 | OECD iLibrary (oecd-ilibrary.org) <https://www.oecd-ilibrary.org/sites/2fde1a1d-en/index.html?itemId=/content/component/2fde1a1d-en>

² Volcano tourism is booming, but is it too risky? (nationalgeographic.com)

³ Iceland-protecting-the-natural-environment-as-a-key-asset-for-economic-growth.pdf (oecd.org)

⁴ december-2020.pdf (ferdamalastofa.is)

⁵ Statistics Iceland - Frontpage (statice.is)

⁶ Talk book template (si.is)

⁷ Phase-out of fossil fuel vehicles - Wikipedia

Box 4.3: An un-concentrated effort to clarify the concentration rules in Icelandic fisheries

Thórólfur Matthíasson, University of Iceland

In fisheries, quota systems are frequently used to allocate limited fish harvest to vessels or firms. All quota systems make it harder for newcomers to enter the industry. Transferable quotas add the new dimension that one or a few firms might exert market power with unwanted societal consequences. In 1998 the Icelandic Parliament Althingi addressed these concerns. Act 27/1998 amends the Fishery Management Act (Act 38/1990). The amended Act prescribes a ceiling on the share of quotas a fishing firm can hold. For species where trade in quotas is unrestricted the ceiling was set to 12 per cent, otherwise 8 or 10 per cent. The objective of Althingi in the new legislation was striking a balance between efficiency, distributional concerns and fairness.

Development of concentration of quotas in Icelandic fisheries

After nearly two decades of quota trading, a study¹ mapped the actual development of concentration of quotas by firms and by geography during 2000-2023.

The Icelandic quota system is organized in two categories, the regular system and the hook-and-line system. Quotas can be moved from the regular system to the hook-and-line system, but not the other way around. It should be noted that the quota ceiling for the hook-and-line system are considerably lower than in the regular system. One firm can at most hold 4 per cent of the cod quota and 5 per cent of the haddock quota earmarked for the hook-and-line system.

Figure 1 shows that the 25 biggest firms under the regular system increased their share of total quotas in all species under regulation from 40 per cent to 65 per cent during the first nine years the system was in operation. The increase in concentration was even faster in the hook-and-line system, as the 25 biggest firms increased their lot from 23 per cent to 53 per cent during the first seven years in operation. The pattern in both systems is similar, with fast increase in concentration during the first years of operation, then a slow, almost microscopic, increase in concentration of quotas. The pattern suggests that there is an economy of scale in fisheries that only can be realized if entry is restricted. The increase in concentration, as measured by the quota share of the biggest firms, slows considerably in both systems 7-10 years after implementation of tradable quotas. That might indicate that the

scope for efficiency through sizing up the operation was exhausted. Alternatively, it might indicate that the quota ceiling is effectively restricting the drive towards concentration or it might indicate that the operators have learned to game the system.

Criticism by The Icelandic National Audit Office

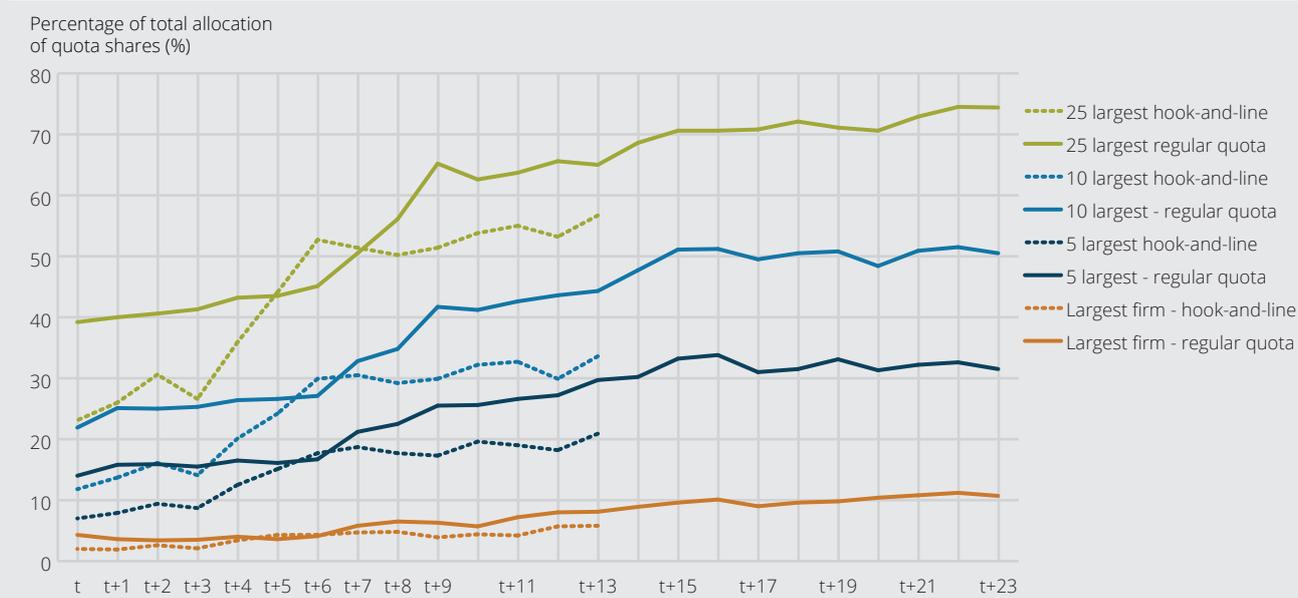
When Althingi amended the Fishery Management Act in 1998 to include the quota ceiling in the regular quota system it tried to prevent “ceiling hopping”, i.e. that a big investor could “disinvest” her quota holdings into several daughter-firms. If a firm holds the majority of voting rights in another company, the former is a mother-company and the other is the daughter-company, whereas the whole conglomerate is termed “related parties” and their quota holdings are counted as if this was one firm. The law also stipulates that spreading out the voting rights in smaller portions to more holding firms does not alter the rule that quota holding shall be counted as if the whole conglomerate is one firm. It should be noted that a mother-firm or a set of mother-firms must have a majority of voting rights in a daughter-firm to invoke the “related parties” rule. This is in contrast to regulation in financial markets where a stake as low as 20 per cent will invoke a “related parties” rule (§18 of Act 161/2002).

The Directorate of Fisheries (Fiskistofa) is given the task to regulate the quota-ceiling. The Icelandic National Audit Office (INAO) did a management audit (stjórnsýsluendurskoðun) of the directorate in 2018. Their report² from 2019 concludes that the directorate collects and processes voluntary reports from the fishing firms regarding quota-holdings and “related parties” status. The directorate stated to have initiated un-expected audits but the National Audit Office expressed that this effort was not sufficient. Enforcing the rule regarding “related parties” seems not to have been prioritized by the directorate. This conclusion suggests that the slow development of concentration as shown in Figure 1 might be due to weak enforcing and/or incorrect understanding of the term “related parties” among those voluntarily reporting mergers and acquisitions to the directorate.

Quotas of the firms Samherji and Síldarvinnslan

The quota holdings of two financially related firms, Samherji and Síldarvinnslan became an object of public discussion in late 2019 for matters independent of the quota ceiling (alleged use of bribes to

Figure 1. Actual concentration of quotas by firms Iceland 1990-2013 (regular quotas) and 2000-2013 (hook-and-line quotas)



acquire quotas in Namibia³). The Directorate had, according to the INAO, concluded that the two firms were unrelated according to the definition in the Fishery Management Act. Samherji has 49 per cent stake in Síldarvinnslan. When presenting Samherji internationally Síldarvinnslan is introduced as the pelagic fishing arm of the Samherji conglomerate.⁴ The CEO of Samherji has from time to time served as Chairman of the Board of Síldarvinnslan. It is therefore no doubt that the two firms would be defined as related if the financial market definition is used. If they were, the conglomerate would hold between 16 and 17 per cent of the total quotas.⁵

Proposal for stricter rules to regulate the quota ceiling

The Ministry of Fisheries prepared amendments to the Fishery Management Act in late 2019 and early 2020. When the bribery debacle in Namibia involving the fishing giant Samherji surfaced the Minister of Fisheries asked the committee that had the task to prepare the amendments to increase the pace of preparing stricter rules.⁶ A proposal was submitted for public hearing in February of 2020. According to the proposal more distant relatives and in-laws of owners would be listed as “related parties”. Furthermore, the concept of “control” was extended beyond majority of voting rights by adding that a party could be considered “controlling” another party if in position to force its will upon that other party. “Related parties” exceeding the quota ceiling would be given six years to resolve that conflict with the law. It is clear that the proposal falls very short of the “related party” definition in financial markets.

Un-concentrated clarification effort

At the moment, the work towards stricter rules to regulate the quota ceiling seems un-concentrated, as only few of the interested parties did submit opinions in the public hearing. The Ministry of Fisheries is yet to prepare a proposal for amendments to the Fishery Management Act. The control efforts of the Directorate of Fisheries still seem weaker than what is called for. While many Member of Parliament have called for concentrated efforts to implement stricter regulations, the Minister of Fisheries has not yet taken steps to make amendments to clarify the concentration rules and curb the excessive market power achieved through the quota system.

Notes

¹ Agnarsson, S., Matthiasson, T., & Giri, F. (2016). Consolidation and distribution of quota holdings in the Icelandic fisheries. *Marine Policy*, 263-270.

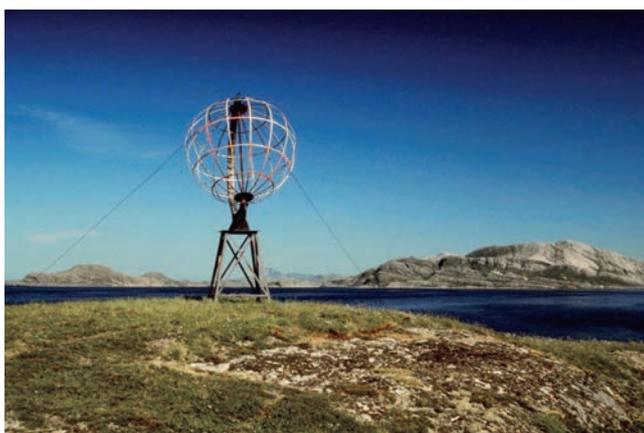
² Icelandic National Audit Office. (2019). Eftirlit Fiskistofu - stjórnsluúttekt. Reykjavík: Icelandic National Audit Office.

³ https://youtu.be/_Fj1TB0nwHs

⁴ <https://kjarninn.is/skyring/2019-11-20-samherji-kynti-sildarvinnslanu-sem-hluta-af-samstaedunni/>

⁵ <https://kjarninn.is/skyring/2019-11-20-samherji-kynti-sildarvinnslanu-sem-hluta-af-samstaedunni/> See also: https://www.stjornarradid.is/library/01--Frettatengt---myndir-og-skrar/ANR/KTHj/Skyrsla%20verkefnastjornar%20-%20lokaskjal_gj.pdf. See <https://kjarninn.is/skyring/2020-01-12-enn-bedid-efirt-tillogum-um-breytingar-kvotathaki/> as also pointed out in the report of a governmental panel headed by former head of the Icelandic National Audit Office.

⁶ <https://kjarninn.is/skyring/2020-02-17-tengdar-utgerdir-fa-taep-sex-artil-ad-koma-ser-undir-kvotathak/>



Arctic Norway

Arctic Norway includes the counties Nordland, Troms and Finnmark, and the Svalbard Archipelago, with a total population of 482 000. The population increased by 3 per cent during 2015 to 2018, less than half the growth in the rest of the country (Figure 3.4).

Fisheries have been a major source of living during history and is now also strengthened by a rapidly growing aquaculture industry. The rise of fish farming is based on the favorable natural conditions of numerous fjords and suitable sea temperatures due to the Norwegian coastal current. The seafood industry including fisheries, aquaculture and fish processing represents a strong sector in Arctic Norway, contributing 11 per cent to GRP in 2018. The fisheries are particularly important to employment in coastal communities.

Gross regional product (GRP) increased by 19 per cent from 2015 to 2018 (Table 4.9). Petroleum extraction contributed 0.8 per cent to GRP in 2018. Income from petroleum extraction increased somewhat during 2015-2018 as the liquefied natural gas (LNG) plant at Melkøya outside Hammerfest approached full capacity, based on natural gas from the Snøhvit field. Other mining only contributed 0.5 per cent to GRP in 2018.

The regional income from oil and gas extraction does not correspond to the income from offshore fields in northern areas of the Norwegian Sea and in the Barents Sea. The reason is that all income in offshore petroleum is registered in a virtual accounting region for this purpose, only a minor share of the income is generated within the context

Table 4.9. Value added¹ by industry. Arctic Norway. 2015 and 2018

	2015		2018	
	Mill. NOK	Per cent	Mill. NOK	Per cent
Agriculture and forestry	1 610	0.9	1 372	0.6
Fishing	5 214	2.8	7 058	3.2
Aquaculture	6 267	3.4	13 245	6.0
Oil and gas extraction including services	1 563	0.8	1 693	0.8
Other mining and quarrying	1 284	0.7	1 022	0.5
Fish processing	3 466	1.9	3 847	1.7
Other food processing	5 323	2.9	5 883	2.7
Wood and paper products	467	0.3	465	0.2
Other Manufacturing	3 554	1.9	4 738	2.1
Electricity, gas and steam	7 448	4.0	13 009	5.9
Water supply, waste	1 666	0.9	1 981	0.9
Construction	14 681	7.9	16 988	7.7
Wholesale and retail trade, repair of motor vehicles	14 599	7.9	16 039	7.3
Transportation	9 306	5.0	9 735	4.4
Accommodation and food services	3 344	1.8	3 979	1.8
Information and communication	3 330	1.8	3 669	1.7
Finance and insurance	5 515	3.0	6 022	2.7
Real estate activities	4 293	2.3	5 275	2.4
Imputed rents of owner-occupied dwellings	11 026	5.9	12 345	5.6
Scientific and technical activities	4 966	2.7	6 327	2.9
Administrative and support services	3 677	2.0	4 554	2.1
Public administration and defence	22 176	12.0	23 682	10.7
Education	15 105	8.1	17 340	7.9
Health and social work	31 873	17.2	36 318	16.5
Arts, entertainment and other services	3 746	2.0	4 052	1.8
Total	185 499	100.0	220 638	100.0

¹ At basic prices net of taxes and subsidies.

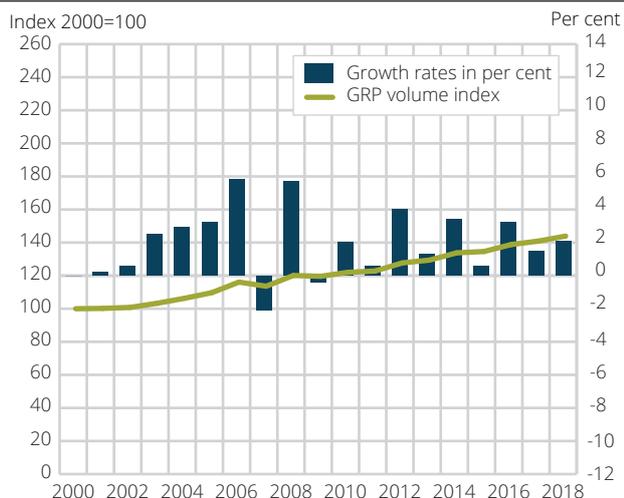
of the regional economy. There is no onshore oil and gas production in Norway.

The rapidly growing aquaculture industry increased its share of GRP from 3.4 per cent in 2015 to 6.0 per cent in 2018. Only two private industries were larger in 2018: Construction (7.7 per cent) and Trade (7.3 per cent).

Within manufacturing, both Fish processing and Other food processing reduced their shares of GRP, so did manufacturing of Wood and paper products. Other manufacturing increased markedly more than the average for the economy, but still made up only 2.1 per cent share of GRP in 2018.

Although tourism has increased in many Arctic regions, this is not clearly indicated in the

Figure 4.33. GRP volume index¹ and growth rate. Arctic Norway. 2000-2018



¹ The GRP volume index for 2000-2018 for Arctic Norway is constructed for the circumpolar comparison in ECONOR and may differ from official data from Statistics Norway for regional volume growth rates, only available from 2009.

development of the related service industries of Accommodation and food services and Transportation. Hotels and restaurants sustain their share of the growing economy, whereas Transportation decreases by 4.6 per cent. However, land transport increased by 6.6 per cent, overshadowed by the decline in all other transportation activities.

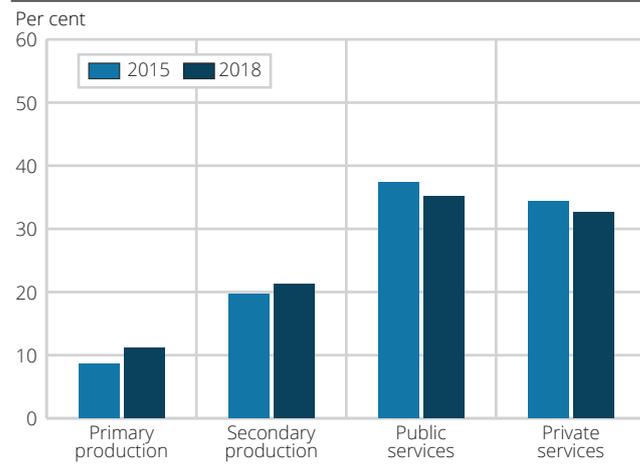
There was higher than average growth in Scientific and technical services (27 per cent), followed by Administrative services (24 per cent) and Real estate activities (23 per cent).

Among public services, Health care and social works are by far the largest, with 16.5 per cent of GRP, followed by Public administration (10.7 per cent) and Education (7.9 per cent). The public sectors all had lower than average growth, above all Public administration, whereas Education and Health care came closer to the average growth rate with 15 and 14 per cent growth, respectively.

Aquaculture more than doubled its income during 2015-2018. After Aquaculture, Electricity production had the second strongest growth by 75 per cent, also driven by the expansion of on-shore wind power, in response to the favorable incentives related to the Green Certificates.¹

Fish processing increased by 11 per cent, around half the growth of the economy at large. Fisheries

Figure 4.34. Value added by main industry. Arctic Norway. Per cent of GRP. 2015 and 2018



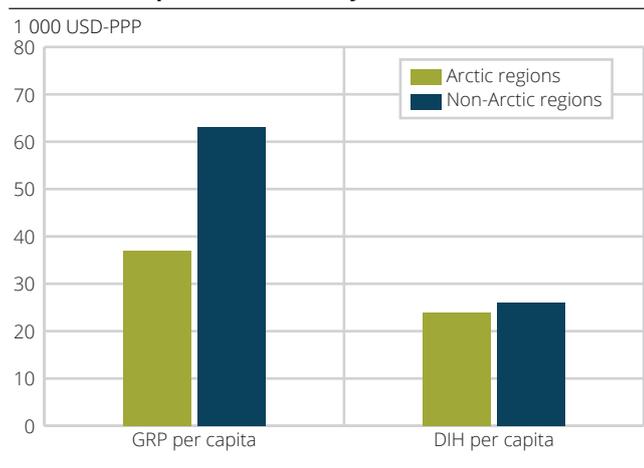
on the other hand increased by 35 per cent, indicating higher prices on landed fish rather than a growth in quantity.

Figure 4.33 shows real GRP growth rates 2000-2018 and GRP volume index² for Arctic Norway, assuming fixed prices. Over the whole period the economy increased by 42 per cent. There has been variable but continuous growth from 2010 to 2018.

Figure 4.34 shows the development in the main structure of the economy. Primary production containing the extractive industries represents 11.1 per cent of GRP, up from 8.6 per cent in 2015. Growth in fisheries and in particular fish farming explains most of the increase from 2015. Within secondary industries a major force behind the increase comes from electricity production. Both private and public services reduce their shares in the economy from 2015 to 2018. The public sector accounted for 35 per cent of GRP in 2018.

Figure 4.35 compares the GRP per capita and disposable Income of households per capita in the Arctic and non-Arctic regions of Norway. GRP per capita is considerably higher in the non-Arctic regions, however, for disposable income per capita there is only a minor gap. The national petroleum income is transferred to the Norwegian Government Pension Fund Global, currently the largest sovereign wealth fund in the world. Norway does not pay dividends to individuals, as in Alaska. Use of the fund for government budgets is limited to the return on the fund's financial investments, as determined by the Norwegian parliament.

Figure 4.35. Gross regional product (GRP) per capita and Disposable Income for Households (DIH) per capita. Arctic Norway. 2018. 1 000 USD-PPP



Petroleum

Retreating sea ice, development of subsea technology and cost reductions increase the attraction of future offshore activity in arctic waters. Today Norway is producing gas in the Norwegian Sea and the Barents Sea (Snøhvit). The Johan Castberg oil field 100 km north of Snøhvit in the Barents Sea will come on stream in 2023 and is expected to produce oil for the next 30 years.³ Environmental organizations argue that this activity will take Norway further away from the climate target agreed upon in the Paris agreement in 2015. The development of petroleum activity in Lofoten, Vesterålen and Senja, the spawning ground of the North-Atlantic cod, which is the pillar of the Norwegian wild fisheries, has been put on hold and will be reconsidered in 2021.⁴



The arctic sea ice edge sustains the whole ecosystem in the arctic through the nutrition generated by the early spring bloom of plankton and algae in the surrounding waters. The density and geographical position of the ice edge delineates the area open for petroleum exploration. In 2020 the government redefined the ice edge, moving it further north by accepting ice cover up to 30 per cent at certain times of the year for drilling.

Renewable energy

Nordland has a substantial electricity surplus and is 100 per cent renewable, mostly by hydro power. Finnmark used natural gas for almost half of its electricity supply in 2018, generating electricity for the LNG plant at Melkøya. At the same time, Finnmark has a high share of wind power, representing 15 per cent of all wind power in Norway in 2019. In 2020, 37.5 per cent of all wind power production in Norway takes place in Sámi reindeer herding areas⁵; areas also under pressure from mining, hydropower, transmission lines and cabins, however wind power is the primary concern. The Norwegian reindeer herding Act states the rights of Sámi people to their traditional livelihood and land.

The power surplus of Nordland is due to limited transmission capacity. The option to produce zero-emission hydrogen based on renewable electricity is attractive to regions with a surplus of renewable power. A hydrogen plant is under development in Glomfjord in Nordland,⁶ for supplying hydrogen to ferries in the Lofoten area in addition to many other applications as fuel for sea transport, heavy vehicles and industrial use, like in the HYBRIT project of fossil free steel (see section on Arctic Sweden). A factory for production of fuel cells that convert hydrogen to electricity is being developed in Narvik.⁷

Notes

¹ Electricity certificates - Energifakta Norge

² The GRP volume index for 2000-2018 for Arctic Norway is constructed for the circumpolar comparison in ECONOR, and may differ from official data from Statistics Norway for regional volume growth rates, only available from 2009.

³ Johan Castberg - field in the Barents Sea - equinor.com

⁴ Lofoten bør ikke åpnes for oljeaktivitet | Havforskningsinstituttet (hi.no)

⁵ vindrein-eng-alt (motvind.org)

⁶ Pressemelding - - Glomfjord Hydrogen <https://www.glomfjord-hydrogen.no/ac/pressemelding>

⁷ Teco 2030 og AVL vil etablere hydrogenfabrikk i Narvik og skape 500 arbeidsplasser – NRK



Russian trawler in the Barents sea. © Helge Sunde / Samfoto

Arctic Russia

Arctic Russia is by far the largest among the Arctic regions both in terms of land area and population. In 2018 the population counted 6.7 million, down 0.4 per cent per year on average since 2012, however, in recent years the population has been stable. The economy is largely based on petroleum and other mining industries, and the development during the period 2015-2018 strengthened the mineral basis of the economy.

The Russian Arctic is the Arctic region which faces the most impacting changes in terms of climate change. The shrinking sea ice opens the Northern Sea Route, offering groundbreaking possibilities for trade and development as demanding transportation over land can be replaced by river and sea transport, a great benefit to the extractive industries.

A broad regional development targeting large projects in the extractive industries in the Russian Arctic was initiated during the second half of the 2000s. The development program includes both new projects and upgrades of old plants, with the aim of building a cargo base for the Northern Sea Route. The opening of the Northern Sea Route is a large windfall gain for Arctic Russia from global warming, although the warming incurs costs, including expected increasing costs from impacts of thawing permafrost related to damage of buildings and infrastructure (see Chapter 8).

Table 4.10 shows the industry structure of the economy in 2015 and 2018. The economy as a whole increased by 45 per cent during 2015-2018, a development reflecting the higher world prices

Table 4.10. Value added¹ by industry. Arctic Russia. 2015 and 2018

	2015		2018	
	Mill. Rubles	Per cent	Mill. Rubles	Per cent
Agriculture, forestry, hunting, fishing and fish farming	124 823	1.6	173 003	1.6
Petroleum and other mining	4 002 211	52.3	6 669 869	60.0
Manufacturing	342 548	4.5	498 686	4.5
Production and distribution of electricity, gas and water	235 156	3.1	285 604	2.6
Construction	568 328	7.4	850 754	7.7
Wholesale and retail trade	480 582	6.3	515 598	4.6
Transportation; Information and communication	611 198	8.0	686 681	6.2
Hotel and catering activities	48 213	0.6	56 029	0.5
Finance and insurance	6 221	0.1	10 712	0.1
Real estate activities	485 656	6.3	192 107	1.7
Public administration and military security; social security	279 115	3.6	315 532	2.8
Education	169 441	2.2	200 116	1.8
Health and social services	229 166	3.0	291 121	2.6
Other private services	68 096	0.9	366 174	3.3
Total	7 650 753	100	11 111 986	100

¹ At basic prices net of taxes and subsidies.

on metals and oil in 2018. However, strong growth primarily in gas production on the Yamal peninsula contributed markedly to the overall growth. Petroleum and other mining combined increased their contribution to GRP from 52 to 60 per cent.

Besides petroleum and other mining, construction is the only industry with higher than average growth, increasing its share in GRP from 7.4 per cent in 2015 to 7.7 per cent in 2018. This increase looks modest, however, the strong growth in petroleum and mining (66 per cent) easily “shrinks” the relative contribution from other industries. Construction is an industry that is heavily involved in

Figure 4.36. GRP index and growth rate. Arctic Russia. 2000-2018

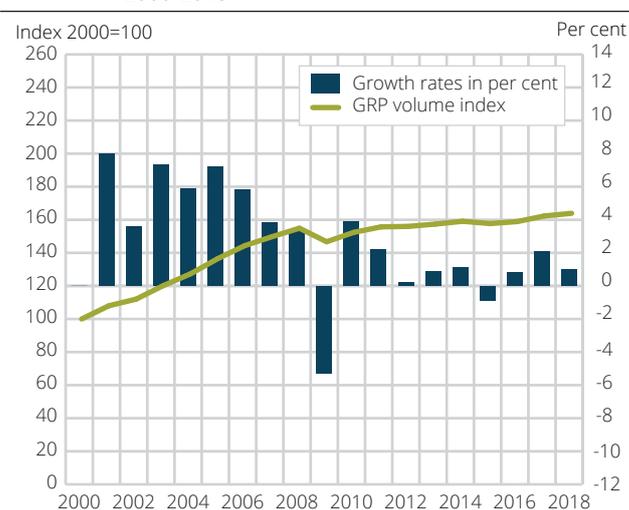
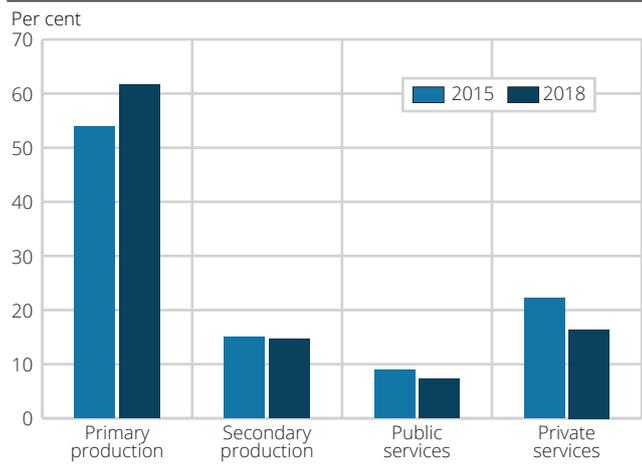


Figure 4.37. Value added by main industry. Arctic Russia. Per cent of GRP. 2015 and 2018



resource extraction and infrastructure investments in Arctic Russia.

Within service industries, Trade, Transportation, Information and communication and Hotel and catering increased by 7, 12 and 16 per cent respectively in nominal terms, growing markedly slower than the economy at large and seeing their shares of the economy of Arctic Russia decline from 2015 to 2018. Manufacturing followed the growth of the total Arctic Russian economy, sustaining its share in GRP at 4.5 per cent.

Finance and insurance continue to be a marginal industry. Real estate services used to be significant at 6.2 per cent of GRP in 2015 but declined to only 1.7 per cent in 2018. The group Other private services generated a value in 2018 which is 5 times the 2015 level, contributing 3.3 per cent to GRP, more than Public administration in 2018.

Education did not keep track with the rest of the economy, neither did Health and social services, although the health sector had a more marked growth than Education and Public administration.

If we disregard price changes and calculate the volume changes in fixed prices, we have the growth in real terms (Figure 4.36). GRP measured in fixed prices show strong yearly growth from year 2000 until 2009, the year when GRP declined by 5.3 per cent in response to the financial crisis and the following recession. Afterwards, the economy entered a period with variable but mainly modest real growth towards 2018.

Figure 4.38. Gross regional product (GRP) per capita and Disposable Income of Households (DIH) per capita. Arctic Russia. 2018. 1 000 USD-PPP

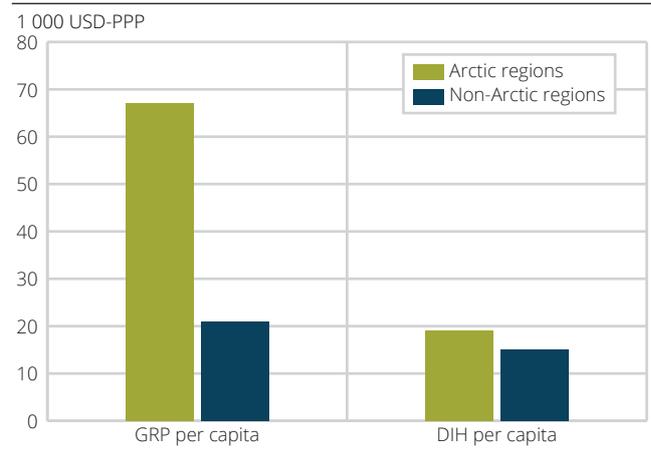


Figure 4.37 illustrates the dominating role of primary or extractive industries in Arctic Russia, increasing from 53.9 per cent of GRP in 2015 to 61.6 per cent in 2018, of which Agriculture, forestry, hunting, fishing and fish farming only contributed 1.6 per cent points. Secondary production covering Manufacturing, Production and distribution of electricity, gas and water and Construction practically maintained its level at 15 per cent. Within secondary production, Production and distribution of electricity, gas and water had the weakest growth. Public services including Public administration, Education and Health declined, and private services even more so.



Murmansk © Colourbox

GRP per capita in Arctic Russia was more than three times that in non-Arctic Russia. This gap is largely a result of the petroleum industry in Arctic Russia producing 70 per cent of total Russian oil and 90 per cent of Russian natural gas (see Figures 4.39 and 4.40).

While GRP depicts value generation, disposable income of households (DIH) indicates the economically sustainable potential for private consumption. The Russian Arctic has a moderately larger disposable income per capita than non-Arctic regions. The higher wage level in petroleum and mining can explain the somewhat higher DIH in the Arctic region.

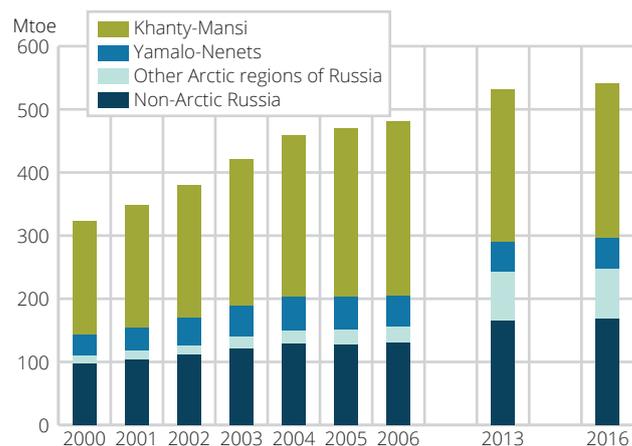
Petroleum

Russian oil and gas production is dominating within the Arctic and largely determines the production profile for the Arctic as a whole.

The Yamal Peninsula is a power center of above all gas related, but also to some extent oil based industrial development in Arctic Russia. The first Russian Arctic offshore oil field, the Prirazlomnoye oil field at 20 meters depth in the Pechora Sea, started production in 2014. The Yamal LNG plant started production in 2017 for export to Asia along the Northern Sea Route and to Europe and the plant reached full capacity by the end of 2018. A new port facilitates the expected increase in export of oil and gas as well as other minerals along the Northern Sea Route to Asia. A new pipeline – North Stream 2 – will transport gas to Western Europe from the super-giant Bovanenkovo gas field, the largest on the Yamal Peninsula. This pipeline is close to being finalized in summer 2021, however, delays may occur due to sanctions from the USA.

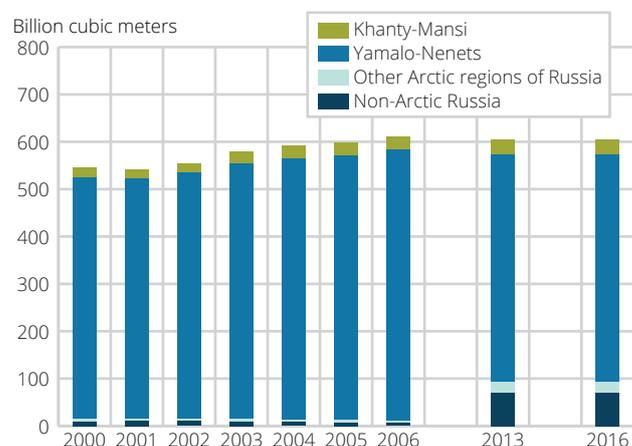
Figures 4.39 and 4.40 illustrate the position of Arctic sub-regions in oil and gas production in Russia. Russian Arctic oil production is dominated by Khanty-Mansii, with smaller shares from Yamalo-Nenets and the other arctic regions of Russia. Oil production in non-Arctic Russia is relatively stable at around 30 per cent. Yamalo-Nenets dominates the Russian gas industry, however, the last decade or so gas production outside Arctic Russia and also in other Arctic sub-regions becomes increasingly important.¹

Figure 4.39. Russian oil production. 2000-2016



Source: See note 1.

Figure 4.40. Russian gas production. 2000-2016



Source: See note 1.

Khanty-Mansii provides a small and about constant contribution to gas supply. However, the increase in Bovanenkovo gas production and the adjacent Kruzenshternskoye field might increase the relative importance of Yamalo-Nenets.

A large program for investments in oil and gas extraction and transportation has been carried out in the Eastern regions of Arctic Russia to serve the increasing demand from Asian markets. The pipeline Power of Siberia started to transport gas in 2019.²

Regional development

The rich mineral resources of Arctic Russia are unevenly distributed and utilized across the 9 subregions. Table 4.11 shows GRP by sub-region in current rubles in 2012, 2015 and 2018.

GRP for the Russian Arctic increased 45 per cent from 2015-2018. Rapidly growing exploration and development of gas reserves in Yamal-Nenets, including the development of the world's largest gas field Bovanenkovo, increased its share in the Russian Arctic economy from 23.4 per cent to 27.7 per cent during the period. In contrast, oil producing Khanty-Mansii saw somewhat less than average growth (41 per cent) and reduced its contribution slightly to 40 per cent during this period. There was a tendency of lagging behind in Murmansk, Karelia, Arkhangelsk and Komi, whereas other regions roughly kept track with the Arctic Russian economy at large.

Global warming is opening up the Northern Sea Route for longer periods during the year and there has been a strong increase in transport along the Northern Sea Route over the last ten years, with cargo reaching 32 million tonnes by 2020³, up from 2 million tonnes in 2013 and 18 million tonnes by 2018, mostly a result of increasing activity at the Yamal LNG project and upgrading of the Prirazlomnoye platform in the Pechora Sea. Sailings to and from the Yamal Peninsula carried 80 per cent of the total cargo in 2020. The low bunker oil prices during the last years have made the Northern Sea Route less competitive for cargo in transit between Asia and Europe

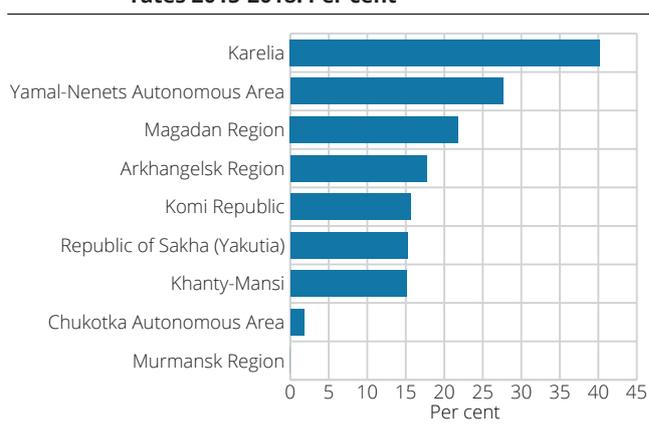
The prospects for the Northern Sea Route give incentives for further development of harbors and other infrastructure for access to sea transport. A system of floating storage units is developed for LNG transport, taking cargo from Yamal across the ice-covered parts of the Northern Sea Route with ice-class Arc-7 vessels to year-round ice-free harbors near Murmansk and Kamchatka (See chapter 8).

Figure 4.41 shows average annual income growth in petroleum and mining by sub-region during 2015 to 2018. Murmansk and Chukotka have zero and marginal growth, respectively, in mineral extraction. For Chukotka the limited growth is a result of a declining trend in gold production.

Table 4.11. GRP by sub-regions of Arctic Russia. 2012, 2015 and 2018

	2012		2015		2018	
	1 000 mill. Rubles	Per cent	1 000 mill. Rubles	Per cent	1 000 mill. Rubles	Per cent
Murmansk Region	284	4.8	402	5.2	483	4.3
Karelia	161	2.7	212	2.8	280	2.5
Arkhangelsk Region	472	7.9	628	8.2	819	7.4
Komi Republic	479	8.0	528	6.9	666	6.0
Yamal-Nenets Autonomous Area	1 191	20.0	1 792	23.4	3 084	27.7
Khanty-Mansii	2 704	45.4	3 154	41.2	4 447	40.0
Republic of Sakha (Yakutia)	541	9.1	748	9.8	1 085	9.8
Magadan Region	78	1.3	126	1.6	171	1.5
Chukotka Autonomous Area	46	0.8	62	0.8	78	0.7
Total	5 956	100.0	7 651	100.0	11 112	100.0

Figure 4.41. Value added in petroleum and other mining in Arctic Russia in current rubles. Annual growth rates 2015-2018. Per cent



Karelia had the largest percentage growth among all. The staples in Karelian mining are non-metal minerals like stone, sand and other construction materials, an activity that was re-activated after a standstill of several years. The petroleum development of Yamal-Nenets took place at an average annual growth rate at 27 per cent.

Notes

¹ IEA (2014): Medium-Term Gas Market report, IEA/OECD.

² Power of Siberia (gazprom.com)

³ Cargo Volume on Northern Sea Route Remains Stable at 32m tonnes in 2020 (highnorthnews.com)



Arctic Sweden

Arctic Sweden consists of the sub-regions Norrbotten and Västerbotten with a total population in 2019 of 522 000 with 123 000 living in the largest city of Umeå. The majority lives along the coast, leaving vast areas of wilderness thinly populated and attractive for renewable energy and mining, increasingly in interest conflict with traditional reindeer herding, hunting and tourism.

GRP or total value added for Northern Sweden increased by 18 per cent from 2015 to 2018 (Table 4.12). In 2018, the Mining industry surpassed its 2015 level by nearly 90 per cent, increasing its share in GRP from 6.2 per cent to 10.0 per cent. All other industries saw growth in the range of 10-20 per cent, mostly lower than growth in the economy at large. The exception is Finance and insurance services, which declined by 6 per cent during the period.

Manufacturing is still the dominant activity in Northern Sweden, but grew at only 9 per cent, as did Utilities containing the production and distribution of electricity, with manufacturing as an important customer. Västerbotten has a power surplus due to limited transmission capacity to Southern Sweden and higher supply tends to lower prices.

Construction and most private services kept better track with the economy at large, with growth around 15 per cent during 2015-2018, with strongest growth at 19 per cent in Real estate, slightly above growth in GRP.

Table 4.12. Value added¹ by industry. Arctic Sweden. 2015 and 2018

	2015		2018	
	Mill. SEK	Per cent	Mill. SEK	Per cent
Agriculture and forestry	5 292	3.0	5 878	2.8
Mining and quarrying	11 086	6.2	20 982	10.0
Manufacturing	25 238	14.2	27 498	13.1
Utilities	9 744	5.5	10 585	5.1
Construction	14 051	7.9	15 986	7.6
Wholesale and retail trade	12 949	7.3	14 604	7.0
Transportation and storage	11 241	6.3	13 046	6.2
Accommodation and food services	3 081	1.7	3 577	1.7
Finance and insurance	3 836	2.2	3 610	1.7
Real estate activities	10 150	5.7	12 121	5.8
Public administration and defence	10 675	6.0	12 233	5.8
Education	12 083	6.8	13 747	6.6
Health care and social work	22 546	12.7	24 989	11.9
Other service	26 110	14.7	30 437	14.5
Total	178 082	100.0	209 293	100.0

¹ At basic prices net of taxes and subsidies.

Public administration and Education nearly kept track with overall growth, whereas Health care and social services lagged slightly behind.

Figure 4.42 shows real growth since 2000, i.e. the growth in production volume assuming fixed prices. A few years after the turbulence around the financial crisis, there were low or negative growth rates until 2015 when the economy saw four years of marked growth rates leading up to 2018.

The development shows variable impact on the industrial structure (Figure 4.43). Income from primary production or extractive industries jumped from 9.2 to 12.8 per cent of GRP, whereas secondary production containing Manufacturing, Construction and Utilities declined somewhat to 25.8 per cent. Both public and private services reduced their shares in GRP.

As seen from Figure 4.44, GRP per capita and disposable income per capita are slightly lower in Northern Sweden than in Southern Sweden.

Natural resources and the global climate

Northern Sweden sees prospects of an industrial development where renewable energy, minerals and technology merge to improve the global climate. Within the HYBRIT project, industrial giants

in Northern Sweden have joined forces to produce the world's first fossil free steel.¹ The companies are the energy company Vattenfall, the iron ore producer LKAB and the steel manufacturer SSAB with plants in Luleå and in Finland. The fossil free technology relies on large amounts of renewable electricity and bio-oil, both available in Northern Sweden with its large forests and surplus of electricity. The target is a fossil free value chain for steel by 2035, reducing the CO₂ emissions by 10 per cent in Sweden and 7 per cent in Finland. To fulfill the prospects the iron ore mining will switch from diesel fueled to battery driven machinery and the iron ore pellets production will as a first step take heat from bio-oil from a plant commissioned by LKAB.² A pilot plant in Luleå will develop the technology for steel production, testing hydrogen as a reduction agent to replace coal and coke. The hydrogen will be produced by renewable electricity to qualify as green.³ If all steel production adapted this technology, global CO₂ emissions would fall by 10 per cent.

However, the greening of steel is increasing the pressure on the environment through wind parks and infrastructure, interfering with wilderness for hunting, herding, fishing and tourism. Reindeer herders object to the expansion of wind energy, as roads and transmission lines create barriers to reindeer migration routes and disturb grazing areas. Reindeer herding is particularly exposed to the planned expansion of wind energy in Sweden,⁴ which will mainly take place in the northern regions. Visible and other damage to the wilderness is seen as a threat to a growing tourist industry.

Notes

¹ HYBRIT – Towards Fossil-Free Steel (lkab.com)
² LKAB produces the world's first iron ore pellets with fossil-free fuels
³ The clean hydrogen future has already begun – Analysis - IEA
⁴ <https://www.nrk.no/urix/tror-svensk-vindkraftsatsing-vil-gi-storre-forskjeller-pa-strompriser-i-norge-1.15396083>

Figure 4.42. GRP volume index and growth rate. Arctic Sweden. 2000-2018

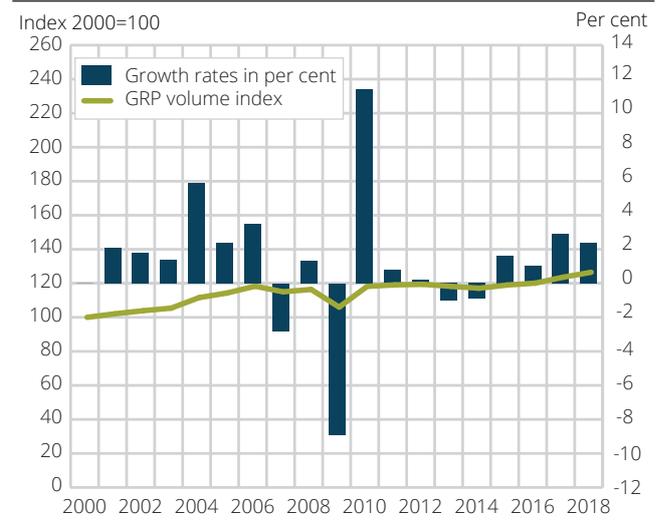


Figure 4.43. Value added by main industry. Arctic Sweden. Per cent of GRP. 2015 and 2018

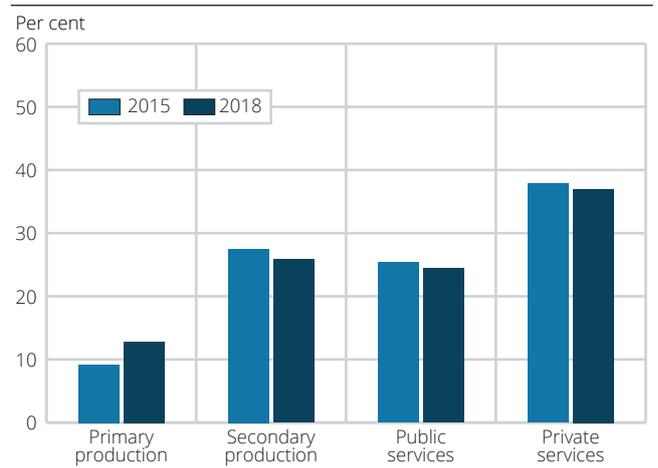
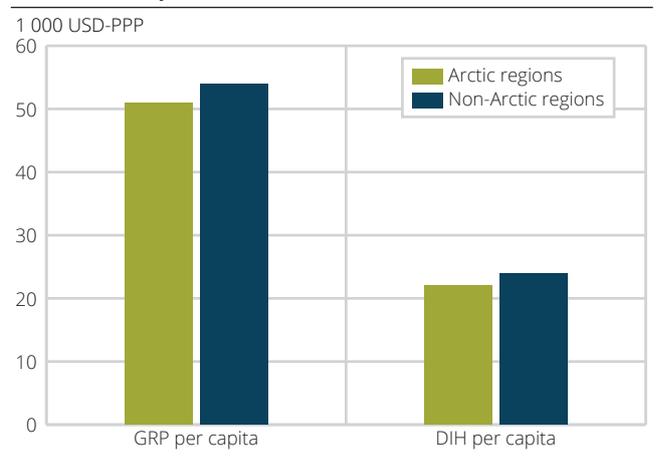


Figure 4.44. Gross regional product (GRP) per capita and Disposable Income for Households (DIH) per capita. Sweden. 2018. 1 000 USD-PPP



Cicumpolar overview

Although this chapter has mainly focused on the individual arctic regions, the format of data allows for an overview at circumpolar level. When looking at the overall picture, the regions emerge as heterogeneous although as some, recognizable clusters.

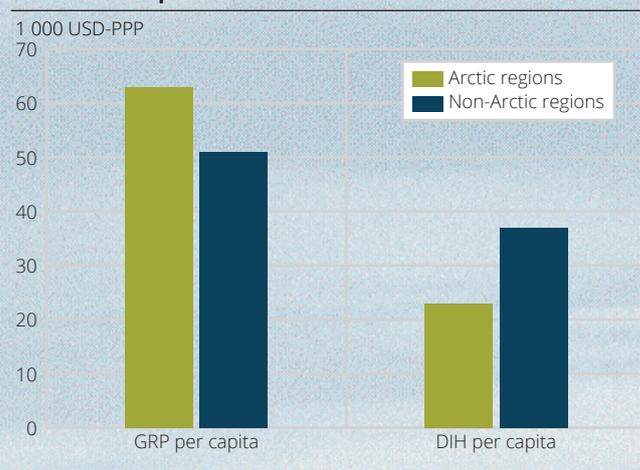
Arctic Russia, Alaska and Northern Canada are the main producers within petroleum and other mineral mining. In Arctic Russia, the primary production, consisting of mainly petroleum and mining, totally dominates the income generation as 60 per cent of GRP originate in these activities in 2018 (Table 4.10, Figure 4.37). The other two major petroleum and mineral based regions also tend to have high shares of primary (extractive) industries in their economies.

The same three regions have the lowest percentage contribution to GRP from secondary industries, with around 14 per cent in Arctic Russia and 10 per cent each for Alaska and Northern Canada. In secondary industries including manufacturing, utilities and construction, Finland takes the lead with 28 per cent of GRP, closely followed by Arctic Sweden (26 per cent).

Among the other regions, Greenland and Faroe Islands are equally and most dependent on Primary industries (20 per cent), mostly relying on fisheries. Still, each of them has close to 20 per cent of GRP from secondary industries. Iceland has the lowest share of primary industries of 4 per cent, mainly from fisheries, whereas secondary industry accounts for 21 per cent, and the private services dominate by around 50 per cent of GRP.

Figure 4.45 shows that on average GRP per capita is higher in the Arctic regions of the Arctic countries than in the non-Arctic regions, whereas average disposable income of households per capita is markedly lower in the Arctic regions. However, there are substantial variations between countries.

Figure 4.45. Gross regional product (GRP) per capita and Disposable Income for Households (DIH) per capita. Total. 2018. 1 000 USD-PPP



Box 4.4. Regional accounts data sources**Alaska**

US Department of Commerce, Bureau of Economic Analysis, United States.

Alaska permanent fund dividend. <https://web.archive.org/web/20141006103714/http://www.apfc.org/home/Content/dividend/dividendamounts.cfm>, and https://en.wikipedia.org/wiki/Alaska_Permanent_Fund

Mineral production of Alaska. 2016-2018. From Table 11 of Athey, J.E., and Werdon, M.B., 2019, Alaska's mineral industry 2018: Alaska Division of Geological & Geophysical Surveys Special Report 74. <https://dggs.alaska.gov/pubs/id/30227>

Canada

Statistics Canada, Gross domestic product, expenditure-based, provincial and territorial. <https://www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=3610040201>

Natural Resources Canada. Annual Statistics of Mineral Production. Available at: <https://sead.nrcan-rncan.gc.ca/prod-prod/ann-ann-eng.aspx?FileT=2008&Lang=en>

Canadian Association of Petroleum Producers. <https://www.capp.ca/resources/statistics/>

Greenland

Statistics Greenland, StatBank: <https://bank.stat.gl/pxweb/en/Greenland/>

Faroe Islands

Statistics Faroe Islands, StatBank: <https://statbank.hagstova.fo/pxweb/en/H2/>

Iceland

Statistics Iceland: <https://www.statice.is/Statistics/>

Norway

Statistics Norway, Regional Accounts: <https://www.ssb.no/en/statbank/table/11713/>

Sweden

Statistics Sweden, Regional accounts: https://www.statistikdatabasen.scb.se/pxweb/en/ssd/START__NR__NR0105__NR0105A/

Finland

Statistics Finland, Regional account: https://pxnet2.stat.fi/PXWeb/pxweb/en/StatFin/StatFin__kan__altp/

Russia

Federal State Statistics Service of Russian Federation: <https://rosstat.gov.ru/>

National Minerals Information Center of U.S. Geological Survey: <https://www.usgs.gov/centers/nmic/international-minerals-statistics-and-information>

OECD Stat

PPPs and exchange rates. https://stats.oecd.org/viewhtml.aspx?datasetcode=SNA_TABLE4&lang=en#

The arctic regions are rich in natural resources; Alaska, Khanty-Mansi and Yamalo-Nenets have vast oil and gas resources. Greenland, Iceland and Northern Norway enjoy access to rich fishing grounds and Canada's Northwest Territories have found large diamond resources. Furthermore, other regions like Northern Norway, Murmansk and Arkhangelsk, have hopes for discovering more oil and gas in the Barents Sea.

The natural resource industries contribute by a large share to Arctic GDP. On the other hand, it does not follow that without the natural resources Arctic GDP would have been reduced by the same amount. GDP figures reflect the use of labour and capital for extraction. Without the natural resources, this labour and capital could have been utilized in other economic activities, and hence, contributed to GDP anyhow.

In national accounting terms stocks of unexploited natural resources should be viewed as capital assets. The value of a capital asset is usually reckoned as the total discounted net income accruing from it. With respect to natural capital this is usually referred to as a stream of resource rents. The resource rents are thus the additional income a nation/region obtains from having the exclusive right to exploit a natural resource.

There are several definitions of resource rent in the literature. Since we apply figures from the National Accounts, we use the definition of United Nations System of Environmental Economic Accounting.¹ Below we go through the individual components:

Value Added

- Other taxes on production + other subsidies on production
- Compensation of employees (input costs for labor)

= Gross operating surplus (SNA basis)

- Product subsidies
- + Product taxes

= Gross operating surplus (for the derivation of resource rent)

- Consumption of fixed capital (depreciation) - return to produced assets

= Resource rent

The value added earned through domestic production activity in an industry, is defined as output minus intermediate uses. To get the gross operating surplus-SNA basis we deduct other taxes on production and add other subsidies on production and in addition we deduct compensation of employees. Since output includes all subsidies on products and excludes taxes on products, we must adjust for this by adding product taxes and deducting product subsidies to get the gross operating surplus - for the derivation of resource rent. Finally, we deduct return on fixed capital and capital consumption from the gross operating surplus to get the resource rent. When calculating compensation of employees and return to fixed capital, the idea is to use wage rates and rates of return that reflect the alternative value of both the workers and the capital employed to extract the resource. For Norway the average wage rate and the average rate of return to capital for all non-natural resource based industries have been used as a measure of the alternative value. Below is an example from oil and gas extraction in Norway. All figures connected to oil and gas extraction accrue to a separate «off-shore» industry in the Norwegian national accounts. Note that the subsidies/taxes are negligible and disregarded.

The size of the resource rent is very dependent on world market prices of oil and gas. Output price movements can explain the large increase in resource rent from the 1995-1999 period to the period 2010-2014, and the subsequent price drop explains the decline in resource rents in 2015-2019. Note

also that the compensation to labour makes up a very small part of value added, and that the compensation to capital makes up a relatively large part. To the extent that the figures from Norway are representative for the situation in the Arctic, it is of great interest from an Arctic sustainable development perspective to study further whether resource rents are re-invested in other capital assets located in the Arctic.

Not all natural resources have a positive resource rent. Studies from Norway show that even though Norway has access to rich fisheries, the resource rent has not always been positive. These figures indicate that in organizing the fisheries, the Norwegian authorities do not only maximize the surplus from the fisheries, but also focus on other targets such as providing jobs in remote areas. From a resource rent perspective, intervening to provide additional jobs is a cost because labour has an alternative value. One may of course discuss whether the average wage rate in the non-resource sectors is the correct measure of this value. However, we see that the resource rent in fisheries is on an increasing trend. The reason is that there has been a consolidation in the industry with fewer fishermen and fewer and more effective vessels. In hydropower, the increase in resource rent is due to higher electricity prices, at least after 2001. The growth in resource rent in aquaculture the last decade is mainly due to increasing prices of salmon.

¹ SEEA (2014): System of environmental-economic accounting 2012, SEEA Central Framework, Chapter V Asset accounts, United Nations.

Figure 1. Average decomposition of value added in the Norwegian oil and gas sector. Million NOK

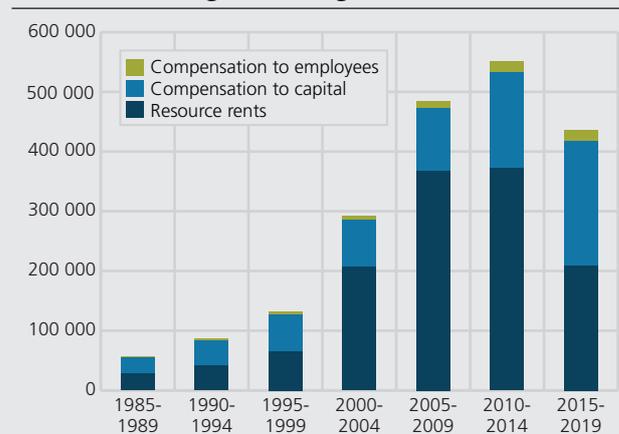
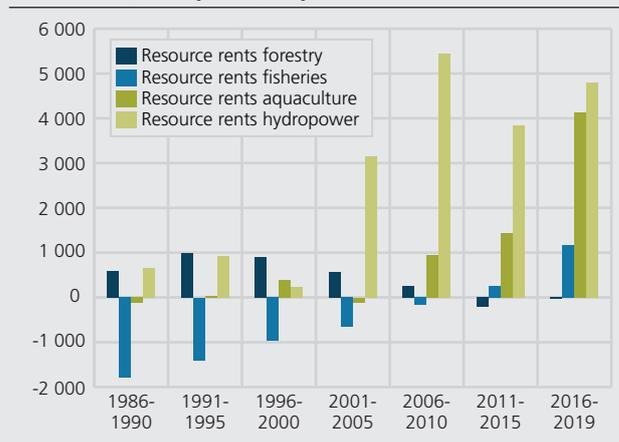


Figure 2. Five-year average resource rents from the renewable natural resources in Norway. NOK (2019-prices)/capita



Box V: Svalbard – coal, tourism and research

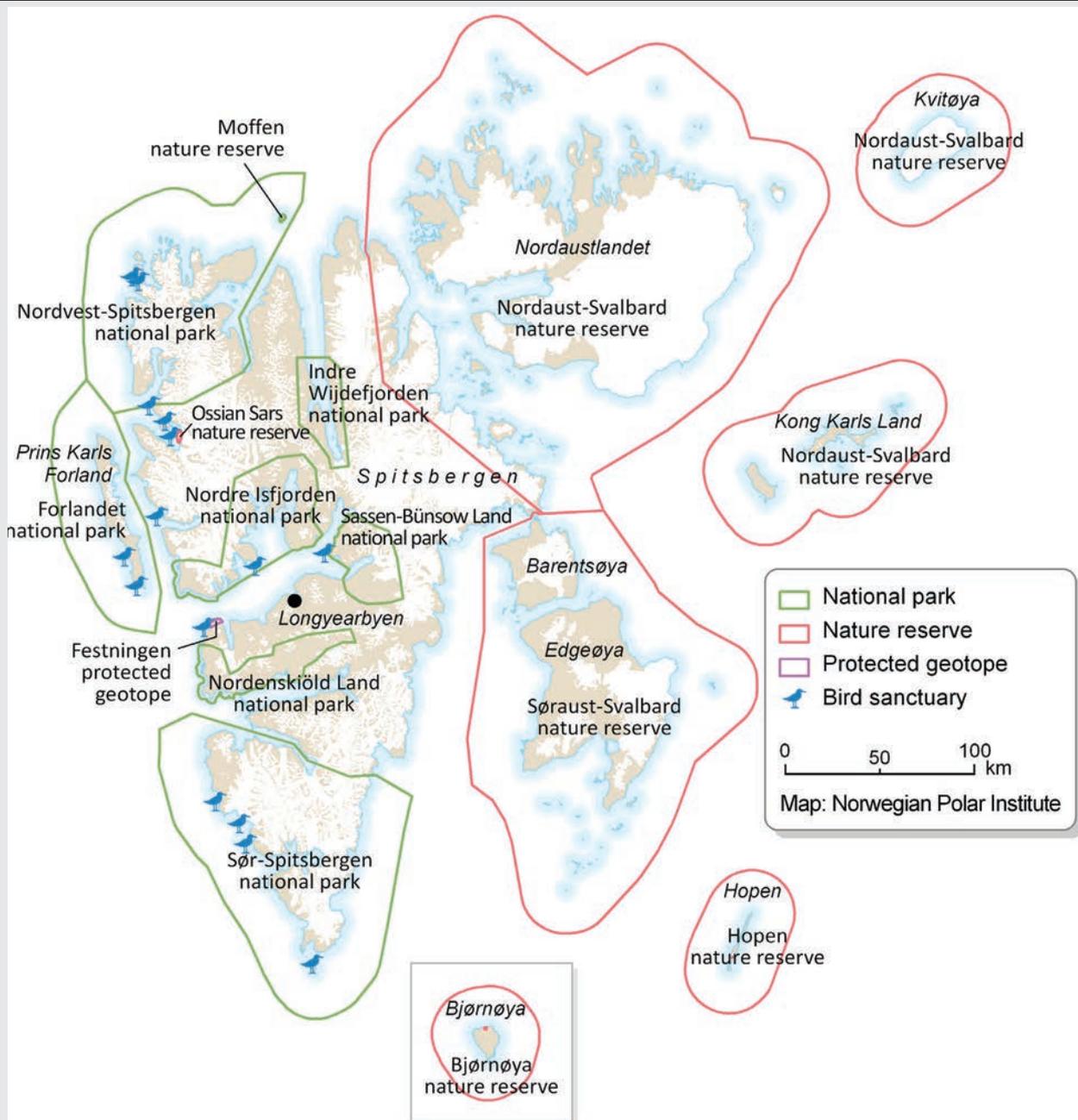
Svalbard is an archipelago¹ in the Arctic Ocean and is part of the Kingdom of Norway, but without the status of county or municipality. The area corresponds to approximately 16 per cent of the total area of Norway. The largest island is Spitsbergen, where all permanent settlements and human activity are located.

Longyearbyen is the Norwegian administration centre and the largest settlement on Svalbard. In the past 30 years, the town has gone from a homogenous community built up around the mining company Store Norske Spitsbergen Kullkompani, to a more diverse society. The other settlements are Barentsburg (Russian), Sveagruba, Ny-Ålesund, Hornsund and the two meteorological stations on Hopen and Bjørnøya.

Norwegian sovereignty

Svalbard was long considered a so-called terra nullius by many nations – literally a ‘no man’s land’ over which no single state held sovereignty. The Svalbard Treaty was signed in Paris on 9 February 1920 as a result of the peace conference after the First World War. The treaty provides for Norwegian sovereignty over Svalbard, while at the same time providing for certain rights for the other signatories. In 1925 the islands were officially brought under the Kingdom of Norway. Norway lays down and enforces laws and regulations on Svalbard. However, the Svalbard Treaty requires Norway to grant persons and companies from the over 40 signatory states equal rights to engage in hunting, fishing and certain forms of commercial activity in the archipelago and its territorial waters.

Figure 1. Protected areas of Svalbard



Protected wilderness

About 65 per cent of the land area of Svalbard is protected in one way or another in order to conserve its unique nature, landscape and cultural heritage. There are seven national parks on Svalbard, six nature reserves, 16 bird sanctuaries and one geotope (geological protection area). The national parks comprise close to 14 500 km². In addition, in excess of 20 000 km² of marine areas are included in the national parks.

The Svalbard Environmental Protection Act regulates what can and what can't be done in Svalbard's nature. It lays down important overriding principles of environmental law with regard to prudence, notification rules, the precautionary principle, total strain assessments, economic accountability for environmental damage, environment techniques and aspects of investment. The purpose of the Act is to safeguard virtually untouched area in Svalbard. Within the limits of this framework, environmentally sound settlement, research and commercial activity is provided for.

On the basis of environmental surveillance programs there are several statistics available on various formats and web portals. The motivation for all of them is to show whether the management is in compliance with the protection act and that the unique wilderness is kept unspoiled. Statistics Norway plays a central role in establishing official statistics for Svalbard and environmental statistics is part of this.

Population of Svalbard

There are no Indigenous Peoples on Svalbard and the population consists mainly of people moving to the archipelago to work. There are about 2900 people settled on Svalbard in 2020 and the population is mainly concentrated in two settlements: Norwegians in Longyearbyen and Ukrainians and Russians in Barentsburg.

In the Norwegian local communities of Longyearbyen and Ny-Ålesund there is about 2400 residents, and the number of foreign residents is over 700, 30 per cent of the population. The Norwegian local communities have residents from over 40 countries.

Few people remain on Svalbard when they get old, and the proportion of children is lower than in mainland Norway. Compared with mainland Norway, there is a clear predominance in the age 25 to 39 years. Nearly 40 per cent of the population in the Norwegian local communities is in this age group.

Svalbard has been characterised as a 'churn society', and Longyearbyen has much greater turnover than a Norwegian municipality of similar size. There is a large number of both arrivals and departures: in 2019 over 400 departures were recorded, corresponding to around 17 per cent of the population.

Figure 2. . Persons in settlements on Svalbard. 1 January

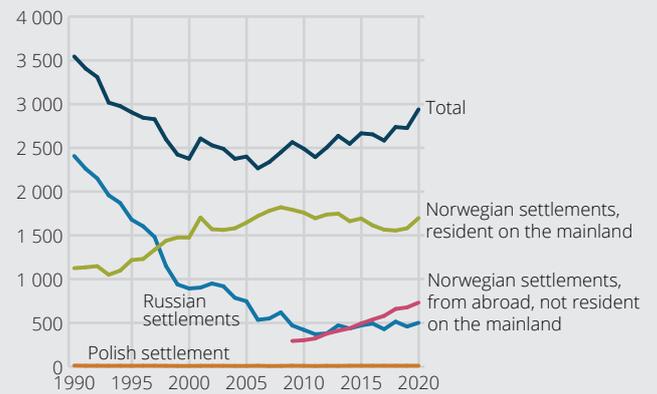
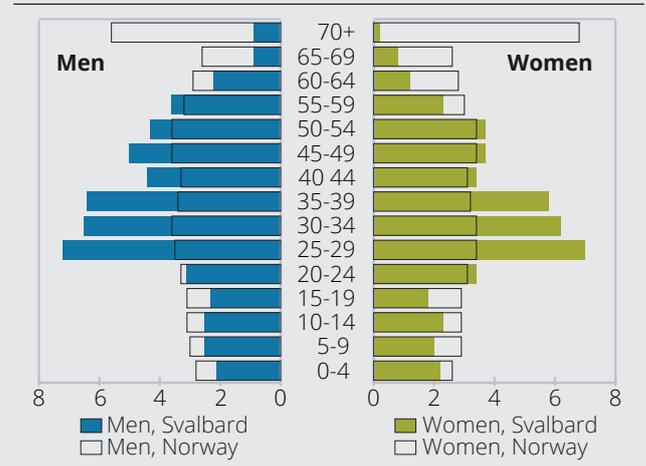


Figure 3. Age distribution in the Norwegian settlement on Svalbard and on the mainland. 1 January 2015. Per cent



The economy of Svalbard

Coal mining was the main economic activity in Svalbard from the early 1900s to 2016. Ny-Ålesund, Longyearbyen and Barentsburg were all founded because of mining operations and coal extraction. Ny-Ålesund is now a centre for international arctic scientific research and environmental monitoring. Owing to low coal prices, the Norwegian government closed down mining operations in Svea and Lunckefjell. As from 2017, coal production is not the most important industry in Svalbard and, measured in turnover, other industries such as construction and accommodation and food service are more important.

Statistics Norway produces annual industry statistics for Svalbard,² and figures for 2019 show that there was a total employment of 1618 FTEs (full-time equivalents) in the Norwegian local communities at Svalbard. Only about 6 per cent of these FTEs are now directly linked to coal production. The statistics also show diversity in industrial structure, shedding light on economic development in tourism, education and research.

Box V: Svalbard cont.

Table 1. Main economic figures for the Norwegian settlements on Svalbard in 2019 (SIC2007)

Industry	Establishments	FTEs	Turnover	Public Subsidies	Wage costs	Investments
NOK 1 000						
Svalbard total	321	1618	3 645 405	764 685	1128204	423213
Mining and quarrying	1	97	152 495	-	93 545	1 552
Manufacturing; Electricity, gas, steam and air conditioning supply; Water supply; sewerage, waste management and remediation activities	15	60	249 159	5 259	59 852	7 800
Construction	21	221	648 449	40	163 114	20 032
Wholesale and retail trade, repair of motor vehicles and motorcycles	26	120	393 721	0	69 910	14 772
Transportation and storage	22	117	457 411	-	119 763	69 265
Accommodation and food service activities	21	240	371 263	33 019	116 223	48 239
Information and communication. Financial and insurance activities	15	66	677 751	520	55 347	101 479
Real estate activities	27	6	92 494	0	4 515	77 941
Professional, scientific and technical activities	49	70	51 184	73 130	51 322	8 857
Administrative and support service activities	64	174	336 052	76 741	97 717	31 933
Public administration and defence; compulsory social security	8	101	30 511	333 654	80 710	14 899
Education	8	166	64 251	189 026	114 564	13 795
Human health and social work activities	9	65	14 158	22 601	49 345	524
Arts, entertainment and recreation	26	103	101 129	25 195	47 303	12 085
Other service activities	7	11	5 377	5 500	4 974	40

Source: Statistics Norway

Production of coal

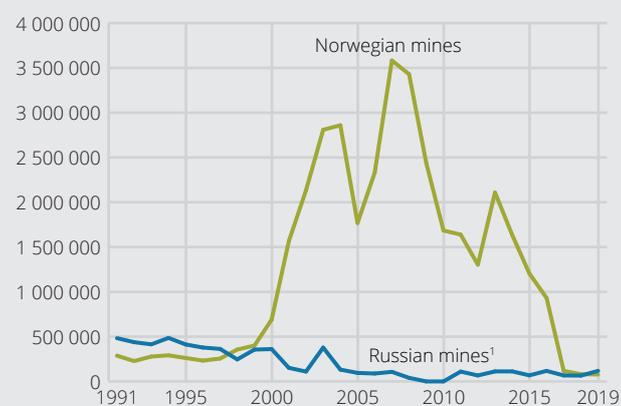
In 1906 the American John M. Longyear founded the Arctic Coal Company and founded Longyearbyen in Adventdalen on the island of Spitsbergen. The American company was purchased ten years later by Store Norske Spitsbergen Kullkompani (Store Norske). Since then Store Norske has been in coal production on Svalbard, and the production grew considerably when the Svea Nord mine started production in 2002. There is still some mining activity in Svalbard, but there are significant changes. A new mine in Lunckefjell began production in 2014 but shut down in 2016. Svea was abandoned in 2017, with

the result that Gruve 7 is the only mine with activity. In 2008 the company Store Norske had about 410 persons employed. It had 97 in 2019. Svea and Lunckefjell mines are subject to a clean-up, and the area will be restored to the condition in which it was before the mining began. The clean-up operation is massive, with an estimated cost of approximately NOK 1.2 billion.

The Russian settlements in Barentsburg are still based on coal production but are also engaged in research and tourism.

The Russian mine in Barentsburg has been in production since the 1930s and is operated by the company Trust Arktikugol. The company has also operated mines in other parts of Spitsbergen, but Barentsburg is the only one currently in production.

Figure 4. Shipped coal from Svalbard. Tonnes



¹ It has not been any coal shipping from Russian mines in Barentsburg in 2009 and 2010 due to fire spring 2008.

Source: Directorate of Mining with Commissioner of Mines at Svalbard, Store Norske Spitsbergen Kullkompani.

Tourism

The Norwegian government has pursued a policy where it has been important to facilitate industries other than coal mining to ensure a robust basis for settlement in Longyearbyen in the long term. The tourism industry lives of the untouched nature and ecotourism is a niche they have wanted to develop. After the commercial focus on tourism in Longyearbyen started up in the early 1990s, this industry has exhibited strong growth. Enterprises classified as accommodation and food service activities on Svalbard had a turnover of NOK 371 million in 2019 and accounted for 240 of the 1618 FTEs of employment on Svalbard. Accommodation statistics from Statistics Norway show more than a doubling in the number of guest night on Svalbard from 2010 to 2019.

Research and education

To enhance Svalbard as a platform for Arctic research the Norwegian government has since the 1990s developed significant research infrastructure in terms of research stations and laboratories, satellite download stations and observatories on Svalbard. In addition, several Norwegian research vessels operate in Arctic waters. Kings-Bay AS is a state-owned company situated in Ny-Ålesund. The company activities are to provide services and promote research and scientific activities, as well as to develop Ny-Ålesund as an international Arctic scientific station. Several nations have permanent research stations located in Ny-Ålesund, such as Norway, China, Great Britain and Germany. According to statistics from Kings-Bay AS there were performed 15 100 research person-days in 2019, a growth of 13 per cent from 2018. Research person-days include field days, and support and logistics activity originating at the stations.

The University Centre in Svalbard (UNIS) situated in Longyearbyen was created by the four oldest Norwegian universities in 1993. The University offers various courses at the master's and doctoral levels. The courses focus on Arctic biology, Arctic geology, Arctic geophysics and Arctic technology. The number of students increased significantly until 2017, and about 740 students were affiliated with the University Centre in 2019.

More statistics on Svalbard

Svalbard has a separate section on Statistics Norway's website,³ under the STATISTICS' tab. Current and up-to-date statistics on and analyses of topics discussed in this article can be found there. The website also provides detailed background data on the various statistics

¹ Svalbard is defined as a land area situated between 74 and 81 degrees north, between 10 and 35 degrees east.

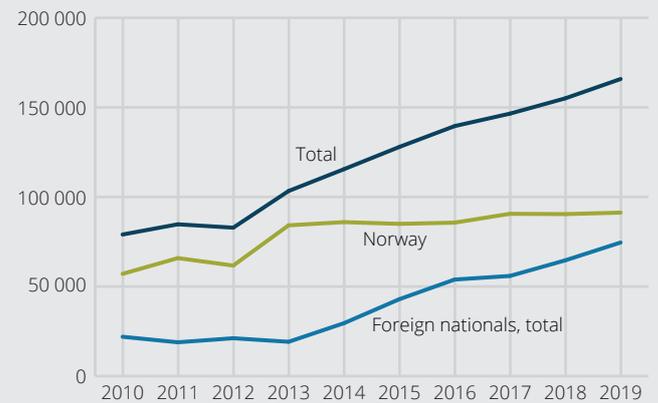
² <http://www.ssb.no/en/sts>

³ <https://www.ssb.no/en/svalbard>



Svalbard. Colourbox

Figure 5. Number of guest nights in accommodation establishments on Svalbard, by nationality



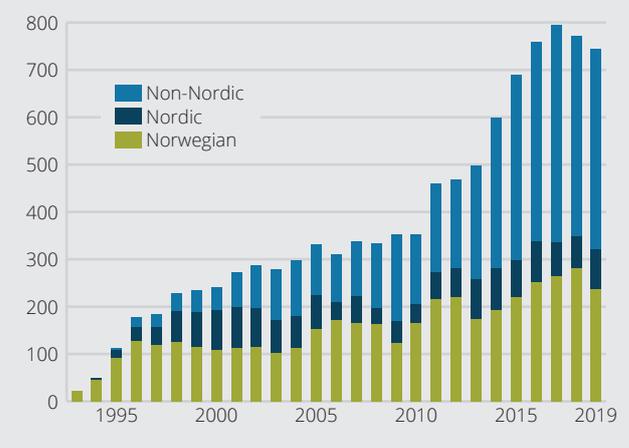
Source: Statistics Norway

Figure 6. Research person-days in Ny-Ålesund, including field days, support and logistics activity



Source: Kings-Bay AS

Figure 7. Students at the University Centre in Svalbard (UNIS)



Source: UNIS

Oceans contribute with large economic values. Environmental management of oceans is crucial in order to maintain sustainable use of natural resources, as basis for current and future economic activity. Norway has ocean management plans for the ocean areas outside Arctic Norway, from the Barents Sea to Lofoten, denoted the ocean management area (forvaltningsplanområdet). Economic values from economic activities in and related to the ocean management area have been assessed by Statistics Norway for a recent report from the Norwegian Environment Agency.¹ The main results from the assessments of production and employment are presented here.

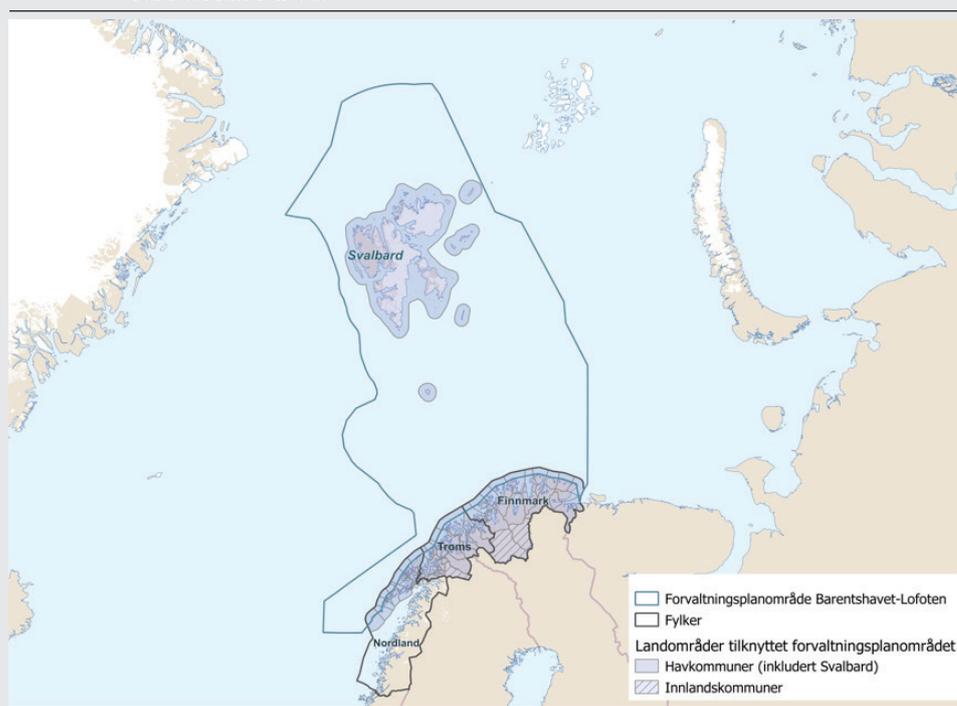
The economic activities most directly related to the ocean management area are found in the four ocean based sectors seafood, petroleum, shipping, and tourism. In this study the sectors are defined as both the core activities of the sectors and the main deliveries of intermediate consumption to the sector. The land areas related to the ocean management area from the Barents Sea to Lofoten, consist of all municipalities in the counties of Finnmark and Troms and the northernmost municipalities of the county of Nordland, i.e. north of Lofoten, as well as Svalbard.

For sector tourism the geographical delineation is the same regarding Svalbard and Nordland as for the other three sectors. Finnmark and Troms as counties are also included in the sector tourism but value added and employment are estimated only for the ocean municipalities in these counties and not for all municipalities. That is due to the assumption that tourists that only visits inland municipalities are not interested in sea as tourist attraction. Definition of core activities in the sectors and the geographical areas are given in Table 1.

The economic values from the ocean management area consist of value added and employment in the four sectors seafood, petroleum, shipping, and tourism. Results are presented for 2010 and 2016, in Table 2 for value added and Table 3 for employment.

Data are from regional national accounts, with some additional data sources, including production data. For fisheries and petroleum, production data are utilized

Figure 1. Ocean management area in Norway for the Barents Sea and Lofoten and related land areas



Source: Faglig forum for norske havområder (2019): Verdiskaping i næringene - Faggrunnlag for revisjon av forvaltningsplanen for Barentshavet og havområdene utenfor Lofoten M-1297/2019. Figure 2.1.

as basis for regionalizing production. As several shipping services take place in other sectors, value added in the shipping sector is underestimated, in order to avoid double-counting.

Assessments for the tourism sector is based on the satellite account for tourism.² Estimates of the economic value of tourism can be consumption based, assessing expenditures by tourists, or production based, assessing value added from businesses delivering goods and services to tourists. In this study, the economic value of tourism is based on estimates of consumption by tourists.

As shown in Table 2, value added in the four ocean based sectors, for all of Norway, was about 623 billion NOK in 2016. For the ocean management area from the Barents Sea to the Lofoten area, the value added in the four ocean based sectors was assessed at 51.4 billion NOK in 2016, which was 14.6 billion NOK higher than in 2010

Petroleum and seafood represent most of value added in the ocean management area, and together the value added of these two sectors represent 91 per cent of value added in the ocean management area in 2016.

The value added of the seafood sector in the ocean management area was 12 billion NOK in 2010 and 21.4 billion NOK in 2016. As shown in Table 2, the value added of the seafood sector in the ocean management area is 37 per cent of the value added of the seafood sector for all

Table 1. Sectoral and geographical delineation of ocean based sectors

Sector	Core activity	Geographical delineation
Seafood	Fisheries and catch, aquaculture, processing, wholesale trade of seafood, and production of raw fish oils and fat	Fisheries and catch: Economic activity in the ocean management area Aquaculture: Economic activity in the land areas related to the ocean management area Processing and wholesale trade of seafood: Share of total fisheries and aquaculture in Norway that can be related to the ocean management area Production of raw fish oils and fat: Share of total fisheries and catch in Norway that can be related to the ocean management area
Petroleum	Extraction and production of oil and natural gas, and related services	Exploration and extraction activities in the ocean management area
Shipping	Domestic and international shipping of goods, and domestic coastal transportation of passengers and goods	Economic activity in the land areas related to the ocean management area
Tourism	Accommodation and meals, transportation, other services and goods	Norwegian and international tourists' consumption of goods and services in the ocean municipalities , defined as the municipalities related to the ocean management area except inland municipalities

Source: Faglig forum for norske havområder (2019): Verdiskaping i næringene - Faggrunnlag for revisjon av forvaltningsplanen for Barentshavet og havområdene utenfor Lofoten M-1297/2019. Table 2.1.

of Norway, and in the ocean management area, seafood has a larger share of the national economy than the other ocean based sectors together.

While the value added of the petroleum sector, for all of Norway, declined between 2010 and 2016, the value added of the petroleum sector increased in the ocean management area, from 21.2 billion NOK to 25.3 billion NOK, an increase of four billion NOK. The petroleum sector in the ocean management area consists of production of liquefied natural gas (LNG) at Melkøya outside Hammerfest with natural gas from the Snøhvit field, and from 2016, oil production from Goliat field.

The value added of shipping increased, for all of Norway, from 2010 to 2016, while it decreased in the ocean management area, from 1.3 billion NOK to 1.0 billion NOK. The value added of tourism in the ocean management area was 3.7 billion NOK in 2016, an increase of 1.3 billion NOK from 2010.

As shown in Table 3, employment in the four ocean based sectors, for all of Norway, was about 263 500 persons in 2016. In the ocean management area, employment in the four ocean based sectors was estimated to about 34 800 persons in 2016. The highest employment in the ocean management area was in the petroleum sector, with about 14 500 persons in 2016, an increase of about 800 persons from 2010. Together the seafood and the petroleum sectors represent 18 per cent of employment in the ocean management area in 2016.

¹ Faglig forum for norske havområder (2019): Verdiskaping i næringene - Faggrunnlag for revisjon av forvaltningsplanen for Barentshavet og havområdene utenfor Lofoten M-1297/2019.

² <https://www.ssb.no/en/nasjonalregnskap-og-konjunkturer/statistikker/turismesat>

Table 2. Value added in ocean based sectors. Norway and ocean management area. Billion NOK (current value) and per cent

Sector	Norway (billion NOK)		Ocean management area: Barents Sea to Lofoten (billion NOK)		Share of total in Norway (per cent)	
	2010	2016	2010	2016	2010	2016
Seafood	33.1	57.9	11.9	21.4	36	37
Petroleum	596.6	478.5	21.2	25.3	4	5
Shipping	32.2	40.7	1.3	1.0	4	2
Tourism	32.2	45.4	2.4	3.7	7	8
Total	694.1	622.5	36.8	51.4	5	8

Source: Faglig forum for norske havområder (2019): Verdiskaping i næringene - Faggrunnlag for revisjon av forvaltningsplanen for Barentshavet og havområdene utenfor Lofoten M-1297/2019. Table 2.10.

Table 3. Employment in ocean based sectors. Norway and ocean management area. 1 000 persons and per cent

Sector	Norway (1 000 persons)		Ocean management area: Barents Sea to Lofoten (1 000 persons)		Share of total in Norway (per cent)	
	2010	2016	2010	2016	2010	2016
Seafood	24.9	28	9.4	11.3	38	40
Petroleum	113.4	114.6	13.7	14.5	12	13
Shipping	27.8	32.5	1.7	2.9	6	9
Tourism	74.2	88.4	4.8	6.1	6	7
Total	240.3	263.5	29.6	34.8	12	13

Source: Faglig forum for norske havområder (2019): Verdiskaping i næringene - Faggrunnlag for revisjon av forvaltningsplanen for Barentshavet og havområdene utenfor Lofoten M-1297/2019. Table 2.10.



Local marketplace, Nuuk, Greenland. Photo: Tom Nicolaysen

5. Arctic petroleum extraction with increased rates of return

Lars Lindholt and Solveig Glomsrød

Introduction

This study looks at the potential effects on the oil and gas extraction in the Arctic if petroleum companies increase their required rate of return (RRR) on investments. The required rate of return serves as an economic criterion for investment decisions and is also used as the discount rate for expressing future income in present value. Various trends indicate that the required rate of return for the petroleum companies may be higher today than only some years ago as companies increasingly focus on projects that deliver high rates of return rather than high reserve volumes.¹ A consequence has been a shift towards projects with shorter investment cycles. Since the price drop in 2014 many oil majors have moved from high-cost undeveloped resources to lower-cost areas where resources can be brought on relatively quickly.² The clearest example of this is investment in light

tight oil reserves (shale oil) but is also seen in conventional crude oil projects with shorter time lags between development approval and production.³ In a recent study The Oxford Institute for Energy Studies⁴ shows that investors now are demanding a much higher minimum return to invest in long cycle oil projects than they did before. Further, the industry seems to drill fewer and better wells in commercially attractive areas than before, meaning that high returns are preferred over high volumes.

Perceived risk is among factors raising investor's required rate of return. Risk can relate to operations or policy interventions. There has been arising awareness within the business community of climate risk to the economy.⁵ Future investment bears the risk of assets being undeveloped and the fossil industry is under scrutiny from investors



Trans-Alaska Pipeline. Photo: Colourbox



Part of the Labrador Iron Mine facilities in Schefferville, at the beginning of open pit operations in Schefferville. Photo Gérard Duhaime, 2011.

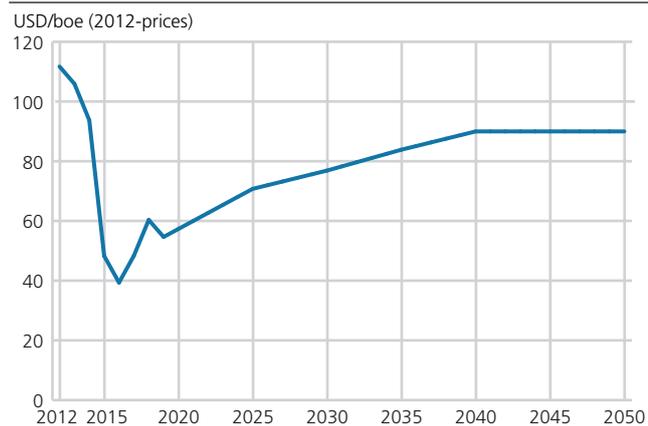
about the impact of climate policies on their future earnings. Worldwide, pension funds and sovereign funds have increasingly pledged to avoid investments in fossil fuel companies over fears that their assets could become “stranded”, or worthless, if governments across the world introduce stricter rules to tackle global warming.⁶ This can lead to more near-sighted investment strategies by the oil and gas companies and hence, a higher required rate of return. This is confirmed by the study of The Oxford Institute of Energy Studies, which concludes that higher required rate of return in general is due to concerns of the green energy transition.

A possible threat to future oil demand is that the cost of electric vehicles (EV) is expected to be at par with the cost of cars with internal combustion engines as soon as by 2022.⁷ The largest emerging economies China and India have signaled high ambitions for EV⁸ and car producers have pledged to end production of cars with only internal combustion engines.^{9,10} Technological breakthroughs in battery technology could also promote EVs and reduce the oil demand from transportation, as can phasing in of hydrogen. In addition, oil deliveries to the petrochemicals industry are vulnerable to environmental concerns as an emerging “war on plastics” is taking place,¹¹ thus increasing the uncertainty about the prospects of oil. The effects described above are linked to a business environment of both higher required rate of return for the oil and gas companies as well as expectations of lower future prices.

There are different opinions on the appropriate rate of return to apply in petroleum analyses. The rate of return shall reflect the return to capital in the best alternative investment option, while the investor is compensated for taking risk. Hence, the real rate of return is the risk-free rate plus a premium for risk.¹² Wood Mackenzie, a consultant, considers the standard industry benchmark for the internal rate of return for a robust oil and gas project to be around 15 per cent or even somewhat higher.¹³ Further, according to The Oxford Institute for Energy Studies the rate to investors is now closer to 20 per cent for new international oil and gas projects, especially deep-water and other long cycle projects. At the lower end, the Norwegian Ministry of Petroleum and Energy has set the discount rate in petroleum projects to be 7 per cent,¹⁴ which we assume can represent a lower level of a relevant variation area.

Hence, we look at the prospects for oil and gas in arctic regions until 2050 at 20 per cent required rate of return (the high RRR scenario) and compare with the case of 7 per cent (the reference scenario).

This study applies a comprehensive and transparent global oil and gas model (FRISBEE) with prices, costs and reserves. An important contribution of our approach is the detailed modelling of the supply side. Petroleum producers base their investment and production decisions on profit maximization and detailed information about the access to fields worldwide. The producers might invest in

Figure 5.1. Oil price assumption. 2012-USD/boe

Source: IEA 2019 Stated Policy Scenario

new reserves, which can be new fields or increased oil and gas recovery from already producing fields. The assumption that investments first target the most profitable reserves leads to a geographical spread of oil and gas extraction worldwide. Gradually less profitable resources are developed until the internal rate of return is equal to the required rate of return. An important feature of the model for this study is that due to generally long lead times, it takes time before a decline in oil and gas investment in new field reserves leads to reduced production. However, changes in investments in oil and gas recovery from existing fields will have a more rapid effect on supply. We emphasize that due to uncertainty in many estimates, the focus of this analysis is not on the future level of extraction itself, but the relative effects of higher required rates of returns on oil and gas production.

The oil price follows an exogenous trajectory in FRISBEE. Firstly, we develop the reference scenario with a RRR of 7 per cent and an oil price based on the Stated Policy Scenario of IEA.¹⁵ In this IEA scenario the real oil price (2012-USD)¹⁶ is expected to increase to 70 USD per barrel in 2025 before rising to reach almost 90 USD in 2040, all in 2012 USD (Figure 5.1). As we study the effects until 2050, we keep the oil price constant after 2040. Note that we focus on long-term developments and not short-term fluctuations, like the drop in oil prices in 2014/2015 and in 2020 due to the covid-19 pandemic.

Historically the gas price has followed the oil price relatively closely, but with a lag. During the last years the link between oil and gas prices seems to be weaker, at least in certain regions where prices are determined in spot markets rather than in

contracts. The regional gas prices in FRISBEE are endogenous, determined by supply and demand under influence of transportation costs. Traded gas will find its way to buyers via the least cost transport mode. In the FRISBEE model, investors respond with adaptive price expectations, assuming that the future oil and gas prices will settle at the average over the 6 previous years. When the price of oil is increasing, the adaptive expectations will lead investors onto a rising expected price path that is lagging somewhat behind the real price development. This will also be the case for gas, if the endogenous market price for gas is increasing.

Arctic oil supply

Figure 5.2 shows the simulated future production of oil in the Arctic in both scenarios. The reference scenario with 7 per cent RRR will lead to a minor decline in total Arctic oil production up until the early 2040s, before it begins to increase from around 440 Mtoe to almost 500 Mtoe by 2050, slightly above the current production level. Behind this development, many fields are exhausted, while new fields are being developed. The reason for this surge towards the end of the projection period is rapidly rising supply from Greenland and Alaska.

Intuitively one would think that if companies raise the RRR to 20 per cent fewer high-cost reserves become profitable and investments would decline, ultimately leading to lower supply. However, Figure 5.2 shows that the effect of higher RRR does not quite match this picture. With a 20 per cent RRR the arctic oil production falls markedly as expected at an early stage and stays there until the early 2040s. Then, counterintuitively, production takes off and nearly reaches the level in the 7 per cent scenario by 2050.

With identical oil prices in both scenarios, one would expect that with a high RRR production would stay low or continue to decline rather than rebound after 2040 as fewer of the high-cost fields are profitable to develop. However, lower investments in an initial period entail lower future capital costs, both because of reduced investment activity by itself and also because the pool of undeveloped reserves declines more slowly. This means that it will be less costly and more profitable to invest in these fields at a later stage, explaining why production is higher after 2047 in the 20 per cent case compared to the reference scenario.

Figure 5.2. Arctic oil production. Reference scenario and increased rate of return scenario. Mtoe

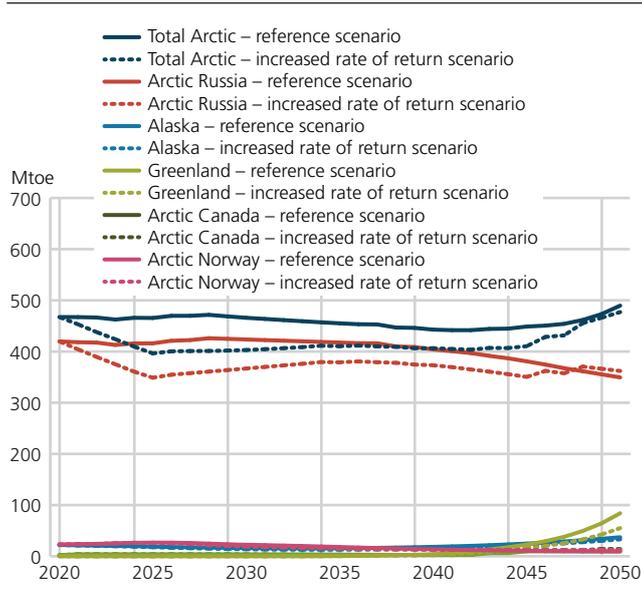
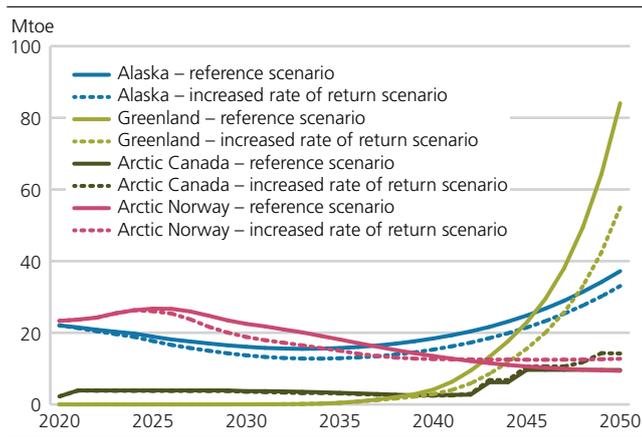


Figure 5.3. Regional distribution of West Arctic oil production. Reference scenario and increased rate of return scenario. Mtoe



Oil production by region

Arctic Russia

Russian oil production is dominating within the Arctic and largely determines the production profile for the Arctic as a whole. Figure 5.2 shows Arctic Russian oil production in both scenarios. In the reference scenario, production is relatively constant up until the mid-thirties, before it starts to decline to 17 per cent below today’s level by 2050. Almost all oil production prior to 2030 comes from already discovered reserves, onshore in Yamal-Nenets, Khanty-Mansii and Komi. Production offshore currently comes from the single field of Prirazlomnoye at 20 meters depth in Petchora Sea, which came into production in 2014. From 2030 a

Table 5.1. Change in accumulated oil production 2020-2050. Increased rate of return scenario. Deviation from reference scenario. Per cent

Total Arctic	Greenland	Arctic Russia	Arctic Canada	Arctic Norway	Alaska
-9	-50	-9	8	-4	-13

relatively large part of the production must come from undiscovered fields.

Oil production in Arctic Russia declines when introducing a higher required rate of return. However, after 2047 extraction is slightly higher in the 20 per cent scenario. First, introducing a higher RRR leads to lower investment and lower production from existing fields. Lower reserve investments drive down the capital costs and makes it profitable to invest in these reserves at a later stage, and eventually production is somewhat higher in the 20 per cent scenario. Accumulated supply in Arctic Russia and the Arctic as a whole decline by 9 per cent each during 2020- 2050 (Table 5.1).

Figure 5.3 highlights the impact of a higher RRR in other and less dominating petroleum regions in the Arctic.

Alaska

Alaska’s oil production is mainly taking place on the North Slope, which covers the Central Arctic state lands and adjacent waters of the Beaufort Sea. Alaskan oil production has been declining for years and continues to decline up until the mid-2030s in our reference scenario. However, new resources at relatively low cost are available and over time, investment in new reserves steadily increases supply towards 2050 to around 15 Mtoe above the present level. However, substantial future increase in Alaskan oil production requires that onshore areas including the area of the Arctic National Wildlife Refuge (ANWR)¹⁷ and the National Petroleum Reserve Alaska (NPR) are accessible. It is possible that 90 per cent of the Alaskan undiscovered oil is found onshore on the North Slope as well as offshore in adjacent areas in the Arctic Ocean and closer to land than the Chukchi Sea.

A higher RRR further reduces production in Alaska towards the early 2030s, but the loss of output becomes smaller over time in relative terms. Aggregated supply over the whole period declines by 13 per cent (Table 5.1).

Northern Canada

Canada produces lots of oil and gas, but little in the Arctic (Figure 5.3). There is some oil production in the Northwest Territories. In 2016, the federal government announced that Canadian Arctic offshore, including areas offshore of Northwest Territories, is off limits to new offshore oil and gas licensing to be reviewed every five years. The first five-year review is due in 2021.¹⁸ From 2016 to 2018, the Norman Wells Oil Pipeline was shut-in because of safety concerns, and as a result, production at Norman Wells was suspended and Arctic Canadian oil supply almost came to a halt. In our reference scenario oil production in Arctic Canada remains rather low up to 2042, followed by a relatively strong increase up to almost 10 Mtoe by 2050, a level which will require infrastructure investments.

A higher RRR leads to a minor reduction in supply towards 2040. From then on production increases and surpasses the reference scenario in 2050 by almost 50 per cent, an effect of delayed investments. Accumulated supply increases by 8 per cent over the period.

Northern Norway

Arctic Norway includes the Norwegian Sea, where production started on the Draugen-field in 1993, and the Barents Sea. There is only production from one oil field in the Barents Sea, as Goliat was developed in 2016. Another Barents Sea field, Johan Castberg, is expected to start production in 2023/2024. We keep the areas of Lofoten, Vesterålen and Senja closed for petroleum activity. In the reference scenario, oil production increases over the next few years, reflecting increasing supply from the Norwegian Sea and the Barents Sea up to 2025 and 2027, respectively, as relatively large amounts of new reserves are coming into production (Figure 5.3). From then on oil production in Arctic Norway declines. The Norwegian Sea shows the steepest decline, and total oil production in Arctic Norway in 2050 ends up at 40 per cent below the present level.

In the high RRR scenario we see that production initially declines but is above the reference scenario after the early 2040s (Figure 5.3). Again, higher RRR leads to lower reserve investments initially which drives down future capital costs and makes it profitable to invest in these reserves at a later stage.



Photo Mary Stapleton

Greenland

Greenland has almost one-sixth of undiscovered oil in the Arctic, but no reserves have been proven as profitable and recoverable. In addition, Greenland has the longest lead times and highest costs. However, Greenland Gas & Oil Limited is planning for a drilling program commencing in the fall of 2020.¹⁹ In our simulations production for total Greenland starts as late as from around 2035 and reaches over 80 Mtoe by 2050.

A higher RRR leads to lower production in Greenland, although the reduction becomes relatively smaller over time. Aggregated oil supply from Greenland over the period declines by 50 per cent (Table 5.1).

Gas production and gas prices

Contrary to the oil price, the gas price is determined in regional markets and introduces a different dynamic in the scenario development.

Figure 5.4 shows total Arctic gas production in the reference scenario. Gas supply declines markedly towards the late 2030s to around a quarter below today's level. From then on Arctic gas production increases to 2050 but ends at 10 per cent below the 2020 level. In our reference scenario the average regional gas price is 75 per cent higher in 2050 than in 2020, compared to an oil price increase of almost 60 per cent over the same period.

Introducing a 20 per cent required rate of return leads to higher production after the late 2020s (Figure 5.4). Hence, the long-lasting decline in total Arctic supply of gas in the reference scenario until about 2038 has been modified already a decade earlier before it starts to rise around mid-2030s. By 2050 production increases to almost 510 Mtoe, more than 55 Mtoe above the level in the reference

Figure 5.4. Arctic gas production. Reference scenario and increased rate of return scenario. Mtoe

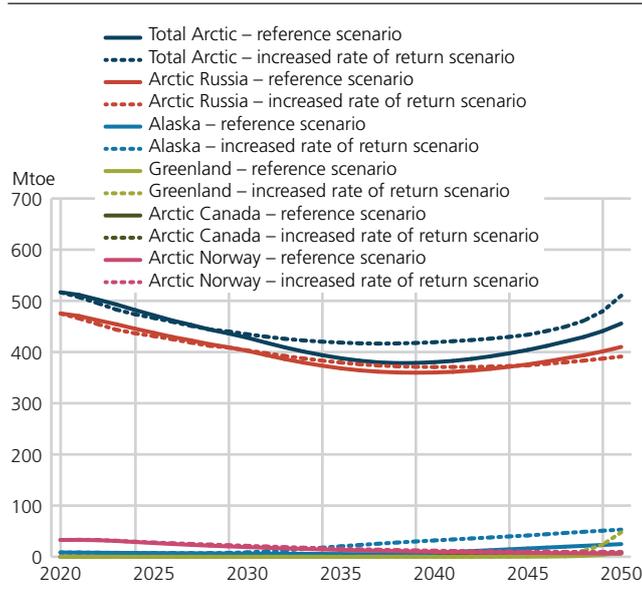
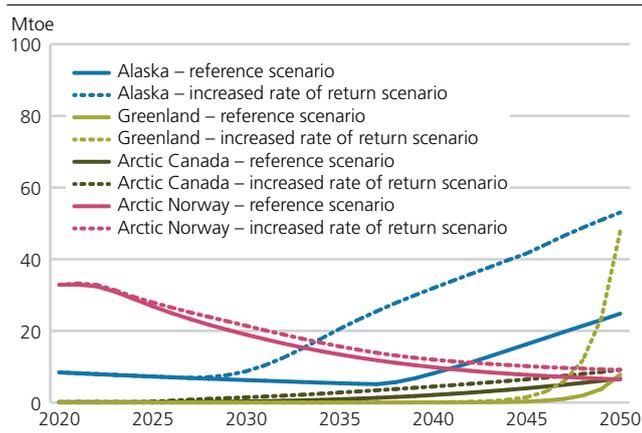


Figure 5.5. Regional distribution of West Arctic gas production. Reference scenario and increased rate of return scenario. Mtoe



scenario. The initial period with lower gas production is much shorter than what the oil market experienced with a higher RRR. Again, higher RRR leads to lower reserve investments initially which drives down the capital costs and makes it profitable to invest in these reserves at a later stage. As for oil, this eventually can lead to higher supply than in the reference scenario. However, for gas markets we have an additional effect that can stimulate investment and production and counteract the negative effect on investment from higher RRR. This effect relates to the endogenous regional gas prices in contrast to our fixed, exogenous oil price. Higher RRR and the corresponding lower production will, inter alia, lead to higher gas price. Higher regional gas prices will stimulate supply over time and we can therefore more easily end up with production above the reference scenario. This effect may

Table 5.2. Increase in accumulated gas production 2020-2050. Increased rate of return scenario. Deviation from reference scenario. Per cent

Total Arctic	Greenland	Arctic Russia	Arctic Canada	Arctic Norway	Alaska
5	505	0	84	12	135

differ between regions and field categories. With a higher RRR, some suppliers reduce production relatively more and for a longer initial period than others, depending on to what extent increased RRR makes the high cost fields become unprofitable. In addition, in regions with shorter lead times compared to the Arctic the period from reduced investment to lower production is relatively short. As a result, the increase in gas prices and, hence, production, differ across regions. The various arctic regions also export to different parts of the world and changes in export gas prices will not be equal across regions. All regions increase production in the high RRR scenario, largely without initial declines except Russia.

Arctic Russia

Arctic Russia is a giant petroleum producer in Arctic and global context, with over 90 per cent of the total Arctic petroleum production today (and 90 per cent of total Russian gas production). Arctic Russia has the lion’s share of total Arctic resources in terms of undiscovered gas resources, of which almost 90 per cent are found offshore. Supply declines until the late 2030s and then increases but only to 15 per cent below today’s level. In Arctic Russia the reference scenario is largely based on production from already discovered reserves, both developed and undeveloped.

With a high RRR Arctic Russia experiences an initial period with marginally reduced activity but eventually supply starts to increase and surpasses that of the reference scenario around 2030. However, the higher activity in this mid-period eventually leads to higher costs and marginally lower supply than in the reference scenario as from 2045.

Fields are emptied over time and to prevent production from declining even further, new fields must be discovered and developed to keep an increasing, or even constant, production profile over time. The lion’s share of new reserves in Arctic Russia may have to come from offshore resources not yet discovered. One can question if this is realistic as there is yet no gas production

in Russian Arctic waters (the only offshore gas production takes place in shallow waters near the island of Sakhalin in more temperate regions). However, Russian engineers are world leaders in inland arctic pipeline technology crucial for the Yamal Peninsula projects, where almost all Arctic Russian gas production takes place. Offshore extraction is costlier and more demanding than onshore production and is also dependent on different technological expertise and experience. Today, western gas companies are not allowed to deliver such technologies due to economic sanctions. The supergiant Bovanenkov onshore gas field, larger than the giant offshore Stockman gas field put on hold, began production in 2012. Bovanenkov is now producing over 20 per cent of total Russian gas. Another giant field, the Kruzenshternskoye field, will probably start production in the mid-2020s and will be connected to the Bovanenkovo field via pipelines.²⁰ It is difficult to predict how future European gas import will develop and affect future Russian gas export. However, a new gas pipeline -North Stream 2- from Russia to Germany is expected to be finished in 2021. In addition, we can expect an increase in Asian demand. A new pipeline from East Arctic Russia is currently delivering gas to China. There are plans for connecting this pipeline to the rest of the Russian network, so that in some years it might be possible to transport gas from Yamal in Western Siberia to the Asian markets.

Also, the Yamal LNG plant started production in 2017 for export to Asia along the Northern Sea Route and to Europe. Hence, future demand for Russian gas in Europe might not decline, and in addition there will probably be an increase in Asian demand, leading to increased Russian output after late 2030s.

Note that in our model gas will be traded if profitable, using the lowest cost transportation method, via pipelines or sea. Hence our study reflects a situation in the long term without sanctions.

Figure 5.5 highlights the projected future reference supply of gas from other Arctic regions than Russia.

Alaska

The long-lasting decline in Alaskan supply of gas until the late 2030s has been turned into growth a decade earlier with a high RRR, raising supply to about 30 Mtoe above the old reference scenario in 2050 (Figure 5.5). Aggregated supply from 2020 to 2050 is 135 per cent above the reference scenario (Table 5.2). This increase is due to relatively large increase in gas prices in the US market following a higher RRR. With a higher RRR, US suppliers reduce production relatively fast and to a relatively large extent, because of short lead times and the fact that relatively many fields become unprofitable. The regional gas price increases twice as much as the average world gas price. Alaska does not even reduce supply in an initial period with higher RRR as higher gas prices already counterweighs the negative effect of higher RRR on investment and production.

Alaska has probably as much as one-fifth of undiscovered gas in the Arctic, including Alaskan shale gas. Shell and Statoil (now Equinor) withdrew from offshore exploratory drilling in the Chukchi Sea in 2015. However, over 90 per cent of the Alaskan undiscovered gas is found onshore on the North Slope as well as offshore in adjacent areas in the Arctic Ocean closer to land than the Chukchi Sea. The increase in gas supply is probably conditioned on a gas pipeline from Prudhoe Bay to the port city of Nikiski in southern Alaska, similar to the existing North Slope oil pipeline. There are plans of other pipelines and LNG factories, above all a new LNG plant in Nikiski. In 2018 the federal authorities



Pipelines in Alaska. Photo: Colorbox

decided to expand federal oil and gas leasing in the ANWR, in an even larger area of the NPRA and offshore. After decades of opposition to drilling in the ANWR oil leases were auctioned in January 2021. However, interests were low,²¹ possibly reflecting a more risk averse attitude towards large projects with a longtime horizon.

Northern Canada

The present level of gas production in Arctic Canada is very low and is consumed locally. Natural gas production at Norman Wells was suspended from 2017 to 2018 in response to the suspension of oil production in the region. Higher RRR and higher gas prices means that the increase in gas supply now starts around the mid-2020s, a decade earlier than in the reference case. This leads to an increase in aggregated gas supply of over 80

per cent over the projection period, albeit from a low level. Developing Canada's gas reserves at this scale might require substantial investments in infrastructure as pipelines or large-scale LNG facilities. The Mackenzie Gas Project was cancelled in 2017, because it was not considered economically feasible due to the low North American gas prices at that time. The Mackenzie pipeline was meant to transport gas from the North West Territories and south to Alberta oil sands areas and further.

Northern Norway

Today Arctic Norway produces gas in the Norwegian Sea and the Barents Sea (the Snøhvit field). In the reference scenario production steadily declines to only one-fifth of today's level by 2050. Higher gas prices lift the production profile so that accumulated production increases by 12 per cent

Box 5.1. The FRISBEE model of global petroleum markets

Method

The FRISBEE-model is a recursive, dynamic partial equilibrium model for fossil fuels (oil, gas and coal), renewables and electricity in 16 regions worldwide. Demand is a function of end-user prices of energy, population, GDP per capita and AEEI-autonomous energy efficiency improvement. Each region has three end-users: Industry, households (incl. services) and power producers.

The relevant consumer price of a fuel in a region is the sum of the producer price, delivery costs (due to transport, distribution and refining) and existing taxes/subsidies. The CO₂ tax comes in addition to delivery costs and existing taxes.

FRISBEE has previously been used for studies of petroleum production, emission from shipping and petroleum activities in the Arctic and impacts of petroleum industry restructuring.

On the oil market OPEC is a dominant player and covers the residual demand (difference between global demand and Non-OPEC supply). The oil price scenario is from IEA (2019). We have perfect competition on the gas and coal markets (endogenous prices). Regarding oil and gas the model differs between fields in production, fields not developed and undiscovered fields. Both production and investment decision are modelled explicitly and are based on profitability. We model low flexibility in the short-term and full flexibility in the long-term, and differ between capital and production costs. We also implement bilateral gas trade between regions. Coal supply is based on more simple cost functions. Renewables are introduced in exogenous amounts.

The model assumes that the basic incentive for oil and gas companies is to invest in provinces and field types with the highest expected return. We apply a

pre-specified required rate of return, which is set to 7 and 20 per cent in real terms in the reference and the alternative scenario, respectively. The oil and gas companies only invest in projects with a RRR above or at the pre-specified level. The assumption that investments first target the most profitable reserves leads to a geographical spread of extraction. Gradually, reserves that are costlier to extract become candidates for investment, and the cost of development will rise as reserves are depleted. On the other hand, new discoveries add to the pool of undeveloped reserves.

Data on discovered reserves (both producing, developed and undeveloped) and operational and capital costs are based on the extensive database of global petroleum reserves in the year 2012. The parameters in the cost function are based on available cost data.

The model covers five arctic regions; Alaska, Arctic Canada, Arctic Norway, Greenland and Arctic Russia.

While discovered reserves already generate production or may lead to production in the relative short term, undiscovered resources identified through geological surveys (or seismic activity) are more uncertain and will only lead to production in the long-term. Expected undiscovered oil resources are mainly based on various reports from USGS, e.g. USGS (2012), as well as Norwegian Petroleum Directorate (2017).

References

- IEA-International Energy Agency (2019): World energy outlook, OECD/IEA, Paris.
- Norwegian Petroleum Directorate (2017): Doubling the resource estimate of the Barents Sea, Stavanger, <http://www.npd.no/en/news/News/2017/Doubling-the-resource-estimate-for-the-Barents-Sea/>
- USGS (2012): Fact Sheet 2012-3042, An estimate of undiscovered conventional oil and gas resources of the world, <http://pubs.usgs.gov/fs/2012/3042>.

(Table 5.2). This may be credible, partly due to the new pipeline that was opened in 2015 – Polarled – which crosses the Arctic Circle and can transport gas from the Aasta Hansteen field to Nyhamna/Molde on the west coast of South Norway.

Greenland

In Greenland gas has been indicated by seismic surveys, but no findings have proven viable. Many parts of the Greenland continental shelf area are still relatively unexplored. However, there is still exploration for gas (and oil), and licenses for exploration and extraction of gas (and oil) have recently been granted.²² Our simulations show that even with relatively large undiscovered resources, the relatively high costs and long lead time means that Greenland is unable to start production before the mid-2040s. In the high RRR scenario the opportunity for profitable investments opens up for Greenland, experiencing a five-fold increase in aggregated production, almost reaching the level of Alaska in 2050 (Table 5.2). Greenland has no natural gas or LNG infrastructure or installations, including storage facilities and pipelines. Hence, our simulations assume the building of the necessary infrastructure.

Summary

This study looks at the effects on the oil and gas extraction in the Arctic until 2050 if petroleum companies increase their required rate of return on investments. A higher rate of return means that the oil and gas companies become more near-sighted and reflects concerns of the green energy transition which could make their assets “stranded”, or worthless.

When companies raise the required rate of return fewer high-cost reserves become profitable and investments decline, ultimately leading to lower supply. However, lower investments in an initial period entail lower future capital costs and this means that it will be less costly and more profitable to invest in these fields at a later stage. This explains why production does not decline as much as one initially would expect. Consequently, a higher required rate of return generally leads to a relatively small decline in arctic oil production. Arctic gas producers in addition experiences higher prices, which means that production generally increases with a higher required rate of return.

Notes

- ¹ IEA-International Energy Agency (2017a): World energy outlook, OECD/IEA, Paris.
- ² PIW-Petroleum Intelligence Weekly (2018): Big oil comes around to stranded asset risks, 19. February.
- ³ IEA-International Energy Agency (2017b): World energy investment 2017, OECD/IEA, Paris.
- ⁴ The Oxford Institute for Energy Studies (2019): Energy transition, uncertainty and the implications of change in the risk preferences of fossil fuels investors, Oxford Energy Insight 45, University of Oxford
- ⁵ Carbon Tracker (2017): 2 degrees of separation: Transition risk for oil & gas in a low carbon world 2017, http://2degreeseperation.com/reports/2D-of-separation_PRI-CTI_Summary-report.pdf
- ⁶ Financial Times (2018): New York sues big oil companies over climate change, 11. January, <https://www.ft.com/content/4de8e4fc-f62b-11e7-88f7-5465a6ce1a00>
- ⁷ Randall T. (2016): Here's how electric cars will cause the next oil crisis, Bloomberg 25. February, <https://www.bloomberg.com/features/2016-ev-oil-crisis/>.
- ⁸ Reuters (2017): India's electric vehicles push likely to benefit Chinese car makers, 24. May, <http://www.reuters.com/article/us-india-autos-policy-analysis-idUSKBN18K062>.
- ⁹ The Guardian (2017a): All Volvo cars to be electric or hybrid from 2019, 5. July, <https://www.theguardian.com/business/2017/jul/05/volvo-cars-electric-hybrid-2019>.
- ¹⁰ The Guardian (2017b): France to ban sales of petrol and diesel cars by 2040, 6. July, <https://www.theguardian.com/business/2017/jul/06/france-ban-petrol-diesel-cars-2040-emmanuel-macron-volvo>
- ¹¹ Energy Intelligence (2018): Energy Intelligence 2018 outlook – Looking past the downturn, Energy Intelligence group.
- ¹² There will be no premium if it is possible for an investor to diversify away from the risk.
- ¹³ Upstream (2016): WoodMac votes for Castberg floater, 4. June, <http://www.upstreamonline.com/live/1154339/statoil-in-castberg-pipe-talks>
- ¹⁴ Riksrevisjonen (2015): Riksrevisjonens undersøkelse av myndighetenes arbeid for økt oljeutvinning fra modne områder på norsk kontinentalsokkel, Dokument 3:6 (in Norwegian).
- ¹⁵ IEA-International Energy Agency (2019): World energy outlook, OECD/IEA, Paris
- ¹⁶ The oil price in 2019 of 54 USD per barrel in 2012-prices corresponds to around 62 USD in 2018-prices. This might deviate from the present price level, but the study focuses on long-term prices and not short-term fluctuations.
- ¹⁷ Also EIA (2018) finds increased oil production from ANWR in Alaska from the beginning of the 2030s if the reserves in the region are developed.
- ¹⁸ Canada Energy Regulator (2020): Provincial and Territorial Energy Profiles – Canada, <https://www.cer-rec.gc.ca/nrg/ntgrtd/mrkt/nrgsstmprfls/cda-eng.html>
- ¹⁹ WorldOil (2019): Greenland Gas & Oil gets new license, provides Jameson update, March 20, <https://www.worldoil.com/news/2019/3/20/greenland-gas-oil-gets-new-license-provides-jameson-update>
- ²⁰ The Moscow Times (2020): Gazprom fixes eyes on new gas field, January 29.
- ²¹ The Economist 9th January 2021
- ²² Oilprice (2018): Greenland to launch onshore oil, gas tender in 2021, October 30, <https://oilprice.com/Latest-Energy-News/World-News/Greenland-To-Launch-Onshore-Oil-Gas-Tender-In-2021.html>

Box VII: Mineral extraction in the Arctic

In addition to oil and gas, the arctic region contains other abundant mineral resources. However, many known reserves are not exploited because of their inaccessibility. Arctic Russia clearly extracts the largest amount of minerals, but the other arctic regions also have certain important extractive industries, providing raw materials to the world economy.¹

Below is an overview of important minerals that are found in the Arctic, including coal, iron and ferro-alloy minerals, several non-ferrous minerals, precious metal ores and industrial minerals. Due to the numerous sorts of minerals that exist, the list will obviously not be exhaustive. We also lack data for certain minerals. Some limited information on reserves will be included in the comments to production of the specific mineral. For information on the application of the different minerals, we have leaned heavily on the websites of Mbendi² and Mineral Gallery.³ Other sources have information on world production decomposed to a country level.⁴

Mineral fuels

Coal is the world's most abundant and widely distributed fossil fuel, primarily used for electricity generation and steel production. Coal is a less abundant fossil fuel in the Arctic than oil and gas. Arctic coal production increased by 272 per cent from 2002 to 2015 (Table 1), leading to a doubling in the Arctic share of the world's coal extraction, from 2 to 4 per cent (Figure 1). Coal production takes above all place in Arctic Russia, but in 2015 there is still some minor production in Norway (Svalbard) and Alaska.

Climate policies worldwide is expected to reduce demand for fossil fuels, above all for coal. The Arctic has, however, a share of around 25 per cent of global gas resources likely to substitute for coal and play a role in production of low carbon energy through hydrogen production with CCS.

Iron and ferro-alloy minerals

Iron ore is the basic raw material used by the iron and steel making industry. Although iron has many specific uses, its main use is in the production of steel. The arctic share of global iron ore extraction declines from 2.3



Kuannersuit mountain where the potential REE-mine will be situated. Photo: Mads Fægteborg

Figure 1. Arctic share of global coal and iron and ferro-alloy mineral extraction. Per cent. 2002, 2011 and 2015

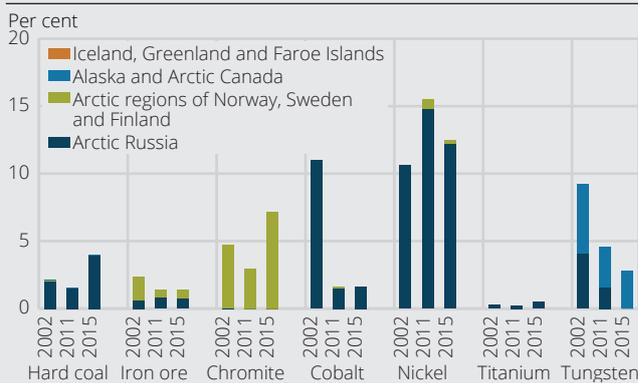


Table 1. Change in volume of coal and iron and ferro-alloy mineral extraction in the Arctic from 2002 to 2015. Per cent

Coal	Iron ore	Chromite	Cobalt	Nickel	Titanium	Tungsten
272	146	245	-24	116	99	-65

per cent to 1.3 per cent (Figure 1). However, there is an increase in production volume of 146 per cent over the period. In 2015 iron ore extraction takes place in Russia, in Kiruna in Sweden and to a minor extent in Rana and Syd-Varanger in Norway.

Chromite is used for a host of purposes. It is considered a strategic metal and is used in alloys for hardening and corrosion resistance. There are no economical substitutes for chromite ore in the production of ferro-chromium. Northern Finland is the only arctic producer. Production is 245 per cent higher in 2015 than 2002, leading to an increase in the arctic share of global chromite production from 4.7 to 7.2 per cent of total global production.

Cobalt is mainly used as an alloy with iron, nickel and other metals to produce corrosion and wear resistant products for high temperature applications such as in jet engines and gas turbines. Cobalt based alloys are also used in highly durable steels. Cobalt oxide is an important additive in paint, glass and ceramics. Arctic production decreases by 24 per cent over the period, leading to a steep decline in the share of global cobalt production from 11 to 1.6 per cent. In 2011 there is some minor production in Arctic Finland. In 2015 production only takes place in Arctic Russia.

Nickel is used in the manufacture of stainless steel, steel alloys and super alloys, central in the chemical and aerospace industries. Nickel is also used in batteries and fuel cells, and as a catalyst in the production of fats and oils. The lion's share of nickel mining takes place in Arctic Russia and total arctic extraction increases by 116 per cent from 2002 to 2015 (Table 1). Arctic production amounts to 10.6 per cent of the world's production

Figure 2. Arctic share of global non-ferrous mineral extraction. Per cent. 2002, 2011 and 2015**Table 2. Change in volume of non-ferrous mineral extraction in the Arctic from 2002 to 2015. Per cent**

Bauxite	Copper	Lead	Zink	Palladium
39	25	-1	16	1

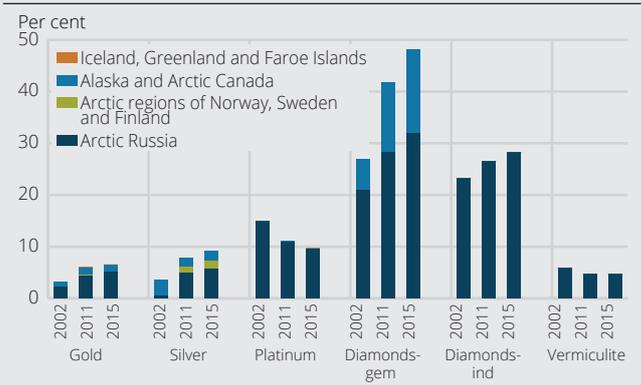
in 2002 and 12.5 per cent in 2015. In 2015 there is also some minor extraction in Arctic Finland.

Titanium is a lightweight mineral, non-corrosive, able to withstand temperature extremes and with strength as steel. Titanium alloys have many applications in air-planes, missiles, space vehicles and in surgical implants. Arctic Russia is the only producer in the Arctic. Production doubles over the period, leading to an increase in the arctic share of global titanium from 0.3 to 0.5 per cent.

Tungsten is produced both in Arctic Canada and Arctic Russia, and the arctic share of worldwide production declines from around 9 to 3 per cent as extraction declines by 65 per cent from 2002 to 2015. Tungsten is used for hardening steel and the manufacture of "hard metal", with hardness close to that of diamond. Tungsten metal products are extensively used in electric and electronic equipment and in the chemical industry as a catalyst.

Non-ferrous minerals

Bauxite is the main raw material to produce alumina, and ultimately aluminium. The production of alumina consumes over 90 per cent of global bauxite output. Aluminium is used in electrical equipment as well as cars, ships and aircrafts, and is also used in metallurgical processes, buildings and packaging materials. Figure 2 shows that extraction in the Russian arctic declines from 1.9 per cent of global production of bauxite to 1.3 per cent even if the production volume increases by 39 per cent (see Table 2). When it comes to production of aluminium, we find the Arctic share to be around 3.6 per cent of world production in 2002. Russia's bauxite reserves were then less than 1 per cent of world's total⁵ and therefore nepheline and apatite has been used as alternatives.

Figure 3. Arctic share of precious metal ores and industrial mineral extraction. Per cent. 2002, 2011 and 2015**Table 3. Change in the volume of precious metal ores and industrial mineral extraction in the Arctic from 2002 to 2015. Per cent**

Gold	Silver	Platinum	Diamonds-gem	Diamonds-ind	Vermiculite
163	268	-8	62	-8	-5

These minerals have the disadvantage of needing more energy than bauxite in the production of aluminium. The Kola peninsula is the main region of nepheline and apatite production in Arctic Russia, and production capacity was around 26 million tonnes in 2015.⁶

Copper has its end uses in construction and in the electrical and electronic industries. The Arctic produces around 3.7 per cent of global copper production in 2002, above all in the Russian Arctic. An increase in arctic production of 25 per cent towards 2015 leads to a more or less constant share of global extraction over the period. In 2015 there is also some copper production in Arctic Sweden and to a lesser extent in Alaska and Northern Finland.

Lead has a variety of uses in chemical industries and other manufacturing, and in construction. The manufacture of lead-acid storage car batteries, chemical products



Greenland Minerals and Energy's administration building in Narsaq. Photo: Mads Fægteborg

Box VII: cont.

and cables dominate the end uses of lead. Lead is also used for X-Ray shielding and at nuclear plants. Environmental regulations (particularly in the western world) are now controlling the use of lead in end products such as tetra ethyl, paint and as a petroleum additive. A large amount of lead is recycled, generating about 50 per cent of current global lead supply. Production in Northern Canada was around 1 per cent of world production during 2000-2002, but as was the case with zinc, the mines were closed due to depleted resources. The Arctic produces around 5.6 per cent of the world total in 2002, above all in Alaska and to a minor degree in the Russian Arctic. The arctic volume of production is practically constant and the share of global extraction of lead declines by two percentage points from 2002 to 2015. While Russian production halts during the period some production starts in Arctic Canada.

Zinc is used in special alloys for its unique industrial properties from great strength to unusual plasticity. Zinc coating of iron and steel products make them more corrosion resistant. Total extraction in the Arctic mainly takes place in Alaska and declines by 1 percentage point from 7.7 per cent of the world production over

the period, even if the volume increases by 16 per cent. In 2015 a large part of the zinc production in the Arctic takes place in Alaska. There is also some production in Arctic Sweden and minor production in Arctic Canada.

Palladium is mainly used by the car industry for making catalytic converters. It is also used as a catalyst, in the production of nitric acids and in laboratory equipment. Palladium is also used in the electronics industry and as a dental material. Arctic Russia alone produces as much as around 40 per cent of the world's palladium during 2002-2015 as extraction increases by 1 per cent. Data suggest that Arctic Russia has around 10 per cent of global reserves in 2002.⁷

Precious metal ores

Gold has historically been used for jewelry and as a base for global monetary reserves. However, gold reserves have largely been disconnected from currencies. However, most countries still hold gold as reserves as do banks and investors worldwide. As a material, gold has a wide range of uses from catalyst in industrial processes to dental material and for decorative purposes. Of the world's gold production, the arctic share is 3.2 per cent,



True North Gems Greenland Ruby Mine Site, Greenland. Photo: Hunter T. Snyder

primarily taking place in Arctic Russia and to some extent in Alaska and Northern Canada (Figure 3). Some small production also takes place in Northern Finland and Sweden. As total arctic extraction increases by 163 per cent (see Table 3), its share of world extraction increases to 6.6 per cent during 2002-2015. The tiny amount of gold production in Greenland ceased before 2015.

Silver is often classified along with gold and platinum as a precious metal. Silver is primarily used in photographic paper and film, as well as for medical and dental purposes. It is also used as jewelry and in the electronic industry. The Arctic extracts 3.6 per cent of global silver in 2002 and following an increase in extraction of 268 per cent the share increases to over 9 per cent in 2015. Production over the 2002-2015 period above all increases in Arctic Russia and to some extent in Northern Sweden, while declining somewhat in Alaska. The small silver production in Arctic Canada decreases, while the tiny production in Arctic Finland is closed down.

Platinum is used in jewelry, laboratory equipment, cars, electrical contacts and dentistry. Around 15 per cent of the world's platinum extraction is found in Arctic Russia in 2002. Production declines by one third over the period leading to a share of almost 10 per cent of global extraction in 2015. Alaska has stopped its small platinum production in 2015, while there still is a small platinum production in Arctic Finland.

Industrial minerals

Diamonds are famous as jewelry. However, not all diamonds are of gem quality and in fact most diamond deposits contain a mixture of industrial and gem quality. Industrial diamonds in Arctic Russia make up around 23 per cent of global production by weight in 2002 and 28 per cent in 2015. Industrial diamonds' main use is in lens manufacture and electrical wires. Originally crushed industrial diamonds were used for these purposes, however, synthetic diamonds now pose a threat to industrial diamond mining. Synthetic diamonds have replaced natural diamonds in more than 90 per cent of industrial applications. Table 3 also shows that production of gem quality diamonds in the arctic part of Russia and Canada combined increases by 62 per cent from 2002 to 2015. This leads to a large upturn in the arctic share of global extraction from 26.8 per cent in 2002 to 48.1 per cent in 2015. Hence, almost half of the world's production of diamonds of gem quality takes place in the Arctic.

Vermiculite is a kind of clay, which is very useful for many industrial purposes. It is very light, chemically non-reactive and fire resistant. Vermiculite can be used to soak up toxic liquids like pesticides. This ability makes vermiculite serve well as bedding for pets and livestock. In addition, vermiculite can be used in concrete and ceramics as a heat resistant additive. Of total global production in 2002, the Russian Arctic contributes 5.8 per cent. Arctic production declines by almost 5 per cent and the share of worldwide extraction declines by one percentage point towards 2015.

Notes

¹ All figures for 2002 are taken from Glomsrød, S. and I. Aslaksen (2006): *The Economy of the North*, Statistical Analyses 84, Statistics Norway. For some of the surveyed minerals in Russian regions it was difficult to measure the arctic share. The most important source for separation between arctic and non-arctic extraction is USGS (2019): *Annual data of the mineral industry in different countries*, <https://www.usgs.gov/centers/nmic/international-minerals-statistics-and-information>. It describes specific mining areas and locations of mines, but sometimes the production figures are lacking. The arctic shares must therefore be regarded as approximate estimates. Consequently, the findings that follow must be treated with caution. Other sources: USGS (2013, 2016): *The mineral industry of Russia*, Alaska Department of Natural Resources (2012): *Alaska's mineral industry 2012*, Special report 68, Alaska Department of Natural Resources (2015): *Alaska's mineral industry 2015*, Special report 71, Energy and Mines Ministers' Conference (2019): *Mining sector performance report 2008-2017*, Cranbrook, British Columbia, Statistics Canada (2013): *Mining sector performance report 1998-2012*, Energy and mines ministers' conference, Mining Journal (2016): *Various issues of supplements to Mining Journal*, Andrew, R. (2014): *Socio-Economic Drivers of Change in the Arctic*, AMAP Technical Report No. 9, Arctic Monitoring and Assessment Programme (AMAP), Wilson, E. and F. Stammeler (2016): *Beyond extractivism and alternative cosmologies: Arctic communities and extractive industries in uncertain times*, *The Extractive Industries and Society* 3, p. 1-8, Yukon Bureau of Statistics (2018): *Yukon Monthly Statistical Review*, February 2018.

² Mbendi (2019): <https://mbendi.co.za/indy/ming/mingsa.html>

³ Mineral Gallery (2019): http://www.galleries.com/minerals_by_name.

⁴ British Geological Survey (2014): *World mineral production 2008-2012*, British Geological Survey (2019): *World mineral production 2013-2017*, Reichl, C., Schatz, M. and G. Zsak (2018): *World mining data*, Vol. 33 Minerals production.

⁵ Leijonhielm, J. and R. Larsson (2004): *Russian strategic commodities: Energy and metals as security levers*, FOI Report 1346, Swedish Defense Research Agency.

⁶ USGS (2015): *The mineral industry of Russia*.

⁷ Leijonhielm and Larsson (2004): op. cit.



Increasingly larger areas that formally were reindeer pastures become deteriorated by oil prospecting and production activities. Varandey area, Nenets Autonomous Okrug. Photo: Yasavey

Box VIII: Benefit sharing in Arctic Extractive Industries

The notion of **benefit sharing** originated from the Convention on Biodiversity in 1992 and was shaped in the Nagoya Protocol supplementary agreement of 2010. Benefit sharing can be defined as the act of sharing a portion of advantages/profits derived from the use of resources, land, or traditional knowledge with the resource. The notion of benefit sharing has been promoted by the global development institutions as standards of environmental and social performance and governance.

Benefit sharing aims to address social justice and inequalities between communities and those who commercialize resources. Indigenous and local communities are understood as rights-, stake- and knowledge holders. Benefit sharing is connected to corporate social responsibility that companies should meet.²

Benefit sharing may include monetary and non-monetary benefits. Monetary benefits may take the form of development and investment funds, profit sharing, equity sharing and tax payments to governments, including tax revenues from resource extraction and from stimulating economic activity through benefit sharing. The non-monetary forms may encompass investment in social infrastructure, investment in local employment opportunities, local procurement, professional training, and improved services.²

The arrangements are often driven by national and local laws and practices:

- *Compensation* implies that the benefits are distributed to compensate for a past or future damage or loss of value resulting from extractive activity.³ This could be a compensation for lost income, land, pollution or loss of access to resources.
- *Investment* targets priorities identified by the receiving party or negotiated with the company and/or the government. It focuses on training and education, developing infrastructure, providing employment opportunities for the residents, contracting local businesses, etc. This principle could be empowering for local communities.
- *Charity* assumes that a company has no fundamental obligation to provide benefits, but it chooses to share some benefits as a matter of philanthropy and good will.

Modes of benefit sharing describe interactions between an extractive industry and Indigenous/local community for benefit distribution:

- The *partnership mode* is based on partnerships among the extractive companies, government, and local, in particular Indigenous communities. This mode is positioned to generate investment in local capacities, infrastructure and businesses and promoting development and self-reliance in the Indigenous communities.
- The *beneficiary mode* establishes community-oriented non-profit organizations to run community services,

businesses, and civic institutions. These entities invest in local businesses, ventures, and financial markets. Revenues can be administered through community funds or be distributed on equal basis to all beneficiaries.

- The *shareholder mode* involves dividend funds and shares from native corporations. Indigenous shareholders receive dividend payments. Native corporations provide services to industries on contractual basis and may receive royalties from extraction on the Indigenous-owned rights to resources.

Benefit sharing mechanisms are financial, legal, and procedural ways used to operationalize benefit sharing. Each benefit sharing mechanism would entail certain implementation forms depending on what principle is utilized to construct the benefit sharing regime.

- *Streamlined benefits* are enshrined in legislation and regulations. Long-term contractual obligations, taxes, royalty payments, production sharing agreements became streamlined when agreements are reached.
- *Negotiated benefits* are negotiated arrangements between companies and local authorities or directly with communities or Indigenous organizations.
- *Semi-formal benefits* represent a more informal system, where a company may choose to share benefits on requests from community actors, local authorities or private citizens.
- *Trickle-down benefits* are gains through general economic impacts, such as income growth, employment, increased consumer spending, rising real estate prices, new infrastructure development, etc.

Benefit sharing can be an important mechanism for attaining sustainable, just, and equitable economic development in the Arctic by retaining some of company incomes locally. Positive impacts can best be achieved when companies and communities work together as equal partners.

Benefit sharing is evolving as Indigenous and local communities strengthen their voices.

From Paternalism to company centered social responsibility (CCSR): Nenets Autonomous Okrug (NAO), Russia

Several large Russian and international oil and gas companies are operating in NAO. Benefit sharing is implemented through negotiated socio-economic agreements with the governor's office. The transfers contribute to community investment, e.g. the construction or repair of sports halls, kindergartens, schools, medical centers and recreation centers. To some extent companies also provide charity for culture and education to earn the license to operate.

By law, companies are required to compensate the herders for expropriated lands, which in NAO are designated for agriculture and leased by reindeer herders.⁴



Fjarðal Aluminium Smelter, West Iceland, one year after its opening. Photo Gérard Duhaime, 2008

Partnership Mode: Chukotka, Russia

The Kupol Foundation was established in 2009 by the Chukotka Mining and Geological Company (CMGC) to support sustainable development in the Chukotskiy Autonomous Okrug. In 2008 the company signed an agreement with the regional Association of the Indigenous Peoples of the North to form a long-term partnership. Grants from the funds cover four focus areas: traditional livelihoods and culture of the Indigenous Peoples, healthcare, education and training, and sustainable development of small and medium-size businesses.⁵

Beneficiary Mode: Nunavik⁶, Canada

The benefit sharing regime in the Canadian Arctic mostly builds upon the investment principle. Impact and Benefit Agreements is a prevalent mechanism.

The Raglan Mine is one of the two major mining projects in Nunavik started in 1994. According to the IBA 4.5 % of the mines profits is divided between Salluit (45 %), Kangiqsujuaq (30 %) and Kaktivik Regional Government (25 %). The distribution of money depends on the community decisions by annual voting.⁷

Shareholder mode: Alaska, USA

The Alaska's North Slope benefit sharing arrangements are based on investment, compensation and charity. In Alaska there are several layers of benefit sharing, of which shareholder mode is the most unique and essential. Through the Alaska Permanent Fund every citizen receives a share of money from the oil income (see Box 4.2). In addition, the Indigenous Peoples are shareholders of regional and village corporations established under the Alaska Native Claims Settlement Act.⁸

¹ Petrov, A. N., & Tysiachniouk, M. S. (2019). Benefit Sharing in the Arctic: A Systematic View. *Resources*, 8(3), 155.

Tysiachniouk, M. S., & Petrov, A. N. (2018). Benefit sharing in the Arctic energy sector: Perspectives on corporate policies and practices in Northern Russia and Alaska. *Energy Research & Social Science*, 39, 29-34.
Wilson, E. 2019. What is Benefit Sharing? Respecting Indigenous Rights and Addressing Inequities in Arctic Resource Projects. *Resources*, 8, 74.

² Söderholm, P., & Svahn, N. (2015). Mining, regional development and benefit-sharing in developed countries. *Resources Policy*, 45, 78-91.

³ Gassiy, V.; Potravny, I. 2019. The Compensation for Losses to Indigenous Peoples Due to the Arctic Industrial Development in Benefit Sharing Paradigm. *Resources*, 8, 71.

⁴ Tysiachniouk, M. S., Henry, L. A., Tulaeva, S. A., & Horowitz, L. S. (2020). Who Benefits? How Interest-Convergence Shapes Benefit-Sharing and Indigenous Rights to Sustainable Livelihoods in Russia. *Sustainability*, 12(21), 9025.

⁵ Kinross Gold Corporation 2019. Sustainability Report. Accessed on November 10, 2020. https://s2.q4cdn.com/496390694/files/doc_financials/2020/Kinross-Gold-2019-Sustainability-Report.pdf

⁶ Nunavik, the northernmost area of Quebec, is not included as a region in the circumpolar comparison in ECONOR, since the delineation of regions in ECONOR follows administrative boundaries.

⁷ O'Faircheallaigh, C. 2018. Using revenues from Indigenous impact and benefit agreements: Building theoretical insights. *Can. J. Dev. Stud. Can. d'études Dév.* 39, 101-118.

Rodon, T.; Lévesque, F. 2015. Understanding the social and economic impacts of mining development in Inuit communities: Experiences with past and present mines in Inuit Nunangat. *North. Rev.*, 41, 13-39.

⁸ Tysiachniouk, M. S. (2020). Disentangling Benefit-Sharing Complexities of Oil Extraction on the North Slope of Alaska. *Sustainability*, 12(13), 5432.
Huskey, L. 2018. An Arctic development strategy? The North Slope Inupiat and the resource curse. *Can. J. Dev. Stud. Can. d'études Dév.*, 39, 89-100.

Box IX: Social dimensions of mining in Yukon Territory



Different understandings of the environment

Remote, resource-rich regions far away from urban centres are widely considered to be “resource frontiers”. First Nation people in Canada’s Yukon Territory – who make up 23.3 per cent of the entire population of 42 152 people – have been dealing with the implications of large-scale mining since the Klondike Gold Rush in the late 19th century. Today, Indigenous Peoples, settlers and miners as well as Canadian state institutions and extractive industry stakeholders share the land and the resources of the Yukon region, while also ascribing differing, contesting and conflicting meanings to this environment as “resource frontier” and basis of economic wealth and settler colonial history or alternatively, “land” as being at the centre of Indigenous life and worldviews.¹

Relations to stakeholders in mining

The Yukon First Nations’ Umbrella Final Agreement between the Canadian State and the Yukon Government (finalized in 1993) and the subsequent Land Claims Agreements (signed by 11 out of 14 Yukon First Nations during the 1990s and 2000s) enabled strong participation of First Nations in decision making over mining projects.² First Nations hold the land title to 8.5 per cent of total land. The Indigenous Peoples’ right to be consulted is facilitated by the Yukon Environmental and Social Impact Assessment Act (YESAA).³

Mining is a key industry in the Yukon; however, local communities are in an unequal position towards the companies and the state bodies. This problem has been pronounced in the so called “Peel Watershed legal case”, when the Na-Cho Nyäk Dän, Tr’ondëk Hwëch’in and Vuntut Gwitchin First Nations took the Yukon Government to the Canadian Supreme Court, arguing over the unfaithful consultation process in the land use planning process.⁴ In 2017, the Supreme Court ruled in favour of these First Nations and the consultation process had to start from scratch. Currently a new mineral development strategy for the Yukon is being negotiated⁵ which tackles the revision of the Yukon Quartz Mining Act and the Yukon Placer Mining Act; the latter has been nearly unchanged since the early 1900s. These acts do not meet anymore the requirements set out in the LCA and the contemporary political demands of the First Nations.

Working in mining and land-based activities

Many Indigenous people in the Yukon are employed in mining and traditional land-based activities at the same time. Subsistence harvesting is crucial for the First Nations way of life and the sharing economy is still the essence of social bonds. At the same time, more and more First Nation people work in the mining sector while still having the sense of being stewards of the land. For the Indigenous workforce the high-income potential of mining has a specific relevance by supporting subsistence activities and living off the land,⁶ which

has become more expensive over time due to high fuel prices and the costs of vehicles such as boats, snowmobiles and other equipment.

Unpredictable mining industry and potentials for sustainability

Benefit sharing agreements between the First Nations and mining companies include revenue sharing and local business development and also other items like commitments to support training and local employment. A challenge is that professional training for Indigenous people lags behind the booming labour demand in the region. Indigenous people compete with many of the fly-in/fly-out (FIFO) workers from the south, while Indigenous workers are often employed in entry-level jobs. However, vocational training programs such as those at the Centre for Northern Innovation in Mining (CNIM) at the Yukon University take place in the capital Whitehorse, and also at the local campuses in the villages throughout Yukon, through mobile training facilities.

Sustainable economic paths beyond mining

First Nations in the Yukon intensely debate new orientations for socio-economic development and a sustainable future.⁷ Options include community gardening, agricultural tourism as well as the development of small businesses including arts and crafts. A key issue of these

debates is the need to provide opportunities for the younger generations to be trained in the various professions relevant for new businesses. Besides cultural tourism, a future area could be the development of tourism in abandoned mining sites.

Way forward to a more equal partnership in mining development

The requirement to seek free, prior and informed consent (FPIC) from local communities for mining development are essential part of the UN Declaration on the Rights of Indigenous Peoples and of the earlier ILO Convention 169 on Indigenous and Tribal Peoples. The right to be consulted also exists in other international standards and legal and corporate regulations related to mining.⁸ These rights are also points of reference for Indigenous claims and for authorities managing frameworks for extractive industry operations. A key question for local communities is how to make decisions about mining, which may have massive, long-term effects on their environment, and socio-cultural livelihoods. There is often insufficient knowledge in communities about the complex nature of the mining industry and the manifold structures of community-industry relationships. Therefore, capacity building and formal education in the field of the mining-community nexus can play an important role in community empowerment, conflict mitigation and in socially just, equitable and sustainable resource development.



Conclusion

Mining and settler colonialism in Yukon has brought about tremendous effects and tragedies such as – to name a few – the decline in use of Indigenous languages, inter-generational residential school traumas, discrimination on the job market and disadvantage in the educational system. The mining sector as well as the state authorities are considered to be responsible for taking the recommendations of the Truth and Reconciliation Commission in Canada serious and to put forward more effective steps toward de-colonisation. The setup of more equal partnerships and power balances in negotiations and consultations is of utmost importance. The Umbrella Final Agreement and the Land Claims Agreements with their associated legislation are important, but a lot has to be done to prevent political bypassing and biased interpretation of the spirit of these frameworks – a viewpoint that is shared not only by Indigenous rights-holders but also by politicians of the political parties in Yukon. First Nations in the Yukon want to see the realization of sustainable mining as well as new and diversified economic opportunities to achieve social equality and decolonize societal relations.

References

- ¹ Willow, Anna J. (2016) Indigenous ExtrACTIVISM in Boreal Canada: Colonial Legacies, Contemporary Struggles and Sovereign Futures, *Humanities*, 5(55), 1-15.
- ² see e.g. Council of Yukon First Nations (2020) Umbrella Final Agreement.
- ³ Government of Canada (2020) Yukon Environmental and Socio-economic Assessment Act.]
- ⁴ Protect the Peel (2020) FAQ Peel Watershed Legal Case.
- ⁵ Yukon Mineral Development Strategy Panel (2020) Yukon Mineral Development Strategy.
- ⁶ Saxinger, Gertrude and Susanna Gartler (2017). *The Mobile Workers Guide. Fly-in/Fly-out and Rotational Shift Work in Mining. Yukon Experiences*. Whitehorse: ReSDA, First Nation of Na-Cho Nyäk Dun, Yukon College.
- ⁷ Saxinger, Gertrude, Robert Gebauer, Jörg Oschmann, Susanna Gartler (2017) *Mining on First Nation Land*. Film produced by the First Nation of Nacho Nyäk Dun <https://www.youtube.com/watch?v=u4UXywmkoqM>
- ⁸ Wilson, Emma (2020) Indigenous rights and resource development in the Arctic: An overview of international standards and principles for consultation, participation and consent. In Johnstone, R.L., Hansen, A.M. (eds.) *Regulation of Extractive Industries*. London: Routledge. 11-46.



Raipon – The Russian Association of Indigenous Peoples of the North. Photo: Gérard Duhaime

6. Interdependency of subsistence and market economies in the Arctic

Inuit Circumpolar Council, Gwich'in Council International, Davin Holen (coordinating author), Hannah L. Harrison, David Natcher, Ryan Macdonald, Alexander Pilyasov, Valeriy Kibenko, Ravdna Biret Marja E. Sara, Ellen Inga Turi, Risten MN Buljo, Anders Oskal, Svein Disch Mathiesen, Iulie Aslaksen, MarieKathrine Poppel, Birger Poppel and Susanna Gartler

An Inuit way of looking at the Arctic economy

Inuit Circumpolar Council

Twentieth century ideals of development in the Arctic centered around industrial economies focused on resource extraction and processing or manufacturing. In the 21st Century it is necessary to broaden the definition of economic development, to be transformative to ensure that a new Arctic economy is well-adapted for the people it serves. A vision of a sustainable Arctic economy must ensure benefits stay in the Arctic and do not flow south at the expense of the people and the environment. As stated in the Inuit Circumpolar Council's (ICC) 2018 Utqiaġvik Declaration, "...economic development and social and cultural development must go hand-in-hand, resulting in self-sufficiency, which is an essential part of greater political self-determination." The Declaration also states: "Sustainable wildlife management is an important element for achieving Inuit food security. Inuit have rights in national and international agreements that protect Indigenous hunting and fishing activities. These human right instruments affirm Inuit rights to self-determination, including our right to govern wildlife management."¹

Inuit and other Arctic Indigenous Peoples have experienced numerous failed attempts to impose economic development which disregards social and cultural circumstances. To be truly sustainable, development must be in accord with the realities of life in Inuit Nunaat and support Inuit rights to self-determination in governing our land, our resources and ourselves.

In the Canadian Arctic, Inuit are exploring a "conservation economy" based on the establishment of marine protected areas negotiated with

the federal government. Impact benefits agreements between Inuit and the government cover management planning, rights to resources, Inuit stewardship, research and monitoring, career and training opportunities and economic opportunities for Inuit, among other things.

In its early stages, this new economy is centered on development that supports communities by providing sustainable jobs based on partnerships that recognize that Inuit continue to be the best stewards of our land and waters. These new models will be managed through Indigenous Knowledge and the lived experience of generations of Inuit. In addition, by leveraging Inuit expertise and Inuit Quajimajatuqangit (Inuit Knowledge), this type of partnership empowers Inuit to exercise self-determination by managing our own communities and environment. Finally, an Inuit conservation economy is guided by Inuit-led research which in turn is based on the co-production of knowledge.

Conservation is not usually considered a form of economic development; in fact, conservation and economic development are often thought of as opposing realities. However, Inuit see things differently. Inuit are a part of the ecosystem, and we understand conservation as a way to sustain the resources that we rely on to feed our families, share our food, celebrate our catch and pass on our knowledge. This in turn provides spiritual balance, mental and physical well-being, traditional values, medicines, energy, identity, and overall cultural sustainability. The connection between the economy and a healthy environment is, for us, obvious and was reaffirmed in the outcome document of ICC's 2017 Circumpolar Inuit Economic Summit, which referred to:

*The desire of Inuit to maintain and strengthen their distinct institutions, cultures and traditions, and to promote their development in accordance with their aspirations and needs as well as to foster greater respect for Inuit knowledge, sustainable and equitable development, and proper management of the Arctic environment.*²

As the first inhabitants and stewards of the Arctic, we assume the responsibility to ensure meaningful and equitable roles for Inuit are built into conservation efforts. The preamble of the UN Declaration on the Rights of Indigenous Peoples recognizes that “respect for Indigenous Knowledge, culture and traditional practices contribute to sustainable and equitable development and proper management of the environment.”³

Increasing evidence shows that conservation has economic impacts far beyond the area conserved. For example, fisheries research has found that marine conservation areas can increase the productivity of commercial fisheries by up to 20 percent.⁴

Protected areas developed through a conservation economy approach create meaningful jobs in Inuit-led research, monitoring, as stewards, for artisans and harvesters. This approach protects coastal communities from the impacts of climate change, improves the lives of Inuit, and empowers Inuit and strengthens Inuit culture and language.⁵ It is critical that Inuit have a meaningful role in the management of these areas so we can continue to use the resources that have always sustained us. Inuit management practices are rooted in Indigenous Knowledge and continue to be used and relied upon every day. They are focused on relationships and lead to “a holistic and adaptive approach that is applied to decision-making. Through this approach, key values such as gratitude, respect, honesty, humility, sharing, cooperation, following animals and the weather as opposed to trying to exert control over the environment, and even humor are all part of maintaining resilience, sustainability, and a healthy environment (including human health).”⁶

Three Examples

The Canadian government agreed under the United Nations Convention on Biological Diversity to protect at least 10 percent of its maritime territory by 2020; 25 percent by 2025 and 30 percent by 2030. At the same time, Inuit organizations

sought to advance development goals and increase self-determination in the territory of Nunavut. Although each government had different reasons to seek conservation, this collaboration has led to successful negotiations to create marine protected areas in Nunavut, along with agreements to further development goals. Three regions in Nunavut are discussed below; further agreements between the Federal Government and Nunavummiut partners will lead to increased benefits from these conservation projects.

Tallurutiup Imanga

In ancient times the sea mammals and all life in the sea were created from the fingers and hands of a woman who lives in the vast Arctic sea. She is the mother of the sea and when she is angry the seas are rough and dangerous and there is no food. She is angered when people do not care for her and the life that she has created. Inuit respect and honour her, and all life stemming from her, as a symbol of our reciprocal relationship.

*Our legend is profoundly connected to us, our spirituality, and our views of marine stewardship and Tallurutiup Imanga. Inuit of Tallurutiup Imanga, and the Qikiqtani region, are a coastal people, and have been so from time immemorial, with cultural values and identities intrinsically connected to our Arctic marine environment and wildlife.*⁷

Tallurutiup Imanga (also known as Lancaster Sound) is one of the most biologically diverse regions in the Canadian Arctic. Sometimes called the “Serengeti of the Arctic,” Tallurutiup Imanga is ecologically important due to the presence of polynyas which attract large numbers of Arctic birds and marine mammals, and as an important migration route through the Canadian archipelago.⁸ Among other animals, the region is home to approximately 75 percent of the world’s narwhal population.⁹ This diversity and ecological wealth also makes the sound important for the 3,600 Inuit who live in five communities in the region. The government of Canada proposed the creation of a National Marine Conservation Area (NMCA) in 2010 covering only 44 000 square kilometers. After negotiations with the Qikiqtani Inuit Association (QIA), and Shell agreeing to surrender oil leases it held in the area, the size of the proposed NMCA was increased to 107 000 square kilometers in 2017, covering the

entire sound and bordering several smaller NMCAs and national parks.

Because the NMCA lies within the Nunavut Land Claim Settlement area, the Canadian Government was required to negotiate an Inuit Impact Benefit Agreement (IIBA) with the government of Nunavut and QIA. This IIBA, which was finalized in August 2019, provides nearly \$250 million in investments for the region in order to empower Inuit communities to benefit from the conservation area.¹⁰ Among other things, the agreement sets aside money to establish a joint Inuit-government consensus management board for the Tallurutiup Imanga NMCA, and for infrastructure investment, including multi-use facilities and harbor development in the five communities, and funding for Inuit-led research, monitoring, training and capacity development.¹¹

The IIBA also sets aside funding for development for fisheries near and within the NMCA (Inuit hunting, fishing and collecting rights are guaranteed within the NMCA). Additionally, the IIBA provided funding for the Nauttisuqtiit program. Nauttisuqtiit (“Guardians”) are members of the community who fulfill a dual role, providing food for their communities while also monitoring the conservation area and assisting in any search and rescue operations.¹² Through programs like these, both sides can benefit, as the Nauttisuqtiit program helps Inuit to transfer knowledge from Elders to the community’s youth, and the Nauttisuqtiit have been able to provide food for their communities and materials for local artisans. At the same time, Parks Canada has benefitted from partners who are able to utilize Inuit Quajimajatuqangit and their experience navigating and observing the Arctic environment in order to monitor the region.¹³ The early success of Tallurutiup Imanga has led to calls for similar programs, including the Nauttisuqtiit program, throughout the region.

Tuvaijuittuq Marine Protected Area

On the northernmost shores of Canada, Tuvaijuittuq (“The Place Where the Ice Never Melts”) is expected to be the last place in the Arctic with year-round sea ice as the region warms. For that reason, it is likely to become a refuge for creatures that depend on the sea ice, such as walrus, seals and polar bears, leading to calls for its protection. Fisheries and Oceans Canada

initially proposed a Marine Protected Area (MPA) in Canada’s federally-controlled waters, without imposing limitations on Nunavut waters under the Nunavut Land Claims Agreement. However, in response to QIA’s proposal to create a protected area on the north shore of Ellesmere Island, the proposed MPA was expanded into Nunavut waters.¹⁴

Tuvaijuittuq is beyond even the historic range of Inuit activity, so the impact of a protected area in the region was uncertain. Therefore, Fisheries and Oceans Canada has imposed a five-year moratorium on commercial activity in the area, allowing for feasibility studies and consultations with Inuit partners into the benefits of more permanent protection for the region.¹⁵ The Nunavut portions of Tuvaijuittuq MPA are covered in the Tallurutiup Imanga IIBA, which may lead to development benefits for the region, such as Nauttisuqtiit. Closely associated with Tuvaijuittuq, and building on the Inuit Circumpolar Council’s 2017 Pikialasorsuaq Commission recommendations, QIA is negotiating with the Government of Canada an interim Marine Protected Area called Sarvarjuuaq. This area will cover the Canada side of the Pikialasorsuaq. Canada and Inuit are in discussions with Government Greenland and Kingdom of Denmark on a bi-national agreement for this area.¹⁶

Qikiqtait Protected and Conserved Area

Farther south, on the Belcher Islands in Hudson Bay, the community of Sanikiluaq has been promoting a conservation area to be named Qikiqtait, to protect the archipelago and the surrounding waters, which are an important habitat for marine birds. The project, a joint effort by the Municipality of Sanikiluaq, the Sanikiluaq Hunters and Trappers Association (HTA), and the Arctic Eider Society, combines conservation and development goals in the same mould as the other projects referred to above. The project received funding from the Government of Canada in 2019 to establish a research facility and a community-led stewardship program. The funding will help by providing sustainable local jobs and enable knowledge transfer to the community’s youth, in addition to conserving important habitats.¹⁷

The Qikiqtait project is an important example of a community-led initiative to promote Inuit conservation economy principles.

Box 6.1: Indigenous Knowledge**Ottawa Indigenous Knowledge Principles**

Developed and agreed upon by the Arctic Council Permanent Participants for use in the Arctic Council in 2014, updated in October 2018

Working definition – Indigenous Knowledge¹

Indigenous Knowledge is a systematic way of thinking and knowing that is elaborated and applied to phenomena across biological, physical, cultural and linguistic systems. Indigenous Knowledge is owned by the holders of that knowledge, often collectively, and is uniquely expressed and transmitted through indigenous languages. It is a body of knowledge generated through cultural practices, lived experiences including extensive and multi-generational observations, lessons and skills. It has been developed and verified over millennia and is still developing in a living process, including knowledge acquired today and in the future, and it is passed on from generation to generation.

Preamble

These fundamental principles on Indigenous Knowledge will strengthen the Arctic Council and advance its objectives by supporting the active participation of Permanent Participants. Indigenous Knowledge has been formally recognized by the Arctic Council as important to understanding the Arctic in numerous Ministerial Declarations, including the 1996 Ottawa Declaration on the establishment of the Arctic Council. The "...role of Arctic Indigenous Peoples and their Indigenous Knowledge in the conservation and sustainable use of Arctic biological resources" was also emphasized in the Tromsø Declaration (2009). Furthermore, in 2013 the Kiruna Declaration called for the Arctic Council to "recognize that the use of Indigenous and local knowledge is essential to a sustainable future in the Arctic, and decide to develop recommendations to integrate Indigenous and local knowledge in the work of Arctic Council." Permanent Participants represent Indigenous Knowledge holders and are integral to the inclusion and use of Indigenous Knowledge in the work of the Arctic Council. These fundamental principles represent the foundation for the long term vision and framework for incorporating Indigenous Knowledge in Arctic Council activities.

The inclusion, promotion and use of Indigenous Knowledge in the work of the Arctic Council is a collective expression of Arctic Council States in supporting the domestic and international rights, roles, and place of Indigenous Peoples in the circumpolar Arctic; and will address a collective need to produce information that are of use to Arctic Indigenous Peoples, decision makers and scientists of all cultures from a community level to international governments.

Fundamental Principles for the Use of Indigenous Knowledge in Strengthening the Work of the Arctic Council

1. The use of Indigenous Knowledge is an overarching mandate of the Arctic Council and is a central commitment for implementation by the Senior Arctic Officials, Permanent Participants, and all Arctic Council Working Groups.
2. Indigenous Knowledge enhances and illuminates the holistic and shared understanding of the Arctic environment, which promotes and provides a more complete knowledge base for the work of the Arctic Council.
3. Recognition, respect, trust, and increased understanding between Indigenous Knowledge holders, scientists, and representatives of the Arctic States are essential elements in the meaningful and effective inclusion of Indigenous Knowledge in the work of the Arctic Council.

4. The inclusion, use, review, and verification of Indigenous Knowledge in the work of the Arctic Council will occur at all stages of every agreed-to initiative and will be led and facilitated by the Permanent Participants. Recognizing that Permanent Participants will determine the appropriate use of Indigenous Knowledge in the work of the Arctic Council.
5. Indigenous Knowledge is the intellectual property of the Indigenous knowledge holders, therefore policies and procedures for accessing data and information gathered from Indigenous Knowledge holders should be developed at the appropriate ownership level, recognizing and adhering to each Permanent Participants' protocols.
6. In order to maintain the integrity of specialized information and avoid misinterpretation of Indigenous Knowledge, it is crucial that evaluation, verification and communication of analyzed information be conducted by Indigenous Knowledge holders with appropriate expertise, to be identified by Permanent Participants.
7. Each of the Permanent Participants represent their respective cultures, communities, peoples and Indigenous Knowledge systems and holders; processes of including Indigenous Knowledge in the work of the Arctic Council will respect and reflect this diversity.
8. The inclusion of Indigenous Knowledge in the work of the Arctic Council requires adequate capacity and resources to address the unique needs and circumstances of the cultures, languages, communities, governance processes, and knowledge systems of Arctic Indigenous Peoples represented by the Permanent Participants.
9. Indigenous Knowledge and science are different yet complementary systems and sources of knowledge, and when appropriately used together may generate new knowledge and may inform decision making, policy development and the work of the Arctic Council.
10. The use of Indigenous Knowledge within the Arctic Council must benefit the knowledge providers and appropriately credit indigenous contributions.
11. The co-production of knowledge requires creative and culturally appropriate methodologies and technologies that use both Indigenous Knowledge and science applied across all processes of knowledge creation.
12. Communication, transmission and mutual exchange of knowledge using appropriate language conveying common understanding, including strategies to communicate through Indigenous languages, is critical to work of Arctic Council.
13. Recognize the need to bridge knowledge systems, including leveraging existing Indigenous knowledge networks, institutions and organizations, as well as developing education strategies to broaden mutual understanding.

¹ The following working definition has been adapted from the ICC and GCI TK definitions and forwarded for use by the Arctic Council. This definition is not intended to replace other definitions endorsed and used by individual indigenous organizations

Figure 6.1. Permanent Participants of the Arctic Council



Source: Compiled by Winfried K. Dallmann.

The success of these projects demonstrates that development goals in the Arctic do not only depend on resource extraction projects or tourism. The Arctic provides its own value in ways Inuit and other Indigenous communities have the knowledge to realize, as part of their internationally recognized right to self-determination. These efforts illustrate a new thinking about the Arctic conservation economy. Each protected area will

bring economic opportunities for the communities involved. They will ensure local training and hiring and provide economic opportunities. For Inuit, a conservation economy is an approach that provides an opportunity across Inuit Nunaat for more meaningful partnerships to build equity in the management of resources that will in turn ensure cultural sustainability.

The Caribou Economy

Gwich'in Council International

Economies, at various scales and across different currencies, are essential to functioning communities and wellbeing, and drive policy, behaviour, and actions. In northern and remote communities, sustainable economies may encompass more than monetary values and necessitate recognizing and valuing a broad spectrum of elements. The metrics commonly used do not adequately capture important attributes, including Indigenous and local knowledge; food harvesting and processing skills; language fluency; connections in and to community; understanding animal migrations; and more. However, when communities and governments make decisions about their future, it is important to value these attributes and consider more than dollars. The subsistence economy must be recognized and valued as not only food and nutrition but a practice and worldview holding knowledge, language, culture, and survival.

The Gwich'in are a resilient and self-sufficient Nation in the Arctic, maintaining an economy which has included birds, waterfowl, fish, caribou, and other animals since time immemorial. Gwich'in territory is bisected by the Canada-USA border, and further divided by territorial borders in Canada. Today, Gwich'in communities are located in Alaska, Yukon, and the Northwest Territories, and subject to different jurisdictions and political structures, as well as land claim agreements, self government agreements, or no agreements at all. Gwich'in people reside in their home communities, in urban settings in the north, and around the world.

Settlement patterns and the economy changed following contact with Europeans, but the economy continued to include both economic and social elements, and the production, distribution, and trade of resources between them.¹⁸ When the monetary and wage economies were introduced, the Gwich'in adapted and participated to varying degrees. The Gwich'in economy, intertwined with the resources and species present and abundant through the region, continues today, though changed and adapted.¹⁹ This is especially so with vadzaih.

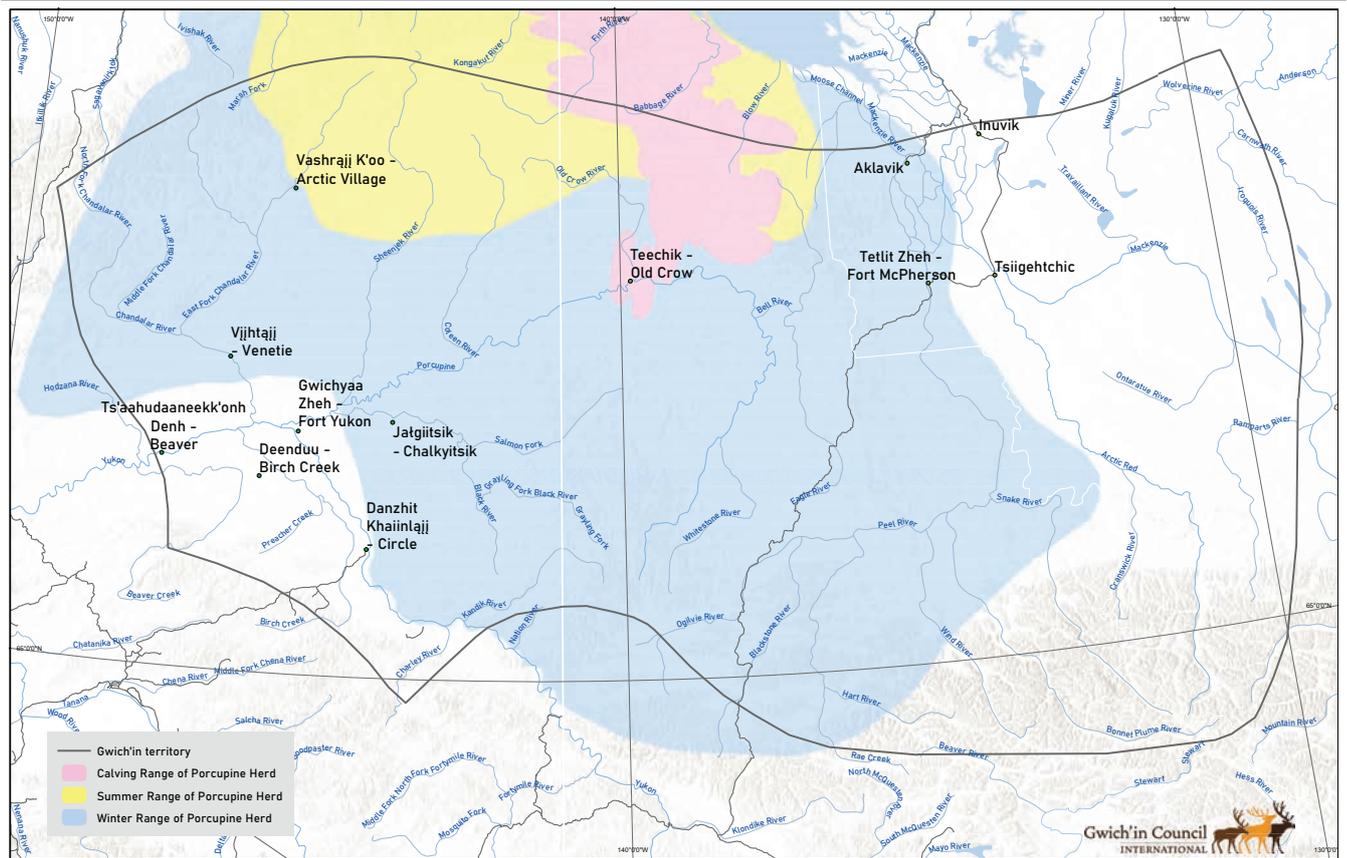
Vadzaih (caribou) remain intricately linked to the Gwich'in, and the relationship between Gwich'in and vadzaih encompasses stewardship, respon-



Intergenerational knowledge transfer while processing vadzaih.
Photo: Malinda Bruce

sibility, life, use, management, land, economy, culture, and survival. In particular, the Porcupine Caribou herd, whose range nearly mirrors the territory of the Gwich'in (Figure 6.2), are the foundation of the caribou economy and centre of Gwich'in culture.²⁰ A fulsome understanding requires a study of Gwich'in language, because language, culture, and subsistence way of life are all closely intertwined.²¹ This overview recommends further reading by Gwich'in scholars, and attempts to leave you with the appreciation that the Gwich'in subsistence economy is complex, rich in values, practiced to this day, and under threat.

All parts of the caribou are valued and used, supporting a subsistence economy which encompasses tangible monetary values but also tangible and intangible non-monetary values. Vadzaih provide food; red meat high in protein and low in fat. Materials, whether hide, bones, or antlers, become clothing, tools, medicine, crafts, and art.²² The practices of harvesting, processing, use, and sharing require time, money (e.g. for fuel to access activities), knowledge, language, and respect, and in turn contribute to networks, intergenerational knowledge transfer, kinship, pride, survival,

Figure 6.2. Range of the Porcupine Caribou herd in Gwich'in territory

Source: Gwich'in Council International.

warmth, wealth, income, self government, food security, and well-being (Photo Credit Malinda Bruce). When compared with the wage economy, or proposed economic development in Gwich'in homelands, often only the monetary costs are considered but it is essential to recognize the suite of additional, and sometimes more important, values than dollars.

Participation in the caribou economy is dependent on knowledge, skills, and resources, and subject to management authorities established to preserve subsistence rights and ensure local access.²³ The knowledge and rules around respectful harvesting continue to be documented and passed down,²⁴ and new programs are emerging to encourage youth, adults, Elders, and families to be out on the land. The Porcupine Caribou herd's core range is approximately 201 190 km² through Alaska, Yukon, and the Northwest Territories, and management must consider two federal governments, three state or territorial governments, eight Indigenous land claim agreements, five national parks or preserves, one territorial park, two special management areas, and two special ordinances.²⁵ Further, the customs and practices, migration patterns,

abundance, and availability of harvesters impact subsistence use. Harvesters are active in monitoring, sampling, and assessing vadzaih health, connecting the economy with the land and stewardship, and demonstrate that the skills to participate and thrive in the subsistence economy are diverse, developed over decades, and honed through use and experience.

Despite the spectrum of values encompassed, importance to cultural livelihood, and continued practice, the caribou economy is in transition and under threat, risking not only food security but language, well-being, and survival. In the words of Gwich'in elder Jonathon Solomon of Fort Yukon, Alaska, "It is our belief that the future of the Gwich'in and the future of the Caribou are the same. Harm to the Porcupine Caribou Herd is harm to the Gwich'in culture and millennia-old way of life."²⁶ Vadziah are affected by ecological and anthropologically linked factors such as climate change and increasing wildland fires, and by global forces and political threats to their calving grounds.²⁷ Oil and gas companies want to develop the Coastal Plain of the Arctic National Wildlife Refuge, lands used by the Porcupine Caribou herd for calving and wintering,

which would have devastating consequences for the vadzia and Gwich'in.²⁸ The Gwich'in call the Coastal Plain "Izhik Gwats'an Gwandai Goodlit" — "the Sacred Place Where Life Begins," and are united in opposition to development there.²⁹

When the full caribou economy is not recognized, and it is compared to the wage economy or proposed developments, its contributions and values are diminished. Subsistence becomes a trade off, and decisions are reduced to comparing dollars. People's participation becomes limited by access, time, borders, knowledge, and skill. However, the caribou economy should not be reduced to numbers and dollars, and the challenge of understanding its valuation system, integration of language, wellbeing, and culture, and relationship between people and vadzia offers an opportunity to learn, appreciate, and celebrate the Gwich'in and resilience. A fulsome understanding requires the study of language, learning from Gwich'in Elders and scholars, and recognition that knowledge, strength, and expertise comes from the hearts and people in communities and on the land.³⁰

Alaska: A Subsistence Way of Life

Davin Holen, University of Alaska, Fairbanks

Subsistence in Alaska is a broad ranging category that refers to both a management regime and a way of life that is meaningful to residents of Alaskan communities. The Alaska Department of Fish and Game, Division of Subsistence defines subsistence as the customary and traditional uses of wild resource for food, clothing, fuel, transportation, construction, art, crafts, sharing, and customary trade. Harvesting wild resources in Alaska occurs under several regulatory regimes. Most fish harvested by rod and reel are subject to sport fishing regulations, whereas the use of set nets to harvest salmon for home use is considered subsistence. Game harvested under general hunts is considered sport hunting, and residents who are engaged in commercial fishing often retain fish for home use called "home pack." Under these regimes, harvesters of wild resources must relate to different seasons, gear allowances, and harvest limits, adding to the complexity of regulations that residents of Alaska must navigate. Sharing with family and community is an important and traditional component of the subsistence economy.



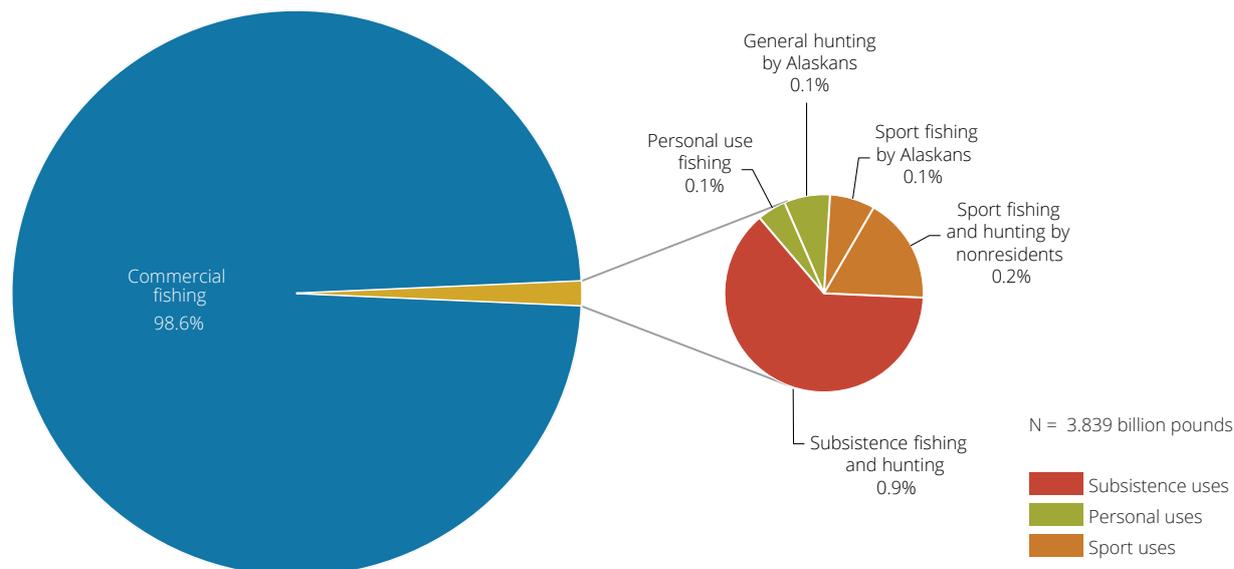
Sockeye salmon drying on the shores of Lake Clark, Bristol Bay, Alaska. Photo: Michelle Ravenmoon, National Park Service.

Wild resources harvesting meets the needs for nutrition and personal, family, and community wellbeing through customary and traditional practices that embody spiritual ties to the land and animals, fish, and birds. In order for the best evidence-based information to be put forward in the management process of harvesting, both Indigenous Knowledge and science are needed, with Indigenous Knowledge holders taking part in the decision-making process and in the analysis of information.

Commercial harvests of salmon, herring, pollock, and other fish are also important for communities. In Alaska, a report on economic impacts of seafood estimated that the seafood industry directly created the full time equivalent of 26 800 jobs. In addition the seafood industry demands services and input from other industries in terms of vessels, machinery, maintenance, transportation and a variety of other services, bringing employment to the



Cleaning sockeye salmon on the shores of Sixmile Lake, Bristol Bay, Alaska. Photo: Davin Holen.

Figure 6.3. Harvest of wild foods in Alaska by management sector. 2017

Source: Division of Subsistence, Alaska Department of Fish and Game, and Fall (2018), see note 38.

full time equivalent of 36 800 jobs, compensated by USD 2 billion as part of a total income in seafood related activities of USD 5.2 billion in 2016.³¹ Commercial and subsistence fisheries are inter-related as fishing equipment is often used for subsistence fishing outside commercial fishing periods. Households with commercial fishing permits often have a high production of subsistence foods.³² A household's wild food harvest increases by 125.8 per cent if the household is also involved in commercial fishing. Subsistence harvests in Alaska are still relatively high compared to other Arctic areas.³³ However, commercial fish harvests account for 98.6 per cent of the harvests of all wild resources in Alaska in terms of volume (Figure 6.3). Subsistence users harvest 0.9 per cent of wild resources while sport activities account for the other 0.5 per cent (Figure 6.3).³⁴

Dual Management in Alaska

Subsistence is regulated by state and federal agencies, referred to as "dual management." The State of Alaska passed the subsistence law in 1978 providing a priority for subsistence over other uses of wild resources. Federal lands in Alaska comprise about 60 per cent of Alaska (222 million acres) and 80 per cent federal land is set aside for public use. Twenty-eight percent of Alaska is designated state lands. In addition, under the Alaska Native Claims Settlement Act (ANCSA), Alaska Natives received 44 million acres, considered private and managed by Alaska Native corporations created as part of

ANCSA. Other private lands make up less than 1 per cent of the total land area. Federal and state regulations differ as to harvest limits and seasons.

The State of Alaska seeks to manage wild resources for maximum opportunity for residents and visitors, through general hunts and sport fishing. If there is a conservation concern, a fishery or hunt may be restricted to Alaska residents only, referred to as Tier I. If the harvestable surplus cannot sustain the harvesting of all Alaska residents, a Tier II fishery or hunt is established where Alaska resident must apply to participate by demonstrating a long term and continued dependence on the resource. Under Alaska state law (1989) all residents of Alaska qualify to participate in subsistence.

Federal law gives rural communities preference to subsistence unlike the State of Alaska which provides for subsistence for all residents. Title VIII of the Alaska National Interest Lands Conservation Act (ANILCA) enacted in 1980 created 10 National Parks and Preserves on existing federal lands, and priority was given to residents of rural communities that border or are located within these lands. The two competing laws, Alaska Subsistence Law and ANILCA, are commonly referred to by Alaskans as the "subsistence dilemma." Federal lands often follow state seasons and harvest limits to make it less confusing for local users. However, there are cases where regulations can be confusing. On federal ANILCA lands and waters, subsistence hunts or

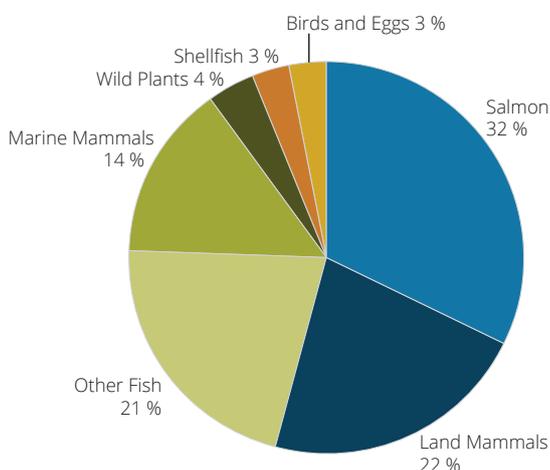
fisheries are often restricted to local residents. This often leads to confusion as crossing from federal land to state land could mean moving from an area where hunting is open to where it is closed.³⁵ Varying court cases and efforts by the State of Alaska have tried to amend this impasse; however, resolution would require a change in the Alaska constitution introducing a rural priority to comply with Title VIII of ANILCA. Marine mammals are managed by the Federal Government through co-management agreements with Alaska Native Organizations. Only Alaska Natives may harvest marine mammals in Alaska, referring to Marine Mammal Protection Act.

Variety of Subsistence Economies throughout Alaska

Surveys completed over the past 30 years have found that there is not one typical subsistence economy in Alaska; they vary by region and even between neighboring communities as Alaska’s ecosystems and natural resources are diverse, stretching from the high Arctic along Alaska’s northern coastal plane, through interior Alaska with its boreal forest environment, southwest Alaska with its expansive tundra and multitude of river systems, the rainy, windswept islands of the Aleutians, to the temperate rain forests of Southeast Alaska.

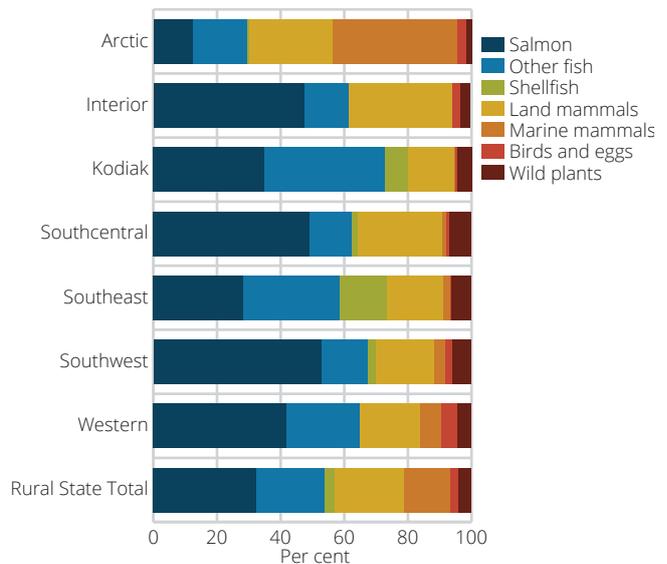
Figure 6.4 shows the composition of wild food harvest in Alaska. Salmon (32 per cent) and large land mammals (22 per cent) such as moose, caribou, bears, and deer make up the highest percentage of harvest in terms of edible weight. Also important are other finfish (21 per cent), especially in coastal

Figure 6.4. Wild foods harvest as share of edible weight by rural residents. Alaska, 2017. Per cent



Source: Division of Subsistence, Alaska Department of Fish and Game, and Fall (2018), see note 12.

Figure 6.5. Composition of the harvest of wild resources in Alaska, by region. Per cent based on pounds edible weight. 2017



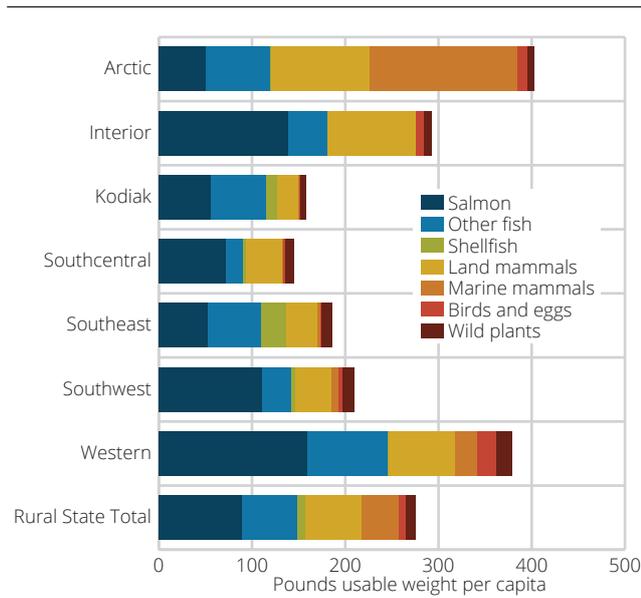
Source: Division of Subsistence, Alaska Department of Fish and Game. Adopted from Fall (2018), see note 12.

communities where halibut and cod are available and in the interior of Alaska where whitefish, sheefish, and grayling are more abundant than salmon. Marine mammals (14 per cent) such as harbor seals are harvested in many coastal communities and whales are harvested in the Arctic. Berries and other edible and medicinal wild plants make up 4 per cent of the harvest, birds and eggs including migratory waterfowl and upland game birds make up 3 per cent, and shellfish such as clams, crab, and other marine invertebrates comprise 3 per cent.³⁶

Figure 6.5 shows the composition of harvests by region. Salmon are common in many areas, making up around 50 per cent of the harvest in Southcentral and Southwest Alaska, whereas in the Arctic households harvest more marine mammals. In the interior of Alaska, large land mammals such as moose and caribou comprise a larger share of the harvest than in other areas. Figure 6.6 shows per capita harvest of wild resources by region.

Harvests are typically higher in rural communities as compared to urban areas (Figure 6.7). Within Southcentral Alaska, there are large differences in household harvest. Anchorage has the lowest harvest at 15 pounds per person, followed by the Mat-Su Area (22 pounds per person), and the Kenai Peninsula (32 pounds per person), compared to

Figure 6.6. Per capita harvest of wild resources in rural Alaska by region, 2017. Pounds edible weight



Source: Division of Subsistence, Alaska Department of Fish and Game, and Fall (2018), see note 12.

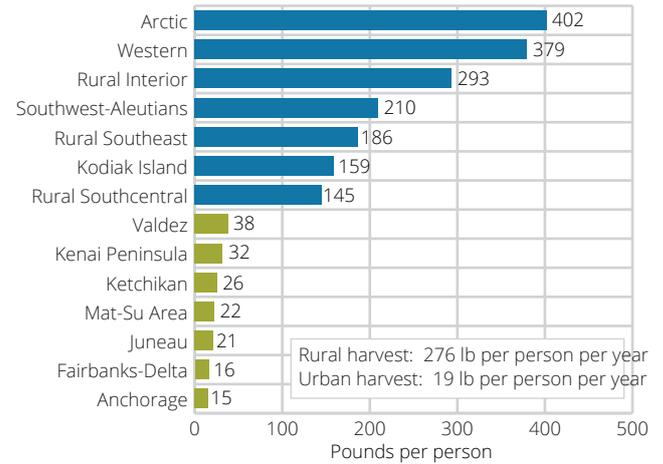
rural Southcentral Alaska in general (145 pounds per person). Fairbanks follows a similar pattern for Interior Alaska and Juneau and Ketchikan for Southeast Alaska.

Participation in harvesting wild resources is highest in Western Alaska with 70 per cent of households participating in harvesting game species and 83 per cent of households participating in fishing activities. In rural Alaska on average 60 per cent of households harvest game and 83 per cent harvesting fish.³⁷ The number of households using wild resources is higher than those harvesting the wild resources. The Division of Subsistence found a general pattern in that 30 per cent of households harvest 70 per cent of the resources as a community average.³⁸ These households tend to have higher incomes and spend more money on gear such as boats, snow machines, nets, rifles, and fuel.

Cash and Subsistence Economy

The cost of living in rural Alaska has risen significantly in recent years due to high gas prices for transportation. With few year-round ice-free ports, most goods must arrive in rural communities by air in winter. In the summer cost of transportation is lower as coastal communities receive barges with fuel and supplies, with smaller barges sailing supplies up major rivers such as the Yukon and Kuskokwim. Residents must order a year’s worth

Figure 6.7. Harvest of wild resources by region. Alaska. Pounds usable weight per person per year



Source: Division of Subsistence, Alaska Department of Fish and Game, and Fall (2018), see note 12.

of groceries and other supplies to be brought in on the barge. During trips to Anchorage or other urban centers rural residents stock up on supplies to be mailed back to their communities or pay fees on air transportation. Energy costs are a main concern in rural communities. A study by the State of Alaska in 2016 found that gasoline was 2.3 times more expensive in rural interior Alaska communities than in urban communities along the coast, and heating oil was 2.6 times more expensive.³⁹ Typically, during cold winters residents will use several barrels of heating oil. Many homes receive electricity from diesel powered generators.

There is an effort to move towards using wood both in efficient home wood burning stoves and in large scale biomass boilers in public buildings, especially in interior Alaska and Southeast Alaska where boreal and rainforest environments provided adequate biomass.

A study in 2012 found that in the eastern interior of Alaska 7 out of 9 rural communities had average incomes lower than the statewide per capita average and lower than the larger interior Alaska communities of Fairbanks and Delta Junction.⁴⁰ Many jobs are short-term summer employment such as working in commercial fishing, fire crews, or construction crews repairing roads or airports, and short-term work through grant funded projects in communities. High transportation costs can represent a barrier to employment and limit benefits of access to wage income, credit, subsidies and market-related transfer payments.⁴¹

Box 6.2: The Alaska Department of Fish and Game, Division of Subsistence

Davin Holen, former Subsistence Program Manager, Alaska Department of Fish and Game

The Alaska Subsistence Law in 1978 laid the groundwork for the Division of Subsistence within the Alaska Department of Fish and Game. The Division has two tasks, identify populations of game or stocks of fish customarily harvested and used by residents, and identify amounts reasonably necessary for subsistence in communities surrounding those resources. The subsistence is identified in regulation as a way of life that is based on consistent, long-term reliance upon fish and game resources for the basic necessities of life.¹

Since 1980 the Division has conducted comprehensive surveys documenting harvest of wild resources in 278 communities in Alaska. The map below shows the locations of survey communities. Comprehensive surveys record all species harvested while targeted surveys record specific species, such as migratory waterfowl, salmon, or large land mammals. Surveys are not done in all communities each year. Hence there are gaps in data

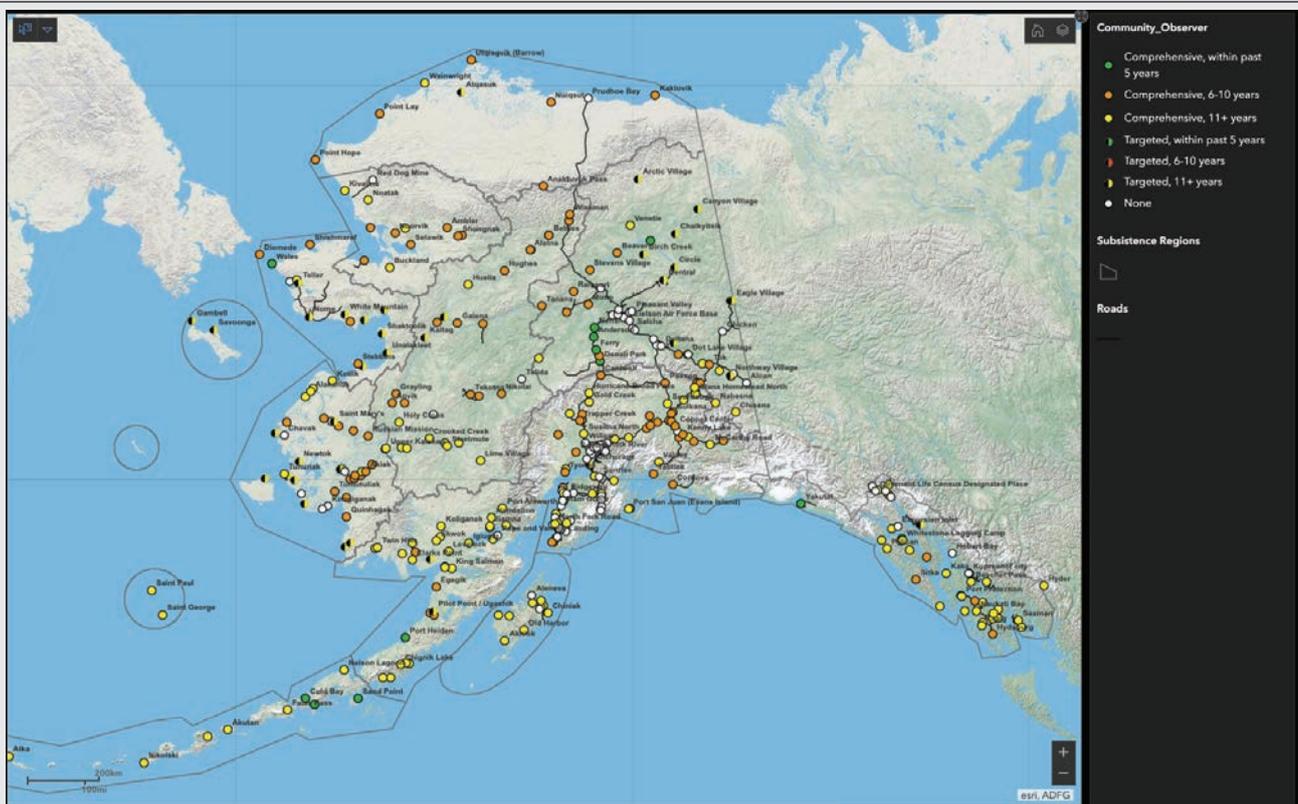
Harvest survey data and permit data for fisheries or harvest ticket data for game are used to inform the Boards of Fisheries and Game. Household harvest surveys record activity for a calendar year. They are administered face-to-face to record demographics, harvests, sharing and distribution, and the cash economy including jobs and income. Typically, the surveys are a census for smaller communities under 200 households and a 50 per cent or 25 per cent sample for larger rural communities. The surveys record efforts, harvest, use and sharing for each wild resource, and a variety of attributes such as month, access to resource, and gear type.

In recent years surveys include food security, health and other indicators to understand patterns and trends. The surveys are in English with Alaska Native translations such as Central Yup'ik and Inupiaq.

A special thanks to Dr. Jim Fall and David Koster at the Alaska Department of Fish and Game, Division of Subsistence for providing data for this chapter. Dr. Fall recently retired as the Research Director of the Division of Subsistence after 40 years with the Alaska Department of Fish and Game.

¹ Alaska Administrative Code 99.005

Location of communities in Alaska surveyed for harvest assessments



Source: Division of Subsistence, Alaska Department of Fish and Game.

Table 6.1. Wild food harvests in Alaska: Nutritional and replacement values

	Annual wild food harvest (pounds per person)	Annual wild food harvest (total pounds usable weight)	Percent of population's required:		Estimated wild food replacement value at \$5.00/pound	Estimated wild food replacement value at \$10.00/pound
			Protein (46 grams/day)	Calories (2,100 kcal/day)		
Rural areas						
Rural Southcentral	145	1 032 896	93	13	5 164 479	10 328 957
Kodiak Island	159	2 106 866	101	14	10 534 332	21 068 665
Rural Southeast	186	4 996 351	119	17	24 981 756	49 963 512
Southwest-Aleutian	210	3 331 143	134	19	16 655 713	33 311 426
Interior	293	2 797 785	187	26	13 988 923	27 977 845
Western	379	9 427 608	242	34	47 138 039	94 276 079
Arctic	402	10 269 886	257	36	51 349 428	102 698 855
Subtotal	276	33 962 534	176	25	169 812 669	339 625 339
Urban areas						
Anchorage Area	15	4 447 633	9	1	22 238 163	44 476 327
Fairbanks-Delta	16	1 713 258	10	1	8 566 292	17 132 584
Juneau Area	21	686 167	13	2	3 430 833	6 861 667
Mat-Su Area	22	2 257 007	14	2	11 285 034	22 570 068
Ketchikan Area	26	359 357	17	2	1 796 787	3 593 574
Kenai Peninsula	32	1 829 072	20	3	9 145 362	18 290 724
Valdez	38	151 750	24	3	758 750	1 517 499
Subtotal	19	11 444 244	12	2	57 221 221	114 442 442
Alaska Total	62	45 406 778	39	6	227 033 890	454 067 781

Source: Division of Subsistence, Alaska Department of Fish and Game, and Fall (2018), see note 12.

Subsistence maintains the ability to continue living in areas where jobs are harder to come by and costs of living are higher. In a study focused on salmon, respondents stated that they rely on salmon to meet their subsistence needs, for cultural continuity, and for economic wellbeing.⁴² A 2017 summary of wild food production in Alaska estimated the cost of replacing the wild food harvest of rural communities with corresponding commercial products at USD 454 million estimated at USD 10 a pound, a realistic amount for many rural communities in Alaska (Table 6.1).

Residents in these communities are eating a higher percentage of protein in their diet than the national average due to their harvest of wild foods that averages from 159 pounds per capita edible weight found on Kodiak Island to a high of 400 pounds per capita in the Arctic (Table 6.1).⁴³

Alaska's Personal Use Salmon Fisheries

Hannah L. Harrison, University of Guelph

Residents living in urban areas may take part in 'personal use' designated fishery that allows for those living on or near the road system to harvest fish for personal consumption. This designation is different from recreational angling in that only

Alaska residents may take part, and personal use fishing requires both a sport license and personal use permit issued by the Alaska Department of Fish and Game.

Personal use salmon fisheries, more commonly known as 'dip net' fisheries, are found in several locations along Alaska's road system (see Figure 6.8 of personal use fisheries in Southcentral Alaska).

The most popular dip net locations are the Kenai and Kasilof River fisheries along the eastern side of Cook Inlet. These fisheries are typically fished by standing on the river shore or wading in the water while holding a net up to 5 feet in diameter out into the water to intercept passing salmon. All dip net fisheries are subject to closure or restricted hours during years where salmon runs are weak.

Personal use salmon fisheries have grown in popularity since the mid-1990s when harvest efforts were first recorded. This is in part due to some fishery's close proximity to major population centers, access along the road system, and ease of participating as little specialized gear or experience is required. Personal use fisheries may support food security for low income households by providing an easily-accessible source of high-

Figure 6.8. Location of personal use salmon 'dip net' fisheries in Southcentral Alaska



quality protein.⁴⁴ Dip net fisheries have been linked to important cultural and social components of urban Alaskan way of life and relationships with local food.⁴⁵ Dip netting is often a kin-oriented activity, where groups of family members or friends fish together and where generational knowledge and values related to salmon fishing are passed on. Few data exist for dipnet fisheries in the state beyond the number of people who participate and estimates for total catch.

The rapid growth of personal use fisheries represents a challenge for state fisheries managers and local municipal governments. Many personal use fishers arrive from other locations, often creating

a seasonal population boom in small communities, where increased demand for goods and services provides economic opportunities. However, lack of local infrastructure may contribute to crowding at the peak of the season. The Alaska Department of Fish and Game and local municipalities inform fishers of the regulations, and infrastructure has been developed, yet tensions arise between local residents and out-of-town fishers, and between personal use fishers and other gear-type users, particularly in the Cook Inlet fisheries.⁴⁶

Increasing interest of subsistence economies in the North: Canadian Research Perspectives

David Natcher, University of Saskatchewan

The term subsistence has received varied and uneven treatment by the social sciences. In the North, subsistence has been characterized as the minimum resources necessary to support life. This has entrenched a belief that subsistence represents the procurement of the most basic of human material needs thus allowing for meager economic existence. Although subsistence does involve food procurement, subsistence also encompasses a complex array of norms, social relationships, technologies, worldviews, and place-based knowledge that are all embedded in food procurement systems. In this way subsistence represents a seamless whole, where culture, economy and



Alaska residents participate in the Kaslof River personal use dip net fishery, Cook Inlet, Alaska. Photo: Davin Holen.

environment overlap, and boundaries become blurred.⁴⁷

Notwithstanding this broader and more holistic view, subsistence is, more often than not, characterized in the literature and public policy as simply a food-getting activity, and a means of household provisioning. This view of subsistence is found for example, in comprehensive land claims agreements in northern Canada, where subsistence is characterized as “the non-commercial means of providing food and other household necessities from the land or simply “the taking of wildlife into possession, and includes hunting, trapping, fishing, ... or taking [wildlife] by any means.”⁴⁸ While these definitions were agreed to by land claims negotiators, and ultimately ratified by Indigenous Peoples themselves, they fail to capture the cultural dimensions of wildlife harvesting. It is this definition, and variations thereof, that more often than not reflect how Indigenous subsistence economies have come to be treated in subsistence research.

Between 1950 and 2019, an estimated 321 papers and books have been published on subsistence in northern Canada, the majority of which have been published in the past two decades. Whereas the subsistence research conducted in the latter half of the 20th century was largely dominated by anthropologists and human geographers whose research explored the cultural dimensions of Indigenous food systems, the last two decades has witnessed a shift to more interdisciplinary research that considers the effects of climate change on subsistence harvesting. General nutrition studies that address the food habits and nutrition of Indigenous Peoples in northern Canada have long been represented in the subsistence literature and more recently traditional ecological knowledge studies that include subsistence and environmental monitoring data have become increasingly common.⁴⁹

A recent area of subsistence studies can be found in the food security literature. Another category includes studies of food procurement in regions, communities, or for specific species. This category includes studies designed to estimate the harvest of fish, wildlife and plants by Indigenous Peoples. These studies tend to focus on the who, what, when, where, how, and how much of wildlife harvesting⁵⁰ In Canada, one of the earliest harvest studies was conducted in Nunavik. In September

1975, the Northern Quebec Inuit Association initiated a seven-year study entitled Research to Establish Present Levels of Native Harvesting. The study set out to determine the extent of Inuit harvesting, the results of which would be used to establish a best estimate of harvest levels by species and community⁵¹ The objective of the harvest study was to provide data needed to establish guaranteed harvesting levels for Inuit households.

Since the completion of the Nunavik study, other land claims regions have carried out harvest assessments. The Inuvialuit Harvest Study was conducted from 1988 to 1997. The object was to obtain a continuous, long-term record of Inuvialuit harvest levels for the six regional communities. Harvest data are to be used by co-management boards and other wildlife and fisheries agencies to determine and recommend subsistence quotas. Environmental screening and impact review boards also use harvest information to fulfill their role in dealing with resource development and for determining compensation in cases of loss or damage.

The Gwich'in Harvest Study (GHS) was a requirement of the Gwich'in Comprehensive Land Claim Agreement (1992). The objective of the GHS was to record the number of animals, fish and birds harvested by Gwich'in within the Settlement Area. These harvest levels would then be used to calculate Gwich'in Minimum Need Levels for Gwich'in households and would inform the management efforts of the Gwich'in Renewable Resources Board (GRRB) and other government partners.

The Nunavut Wildlife Harvest Study (NWHS) was mandated by the Nunavut Lands Claim Agreement (NLCA) and carried out under the direction of the Nunavut Wildlife Management Board (NWMB). The purposes of the Harvest Study were to determine current harvesting levels and patterns of Inuit use of wildlife resources, aid in the management of wildlife resources of Nunavut, and once again to establish 'basic needs levels'.

With the settlement of the Labrador Inuit Land Claims Agreement (LILCA - 2005), Inuit of Nunatsiavut secured clearly defined rights to a 72 500 km² land-base and a 48 690 km² of coastal zone. Within the settlement region, Inuit have the right to harvest wildlife resources in order to meet their domestic needs, or, as defined by the LILCA, Inuit

Domestic Harvest Limits. Domestic need is defined as the amount of resources necessary to satisfy individual non-commercial use. The use of domestic harvest levels as a basis for wildlife harvesting policy was promoted by the federal and provincial governments for its ability to set clearly defined harvest limits and facilitate effective monitoring and enforcement capabilities. Since its settlement, the Nunatsiavut Government has established Individual Domestic Harvest Levels for 138 different species and resources used by Inuit residing within the Nunatsiavut Settlement Region.

Wildlife-harvesting studies have been designed to establish minimal need levels of subsistence resources for Indigenous households. This approach reduces subsistence to a regulatory issue, where conservation of wildlife receives a prior concern. In these studies, household harvesting data are collected, analyzed statistically, and used to chart population dynamics for species in order to allocate harvesting rights. These studies clearly demonstrate that wildlife harvesting remains critical to the nutritional health and well-being of Indigenous communities. Yet this approach obscures the historical, cultural, and institutional contexts that shape Indigenous subsistence economies. Researchers tend to concentrate on methodological challenges of subsistence research rather than the structural conditions that shape and provide cultural meaning to subsistence production. Lost is the fact that subsistence represents a cultural system, which cannot be reduced to an economic activity or regulatory process.

The Market Economy and Land-based Subsistence Economy of Northern Canada

Ryan Macdonald, Statistics Canada

Northern Canada is defined as the three territories: Yukon, Northwest Territories and Nunavut. This comprises the regions for which a majority of comparable statistics are published, but does not include all of Inuit Nunangat, which is the homeland of the Inuit in Canada. In particular, Nunavik and Nunatsiavut are not included, and statistics do not show Inuvialuit Settlement Region separately.

Characteristics of the Northern Canadian communities

Northern Canada is characterized by small populations, with a large proportion of Indigenous

residents (Table 6.2, Figure 6.9). Most communities in Nunavut are located along coastlines, while Yukon and Northwest Territories have more inland communities situated along roads. The majority of communities have less than 500 residents, and only the territorial capitals, Whitehorse, Yellowknife and Iqaluit, have populations exceeding 5 000 people.

The 2016 Census of Population shows that between 2011 and 2016, the population of Yukon grew 5.8 per cent, of the Northwest Territories by 0.8 per cent, and Nunavut's population grew 12.7 per cent.

Across the territories, the capitals all had positive population growth between 2011 and 2016. Whitehorse grew by 7.8 per cent, Yellowknife by 1.7 per cent and Iqaluit by 15.7 per cent. For Yukon and Northwest Territories, the growth in the capital cities more than offset the declines in smaller communities so that territorial population increased. For Nunavut, the growth in Iqaluit added to growth in smaller communities.

The 2016 Census of Population shows 1 673 785 Indigenous people in Canada, including First Nations (North American Indians), Inuit, and Métis. Indigenous populations are young and growing rapidly.⁵² For all of Canada, Indigenous Peoples accounted for 4.8 per cent of the Canadian population, up from 4.3 per cent of the population in the 2011 National Household Survey and 2.8 per cent in the 1996 Census.

In Northern Canada, the majority of the small communities are predominantly Indigenous and represent diverse cultures where tradition is important in daily life. In Yukon, communities tend to have a lower percentage of the population that is Indigenous, while in many communities in Northwest Territories, and particularly for Nunavut which is predominantly Inuit, the Indigenous percentage of the population exceeds 90 per cent of residents.

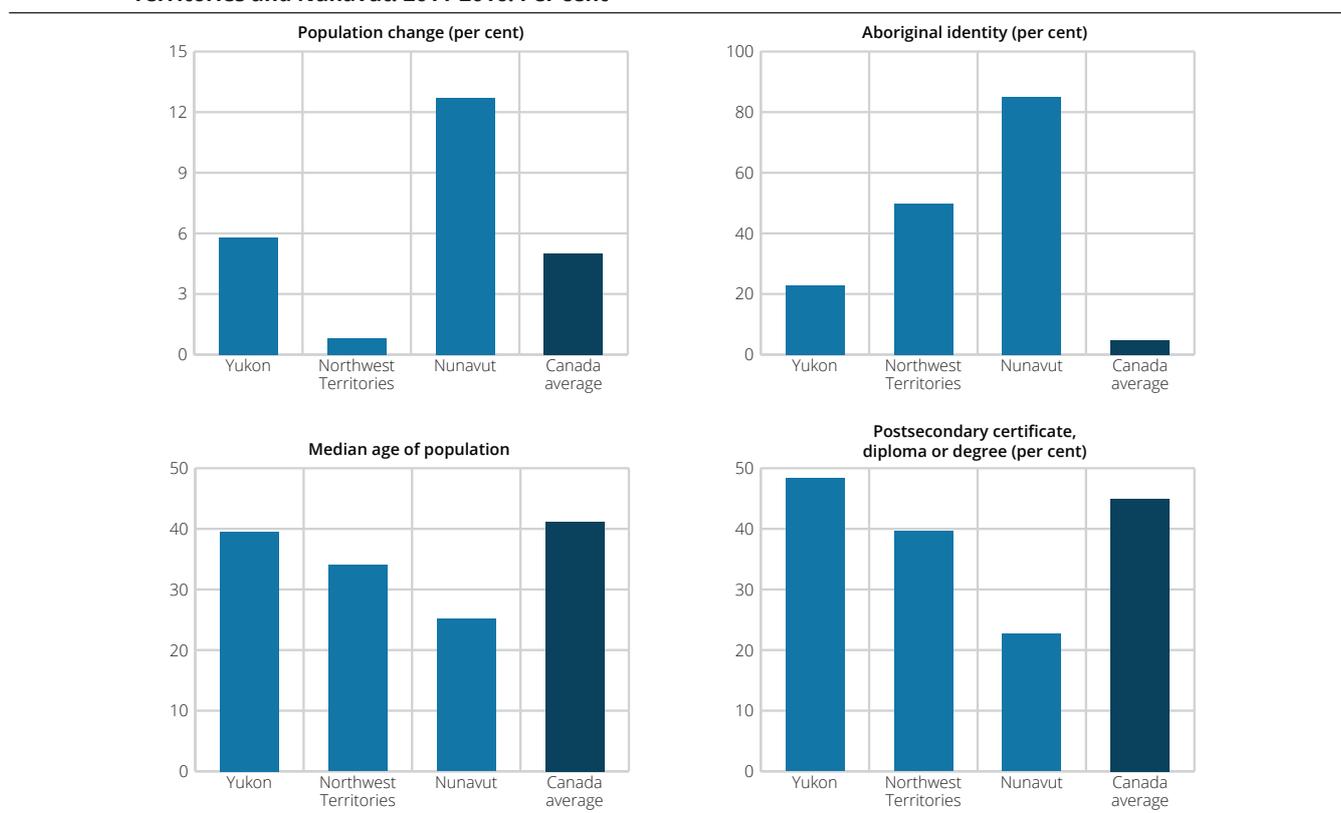
The median age in Northern Canada is lower than for Canada as a whole, with Nunavut having the youngest population. In Nunavut, half of residents are younger than 25.1 years old. Across Yukon, about half of communities have a median age younger than that of Canada (41.2 years old) while in Northwest Territories almost all communities

Table 6.2. Select Population Characteristics of Northern Canada

	Canada	Yukon	Northwest Territories	Nunavut
Population, 2016	35 151 728	35 874	41 786	35 944
Population growth 2011 to 2016 (per cent)	5.0	5.8	0.8	12.7
Median age	41.2	39.5	34.0	25.1
Persons with Aboriginal identity	1 673 785	8 195	20 860	30 555
Share of population that identifies as aboriginal	4.8	22.8	49.9	85.0
Population density (per square km)	3.9	0.08	0.04	0.02
Share of population in urban areas ¹	81.3	60.6	64.1	49.0
Share of families (in census) that are lone female parent families	12.8	14.1	16.1	20.7
Percentage of persons that have a diploma (post-secondary education)	81.7	83.7	72.6	49.4

¹ Urban is defined as community with a population greater than 1 000 persons and a population density greater than 400 people per square kilometer. Source: Statistics Canada 2016 Census of population.

Figure 6.9. Population growth rates, share of Indigenous population, age and tertiary education. Yukon, Northwest Territories and Nunavut. 2011-2016. Per cent



had a younger median age. In Yukon, communities tend to be older, and some are experiencing population decline.

In Northwest Territories and Nunavut, the youthful age structure presents a challenge to gain an education when living in remote communities often entails leaving the community to attend school. Across Northern Canada, smaller communities tend to have fewer persons with at a diploma (post-secondary education), and the effect is most pronounced in Nunavut and then Northwest Territories. The legacy of residential schools con-

tinues to affect generations of Indigenous Peoples and has been identified as a factor negatively affecting high school graduation rates.⁵³

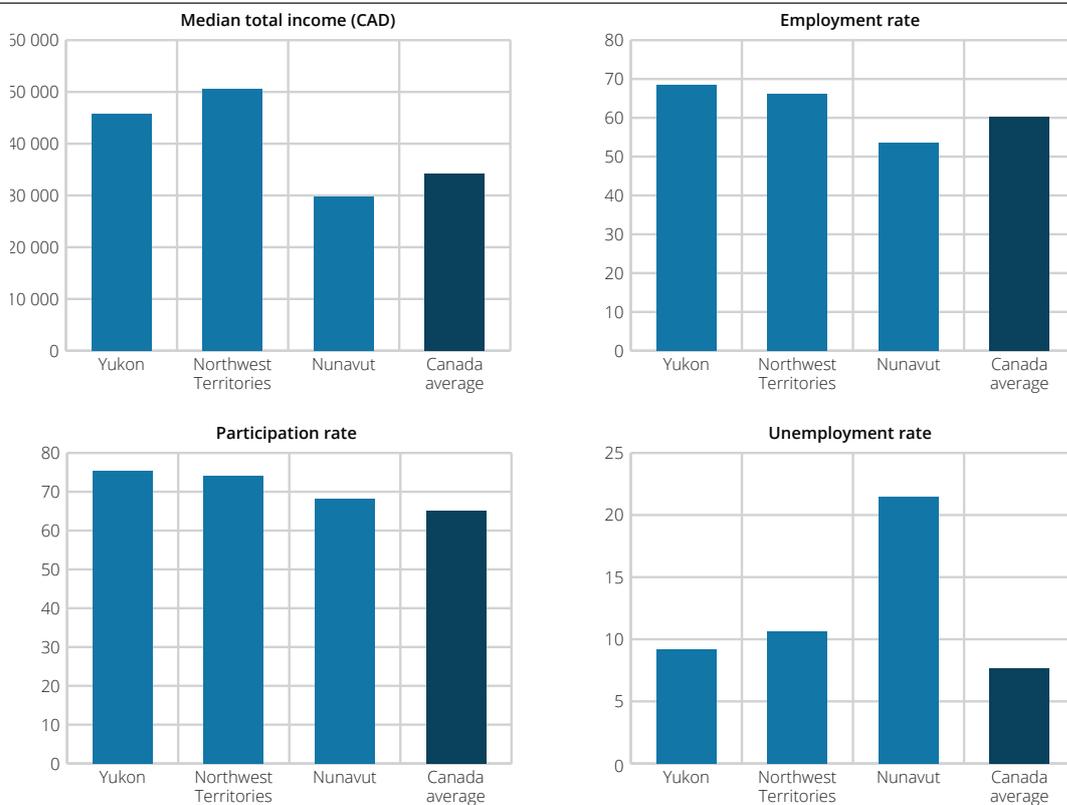
Living conditions in Northern Canadian communities can influence the ability of young people to gain an education, particularly for younger female led households.⁵⁴ Northern Canada has a higher rate of lone female parent families than does the rest of Canada, particularly in Nunavut. However, care is needed with interpreting these rates as the lack of housing in the Canadian North makes comparisons with Southern Canada challenging.

Table 6.3. Main industries and economic activities: Canada, Yukon, Northwest Territories and Nunavut; 2016 or most recent year available

	Yukon	Northwest Territories	Nunavut	Canada
Gross regional product (GRP) (CAD millions)	2 691	4 304	2 536	1 886 103
Government sector share of GRP	36.5	31.7	39.5	17.5
Top 3 industries	Public administration, Real estate and rental and leasing, Mining, quarrying, and oil and gas extraction	Mining, quarrying, and oil and gas extraction, Public administration, Construction	Mining, quarrying, and oil and gas extraction, Public administration, Real estate and rental and leasing	Real estate and rental and leasing, Manufacturing, Construction
Share of top 3 industries in GRP	49.9	45.8	53.8	31.5
Share of Tourism in GRP (2014)	2.7	1.7	1.2	1.9
Share of Exports of goods (customs basis) in GRP	8.17	33.38	0.09	24.83

Source: Statistics Canada 2016 Census of population

Figure 6.10. Labour market characteristics of communities in Yukon, Northwest Territories and Nunavut



Market economies and the role of government in Northern Canada

Market economies in Northern Canada differ markedly from southern regions, as well as between territorial capitals and the smaller, geographically dispersed communities. Compared to Southern Canada, there is less infrastructure and resource extraction, and government activity plays a larger role in the economy than in Southern Canada.⁵⁵ In the territories, the most important industries for employment and GDP are based on natural resource extraction or the provision of government services (public administration and

defense, education, health care). These industries tend to be pay better wages, but not to have jobs located in remote communities. The largest government industries are public administration, health care and social assistance, and education.

Resource extraction has long been a major feature of territorial economies, with a general expectation that development of natural resources will provide benefits to Northerners while progressing in a sustainable manner where adverse environmental and social consequences are minimized.⁵⁶ Yukon has over the last century had important lead,

Table 6.4. Aboriginal peoples survey, harvesting activities by Aboriginal identity, Number of persons, 15 years and over, 2017

Hunting, fishing and trapping	Yukon	Northwest Territories	Nunavut
Hunted, fished or trapped in the last year	2 540	3 630	12 900
Hunted, fished or trapped at least once a week during the season	1 080	1 870	8 620
Hunted, fished or trapped less than once a week but at least once a month during the season	910	990	2 890
Hunted, fished or trapped at least once during the season but not in the last month	520	780	1 370
Gathering wild plants			
Gathered wild plants in the last year	2 210	2 740	7 300
Gathered wild plants at least once a week during the season	1 060	1 460	5 220
Gathered wild plants less than once a week but at least once a month during the season	690	680	1 390
Gathered wild plants at least once during the season but not in the last month	450	600	640

Source: Statistics Canada

nickel, copper mines and continued placer mining for gold, particularly around Dawson city. Northwest Territories has had extensive mining operations for oil and gas, uranium, gold, silver and now diamonds. Nunavut also has a long history with mining and has the potential to produce noteworthy quantities of iron, gold, copper, uranium, and diamonds.

The development and extraction of resources can come with impacts that can manifest over long periods of time. This is particularly the case if planning and regulation do not adequately account for closure and reclamation when resource projects end.⁵⁷ Additionally, effects from the warming climate, such as warmer winters and thawing permafrost, have negative effects on local peoples and the ability of northerners to meet their needs when relying on the environment for subsistence.⁵⁸

Tourism in Northern Canada has been viewed as a method of providing jobs and for developing local economies.⁵⁹ Major tourist activities in Northern Canada include nature based tourism, museums, arts and crafts, hunting and fishing, aurora viewing, hiking and canoeing or whitewater rafting. Tourism encompasses parts of many different industries, such as transportation; accommodation and food services; arts, entertainment and recreation; and, retail trade. The share of tourism is highest in Yukon, which comprises a significant length of the Alaska Highway which sees considerable road traffic in the summer months. While tourism can bring benefits, particularly to local economies, it can also present negative effects such as crowding and degradation of natural locations or degradation of historic sites.⁶⁰

One of the largest recent tourism developments in Northern Canada is the advent of cruises through

the Northwest Passage or among arctic islands. These cruises bring opportunities for employment and income to remote communities, but also associated challenges with managing the new industry.⁶¹ The increased shipping and tourism can also stress search and rescue capabilities struggling to keep up with increased activity.

Land-based subsistence economies

In Northern Canada, land-based subsistence economic activity is an important source of nutrition and well-being.⁶² However, there is limited data on land-based subsistence economic activities in Northern Canada, and a complex inter-play between market economic activity and land-based subsistence economic activity exists. Land-based subsistence economy activities are those where households source food, materials, clothing, art or cultural items from nature.

Across Northern Canada, land-based subsistence economic activities vary by community and territory, with participation being highest in Nunavut and lowest in Yukon. The 2017 Aboriginal Peoples Survey included a number of questions on land-based subsistence economic activities and the responses to a selection of responses on hunting and gathering activities are reported on Table 6.4. Across the territories, hunting and gathering activities were most prevalent in Nunavut where an estimated 19 980 persons hunted and gathered, more than the total for Yukon and Northwest Territories combined. Residents of Nunavut also reported a higher frequency of hunting and gathering than the other territories, with 67 per cent of persons who hunted, fished or trapped reporting they did so at least once a week during the season and 72 per cent of persons who reported gathering doing so at least once a week during the season.

Foods that are sourced from the environment are sometimes referred to as country foods, and they can represent an important source of health.⁶³

Across Northern Canada, there are a number of important plant and animal types for hunting and gathering that are (mostly) common. Numerous berry varieties are available in summer. In tundra/boreal environments, Caribou, Moose, Bison, and Muskox are important species for harvest. In coastal areas, whale, narwhale, seal, walrus, and polar bear are important species. Fish are an important source of protein across wide ranges of Northern Canada, with the various species of salmon being the most sought after. Hares, ducks, geese, grouse and ptarmigan are also harvested.

Interaction between Market Economy and Land-based Subsistence Economy

The presence of the land-based subsistence economy presents the possibility that the poor labour market situation and housing issues in many smaller communities may be alleviated through land-based subsistence economic activity. One type of interpretation would indicate this to be the case when high unemployment, low labour market participation, low incomes and limited access to external markets for expensive goods produces a situation where food insecurity is present and where the land-based subsistence economy thus constitutes an important source of nutrition and well-being. A more nuanced model for understanding the relationship between the market-based economy and land-based subsistence economy may be a mixed model where both market-based activity and land-based activity is necessary for community health.⁶⁴

Research indicates that a complex interaction occurs between market-based activities and land-based subsistence activities.⁶⁵ For example, the 2017 Aboriginal Peoples Survey shows that across Inuit Nunangat employment can be an important determinant for the ability of people to participate in the land-based subsistence economy, while simultaneously acting as a barrier. This occurs because

employed persons can better afford the supplies necessary for land-based subsistence economic activity. These supplies include boats, snow mobiles, rifles and ammunition, gas and food to eat while on the land.⁶⁶ On the other hand, employed

person have less flexibility and more cash income to buy food in the market.

The market-economies and subsistence interact in complex ways, through the traditions and institutions within communities. This interaction has been described as the social economy.⁶⁷ Often, the forms of social capital and social infrastructure that underpin the social economy do not integrate well with practices for measuring market economic activity. As a result, in the future, it will be beneficial to better understand the social and institutional arrangements within Northern Canada, and how they interact within the dual economy, in order to have a fuller understanding of the Northern Canadian economy.

Reindeer husbandry in the Russian Arctic and the private nomadic family-based reindeer entrepreneurship of the Yamal-Nenets Autonomous Okrug

Alexander Pilyasov and Valeriy Kibenko⁶⁸

In the last 30 years, significant changes occurred in the reindeer herding in the Russian Arctic, and as a result of the processes of denationalization and privatization, a very diverse reindeer herding industry, in terms of ownership, has been formed (Table 6.5). Under the Soviet era the majority of domestic reindeer were in state-owned enterprises, while now, in Yamal-Nenets, the opposite is true as the majority is organized in private family enterprises, a new phenomenon in herding. Private reindeer husbandry has become widespread as a type of business.⁶⁹

The types of reindeer ownership in the Russian Arctic, in general, include agricultural organizations, consisting of previous state-owned enterprises with public ownership of reindeer, officially registered peasant farms and private households (Table 6.5).⁷⁰ A specific case of agricultural organizations is small enterprises in public ownership (third column of Table 6.5), which, on the one hand, have characteristics in common with small private enterprises, and, on the other hand, are similar to large agricultural organizations with public ownership of reindeer. The large agricultural organizations, with public ownership of reindeer, consist of teams, resembling the brigades of the state collective agricultural enterprises, different from the family farms of the traditional organization

Figure 6.11. Indigenous Peoples of the Russian North, Siberia and Far East. Compiled and drawn by W. Dallmann



of nomadic reindeer herding. These transitional forms of ownership, resembling the previous state-owned enterprises, are common in the Nenets Autonomous Okrug (NAO), the Republic of Sakha-Yakutia, the Kamchatka Territory and the Murmansk Region.

Reindeer husbandry as a typical Arctic business is an activity with exceptionally high risks, due to annual herd dynamics, annual variations in weath-

er conditions, predators, and diseases.⁷¹ Statistical data on the annual dynamics of domestic reindeer from 1998 to 2015 for each of the ten reindeer-breeding regions of Russia, showing that in six of them there were periods, for example, 2003, 2004, 2006, when the numbers of reindeer in neighboring years differed by 18-20 per cent and in one case, the Magadan region in 2014, the number of reindeer in neighboring years differed by 35 per cent. In the Yamal-Nenets Autonomous Okrug, only

Table 6.5. Number of reindeer in enterprises of different categories as of 01.01.2016. Russian Arctic. 1 000 heads

Region	Sum in enterprises of categories (1), (2) and (3)	Agricultural organizations (1)	Small enterprises within Agricultural organizations	Peasant farms (2)	Private households (3)
Russia	1 906.0	1 133.1	239.4	68.5	704.4
Yamal-Nenets Autonomous Okrug (YaNAO)	886.8	274.0	54.6	7.0	605.8
Nenets Autonomous Okrug (NAO)	207.6	174.0	77.4	14.6	18.9
Chukotka Autonomous Okrug (ChAO)	182.1	177.0	0.0	0.0	5.1
Republic of Sakha (Yakutia)	172.8	162.3	43.1	0.5	10.0
Krasnoyarsk region	146.7	110.4	6.8	35.4	0.9
Republic of Komi	105.3	71.3	0.0	3.4	30.6
Murmansk region	61.1	57.5	25.3	0.0	3.6
Khanty-Mansii Autonomous Okrug (KHAMAO)-Yugra	53.7	26.3	0.0	4.0	23.4
Kamchatka region	52.3	51.6	31.1	0.0	0.7
Magadan region	17.0	14.0	0.0	2.7	0.3
Other regions	20.6	14.7	1.1	0.9	5.1

Source: Preliminary results from All-Russian agricultural census-2016.



Photo: Nenets family in a nomadic reindeer herders' camp, Cooperative 'Voskhod', village Oma, Nenets Autonomous Okrug. Photo: Yasavey

in the Priuralsky district, the number of reindeer livestock decreased by 40 per cent from 55.8 thousand to 33.5 thousand due to the death of reindeer in the autumn-winter of 1998 and spring of 1999.

There are regions where private reindeer livestock is dominated by private households, i.e. nomadic reindeer herding families. More than 90 per cent of all private reindeer livestock in Arctic Russia is concentrated in these regions; the Yamal-Nenets Autonomous Okrug, the Komi Republic, and the Khanty-Mansi Autonomous Okrug (KhMAO)-Yugra. Regions where private livestock is dominated by small and individual enterprises are the Krasnoyarsk territory (Taimyr and Evenkia) and the Magadan region.

Private and nomadic family-based reindeer husbandry in the Yamal-Nenets Autonomous Okrug



Magadan: Each person had permission to catch 50 kg of fish per year without a quota (2004), for their own consumption. This is not much fish to eat for people, whose traditional way of life is fishing for subsistence. Photo: M. Yashchenko (2004).

is particularly notable: the region is the leader in number of privately owned reindeer, not only in Russia, with three-quarters of all privately owned reindeer in Russia, but also in the world.

There are more privately owned reindeer in the Tazovsky district of Yamal-Nenets Autonomous Okrug (YaNAO) alone than in the whole of Finland. Yamal has three times as many family reindeer farms as Finland, and almost six times as many nomadic reindeer herding families as Norway.

The revival of nomadic entrepreneurship in Yamal in the 1990s, was that, as often happens, organizational and institutional changes went along with the technological revolution, expressed in the mass introduction of snowmobiles and other individual technical means (diesel generator, mobile phone, etc.) in the "small" units of the nomadic family reindeer herding.⁷² This technological revolution came to Yamal about 30 years after similar radical changes appeared in the traditional industries of reindeer husbandry and fisheries in Northern Scandinavia, Canada and Alaska. It is no exaggeration to say that it was the nomadic reindeer herders of the Yamal-Nenets Autonomous Okrug who took advantage of this technological revolution to the maximum extent among the peoples of the North of Russia.

Private reindeer herding in the Yamal-Nenets Autonomous Okrug is concentrated in family enterprises of the nomadic populations of the Yamalsky, Tazovsky, and Priuralsky districts of the Yamal-Nenets Autonomous Okrug. In these districts there are about three thousand Indigenous reindeer enterprises (Table 6.6), they employ about 15 thousand entrepreneurs and their relatives, and the average size of a private family farm is about six people.

The internal diversity of the reindeer herding economy, is the most important insurance for nomadic small businesses with reindeer numbers of up to 200-250 heads, with earnings from reindeer, from state subsidies and fishing and hunting. Poor reindeer herders, with reindeer numbers of less than 100 heads, strive to reduce the number of slaughtered reindeer, by providing themselves and reindeer herding dogs with food from other sources, primarily fishing, thus preserving the number of reindeer.

Table 6.6. Institutional structure of the Yamal-Nenets Autonomous Okrug (YANAO) reindeer husbandry as of 1.01.2017. Number and per cent

	Number of enterprises with reindeer	Total number of reindeer	Share of young female reindeer, per cent	Number of reindeer per enterprise
All categories of reindeer enterprise	3 436	1 001 930	23.6	292
Agricultural enterprises, including:	44	428 484	28.3	9 738
Organizations of agricultural industrial complex (APK)	16	196 710	31.5	12 294
Indigenous communities (obshchina)	22	199 886	25.3	9 086
Small enterprises	6	31 888	27.2	5 315
Peasant farms	1	946	27.4	946
Privately owned reindeer	3 347	572 500	20.1	171

Source: Information from Yamal-Nenets information system «Yamal» <https://dkmns.yanao.ru/about/isystems/22/>

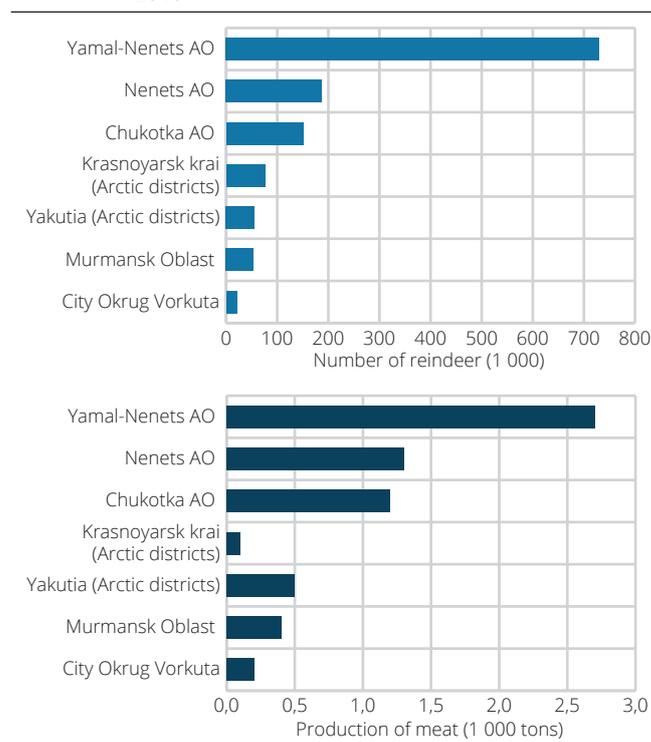
New stereotypes of market behavior among private reindeer herders have revealed a number of paradoxes in private reindeer husbandry in Yamal, which are absent in other reindeer herding regions, where privately owned reindeer do not dominate in numbers. For example, Yamal is the only region in which the production of reindeer meat is radically lower than expected when compared with the total reindeer population (Figure 6.12).

The reason is that the economic incentives for private entrepreneurs are mainly determined by the most important ratios of prices for venison (meat) and gasoline; venison (meat), and the informal market for panta, the highly priced product from the antlers of male reindeer. In social (public or collective) ownership of reindeer herding in other regions, these comparative prices do not affect the economic behavior of herders to such an extent. In fact, Figure 6.12 testifies to the role of the informal panta market, in which thousands of Yamal family reindeer farms are involved.

Problems of Yamal reindeer husbandry, including pasture depletion and loss of pastures to development of infrastructure, are primarily institutional. They are the result of state support institutions that have created the wrong incentives for reindeer herder-entrepreneurs in recent decades. State support should be guided by the specific patterns of the development of reindeer business, in order to find a balance between the revival of the reindeer husbandry based on the Indigenous Nenets family nomadism, and the rise of the entrepreneurial economy. There is a contradiction between the new realities of private reindeer nomadic entrepreneurship and the support to old state institutions inherited from the Soviet era, as if all reindeer herding is still in state-owned enterprises. For example, the development of purchaser prices for reindeer meat lag behind the rise in gasoline

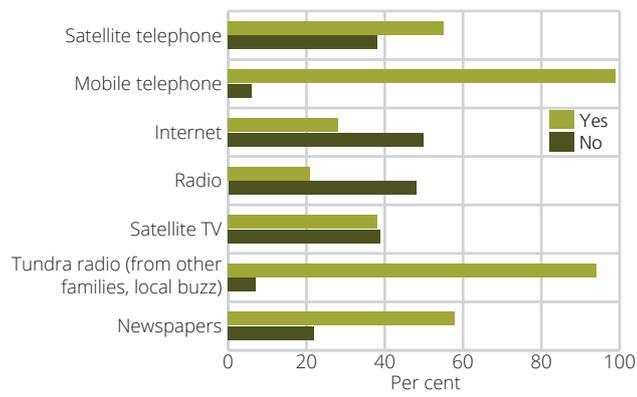
prices, which became, with the massive introduction of snowmobiles, simply the most important element of the reindeer herder's expenditures. Thus, the unfavorable price development contributes to an increase in reindeer livestock, beyond what is in accordance with nomadic reindeer herding, and to an overgrazing of pastures, exacerbated by loss of pasture land to infrastructure development.

The entrepreneurial model of reindeer husbandry is a very complex management system that requires a deep understanding of the patterns of its development.⁷³ An interesting feature of the reindeer-entrepreneurial environment is the

Figure 6.12. Number of reindeer and production of reindeer meat. Reindeer husbandry in the Russian Arctic. 2016

Source: Russian Federal statistic service and mass-media: <http://tass.ru/ekonomika/4231054>; <http://www.ks87.ru/20/28/6521.html> Figure 6.10 prepared by expert of ANO «Institute of Regional Consulting» PhD student Darya Sidorova

Figure 6.13. Dominance of “tundra radio”, i.e. word of mouth from other families in all communication methods of reindeer herders-entrepreneurs of the Yamal district. 2017



Source: Social and economic factors of life and well-being of the Indigenous people living traditional life style in the Yamal district of Yamal Okrug. Volume 1. Sociological survey. Principal investigator: Valerii Kibenko. Salekhard. 2017. 101p. (non-published materials).

importance of knowledge spillovers.⁷⁴ Repeatedly in the course of field research (Figure 6.13), respondents noted the influence of information from neighbors on their moving practice. When asked: “How and from whom exactly do you learn about the impending natural hazards during moving? A common response was: “From nomadic neighbors”, and “Meetings with neighbors more than five times a year, sometimes their decisions strongly influence”. The most reliable and fastest means of communication is considered to be “tundra radio”, i.e. word of mouth, from camp to camp, which by respondents is considered “faster than cellular communication”, which works only near facilities of the fuel and energy infrastructure, trading posts

and settlements. In the tundra, it is very simple to assess how effectively the reindeer owner’s process of commercializing this knowledge is proceeding – by the dynamics of the population of his own private reindeer.

Sámi reindeer pastoralism in Norway: The role of traditional knowledge for economy and governance

Ravdna Biret Marja E. Sara, Ellen Inga Turi, Risten MM Buljo, Anders Oskal, Svein Disch Mathiesen and Iulie Aslaksen⁷⁵

Reindeer pastoralism is livelihood for more than 20 Indigenous Peoples in Arctic and Sub-Arctic areas in Norway, Sweden, Finland, Russia, Mongolia, China, Alaska, Canada, and Greenland, involving about 100 000 people and 2.5 million reindeer (*Rangifer tarandus*) on natural pastures from the North Sea to the Pacific Ocean (Figure 6.15). Reindeer pastoralism is a nomadic livelihood, adapting to natural migration patterns of reindeer, often from coastal grassland in summer to lichen covered inland areas in winter. In Norway, reindeer pastoralism is predominantly a Sámi livelihood. Traditional knowledge is the basis for managing the herd and ensuring diverse use of the reindeer, while adapting to climate change.⁷⁶

Loss and fragmentation of pastures and migration routes, from infrastructure associated with hydropower, mining, cabin areas, forestry, and recently wind power, have severe consequences for

reindeer husbandry.⁷⁷

Reports of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) and the Intergovernmental Panel on Climate Change (IPCC) call for maintaining ecosystems to support climate mitigation and biodiversity.⁷⁸

Traditional knowledge is of key importance for adapting to climate change.⁷⁹ Traditional knowledge is defined by the Ottawa Indigenous



Reindeer herding, Finnmark. Photo: Tom Nicolaysen

Knowledge Principles.⁸⁰ While food governance is the institutional framework for managing food systems, Arctic food sovereignty is defined by scholars from reindeer herding as an understanding of food security based on Indigenous Peoples' possibilities for sustainable use of resources in accordance with their traditional food systems.

Sámi traditional knowledge and governance of reindeer husbandry

While Indigenous rights are implemented in legislation in Norway, a challenge remains to integrate traditional knowledge in governance of reindeer husbandry. There is need to develop institutions that support cooperation, with the aim of governance to achieve ecological, economic, and cultural sustainability. The issue of sustainability involves dealing with the competing objectives of reducing the size of herds and increasing profit in reindeer husbandry.⁸¹

Sámi reindeer pastoralism is based on partnership of the *siida*, households cooperating on reindeer herding.⁸² This traditional organization is similar across reindeer herding regions in the Arctic. A key issue is the possibility for reindeer herders to determine the composition and size of the herd.⁸³ While previously reindeer calves were hardly slaughtered, today subsidies provide economic incentives to slaughter calves. On average, female reindeer make up 77 per cent of herds and male reindeer only 6 per cent. In the 1960s reindeer herds in Finnmark typically comprised up to 50 per cent adult males. Their strength enabled them to break crusted snow, providing access to plants to females and calves.

Structural changes of reindeer herds, in Russia from the 1930s and in Norway from the 1960s, led to the practice of slaughtering calves and low shares of male reindeer.⁸⁴ These structural changes of Sámi reindeer husbandry may have made the pastoral economy more vulnerable in times of climate change and risk of ice-covered pastures. A consequence is increased feeding of reindeer in winter, contributing to erosion of herders' economy. In the winter 2019-20 Sámi reindeer herders in Finnmark used 624 tons pelleted feed, supported by more than 40 mill NOK by the government.⁸⁵ Use of pellets, hay and silage in reindeer herding has increased throughout Fennoscandia.⁸⁶

Table 6.7. Composition of total income in reindeer husbandry in Norway. 2014 and 2018

	2014		2018	
	1 000 NOK	Per cent	1 000 NOK	Per cent
Production based income	128 344		190 543	
Meat and by-products total	122 767	44.3	122 767	31.7
Meat production slaughter house	98 124	35.4	108 742	28.1
Meat production private	24 553	8.9	14 025	3.6
Bonus			3 988	1.0
Changes in the value of the herd	-28 587	-10.3	12 879	3.3
Incomes from related activities	6 861	2.5	13 776	3.6
Other production-based incomes	27 303	9.9	37 132	9.6
Subsidies	76 361	27.6	92 461	23.9
Compensations	72 419	26.1	104 006	26.9
Total income	277 124	100	387 010	100

Source: Norwegian Agriculture Agency (2019), table 4.1.12.

Table 6.8. Incomes from related activities in reindeer husbandry in Norway. 2018. 1 000 NOK

Reindeer herding region	2014	2018
East-Finnmark	2 277	3 630
West-Finnmark	2 214	3 608
Troms	217	4 411
Nordland	662	566
Nord-Trøndelag	313	99
Sør-Trøndelag/Hedmark	1 177	1 462
Total	6 861	13 776

Source: Norwegian Agriculture Agency (2019), table 4.1.12.

The economy of Sámi reindeer husbandry in Norway

The Norwegian Agricultural Agency compiles annual reports of the economy in reindeer husbandry.⁸⁷ The value of meat production was about 32 per cent of total income of reindeer husbandry in 2018 (Table 6.7). Compensations for loss of reindeer, to predators and traffic accidents and loss of area, was about 27 per cent of total income in 2018, hereof 24 per cent for loss to predators and traffic accidents and 3 per cent for loss of area. Of the 22 563 lost reindeer in 2018, 94 per cent were lost to predators and 6 per cent to traffic accidents (Table 6.12). Subsidies to reindeer husbandry were about 24 per cent of total income in 2018. In addition, bonus is paid from surplus in slaughterhouses to the reindeer owners. Changes in the value of the herd are estimated based on number of reindeer, composition of the herd, and assessed weight of reindeer.

Table 6.9. Siida share costs in reindeer husbandry in Norway. 2018. 1 000 NOK

Type of cost	East-Finnmark	West-Finnmark	Troms	Nordland	Nord-Trøndelag	Sør-Trøndelag	Total
Freight and transportation	197	304	50	122	20	0	693
Intermediate goods	8 351	3 465	2 558	6 317	1 131	1 025	22 848
Travels	1 039	634	291	418	180	136	2 698
Equipment	9 070	10 928	2 355	2 953	2 178	1 277	28 762
Vehicles and machinery	8 736	15 056	2 104	2 788	1 519	1 564	31 767
Buildings and infrastructure	2 279	1 963	280	999	405	139	6 064
Depreciation	10 838	13 640	2 983	3 402	2 116	1 462	34 440
Electricity, energy	3 092	3 315	553	628	473	313	8 373
Administration, rent, insurance, sales and marketing	3 634	4 955	1 137	2 608	1 356	659	14 349
Acquisition of services	2 611	2 286	1 186	3 091	920	1 358	11 453
Miscellaneous	5 890	4 682	1 716	729	486	975	14 477
Total	55 737	61 227	15 214	24 056	10 785	8 906	175 924

Source: Norwegian Agriculture Agency (2019), table 4.4.2.

Table 6.10. Share of female and male siida share leaders with wage or self-employment income outside reindeer husbandry¹. 2018. Per cent

Reindeer herding area	Women	Men	Income < 200 000		Income > 200 000	
			Women	Men	Women	Men
East-Finnmark	91	58	6	84	94	16
West-Finnmark	92	65	18	74	82	26
Troms	80	65	13	65	88	35
Nordland	63	47	60	63	40	38
Nord-Trøndelag	86	52	33	81	67	19
Sør-Trøndelag/ Hedmark	100	80	80	95	20	5
Total 2018	88	62	21	77	79	23

¹ In the Economy of the North 2015 the corresponding table gave data separately for the areas Polmak/Varanger and Karasjok in East-Finnmark while we now present total data for East-Finnmark.

Source: Norwegian Agriculture Agency (2019), table 7.1.4.

Table 6.11. Share of female and male spouses with wage or self-employment income outside reindeer husbandry¹. 2018. Per cent

Reindeer herding region	Women	Men	Income < 200.000		Income > 200.000	
			Women	Men	Women	Men
East-Finnmark	98	58	14	29	86	71
West-Finnmark	92	100	10	60	90	40
Troms	81	75	38	33	62	67
Nordland	88	100	20	0	80	100
Nord-Trøndelag	78	100	21	100	79	0
Sør-Trøndelag/ Hedmark	94	50	20	100	80	0
Total 2018	91	73	15	47	85	53
Total 2017	91	81	18	62	82	38

¹ In the Economy of the North 2015 the corresponding table gave data separately for the areas Polmak/Varanger and Karasjok in East-Finnmark while we now present total data for East-Finnmark.

Source: Norwegian Agriculture Agency (2019), table 7.1.5.

Incomes from related activities comprise incomes from handicrafts (duodji) made from skin, bones and antlers of reindeer and incomes from harvesting from nature, such as cloudberries. Table 6.8 shows that incomes from activities related to

reindeer husbandry have increased, however, they vary over time.⁸⁸ Vehicles, machinery and equipment are large items of the total cost, in addition to depreciation (Table 6.9). An important factor behind this development is increase in Sámi food and other products and services to tourists.

Income from work outside reindeer herding is of large importance for the economy of the reindeer herding family (Table 6.10). Among siida share leaders, 88 per cent of women and 62 per cent of men have income from outside employment or self-employment. Of these, 79 per cent of female siida share owners had income above 200 000 NOK, whereas 21 per cent of men had incomes below that level.

In particular, the contribution from female spouses is important, as 91 per cent of female spouses and 73 per cent male spouses have income from outside reindeer herding, and a large share have relatively high incomes (Table 6.11).

With regard to ownership of reindeer, 67 per cent of the reindeer are owned by the leader of the siida share, while 5 per cent of the reindeer are owned by the spouse and 28 per cent are owned by others, i.e. mainly family members.⁸⁹ The total number of reindeer in reindeer herding in Norway was estimated to 214 200 for 2019 and has been stable since 2015 (Figure 6.14).

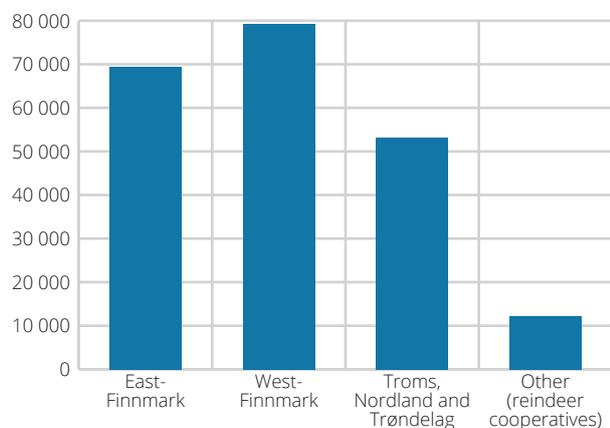
Strategy for creating new value chains

Traditional knowledge may be used to develop strategies for enhanced value creation in Sámi reindeer husbandry, in line with the competitive advantage strategy model of VRIO, i.e. Value

Table 6.12. Number of compensated reindeer in reindeer husbandry in Norway, by region and by cause of loss to predators and traffic accidents. 2018

Cause of loss	East-Finnmark	West-Finnmark	Troms	Nordland	Nord-Trøndelag	Sør-Trøndelag	Reindeer cooperatives	Total
Lynx	1 352	1 633	722	1 143	791	140	5	5 786
Volverine	2 262	1 866	463	1 153	665	256	51	6 716
Bear	156	12	0	0	60	0	0	228
Wolf	3	0	0	0	0	0	0	3
Eagle	2 059	3 657	790	351	362	153	54	7 426
Unspecified predator	64	8	231	380	260	140	0	1 083
Train	0	0	0	546	137	0	0	683
Road traffic	128	175	94	64	51	24	102	638
Total	6 024	7 351	2 300	3 637	2 326	713	212	22 563

Source: Norwegian Agriculture Agency (2019), table 4.3.3.

Figure 6.14. Number of reindeer in reindeer husbandry in Norway, by region. 31 March 2019

Source: Norwegian Agriculture Agency (2019), table 4.1.9.

realizing, Rarity of resources, Imitability (i.e. difficult to imitate) and Organizational ability.⁹⁰ A key element here is that traditional knowledge is non-imitable and that quality products can be developed in long value chains, from reindeer grazing on the mountain to high-quality products to target groups, to provide extended income from reindeer herding. Utilizing more of the resources from the reindeer, such as skin, may also improve work opportunities for more people in activities related to reindeer herding. Rarity of resources refers to their uniqueness, only available in specific seasons of the annual reindeer cycle. Traditional knowledge is a barrier for imitation as the abilities are learned by doing the work. The unique products can reach customers with high willingness to pay. In the Parliament (Stortinget) debate on the White Paper on reindeer husbandry, the Standing Committee on Business and Industry emphasized the importance of the value creation by the reindeer herding families, in addition to meat production.⁹¹

Sámi traditional knowledge, tenderness of reindeer meat, and food sovereignty

A study of reindeer slaughtering practices documents use of Sámi traditional knowledge in reindeer slaughtering and in the skill of food preparation and explores how traditional knowledge can be applied to develop Sámi gastronomy for reaching new groups of consumers and to develop the understanding of food sovereignty and food governance. For example, Sámi reindeer herders have no tradition in hanging meat for tenderization, while using other insights to tenderize meat for everyday gastronomic purposes. In Sámi language there is a variety of concepts that carry knowledge of slaughtering practices and tenderness of reindeer meat, a prerequisite for the food sovereignty of Sámi reindeer herders' families through generations.

While slaughtering of reindeer for sale is strictly regulated, Sámi reindeer owners in Kautokeino, Northern Norway, still slaughter reindeer for own consumption of meat in a similar way as the traditional slaughtering. It is common to leave the carcass inside the skin, for at least an hour before removal of rumen and skin, to make the meat tender. The rumen fills with gas, in a process called baggan. Today this traditional practice conflicts with regulations for industrial slaughtering in Norway. From the 1950s, reindeer meat for the commercial market was slaughtered in an industrialized way as the traditional knowledge of reindeer meat quality was not acknowledged in the modernization processes.⁹²

Many tourists seek knowledge about authentic and traditional ways of living in the Arctic, and a growing interest in Indigenous food culture has resulted

Figure 6.15. Circumpolar reindeer pastoralism



Source: International Centre for Reindeer Husbandry (ICR)

in more Sámi products and tourism companies,⁹³ reflected in increasing income from activities related to reindeer herding (Table 6.8). Sámi family produced reindeer meat is tender, but such meat is rarely available for visiting tourists and other consumers. Sámi reindeer herders mainly boil, smoke and dry reindeer meat when preparing food for the family. The traditional method includes selecting specific reindeer for slaughtering and special slaughtering methods to meet the food culture requirement at home. The unique quality of reindeer meat, a result of the nature of the grazing areas, the traditional knowledge, and slaughtering practices, provides a template for future Sámi gastronomy. Gastronomy, “the art of good eating”, is a key element in tourism, related to culture, knowledge, heritage, and the landscape that provides the food.⁹⁴ According to a study from Canada, food identified as Indigenous, for example Arctic char, is

positively received by consumers, who are interested in knowing how, where and by whom the food was produced.⁹⁵

Traditional knowledge and Convention on Biological Diversity (CBD)

The Convention for Biological Diversity (CBD), Article 8 (j), calls for applying traditional knowledge of Indigenous Peoples to achieve sustainable use and conservation of biodiversity.⁹⁶ The Norwegian Government’s Arctic Strategy recently raised the challenge of land encroachment and need for dialogue with Sámi interests.⁹⁷ The Nature Diversity Act §8 stipulates that authorities shall emphasize knowledge, based on many generations of experience acquired through use of and interaction with the natural environment, including traditional Sámi use, that can promote the conservation and sustainable use of nature diversity.⁹⁸

Gender roles and contributions to the household in Greenland⁹⁹

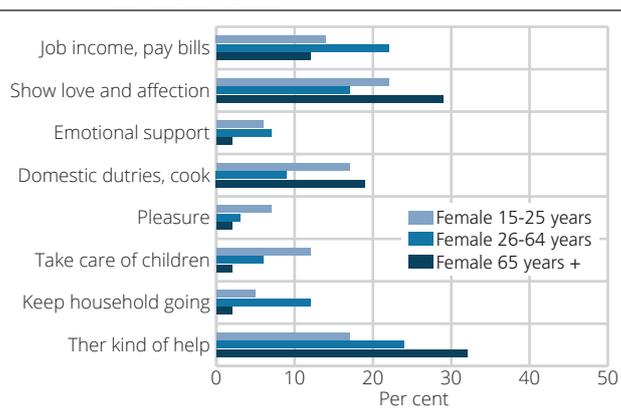
MarieKathrine Poppel and Birger Poppel,
Ilisimatusarfik, University of Greenland

The development of the Greenlandic welfare state has resulted in social, educational and economic improvements for women. The increased share of women in education and the labor force is closely related to changes in occupational structure, from a structure dominated by traditional men's jobs in fisheries and hunting, to a labor market with more jobs in service sectors including health care, social institutions and education that to a larger degree attract women. An analysis of data from the Survey of Living Conditions in the Arctic (SLiCA) supports an assumption that women's changed labor market participation may have influenced perceptions of how women and men contribute to the household.¹⁰⁰

The Survey of Living Conditions in the Arctic (SLiCA) is a comprehensive comparative study of the quality of life among Arctic Indigenous Peoples. As a circumpolar research project, it has taken place among Inuit, Sámi, and the Indigenous Peoples of Chukotka and the Kola Peninsula. More than 8 000 respondents in the northernmost parts of Russia, Alaska, Canada, Norway, Sweden and in Greenland have participated and contributed to the overall comprehensiveness of the SLiCA research program.¹⁰¹ SLiCA has been carried out by an international group of researchers in partnership with Indigenous Peoples of the Arctic. The core questionnaire of SLiCA offers opportunities to examine and grasp some of the economic, and social, cultural, and nutritional significance of subsistence activities. A broad variety of questions have been asked about individual and household activities and behavior.¹⁰² The importance of a mixed cash and subsistence economy for living conditions in the Arctic is one of the research topics suggested by the Indigenous Peoples' representatives participating in SLiCA.

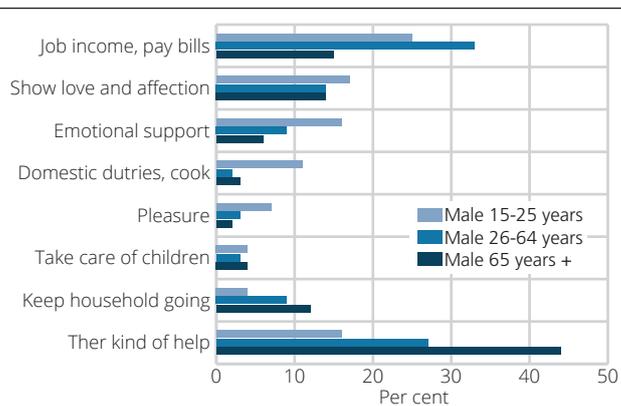
The question in SLiCA about how women and men perceive their contributions to the household was phrased like this: "Now I'd like you to think about what you feel is the most important way you contribute to your household. This may or may not be paid work. Of all the things you do what is the most important way you contribute to your household?"

Figure 6.16. Most important ways women in Greenland contribute to the household, by age group. Per cent. 2004-2006



Source: Survey of Living Conditions in the Arctic (SLiCA) and adapted from Table 2 in Poppel (2015).

Figure 6.17. Most important ways men in Greenland contribute to the household, by age group. Per cent. 2004-2006



Source: Survey of Living Conditions in the Arctic (SLiCA) and adapted from Table 1 in Poppel (2015).

The answers were grouped into categories: job, income, paying bills; showing love and affection; emotional support; domestic duties, cooking; bringing pleasure to the household; taking care of children, hunting and fishing, keeping the household going; other kind of help. Data are presented for women and men by age group (Figures 6.16 and 6.17).

For women, both youngest and oldest group, the three contributions to the household (besides the category other kind of help) they ranked highest are showing love and affection, domestic duties, cooking, and job, income paying bills. For women in the age group most likely to be in the labor force, the three contributions (besides the category other kind of help) they ranked highest are job, income paying bills, showing love and affection, and keeping the household going. The youngest



Photo: Greenland. Colorbox

female group perceives to a larger degree than the older groups that taking care of children and bringing pleasure to the household are their important contributions. Among elder women, almost a third perceive showing love and affection as their most important contribution.

For men, the two younger groups perceive that their main contribution to the household is job, income and paying bills. They see themselves more as providers than as contributing to keeping the household going. Most men perceive the categories (besides the category other kind of help) (1) job, income, paying bills and (2) showing love and affection as their most important contributions to the household. Income is perceived as the most important contribution by the group most likely to be in the labor force, while the oldest group considers more of their contribution to be in keeping the household going.

Hunting and fishing are perceived as important contributions to the household, more by the younger groups of men than the older men. It is often assumed that subsistence hunting and fishing is an obvious alternative to paid labor. However, background data indicate that only 10 per cent of those who did not work in paid employment the

previous year perceive that their primary contribution to the household is from hunting fishing and gathering. This finding might, at least partly, be related to SLiCA results indicating that it is costly (and thus presupposes an income) to buy and maintain equipment necessary to hunt and fish.¹⁰³

In the middle age group, both women and men identify income, job and paying bills and showing love and affection as their most important contribution to the household. Among the older, more men than women see keeping the household going as an important contribution, including taking care of children. A generational pattern can be seen where women in the age group most likely involved in active employment to a larger degree have become bread-winners. The younger women most often take care of younger sisters and brothers, while older women contribute with affection and care in a broad sense, including cooking and domestic duties. The analysis of data from the Survey of Living Conditions in the Arctic (SLiCA) supports an assumption that women's changed labor market participation may have influenced perceptions of how women and men contribute to the household, as the group of women most likely to be in the labor force perceived their most important contribution to be of an economic kind.

Subsistence: A Way of Life in the North

Davin Holen and Susanna Gartler

Most economies of the Arctic are characterized by a combination of market participation and harvest of wild resources. What is often referred to as subsistence is a way of life that includes, but is not limited to, hunting, fishing, gathering, and herding. Subsistence activities are part of a way of life that represents continuity, sharing, and connection to nature.¹⁰⁴ Understanding the centrality of nature-based livelihoods to Arctic residents is important for legal regulations, compensation payments for lost lands, land-use planning, and wildlife management.

In the community of Kokhanok in Southwest Alaska, with a mean household harvest of 559 kg of salmon annually, a group of students was asked why fishing was important to them and their families. They replied “[...] that harvesting salmon meant they did not have to buy as much food, and therefore, could have money for other necessities such as fuel and rent.”¹⁰⁵ In a survey of three communities, Aklavik, Canada; Qeqertarsuaq, Greenland; and Longyearbyen, Svalbard, Norway, almost 60 per cent of respondents regularly hunt, fish and gather (medicinal) plants, berries and mushrooms. In Aklavik and Qeqertarsuaq more than 96 per cent eat country foods at least one time per week. Even in Svalbard, with no Indigenous population, about 18 per cent of respondents indicate that subsistence harvesting is very important for the household.¹⁰⁶ A study of hunters in Greenland showed that the estimated value of production for own consumption was almost as large as the sales value, which is a considerable share of income.¹⁰⁷ Estimates of subsistence production for Indigenous families in Northern Russia indicate that the value of consumed goods from their own production can be several times the monetary income.¹⁰⁸

Hunting and harvesting can be costly, with use of equipment such as snow machines, all-terrain vehicles, and motorized boats. Due to the rapidly changing climate in the North, hunters and fishers must travel further away and under increasingly unpredictable conditions.¹⁰⁹ Other economic activities, such as large-scale industrial mining, can affect and pose considerable risks to Arctic wildlife and vegetation.¹¹⁰ With notable exceptions, such as Alaska, wild harvesting activities are mostly

invisible in official statistics. Calculating the value of subsistence activities in monetary terms poses a challenge, precisely because subsistence is linked to the functioning and identities of entire societies, including their languages, governance, legal structures, and cultural expressions.¹¹¹

Hunting, whaling, reindeer herding, fishing, trapping and gathering continue to shape social relationships and cultural identity, especially of the Indigenous Peoples. The subsistence activities are intertwined with Indigenous Knowledge, as a cultural practice informed by and contributing to the development of Indigenous Knowledge.

There are multiple perspectives and diverse information on subsistence economies. While we have not yet been able to fulfil the aim of ECONOR to present the subsistence economies of all Indigenous Peoples who are Permanent Participants to the Arctic Council, this chapter presents contributions from Indigenous People with whom the ECONOR IV project has established cooperation, in the time available. It is our hope that future ECONOR projects, in partnership with Indigenous Peoples, may enable a more comprehensive understanding of the role of the Indigenous Peoples in the Arctic economies and the intertwined nature of the subsistence and market activities in the Arctic.

The Ottawa Indigenous Knowledge Principles, developed and agreed upon by the Arctic Council Permanent Participants for use in the Arctic Council in 2014, updated in October 2018, define Indigenous Knowledge as “a systematic way of thinking and knowing that is elaborated and applied to phenomena across biological, physical, cultural and linguistic systems. Indigenous Knowledge is owned by the holders of that knowledge, often collectively, and is uniquely expressed and transmitted through indigenous languages. It is a body of knowledge generated through cultural practices, lived experiences including extensive and multi-generational observations, lessons and skills. It has been developed and verified over millennia and is still developing in a living process, including knowledge acquired today and in the future, and it is passed on from generation to generation”.¹¹²

Notes

Notes for Inuit Circumpolar Council: An Inuit way of looking at the Arctic economy

- ¹ Utqiagvik Declaration 2018. (2018, July 19). 13th General Assembly of the Inuit Circumpolar Council, Utqiagvik, Alaska. <https://iccalaska.org/wp-icc/wp-content/uploads/2019/05/FINAL-Utqiagvik-Declaration-2018.pdf>
- ² Inuit Circumpolar Council (2017). Outcome Document, Circumpolar Inuit Economic Summit. <https://iccalaska.org/our-work/circumpolar-inuit-economic-summit/>
- ³ United Nations Declaration on the Rights of Indigenous Peoples, GA Res. 61/295 (Annex), UN GAOR, 61st Sess., Supp. No. 49, Vol. III, UN Doc. A/61/49 (2008) 15.
- ⁴ Cabral, R. B., Bradley, D., Mayorga, J., Goodell, W., Friedlander, A. M., Sala, E., Costello, C., & Gaines, S. D. (2020). A global network of marine protected areas for food. *Proceedings of the National Academy of Sciences*. <https://doi.org/10.1073/pnas.2000174117>
- ⁵ Qikiqtani Inuit Association. (2020). Sarvararjuaq and Qikiqtait: Inuit Stewardship and the Blue economy in Nunavut's Qikiqtani Region DRAFT. https://www.qia.ca/wp-content/uploads/2020/10/qia-regional-marine-protection-strategy_web.pdf
- ⁶ Inuit Circumpolar Council Alaska 2020, Food Sovereignty and Self-Governance: Inuit Role in Managing Arctic Marine Resources. Anchorage, AK, page 22.
- ⁷ Preamble, Inuit Impact and Benefit Agreement for Tallurutiup Imanga National Marine Conservation Area between The Inuit of the Qikiqtani Region represented by Qikiqtani Inuit Association and Her Majesty the Queen in Right of Canada (2019) https://www.qia.ca/wp-content/uploads/2019/09/2019-08-01_TINMCA-IIBA_FULLY-SIGNED-1.pdf
- ⁸ Parks Canada Agency (2019, August 1). Tallurutiup Imanga National Marine Conservation Area—National Marine Conservation Areas. <https://www.pc.gc.ca/en/amnc-nmca/cnamnc-cnmca/tallurutiup-imanga>
- ⁹ Cruickshank, A. (2017, December 9). Inuit seek full management of Tallurutiup Imanga, Canada's largest protected area. *The Star*. <https://www.thestar.com/news/gta/2017/11/28/inuit-seek-full-management-of-tallurutiup-imanga-canadas-largest-protected-area.html>
- ¹⁰ Highlights of the Tallurutiup Imanga and Tuvaijuittuq agreements. (2019, August 7). Qikiqtani Inuit Association. <https://www.qia.ca/highlights-of-the-tallurutiup-imanga-and-tuvaijuittuq-agreements/>
- ¹¹ Parks Canada Agency, G. of C. (2019, December 16). Inuit Impact and Benefit Agreement—National Marine Conservation Areas. <https://www.pc.gc.ca/en/amnc-nmca/cnamnc-cnmca/tallurutiup-imanga/entente-agreement>
- ¹² Taylor-Vaisey, N. (2019, August 1). The plan to save Canada's rapidly-melting Arctic ice. *Maclean's*. <https://www.macleans.ca/news/canada/canada-far-north-arctic-ice-melting-climate-change-inuit/>
- ¹³ Qikiqtani Inuit Association. (2019). Arctic Bay Nauttiqsuqtiit: The Eyes and Ears of Tallurutiup Imanga. https://www.qia.ca/wp-content/uploads/2019/06/QIA-ENG-Nauttiqsuqtiit-2019-05-16_SPREADS_LOW-1.pdf
- ¹⁴ Anselmi, E. (2019, December). The Last Ice (<https://www.uphere.ca/articles/last-ice>) [Text/html]. Up Here Publishing; uphere. <https://www.uphere.ca/articles/last-ice>
- ¹⁵ Public Works and Government Services Canada. (2019, June 22). Canada Gazette, Part 1, Volume 153, Number 25: Order Designating the Tuvaijuittuq Marine Protected Area. Government of Canada, Canada Gazette. <http://gazette.gc.ca/rp-pr/p1/2019/2019-06-22/html/reg3-eng.html>
- ¹⁶ Inuit Circumpolar Council. (2017). People of the Ice bridge: The Future of the Pikialasorsuaq. <http://pikialasorsuaq.org/en/Resources/Reports>
- ¹⁷ LeTourneau, M. (2019, September 3). Sanikiluaq receives \$5.5 million to advance Qikiqtait stewardship project. Nunavut

News. <https://nunavutnews.com/nunavut-news/sanikiluaq-receives-5-5-million-to-advance-qikiqtait-stewardship-project/>

Notes for Gwich'in Council International: The Caribou Economy

- ¹⁸ Dinero, S. C. (2003). Analysis of a 'Mixed Economy' in an Alaskan native settlement: The case of Arctic village. *Canadian Journal of Native Studies*, 1(XXIII), 135–164.
- ¹⁹ Gwich'in Knowledge of Porcupine caribou: State of current knowledge and gaps assessment. March 2019, Department of Cultural Heritage, Gwich'in Tribal Council.
- ²⁰ Vuntut Gwitchin Government website <https://www.vgfn.ca/caribou.php>
Van Lanen JM, Stevens C, Brown CL, Maracle KB, Koster DS (2012) Subsistence land mammal harvests and uses, Yukon Flats, Alaska: 2008-2010 harvest report and ethnographic update. Technical paper No. 377. Division of Subsistence, Alaska Department of Fish and Game, Anchorage
- ²¹ Mishler, C, Frank, K (2019) *The Man Who Became a Caribou*. International Polar Institute Press.
- ²² Heine, M et al 2007. Gwichya Gwich'in Googwandak: The history and stories of the Gwichya Gwich'in. 2nd edn. Tsiigehtshik and Fort McPherson, NT: Gwich'in Social and Cultural Institute. Gwichya Gwich'in Googwandak: The history and stories of the Gwichya Gwich'in
- ²³ Porcupine Caribou Technical Committee. 2021. Porcupine Caribou Annual Summary Report 2019-2020. Available: <https://www.pcmb.ca/resources>
- ²⁴ WRAY, K., & PARLEE, B. (2013). Ways We Respect Caribou: Teet'it Gwich'in Rules. *Arctic*, 66(1), 68-78. Retrieved January 14, 2021, from <http://www.jstor.org/stable/23594608>
Gwich'in Renewable Resources Board, Gwich'in Traditional Knowledge Projects <http://www.grrb.nt.ca/traditionalknowledge.htm>
- ²⁵ Porcupine Caribou Technical Committee. 2021. Porcupine Caribou Annual Summary Report 2019-2020. Available: <https://www.pcmb.ca/resources>
- ²⁶ Gwich'in Steering Committee <https://ourarcticrefuge.org/about-the-gwichin/where-the-gwichin-live/>
- ²⁷ Dinero, S.C. Indigenous perspectives of climate change and its effects upon subsistence activities in the Arctic: the case of the Nets'ail Gwich'in. *GeoJournal* 78, 117–137 (2013).
Berman, M., Nicolson, C., Kofinas, G., Tetlich, J., & Martin, S. (2004). Adaptation and Sustainability in a Small Arctic Community: Results of an Agent-Based Simulation Model. *Arctic*, 57(4), 401-414. Retrieved January 13, 2021, from <http://www.jstor.org/stable/40512643>
- ²⁸ <https://www.vgfn.ca/caribou.php#documents>.
Vuntut Gwitchin First Nation and Smith, Shirleen, 2010, People of the lakes: stories of our Van Tat Gwich'in Elders/Googwandak Nakhwach'anjoo Van Tat Gwich'in: University of Alberta.
- ²⁹ Gwich'in Steering Committee (2020) Arctic Indigenous Climate Summit Report June 10-14, 2019. Available <https://ourarcticrefuge.org/arctic-indigenous-climate-summit-report/>
Media release: Vuntut Gwitchin Government and Gwich'in Tribal Council Denounce Step Towards Lease Sale of the Arctic National Wildlife Refuge. November 17, 2020 <https://gwichintribal.ca/about-gtc/news/gtc-and-vgg-denounce-step-towards-lease-sale-anwr>
- ³⁰ Mishler, C, Frank, K (2019) *The Man Who Became a Caribou*. International Polar Institute Press.

Notes for Holen: Alaska

- ³¹ McDowell Group 2017. The Economic Value of Alaska's Seafood Industry. Anchorage. P. 4.
- ³² Wolfe, R. J. et al. 2010. The "Super-Household" in Alaska Native subsistence economies, National Science Foundation, ARC 0352611. P. 21, P. 23.
- ³³ Poppel 2006: The Economy of the North, p. 68.
- ³⁴ Fall, J. A. 2018. «Subsistence in Alaska: A 2017 Update.»

- ³⁵ Holen, D. 2017. Subsistence and commercial fisheries through the lenses of culture and economy in three coastal Alaskan communities. Anthropology. Fairbanks, University of Alaska Fairbanks. PhD.
- ³⁶ Fall 2018 op. cit.
- ³⁷ all 2018 op. cit.
- ³⁸ Wolfe et al. 2010 op. cit. p. 21.
- ³⁹ Alaska Department of Commerce, Community, and Economic Development. 2016. Alaska Fuel Price Report: Current Community Conditions.
- ⁴⁰ Holen, D., S.M. Hazell, D.S. Koster. 2012. Subsistence harvests and uses of wild resources by communities in the eastern Interior of Alaska, 2011. ADF&G Division of Subsistence, Technical Paper No. 372.
- ⁴¹ Kleinfeld, J., J. Kruse, and R. Travis. 1983. Inupiat Participation in the Wage Economy: Effects of Culturally Adapted Local Jobs. *Arctic Anthropology*. 20:1-21. Kruse, J. 1991. Alaska Inupiat Subsistence and Wage Employment Patterns: Understanding individual Choice. *Human Organization*, 50:317-326.
- ⁴² Holen 2017. op. cit.
- ⁴³ Fall 2018 op. cit.
- Notes for Harrison: Alaska's Personal Use Salmon Fisheries**
- ⁴⁴ Loring, P. A. et al. 2012. Food Security on the Kenai Peninsula, Alaska. Human Dimensions Lab at the Water and Environmental Research Center: Fairbanks, Alaska, WERC-HD Occasional Report No. 1, 2012.
- ⁴⁵ Harrison, H. L. and P. A. Loring 2016. Urban harvests: food security and local fish and shellfish in Southcentral Alaska, *Agriculture & Food Security*, 5 (1).
- ⁴⁶ Harrison, H. L. and P. A. Loring, 2014. Larger Than Life: The Emergent Nature of Conflict in Alaska's Upper Cook Inlet Salmon Fisheries, *SAGE Open*, 4 (4).
- Notes for Natcher: Canadian Research Perspectives**
- ⁴⁷ Lonner, T. D., 1980. Subsistence as an Economic System in Alaska: Theoretical and Policy Implications. Alaska Department of Fish and Game, Division of Subsistence, Technical Paper Number 67. Anchorage, Alaska. Wheeler, P. and T. Thornton, 2005. Subsistence Research in Alaska: A Thirty-Year Retrospective. *Alaska Journal of Anthropology*, 3:69-103; 70. Natcher, D. C., D. Castro and L. Felt, 2015. Hunter Support Programs and the Northern Social Economy. In Chris Southcott (ed.), *Northern Communities Working Together: The Social Economy of Canada's North*. University of Toronto Press: 189-203.
- ⁴⁸ Labrador Inuit Land Claims Agreement (LILCA), 2005. Queen's Printer for Canada, Ottawa. Nunavut Land Claims Agreement (NLCA), 1993. Queen's Printer for Canada, Ottawa.
- ⁴⁹ Gilchrist, G., M. Mallory and F. Merkel 2005. Can Local Ecological Knowledge Contribute to Wildlife Management? *Case Studies of Migratory Birds. Ecology and Society*, 10(1):20. Ferguson, M. and F. Messier. 1997. Collection and Analysis of Traditional Ecological Knowledge about a Population of Arctic Tundra Caribou. *Arctic*, 50(1): 17-28.
- ⁵⁰ Council of Canadian Academies, 2014. *Aboriginal Food Security in Northern Canada: An Assessment of the State of Knowledge*. The Expert Panel on the State of Knowledge of Food Security in Northern Canada, Council of Canadian Academies. Fall J. 1990. The Division of Subsistence of the Alaska Department of Fish and Game: An Overview of its Research Program and Findings. *Arctic Anthropology*, 27(2): 68-92
- ⁵¹ James Bay and Northern Quebec Native Harvest Research Committee (JBNQNHRC, 1988. Final Report: Research to Establish Present Levels of Harvesting for the Inuit of Northern Quebec, 1976-1980. Quebec James Bay and Northern Quebec Native Harvest Research Committee, Quebec City.
- Notes for Macdonald: Northern Canada**
- ⁵² O'Donnell, V. and R. LaPointe. 2019. Response mobility and the growth of the Aboriginal identity population, 2006-2011 and 2011-2016. National Household Survey: Aboriginal Peoples. Statistics Canada Catalogue 99-011-X2019002.
- ⁵³ Palesch, N. 2016. *Creating Opportunity In Inuit: The Crisis In Inuit Education And Labour Market Outcomes*. Canadian Center for Living Standards. Frenette M. 2003. Access to college and university: Does distance matter? Statistics Canada Catalogue 11F0019MIE -201. Statistics are presented on the proportion of persons with post-secondary education, but in many communities attaining a high school certificate is remains a challenge. O'Donnell, V. and Arriagada, P. 2019. Upgrading and high school equivalency among the Indigenous population living off reserve. *Insights on Canadian Society*. Statistics Canada Catalogue 75-006-X. Bougie, E. 2009. *Aboriginal Peoples Survey, 2006: School Experiences of Off-Reserve First Nations Children Aged 6 to 14*. Statistics Canada Catalogue 89-637-X — No. 001
- ⁵⁴ Bougie 2009. op. cit.
- ⁵⁵ Arriagada, P., and Bleakney, A. 2019. Inuit participation in the wage and land-based economies in Inuit Nunangat. *Aboriginal Peoples Survey*. Statistics Canada Catalogue 89-653-X2019003.
- ⁵⁶ Government of the Northwest Territories. 2019. *Socio-Economic Agreement report*. Yellowknife, Northwest Territories. Southcott, C. (ed.) 2018. Special issue: Dealing with Resource Development in Canada's North, *The Northern Review*. No. 47. Polar Knowledge Canada. 2014. *The State of Knowledge in Northern Canada*. Conference Board of Canada, 2013. *Mining North*. Government of Canada. 2011. *Aboriginal Consultation and Accommodation Updated Guidelines for Federal Officials to Fulfill the Duty to Consult*.
- ⁵⁷ Crown-Indigenous Relations and Northern Affairs Canada. 2019. *Giant Gold Mine Remediation Project. The 2018-19 Annual Report of the Giant Mine Remediation Project*. Southcott, C. 2015. *Resource Development and Northern Communities – An Introduction*. *The Northern Review*. 41: 3-12.
- ⁵⁸ Furgal, C. and T. Prowse. 2008. Chapter 3 Northern Canada. In: *From Impacts to Adaptation: Canada in a Changing Climate 2007*. Natural Resources Canada. Ottawa, Ontario.
- ⁵⁹ Government of Yukon. 2018. *Yukon Tourism Development Strategy. Sustainable Tourism. Our Path. Our Future*. Government of Northwest Territories. 2016. *Tourism 2020 Opening Our Spectacular Home to the World*. Government of Nunavut. *Tourism Development Handbook for Nunavut*.
- ⁶⁰ Elmahdy, Y., J. V. Haukeland, J. and P. Fredman. 2017. *Tourism megatrends, a literature review focused on naturebased tourism*. Norwegian University of Life Sciences. MINA fagrappport 42. *Canadian Geographic*. 2013. *Is Arctic tourism sustainable?*
- ⁶¹ Government of Nunavut. *Nunavut Marine Tourism Management Plan 2016 – 2019*.
- ⁶² Arriagada and Bleakney 2019. op. cit.
- ⁶³ Islam, D. and Berkes F. 2016 *Indigenous peoples' fisheries and food security: a case from northern Canada*. *Food Security* 8:815-826. *Public Policy Forum*. 2015. *Toward Food Security in Canada's North Summary Report*.
- ⁶⁴ Kumar, M. B. et al. 2019. *Harvesting activities among First Nations people living off reserve, Metis and Inuit: Time trends, barriers and associated factors*. Statistics Canada. *Aboriginal Peoples Survey*. Statistics Canada Catalogue 89653X2019001. Natcher, D. 2009. *Subsistence and the Social Economy of Canada's Aboriginal North*. *The Northern Review*. No. 30.
- ⁶⁵ Arriagada and Bleakney 2019. op. cit.
- ⁶⁶ Kumar et al. 2019. op. cit.
- ⁶⁷ Natcher 2009. op. cit.
- Notes for Pilyasov/Kibenko: Reindeer husbandry in the Russian Arctic**
- ⁶⁸ Kibenko Valeriy, GKU YANAO «Scientific Center for the Study of the Arctic», West Siberian Branch of the Federal Scientific Research Center of the Russian Academy of Sciences, Yamal-Nenets Autonomous Okrug, Salekhard.
- ⁶⁹ Pilyasov, A.N., Kibenko V.A. 2020. *The entrepreneurship phenomenon in the Yamal reindeer farming: assessment of the situation, paradoxes and contradictions, choice of the future*.

- Arctic: ecology and economy. 1 (37), 122-135. http://www.gks.ru/free_doc/new_site/business/sx/vsxp2014/vsxp2016.html.
- ⁷⁰ http://www.gks.ru/free_doc/new_site/business/sx/vsxp2014/vsxp2016.html Preliminary results from All-Russian agricultural census-2016. Vol. 2. Regions of the Russian Federation, Number of reindeer in the enterprises of all categories on 2016, July 1.
- ⁷¹ Reinert, E. 2006. The economics of reindeer herding: Saami entrepreneurship between cyclical sustainability and the powers of state and oligopolies. *British Food Journal* 108 (7), 522-540.
- ⁷² Pelto, P. J. *The Snowmobile Revolution: Technology and Social Change in the Arctic*, Menlo Park, California: Cummings. 1973.
- ⁷³ Heikkinen, H. 2006. Neo-Entrepreneurship as an Adaptation Model of Reindeer Herding in Finland. *Nomadic Peoples* 10:187-208.
- ⁷⁴ Acs Z. Jaffe-Feldman-Varga (2009): *The Search for Knowledge Spillovers*. A. Varga. Ed. Universities, Knowledge Transfer and Regional Development. Edward Elgar. Cheltenham. UK. P.36-56.
- Notes for Sara/Turi/Buljo/Oskal/Mathiesen/Aslaksen: Sámi reindeer pastoralism in Norway:**
- ⁷⁵ Authors' affiliation: Ravdna Biret Marja E. Sara: Sámii University of Applied Sciences, University of the Arctic/Ealát Institute/International Centre for Reindeer Husbandry (ICR) and UiT Arctic University of Norway. Ellen Inga Turi and Risten MM Buljo: University of the Arctic/Ealát Institute/International Centre for Reindeer Husbandry (ICR) and Sámi University of Applied Sciences. Anders Oskal and Svein D. Mathiesen: University of the Arctic/Ealát Institute/International Centre for Reindeer Husbandry (ICR). Iulie Aslaksen: Statistics Norway.
- ⁷⁶ Burgess, P., et al. 2018. EALLU - Indigenous youth, Arctic change & food culture: food, knowledge and how we have thrived on the margins. International Centre for Reindeer Husbandry. Eira, I.M.G., Oskal, A., Hanssen-Bauer, I., & Mathiesen, S.D. 2018. Snow cover and the loss of traditional Indigenous knowledge. *Nature Climate Change*, 8, 924-936.
- ⁷⁷ Vistnes, I. and C. Nellemann. 2007. Impacts of human activity on reindeer and caribou: The matter of spatial and temporal scales. *Rangifer Report*, 12: 47-56. Skarin, A. and B. Åhman. 2014. Do human activity and infrastructure disturb domesticated reindeer? The need for the reindeer's perspective. *Polar Biology* 37:1041-1054. Uboni, A., B. Åhman and J. Moen. 2020. Can management buffer pasture loss and fragmentation for Sami reindeer herding in Sweden? *Pastoralism: Research, Policy and Practice*, 10:23.
- ⁷⁸ IPBES 2019. *Global Assessment Report on Biodiversity and Ecosystem Services. Summary for Policy Makers*. Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). IPCC. 2019. *IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse gas fluxes in Terrestrial Ecosystems*.
- ⁷⁹ Degteva, A. et al. 2017: "Indigenous peoples' perspectives". Chapter 7 in *Adaptation Actions for a Changing Arctic: Perspectives from the Barents Area*. Arctic Monitoring and Assessment Programme (AMAP), p. 167-194.
- ⁸⁰ Arctic Council Permanent Participants. 2015. *Ottawa Traditional Knowledge Principles*.
- ⁸¹ Norwegian Agriculture Agency. 2016. *Utfordringer for selvstyre i reindriftsnæringen - Tiltak for å nå mål om bærekraftig reindrift*. Landbruksdirektoratet. Rapport 2016/7. Reinert, E. 2006. The economics of reindeer herding: Saami entrepreneurship between cyclical sustainability and the powers of state and oligopolies. *British Food Journal* 108 (7):522-540.
- ⁸² Sara, M.N. 2015. *Siida ja siidastallan /Being siida – on the relationship between siida tradition and continuation of the siida system*. PhD Dissertation. Universitetet i Tromsø/Norges arktiske universitet.
- ⁸³ Haldorsen, S. 2020. *Utarbeidelse av reduksjonsplan i siidaen. En undersøkelse av reindriftslovens § 60 tredje ledd i forhold til samisk rett*. Masteroppgave i rettsvitenskap. Master thesis. Universitetet i Tromsø/Norges arktiske universitet.
- ⁸⁴ Lenvik, D. 1988. *Utvalgsstrategi i reinflokken*. Dr. agric. avhandling, Norges landbrukshøgskole, Ås. Lenvik, D. & Fjellheim, A. 1988. *Utvalgsstrategi i reinflokken*. 2. Ungsimlenes vekt ved 18 måneder relatert til vekten ved 2 og 6 måneder. – *Norsk landbruksforskning* 1: 263-274. Dobrotvorsky, I. M. 1938. Growth and development of reindeer calves in the conditions of the Malozemelsk tundra (in Russian with English summary) *Trans. Inst. Polar. Agric. Anim. Husb., Fish. & Hunt. Ind. Ser. Reindeer Ind.* 3: 93-98. Elgvin, D.T. 1996: *Reindeer pastoralism in Southern Norway: A model for Northern Norway?* *Acta Borealia*, 13, 109-124.
- ⁸⁵ *Reindriftsnytt* 1/2020. (Reindeer herding news, in Norwegian). Norwegian Agriculture Agency.
- ⁸⁶ Tyler, N. J. C. et al. 2007. Saami reindeer pastoralism under climate change: Applying a generalized framework for vulnerability studies to a sub-arctic social-ecological system. *Global Environmental Change* 17(2):191-206.
- ⁸⁷ Norwegian Agriculture Agency. 2019. *Totalregnskap for reindriftsnæringen*, Rapport 31/2019.
- ⁸⁸ In 2019, related incomes were 9097 NOK. *Totalregnskapet 2020*, Rapport 39/2020. (Data not updated here due to late arrival before publishing of *The Economy of the North 2020*.)
- ⁸⁹ Norwegian Agriculture Agency (2019), table 7.2.12.
- ⁹⁰ Buljo, R. M. M. 2018. *Samisk tradisjonell kunnskap kan være nøkkelen til en bærekraftig samisk reindriftsnæring*. (In Norwegian). Master Thesis in economics and administration. Universitetet i Tromsø/Norges arktiske universitet. Lee, C. C., Yang, J. 2000. Knowledge value chain. *Journal of Management Development*. 19, 783-794.
- ⁹¹ Innst. 377 S (2016-2017). *Innstilling fra næringskomiteen om Reindrift -Lang tradisjon -unike muligheter*. Meld.St.32 (2016-2017).
- ⁹² Sara, R. B. M. E., & Mathiesen, S. D. (2020). *Sámi Gastronomy: the Role of Traditional Knowledge*. *Journal of Gastronomy and Tourism*, 5, 33-49.
- ⁹³ Sara, Lykke and Mathiesen, in prep.
- ⁹⁴ Kramvig, B. and Førde, A. 2020. *Stories of reconciliation enacted in the everyday lives of Sámi tourism entrepreneurs*. *Acta Borealia*, 37, 27-42.
- ⁹⁵ Sara & Mathiesen, op. cit.
- ⁹⁶ Yang, Y., Hobbs, J. E., & Natcher, D. C. (2020). *The Arctic as a food producing region: Consumer perceptions and market segments*. *Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie*.
- ⁹⁷ CBD 1993. *The Convention on Biological Diversity*.
- ⁹⁸ Meld. St. 9 (2020-2021). *Mennesker, muligheter og norske interesser i nord*. p.33.
- Notes for Poppel/Poppel: Gender roles and contributions to the household in Greenland**
- ⁹⁹ *Nature Diversity Act*. 2009.
- ¹⁰⁰ This contribution is based on Poppel, M. (2015): *Changes in gender roles in Greenland and perceived contributions to the household*. Ch. 10 in B. Poppel (ed.) (2015): *SLiCA: Arctic living conditions- Living conditions and quality of life among Inuit, Sami and Indigenous peoples of Chukotka and the Kola Peninsula*. Nordic Council of Ministers, TemaNord 2015:501, pp. 297-318.
- ¹⁰¹ Poppel, M. (2015) op. cit.
- ¹⁰² Poppel, B. et al. 2007. *Survey of Living Conditions in the Arctic: SLiCA Results*. Anchorage: Institute of Social and Economic Research, University of Alaska Anchorage. Kruse, J., et al. (2008) *Survey of Living Conditions in the Arctic, SLiCA*. In: Møller, V., Huschka, D. and Michalos, A.C. (eds.). *Barometers of Quality of Life Around the Globe*. Springer.
- ¹⁰³ Poppel, B. 2006. op. cit. Poppel, B. and J. Kruse (2009): *Some results from the Survey of Living Conditions in the Arctic (SLiCA)*. In: Glomsrød, S. and I. Aslaksen (eds.) (2009): *The*



Dghelishla, or «Little Mountain» (Mount Susitna) overlooking Tikahtnu, or «Big River» (Cook Inlet). Many of Alaska's largest communities are in the Cook Inlet region of Alaska, on what is more commonly being recognized today as Dena'ina Elnena, or Dena'ina country, the land of the Indigenous inhabitants of the region. Photo: Davin Holen

Economy of the North 2008, SA 112, Statistics Norway, pp. 96-97. Snyder, H. T. and B. Poppel: Subsistence in the Arctic – results from SLiCA 2015 in Qeqertarsuaasiaat, Greenland. In: Glomsrød, S., G. Duhaime and I. Aslaksen (eds.) (2017): The Economy of the North 2015, SA 151, Statistics Norway, pp. 119-123.

Notes for Holen/Gartler: Subsistence

- ¹⁰⁴Poppel, B. and J. Kruse. 2008. The importance of a mixed cash- and harvest herding based economy to living in the Arctic – an analysis based on Survey of Living Conditions in the Arctic (SLiCA). In: V. Møller and D. Huschka (eds.): Quality of Life and the Millennium Challenge: Advances in Quality-of-Life Studies, Theory and Research. Springer. Poppel, B. (ed.) 2015. SLiCA Arctic living conditions. TemaNord 2015:501, Nordic Council of Ministers.
- ¹⁰⁵Holen, D. 2014. Fishing for Community and Culture: The Value of Fisheries in Rural Alaska. *Polar Record* 50: 403-13: 409.
- ¹⁰⁶Ramage, J. et al. 2021 (forthcoming) How is your life affected by permafrost thaw? Results from a panarctic survey on the impact of permafrost thaw on subsistence activities.
- ¹⁰⁷Rasmussen, R.O. 2005. Socioøkonomisk analyse af fangererhvervet i Grønland [Socio-economic analysis of the Greenland hunters]. Prepared under contract to the Greenland Home Rule Government, Department of Fisheries and Hunting.

¹⁰⁸Unpublished estimates by O. Murashko. See Dallmann, W. (2009), in *The Economy of the North 2008*, pp. 87-91.

¹⁰⁹Laidler, G., et al. 2009. Travelling and Hunting in a Changing Arctic: Assessing Inuit Vulnerability to Sea Ice Change in Igloodlik, Nunavut. *Climatic Change*, 94, 363–397.

¹¹⁰Ford, J.D. et al. 2006. Vulnerability to climate change in the Arctic: A case study from Arctic Bay, Canada. *Glob. Env. Ch.*, 145-160.

¹¹¹Berger, TR. 1985. *Village Journey. The Report of the Alaska Native Review Commission*, New York: Inuit Circumpolar Conference: 52. Tlingit, Haida and Tsimshian Elders in: Newton, R. G. and Moss, M. L. (eds) 2005 *Haa Atxaayi Haa Kusteeyix Sitee, Our Food Is Our Tlingit Way of Life: Excerpts of Oral Interviews 3rd ed.*, USDA Forest Service, Alaska Region. R10-MR-30, Juneau. pp. viii-x.

¹¹²Ottawa Indigenous Knowledge Principles. Developed and agreed upon by the Arctic Council Permanent Participants for use in the Arctic Council in 2014, updated in October 2018. <https://www.arcticpeoples.com/knowledge#indigenousknowledge>



The highway leads on below the Chugach Mountains in Alaska. Photo: Colourbox

7. Tourism in the Arctic

Derek J. Clark, Mikko Moilanen and Stein Østbye

Introduction

Tourism is an economic, social and cultural phenomenon that requires movement of people. The United Nations World Tourism Organization (UNTWO) defines tourism as the activities of persons travelling to places outside their usual environment for leisure, business and other purposes.¹ Travelers are drawn to the Arctic as an area that is largely untouched and still sparsely populated, where the midnight sun and aurora borealis can be experienced against a rugged backdrop of wilderness. Activities like skiing, mountain walking, dog mushing and berry picking can be enjoyed as visitors take in the natural surroundings, and other attractions are based on the cultural heritage of the Indigenous Peoples. Rapid expansion by airlines, cruise operators and package tour providers has made the Arctic areas increasingly accessible.

Tourists are important economically, providing revenue and employment opportunities, thus reducing the likelihood of outward migration from Arctic regions that have previously been heavily based on traditional resource-based industries. Table 7.1 presents the industries that are associated with tourism in the framework of the United Nation's Tourism Satellite Accounts (TSA).

As tourism increases, it is paramount to balance economic growth with the need for inclusive development and environmental sustainability, and to this end, the UNTWO has developed its work for the promotion of responsible, sustainable and universally accessible tourism geared towards the achievement of the "2030 Agenda for Sustainable Development and Sustainable Development Goals".² Here tourism should make optimal use of environmental resources, maintaining essential ecological processes and helping to conserve natural heritage and biodiversity. Moreover, tourism should respect the socio-cultural authenticity of host communities by conserving their built and living cultural heritage and traditional values and contribute to inter-cultural understanding and tolerance. Last, but not least, tourism should ensure viable, long-term economic operations,



Polar fox. Photo: Colorbox.

providing socio-economic benefits to all stakeholders that are fairly distributed, including stable income-earning opportunities and social services to host communities.³

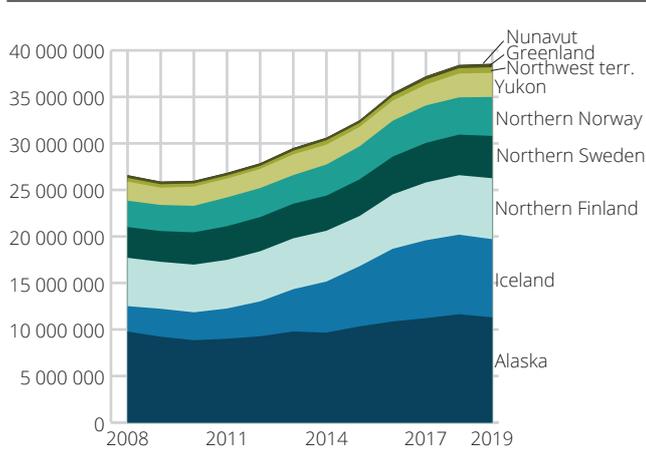
The environmental impact of tourism is especially relevant for the Arctic since it is often the "untouched" nature that tourists flock to experience. Preserving the authenticity of host communities is important due to the many Indigenous Peoples in the Arctic regions, and there is a danger that "Local communities may engage in so called "staged authenticity" to adapt to tourists' demands".⁴ Tourism is an essentially seasonal activity, a factor that must be addressed to provide year-round employment, and long-term economic viability of tourist service providers.

Table 7.1. Tourism industries¹

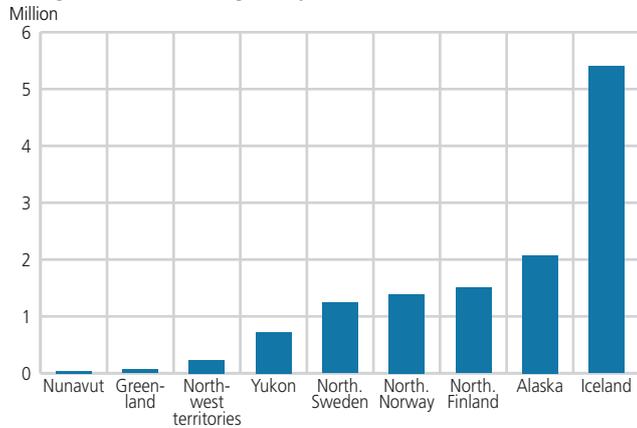
1. Accommodation for visitors
2. Food- and beverage-serving activities
3. Rail, road, water and air passenger transport
4. Transport equipment rental
5. Travel agencies and other reservation services activities
6. Cultural activities
7. Sports and recreational activities
8. Retail trade of country-specific tourism characteristic goods
9. Other country-specific tourism characteristic activities

¹ See Figure 3.1 in "Tourism Satellite Account: Recommended Methodological Framework 2008", United Nations Department of Economic and Social Affairs. https://www.oecd.org/cfe/tourism/TSA_EN.pdf.

Figure 7.1. Overnight stays in the Arctic 2008-2019 and change in annual overnight stays¹



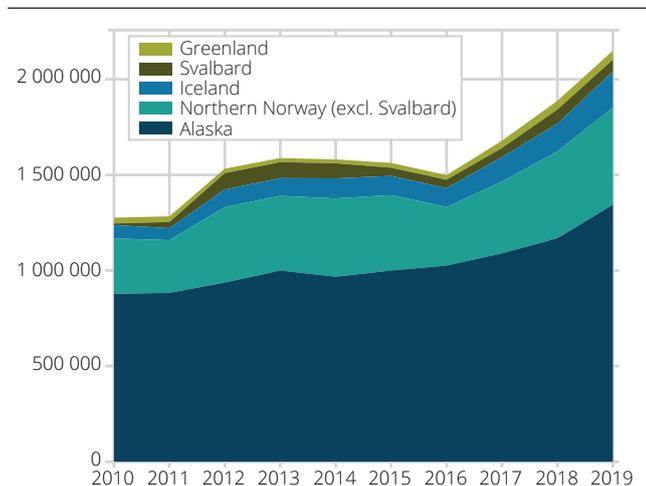
Change in annual overnight stays



¹ Statistics Canada and tourism authorities in Alaska do not register overnight stays. We have estimated number of overnight stays following Müller (2015): Alaska, visitor numbers x 5; Yukon and Nunavut, border crossings x 5; NWT, total visitation x 5.

Sources: Statistical bureaus of Canada, Finland, Greenland, Iceland, Norway, Sweden, Alaska Visitor Volume Reports, Government of Northwest Territories.

Figure 7.2. Number of cruise passengers in main destinations in the Arctic. 2010-2019



Source: Statistics Greenland, The Norwegian Coastal Administration, Icelandic Tourist Board, Alaska Visitor Volume Reports.

Box 7.1: Nordic collaboration – Visit Arctic Europe

Since 2015, the Finnish Lapland Tourist Board, Northern Norway Tourist Board and Swedish Lapland Visitors Board have been involved in an EU-sponsored project designed to increase cross-border cooperation in the Arctic region. Activities in the project have been directed towards marketing the region as a whole, and improving the competence in the areas of digitalization, sustainability, market understanding and product development. In addition, the project seeks to improve transport connections internally and between the countries. One example of this is the establishment from December 2019 of The Arctic Route, a collaboration between three bus companies who operate daily services in the winter season between Tromsø and Narvik, Lyngen, Alta, Rovaniemi, Luleå and Kiruna.¹ This brings visitors to attractions in each country such as Santa Claus Village in Rovaniemi, the Arctic Cathedral in Tromsø, and numerous nature-based activities such as dog sledding and northern lights safaris. The first phase of the project documents an increase of 70 000 new guests to the area as well as an increase in overnight stays of 516 000.²

To recognize these achievements, the EU commission bestowed on the project “The Arctic Award” in the category “Overcoming Critical Mass” in November 2017, and a further phase of the project received funding of 5.3 million Euros stretching into 2021. Visit Arctic Europe II intends to continue the development of Finnish Lapland, Swedish Lapland and Northern Norway as an all year round sustainable and high-quality destination.³

¹ <https://www.thearcticroute.com/>

² <https://interreg.no/2018/09/samarbeid-skaper-vekst-i-den-arktiske-reiselivsnaeringen/>

³ <https://visitarcticeurope.com/>

This chapter looks at recent trends in tourism in the Arctic regions, focusing mainly on the economic impacts and implications of tourist activity. First, we present an overview of the drivers of tourism by looking at the demand and supply sides of the market for tourism as outlined in TSA. Then we consider the developments in each Arctic region, before briefly assessing potential future developments.

We frequently refer to TSA as a source of information.⁵ Another important source of information is data on national and subnational levels published by national statistical bureaus. In addition, a plethora of sources are used to fill in the picture.

Drivers of tourism

The demand side of the market emerges as tourism expenditures paid for consumption goods and services from the industries in Table 7.1. Important

Box 7.2: Tourism policy, infrastructure and accessibility

Strengthening the position of the tourist sector is a priority of governments in Arctic countries. In Sweden, a White Paper in 2017 aimed to “enhance the tourism and hospitality industry’s contribution to economic, social and environmental components of sustainable development throughout the country”.¹ A change of Government has delayed announcement of the new policy which was scheduled to be unveiled in the course of 2020 and fully implemented by 2030. Other countries take a more regional approach, such as Norway whose government in 2019 unveiled a strategy for the future development of Svalbard, emphasizing the impact of tourism on nature and the seasonal pattern associated with the tourist industry.² To enhance sustainability, the strategy recommended to utilize existing capacity as much as possible, so that tourism displays less of a seasonal trait on the islands. In this way, it is hoped that the stream of tourists will be smoothed over the year, in turn leading to a larger proportion of jobs in the tourist industry that employ people all year round.

Tourism policies generally seek to improve access to different markets, and provide necessary infrastructure for providing an attractive experience to visitors. In 2018, the Swedish Lapland Visitors Board followed up the establishment of direct flights to Skellefteå from Rotterdam and to Kiruna from Amsterdam with a targeted campaign on the Dutch market. A Fly & Drive concept was marketed for summer tourists and another targeted at winter ice-skating tourists. This resulted in an increase in Dutch guest nights in Arctic Sweden by 42 per cent.³

Accessibility of tourist attractions in Arctic Finland has improved during the winter season. Several direct international route connections have been opened to the airports of Northern Finland, focusing mainly on Rovaniemi, Kittilä (near Levi), and Kuusamo airports. Direct routes from Europe to Northern Finland have been established since 2015, with seasonal direct flights from London, Paris, Dusseldorf, Berlin, Zurich and Amsterdam. Finnair and Norwegian have also increased their capacity for transporting passengers from Helsinki to Arctic Finland.⁴ From 2016 to 2017, the number of international airport passengers travelling through the capital Helsinki increased by 11.4 per cent, whereas the change was 37.6 per cent for Rovaniemi, 29.1 per cent for Kittilä, and 47.5 per cent for Kuusamo. For summer time tourism, poor accessibility remains a bottleneck.

Cruise traffic generally has a lower regional economic impact than arrivals by air, and these two types of

tourism compete over limited resources in the peak season. The rising cruise trend and limited airport facilities in recent years have been a matter of concern for policy makers in Greenland. The main airport for international travelers is Kangerlussuaq. After decades of political discussions about new airports, the Greenlandic Parliament decided in November 2018 to invest 3500 million DKK in no less than 3 new airports,⁵ corresponding to 40 per cent of the annual GDP (Christensen et al., 2020).⁶ From a tourism perspective, the most important of the new airports is probably Ilulissat. The construction work has started and this new airport is supposed to be opened by the end of 2023. The ambition is to attract direct flights from North America and Europe.

In order to take advantage of the investments in airport capacity, land-based facilities and activities need to be put in place. A report by Nordic consulting group Rambøll in 2014 identified several challenges facing Greenland such as the short tourism season, lack of infrastructure, limited capacity, and a lack of package tours. Insufficient marketing and coordination in the Greenland tourism sector were also highlighted as factors that prevent growth.⁷ Although the new airport will not be operating for another 2 years, steps have to be taken to increase accommodation capacity and provide other infrastructure, stimulating the local economy only indirectly attributable to the tourism industry even in the short run.

¹ “One country to visit - A unified policy for sustainable tourism and the growing tourism industry” SOU 2017: 95 (in Swedish: https://www.regeringen.se/4addac/contentassets/153ef49a58224148be5ae509ebb619b0/sou-2017_95-webb.pdf).

² “Innovation and industrial development on Svalbard”, Department of Trade and Industry and Fisheries, (in Norwegian: <https://www.regjeringen.no/globalassets/departementene/nfd/dokumenter/strategier/innovasjon-og-naringsutvikling-pa-svalbard.pdf>).

³ <https://www.swedishlaplandvisitorsboard.com/nyheter/rekordar-for-besoksnaringen-i-swedish-lapland/>

⁴ <https://thebarentsobserver.com/en/travel/2017/10/bonanza-airports-northern-finland>

⁵ <https://www.dr.dk/nyheder/indland/nye-lufthavne-i-gronland-bliver-realitet-midt-i-politisk-drama>

⁶ Christensen, L., Anker Nielsen, O., Rich, J., Knudsen, M. 2020. Optimizing airport infrastructure for a country: The case of Greenland. *Research in Transportation Economics* 79: 1-25.

⁷ Rambøll Group (2014), «Hvor skal udviklingen komme fra? Potentiale og faldgruber i den grønlandske erhvervssektor frem mod 2015» (in Danish). The issues reported here can be found in «Steaming up or staying cool? Tourism Development and Greenlandic Futures in the Light of Climate Change” Lill Rastad Bjørst and Carina Bregnholm Ren, *Arctic Anthropology*, 52(1), 91-101, 2015.

indicators from the demand side are number of overnight stays, shares of domestic and foreign guests, as well as the occupancy rate in accommodation.

Actors in the tourism industries comprise the supply side of the market, offering goods and services

that visitors might demand. Accommodation services can be provided by a wide array of actors such as hotels, guesthouses, hostels, and campsites. Capacity can be influenced by investment programs or through digital platforms like Airbnb. The number of visitors will be influenced by the capacity, price and perceived quality of transport op-

erators such as airlines and cruise providers. Some parts of the Arctic region can also be accessed by land travel such as rail, or bus/car. Some suppliers may cooperate with other domestic or even cross-border actors to provide attractive offers for tourists. One of these initiatives in the Nordic Arctic region is described in Box 7.1.

To give an initial overview of the development of tourism in the Arctic, consider Figure 7.1 depicting overnight stays in the period 2008-2019 by region.⁶ Clearly, Iceland has been a driving force in the increase in the number of guest nights in the Arctic region. All regions have seen an increase in overnight stays, although not comparable to the increase in Iceland.

Some areas are more dependent on tourists that arrive by sea as illustrated by Figure 7.2, showing that Alaska accounts for roughly half of the number of cruise passengers in the Arctic. Alaska has exhibited steady growth in this type of tourism since 2008, and Northern Norway has experienced an upturn since 2016.

Some of the Arctic countries have introduced strategies for improving the accessibility of their tourist destinations as outlined in Box 7.2.

Iceland: From bust to boom

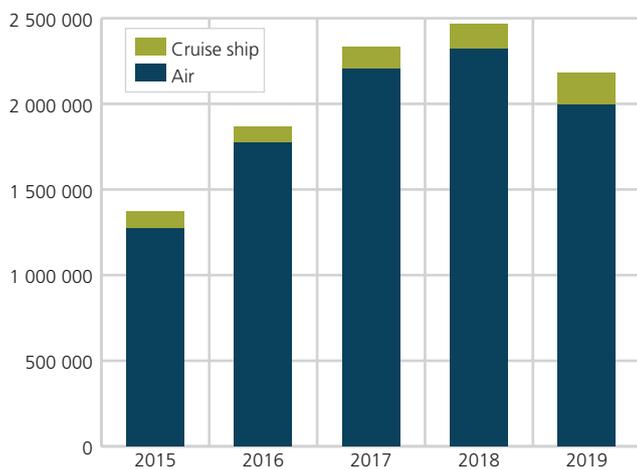
Tourism has been a driving force behind Iceland’s recovery from the financial crisis of 2008, supported by the substantial devaluation of the Icelandic currency in the wake of the crisis. Tourism contributed about 8 per cent directly to GDP each year in

the period 2016-2019. The number of international travelers to Iceland has grown at an average annual rate of 22.4 per cent in the period 2010-2018, with most of the increase due to transport by air. The fall in visitor numbers in 2019 is largely attributable to the bankruptcy of the Icelandic low-cost air carrier WOW air. As Figure 7.3 indicates, the vast majority of foreign tourists access Iceland by air, although the number of tourists arriving on cruise ships has risen in recent years.

Hotel rooms in the capital region of Reykjavik account for about half of the total overnight stays in Iceland, showing an average yearly growth rate of 12.3 per cent in the period 2015-2019. Occupancy rates follow a seasonal pattern that is clearly dominated by the capital region, and in which winter and summer are especially important seasons. Except for 2019, hotels in the capital region had an occupancy rate above 90 per cent in February/March and July/August (Figure 7.4). Additionally, there were approximately 4000 properties to rent on the private market through platforms such as Airbnb in the capital region in summer 2019, with an occupancy rate of 83 per cent, roughly matching the supply of hotel bedrooms in the capital area. The financial crisis coincided with the birth of digital platforms for overnight private rentals and contributed to the boost of tourism.

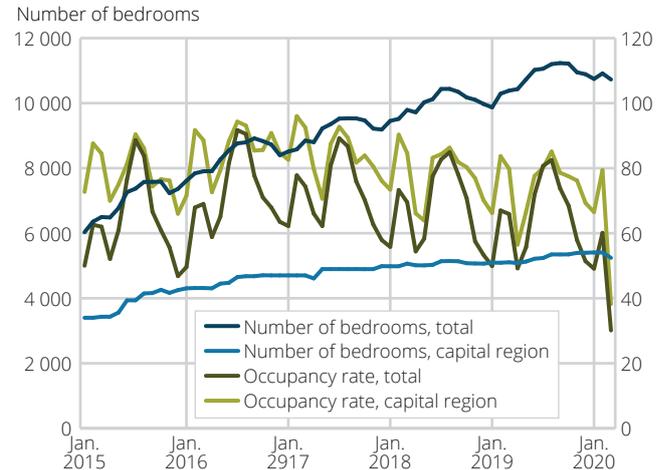
Figures 7.5 and 7.6 illustrate both the rapid growth in the number of overnight stays in Iceland, and their changing seasonal pattern in the period 2010-2019.⁷ Tourism has increased in the summer months, but the largest growth occurs outside of

Figure 7.3. International arrivals to Iceland by mode of transport. 2015-2019



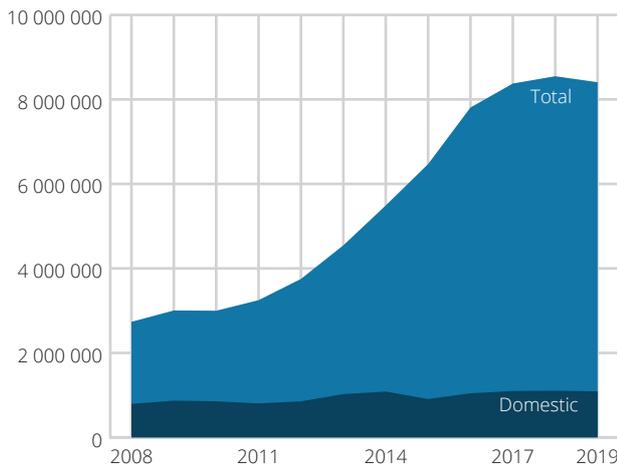
Source: Statistics Iceland.

Figure 7.4. Hotel capacity and occupancy rate. Iceland January 2015-January 2020



Source: Statistics Iceland.

Figure 7.5. Domestic and foreign overnight stays in Iceland. 2008-2019



Source: Statistics Iceland.

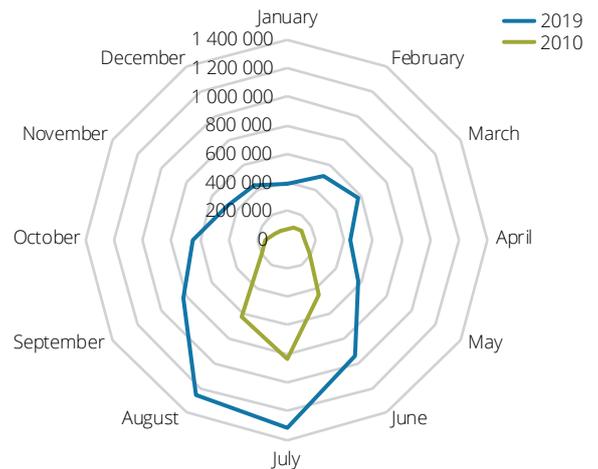
this season. In fact, the number of overnight stays are quite evenly distributed between the autumn, winter and spring seasons, indicating that tourism in Iceland is on the way to being a year-round industry, allowing seasonal variations in tourist related employment to be smoothed if not eliminated.

The rapid expansion of the tourist market has led to an increase in employment in the sector as indicated by Figure 7.7. On average, employment in tourism has risen by 11.8 per cent per year from 2014 to the peak year 2018. However, year on year, employment fell by 6 per cent in 2019. Most jobs in the tourist sector in Iceland are related to the provision of accommodation and food/beverages.

The international market is vitally important for the Icelandic tourist industry, with a steadily increasing share of overnight stays, reaching around 85 per cent in recent years; see Figure 7.8. The steady stream of international visitors is ensured by the fact that two particularly important markets – the UK and USA – prefer different seasons; UK guests mostly come to Iceland in the winter, and US tourists in the summer. Figure 7.8 shows the composition of foreign visitors in 2019, as well as the percentage growth since 2010.⁸ China and the USA are the most rapidly growing tourist groups.

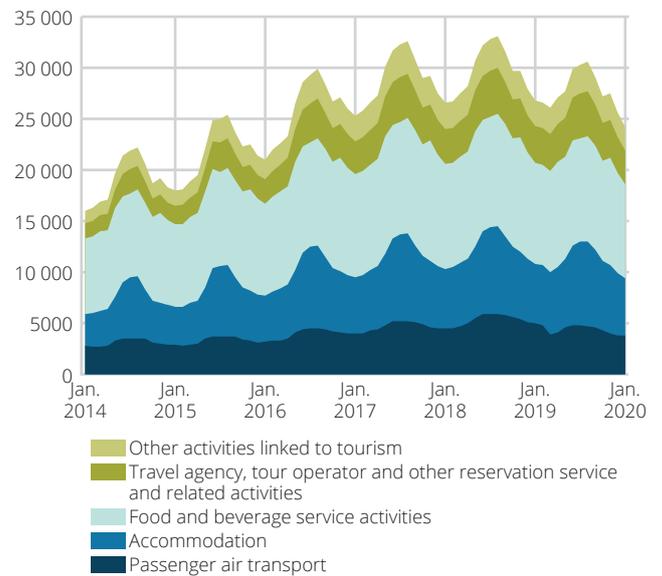
One downside of the rapid growth is the challenge to sustainability and the negative environmental impact. Each year the number of tourists visiting Iceland from abroad is roughly six times the Icelandic population, and this puts pressure on

Figure 7.6. Seasonality measured by number of overnight stays by months. Iceland. 2010 and 2019



Source: Statistics Iceland.

Figure 7.7. Employment related to tourism in Iceland. January 2014-January 2020



Source: Statistics Iceland.

Figure 7.8. Top twenty foreign markets in 2019 and percentage change 2010-2019 in Iceland. Overnight stays



Source: Statistics Iceland.

the natural environment which is one of the main reasons for the tourist boom. Iceland is facing a dilemma in trying to turn mass tourism into sustainable tourism, increasing revenue per tourist rather than by increasing tourist numbers.⁹

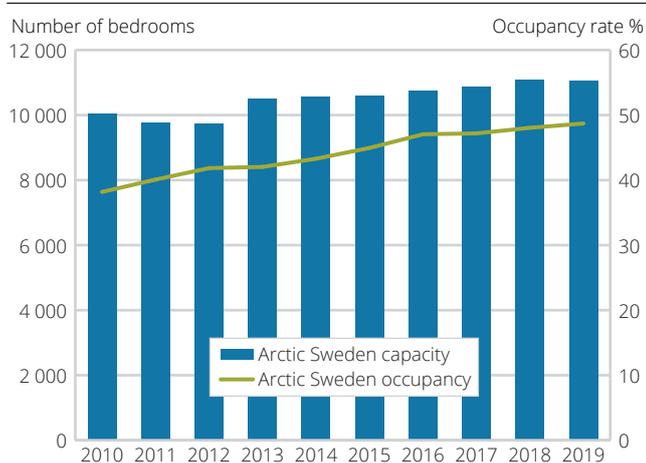
Arctic Sweden: Unrealized potential from foreign markets

Arctic Sweden comprises the counties of Västerbotten and Norrbotten. About 8 per cent of Sweden’s available capacity for housing tourists in 2019 is in these areas, distributed between hotels and holiday villages. Capacity in Arctic Sweden has risen 10 per cent in the period 2010-2019, below the national average of 15.8 per cent. The occupancy rate was 48.7 per cent in the northernmost areas compared to 57.2 per cent on average in Sweden in 2019. The occupancy rate in Arctic Sweden has increased by 10.6 percentage points since 2010, above the national average of 8.1 percentage points (Figure 7.9).

Business customers account for 57 per cent of all guest nights at hotels, compared to the national average of 52 per cent. Domestic customers are important with 75 per cent of hotel stays attributed to Swedish nationals in 2019 (Figure 7.10). Given the reliance on domestic tourism, the low growth and the seasonal pattern of overnight stays in Arctic Sweden in Figure 7.10 is not surprising.

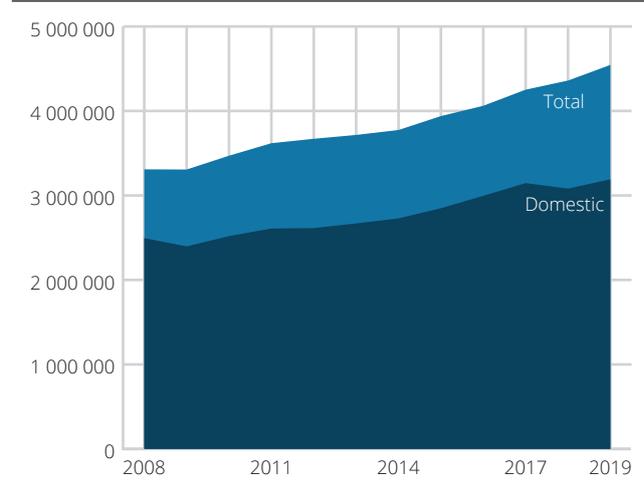
Although a relatively small proportion of hotel guest nights in Arctic Sweden are attributable to foreigners, it would seem to be here that the potential for growth lies. Figure 7.12 indicates the

Figure 7.9. Hotel capacity and occupancy rates. Arctic Sweden. 2010-2019



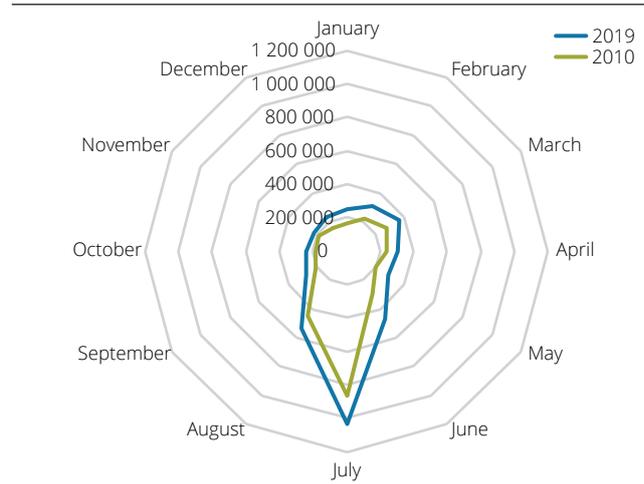
Source: Statistics Sweden.

Figure 7.10. Share of domestic and foreign overnight stays 2010-2019 in Arctic Sweden



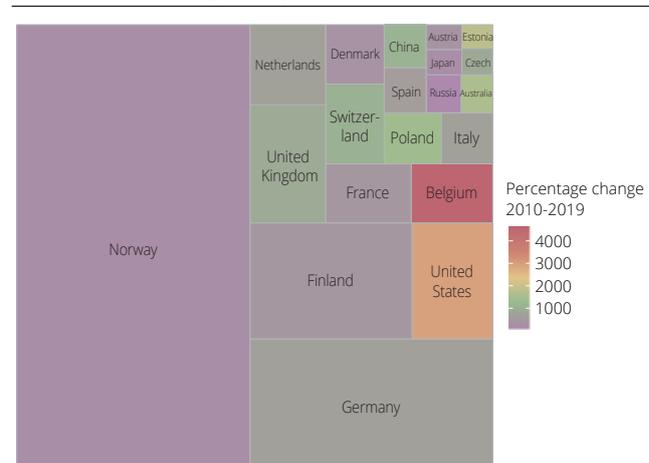
Source: Statistics Sweden.

Figure 7.11. Seasonality measured by number of overnight stays by months. Arctic Sweden. 2010 and 2019



Source: Statistics Sweden.

Figure 7.12. Top twenty foreign markets in 2019 and percentage change 2010-2019 in Arctic Sweden. Overnight stays



Source: Statistics Sweden.

major countries of origin of the largest foreign markets for Arctic Sweden. The number of guest nights has increased by 12.9 per cent from 2010 to 2019 for guests from Scandinavia (except Sweden), 45 per cent for the rest of Europe, and 132 per cent for the rest of the world. There are almost three times as many Chinese guests in 2019 compared to 2010.

Whilst Norwegians are clearly the largest group of foreign visitors to Arctic Sweden, Belgium and the US are the markets that have grown most rapidly since 2010. Of countries with growth potential, China is notable with its current relatively small share of overnight stays in Arctic Sweden.

Arctic Finland: Mass tourism to Santa Claus

Arctic Finland (Lapland, Kainuu and North Ostrobothnia) has specialized in mass tourism at compact resorts. The best-known example is probably Levi in North Lapland, catering for 750 000 visitors per year, mostly in the skiing season.¹⁰ There has also been a large increase in visitors in the months leading up to Christmas, indicating the popularity of the Santa Claus Village in Rovaniemi.¹¹ Accessibility of these attractions has improved during the winter season, especially due to increased air traffic (see Box 7.2).

Hotel capacity has shown a steady increase since 2010, and occupancy rates have increased on a yearly basis since 2014 (Figure 7.13).

Employment is mainly concentrated in the areas of accommodation and restaurant/bar services, although many bus companies are registered in the north, making bus transport an important employer, transporting tourists in and out of the region (see Figure 7.14).

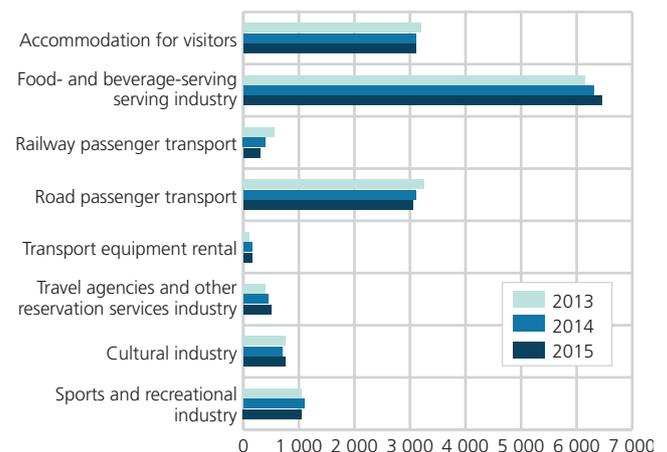
Figure 7.15 shows that international tourism in Northern Finland has grown faster than domestic tourism since 2015. Figure 7.16 indicates the importance of different foreign markets for tourism in Arctic Finland. Since 2010, significant growth has been recorded, especially in the Asian market, and China has overtaken Norway as the fifth largest market (Figure 7.16). This is partly due to a successful cooperation between Visit Rovaniemi and Alitrip, one of the largest online travel booking sites in Asia, belonging to Alibaba Group. A significant UK market has developed in recent

Figure 7.13. Hotel capacity and occupancy rates. Arctic Finland. 2010-2019



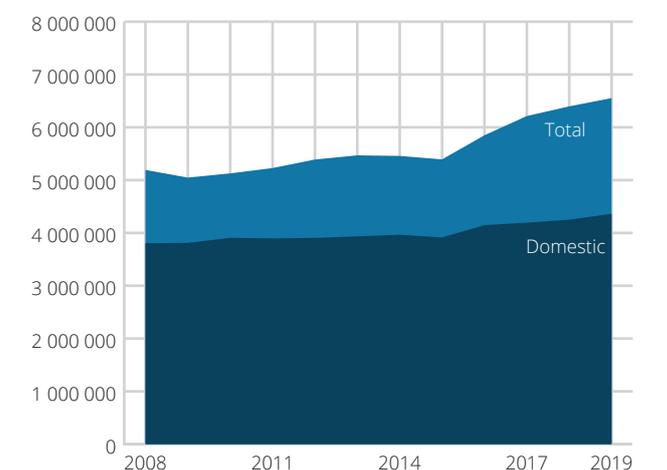
Source: Statistics Finland

Figure 7.14. Employment in tourism industries. Arctic Finland. 2013-2015



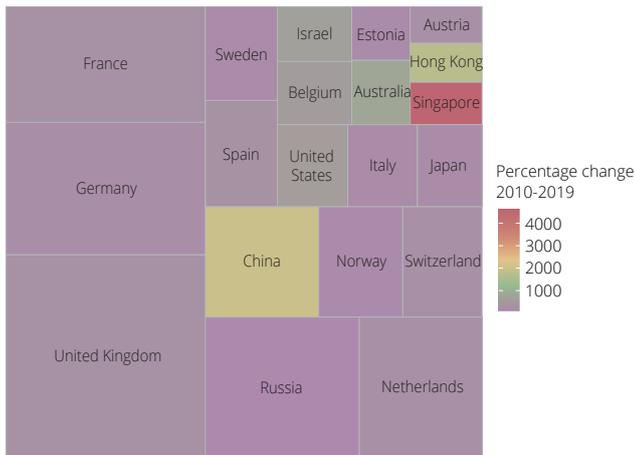
Source: Statistics Finland

Figure 7.15. Share of domestic and foreign overnight stays in Arctic Finland. 2010-2019



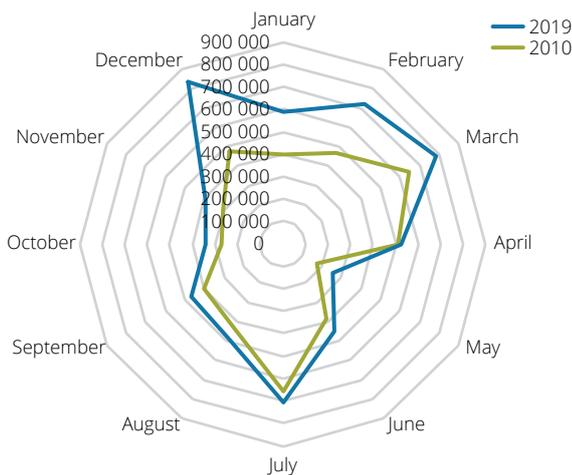
Source: Statistics Finland

Figure 7.16. Top twenty foreign markets in 2019 and percentage change 2010-2019 in Arctic Finland. Overnight stays



Source: Statistics Finland

Figure 7.17. Seasonality measured by number of overnight stays by months. Arctic Finland. 2010 and 2019



Source: Statistics Finland

years, whereas tourism from Russia has not picked up again after the financial crisis. The dependence on only one or two markets has decreased in the last decade, and new emerging markets include the US, Australia and India.

Tourist flows have increased mostly in the winter and spring seasons as indicated by Figure 7.17. Tourism in northern Finland is quite dependent on winter, accounting for nearly two-thirds of annual registered overnight stays. Tourism is also structurally different in winter since the share of international tourists is appreciably higher than the share of domestic ones, and especially in recent years has grown significantly. Summer tourism is quite dependent on the domestic market.



Arctic Norway: The advent of year-round tourism

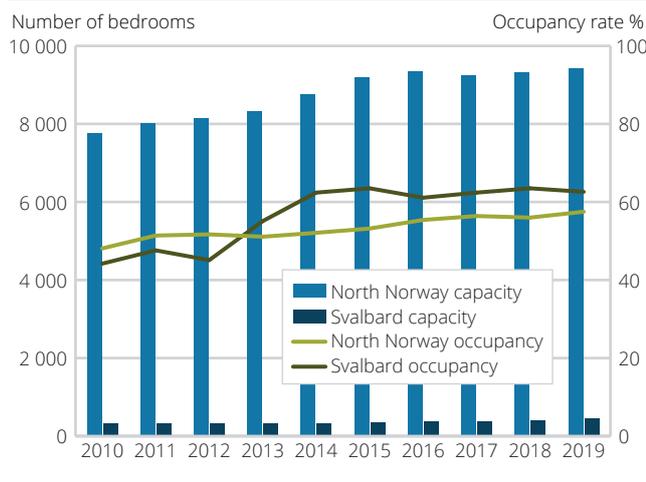
Arctic Norway consists of two counties on the mainland, Nordland and Troms & Finnmark, and the Svalbard islands.¹² Hotel capacity has expanded in the course of the last decade, increasing by 45 per cent on Svalbard and 21 per cent on the mainland in the period 2010-2019. Occupancy rates on Svalbard have been higher than on the mainland in recent years and have stabilized at around 62 per cent since 2014. Occupancy rates in Nordland and Troms & Finnmark have shown a weak upward trend, peaking at 57.5 per cent in 2019 (Figure 7.18).

The share of foreign hotel guests has increased more on Svalbard than on the mainland, peaking at 43.2 per cent in 2019 compared to 30 per cent foreign guests on the mainland. Growth in foreign overnight stays in Arctic Norway has been especially large since 2014 (Figure 7.19). Figure 7.20 indicates that tourists from Germany, Sweden and the US dominate this category, although with rapid growth in the numbers of visitors from China and the US in the decade 2010-2019.

The summer season is most important to Arctic Norway, but there is clear growth in overnight stays in the other seasons in the last decade (Figure 7.21). Arctic Norway seems to be making the transition to a year-round tourist industry, partly driven by the increasing interest in experiencing the northern light, which can best be seen in the dark season.

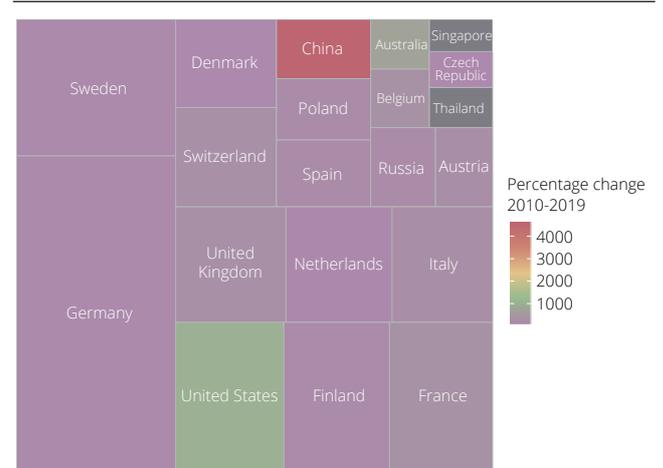
However, there is a concern that tourism might conflict with sustainable development, in particular in vulnerable wilderness on Svalbard. The tourist industry on Svalbard accounted for 54 per cent

Figure 7.18. Hotel capacity and occupancy rates. Northern Norway and Svalbard. 2010-2019



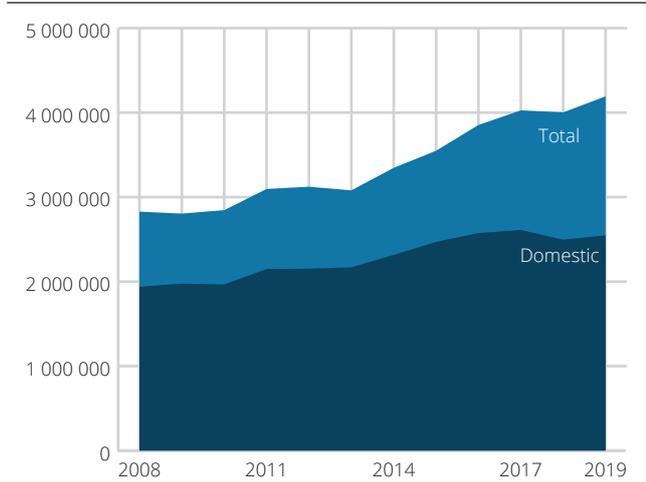
Source: Statistics Norway.

Figure 7.20. Top twenty foreign markets in 2019 and percentage change 2010-2019 in Arctic Norway. Overnight stays



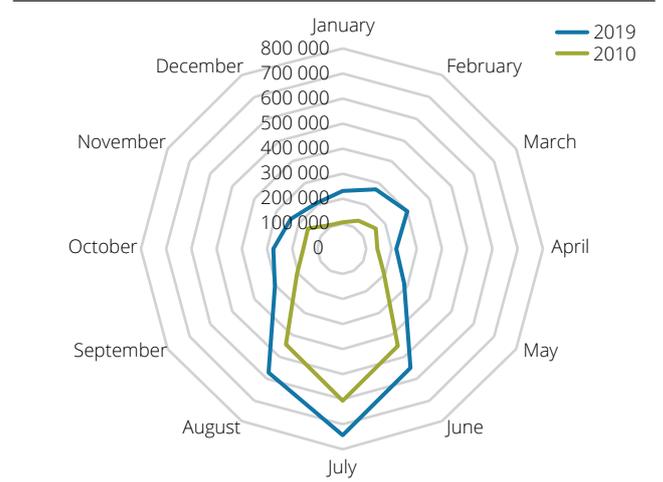
Source: Statistics Norway.

Figure 7.19. Share of domestic and foreign overnight stays in Arctic Norway. 2010-2019



Source: Statistics Norway.

Figure 7.21. Seasonality measured by number of overnight stays by months. Arctic Norway. 2010 and 2019

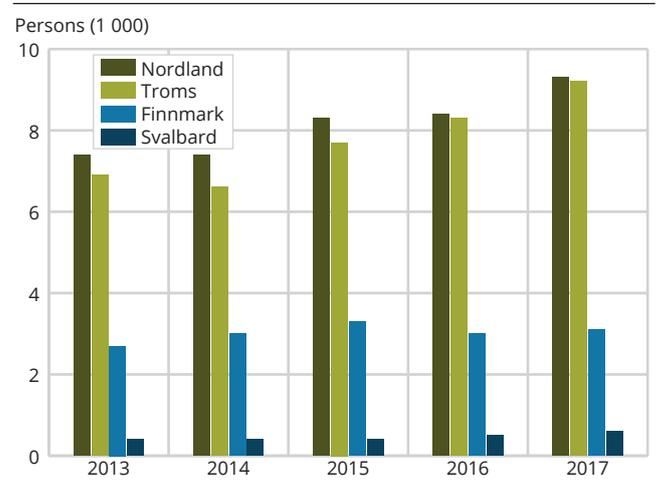


Source: Statistics Norway.

of all employed people in the region in 2017. On the mainland, Troms is the county with the largest proportion of total employees involved in tourism (10.8 per cent), with Nordland and Finnmark both around 8 per cent in 2017. Employment on the mainland has shown a weak upward trend in recent years (Figure 7.22).

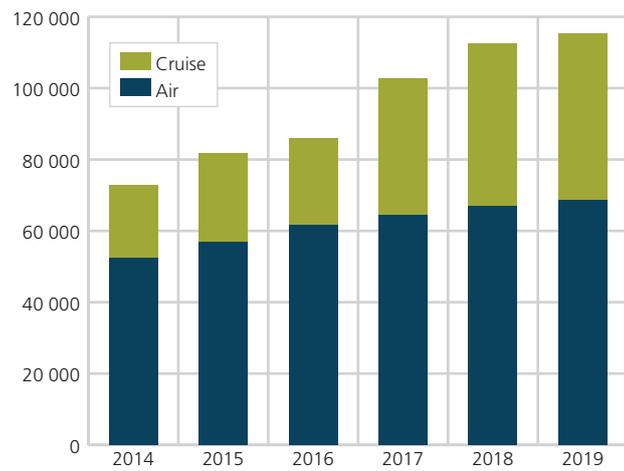
The tourism industry is increasing in importance on Svalbard, especially since the traditional coal mining industry is being closed down. In 2019 there were 155 tour operators registered with activity on Svalbard, an increase of 25 per cent compared to the year before. The operators range from large international companies to one-person enterprises, and about 20 per cent of registered tour operators have an address on Svalbard. Cruise traffic is quite large on Svalbard, although the number of cruise

Figure 7.22. Employed persons in the tourism industry in Arctic Norway. 2013-2017



Source: Statistics Norway.

Figure 7.23. Number of international visitors to Greenland. 2014-2019



Source: Statistics Greenland

passengers arriving in the main city of Longyearbyen was around 40 000 in 2019, down 10 per cent from 2018. On the other hand, there has been an increase in expedition cruises where tourists fly in to Svalbard and then cruise around the islands, often combined with stays in hotels. Around 21 000 tourists participated in this activity in 2019, an increase of 30 per cent compared to 2018. Seventy-six ships were registered with this type of activity in 2019.¹³

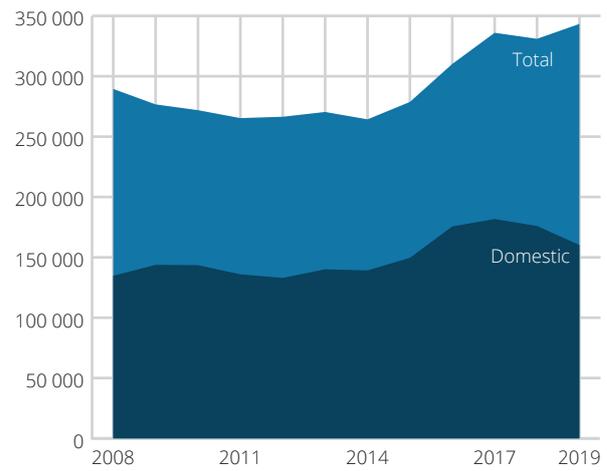
Greenland: A clear strategy for the future

The number of international visitors to Greenland followed a declining trend for several years after the financial crisis in 2008, only interrupted by an increase in 2010 to above the level in 2008. However, there was a steady decline from 2010 to 2014.¹⁴

There has been a continuous increase in number of international visitors since 2014, but the level close to 90 thousand in the previous peak in 2010 was not surpassed until 2017 (Figure 7.23). In 2019, the estimated number of international visitors reached 115 000. The majority of visitors arrive by air, but if we look at the arrivals by mode of transport from 2014, the relative increase has been much higher for cruise visitors with an average annual growth rate of 22 per cent compared to air with 5 per cent.

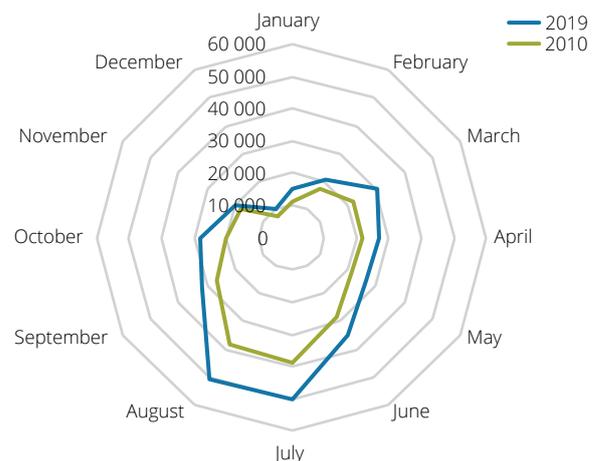
The number of overnight stays in Greenland is illustrated in Figure 7.24 and shows a growth over the last decade; whilst the summer months are dominant, also autumn and spring have grown in importance (Figure 7.25).

Figure 7.24. Share of domestic and foreign overnight stays in Greenland. 2010-2019



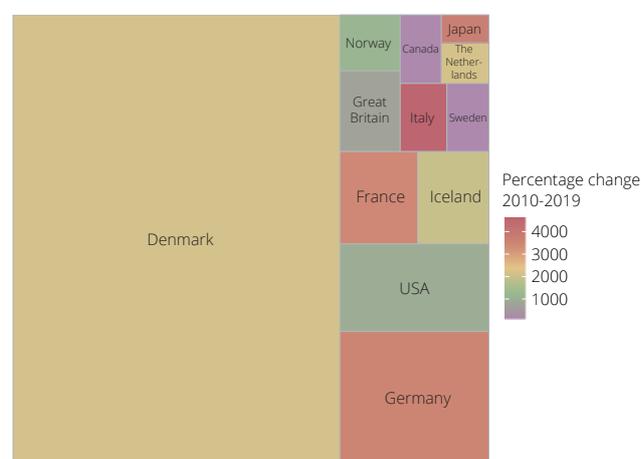
Source: Statistics Greenland

Figure 7.25. Seasonality measured by number of overnight stays by months. Greenland. 2010 and 2019



Source: Statistics Greenland

Figure 7.26. Top twenty foreign markets in 2019 and percentage change 2010-2019 in Greenland. Overnight stays



Source: Statistics Greenland

Figure 7.26 shows that around 2/3 of foreign visitors to Greenland come from Denmark, although the number of visitors from Germany, France and Italy has grown rapidly in the last decade.¹⁵

Arctic Russia: Large potential

The economic impacts of tourism in Arctic Russia are expected to be very low except for the Kola Peninsula (Müller, 2015).¹⁶ The lack of information on tourism from an economic point of view, may be related to regarding tourism more as a cultural phenomenon than an economic activity. The Federal Agency for Tourism was only recently transferred from the Ministry of Culture of the Russian Federation to the Ministry of Economic Development. This is a clear signal that tourism is no longer regarded as a predominantly cultural phenomenon, but also recognized as more important from an economic point of view.¹⁷

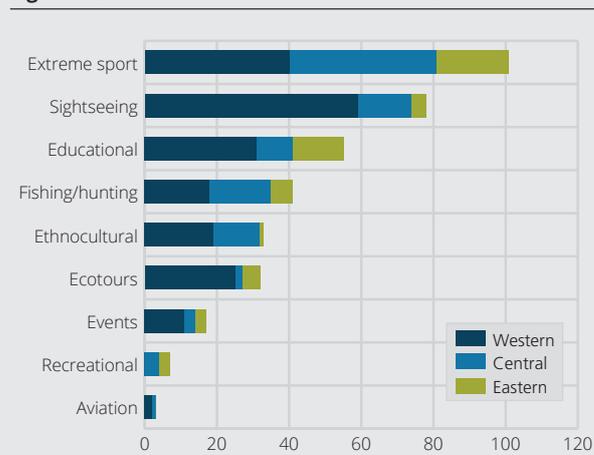
An important attraction is the third largest national park in Russia, established in 2009 and comprising Franz Josef Land and part of Novaya Zemlya. Similar to Svalbard, Arctic Russia stands out as a particular attractive destination for Arctic cruise tourism. In 2011, 11 tours with 800 visitors, among them 90 per cent foreigners, were organized.

In the cruise industry, the supply and quality of terminal facilities are important for attractiveness. In North West Russia, there are two cruise ports: Murmansk and Arkhangelsk.¹⁸ Up until 2016, there was no designated port for cruise vessels in Murmansk, and ships had to dock in a remote fishing harbor. Although less convenient for visitors¹⁹, there was no alternative cruise port, as landing in Arctic Russia coming from the west required customs clearance in Murmansk, the nearest port of entry. A new pier exclusively for cruise vessels was built, and Murmansk was added to the list of ports where visiting cruise tourists were allowed 72 hours visa freedom. However, the number of port calls by foreign cruise ships did not go up as expected, but on the contrary decreased. In 2015, before the new facilities were established, the number of port calls by foreign cruise vessels was 13 with visitors estimated to about 10 000.²⁰ In 2019, the number of port calls by foreign cruise vessels in Murmansk was down to 4.²¹ The disappointing development has most recently triggered a discussion in Russia on alternatives to Murmansk as a gateway to Arctic Russia. The director of the national park suggested

Box 7.3. Tour development in Arctic Russia¹

Kuklina et al. (2017) indicate that Arctic Russia can be divided into three zones: the Western zone (mainly Archangelsk and Murmansk) that border Finland and Norway, the Central zone, and the Far Eastern zone. Regional policy has enhanced the development of infrastructure in the Western zone, so that tourist flows are increasing in this region. In the first nine months of 2015, inbound tourist flows in the Archangelsk region were already 11 per cent above the previous year, and the Murmansk region experienced growth of approximately 10.5 per cent each year on average from 2012-2015. Attracting tourists over time is dependent also upon having a good offer of activities. Figure 7.27 documents the number and types of tourist activities available in Arctic Russia in 2015.

Figure 7.27 Available tours in Arctic Russia 2015



Source: Kuklina et al. (2017). See note 1 (below).

Of the total number 367, 205 tours were available in the Western region, and 106 in the central areas. Extreme sport accounted for 101 of the available activities, and these were well dispersed in all three regions. There were 78 general sightseeing tours, mostly in the Western region.

¹ This section is based on Kuklina, V., Kuklina, M., Ruposov, V, Rogov, V. 2017. Multi-polar trajectories of tourism development within Russian Arctic. *Advances in Economics, Business and Management Research* 38: 379-385.

setting up a security checkpoint on the main island of Franz Josef Land, opening up for direct sailings from Svalbard, saving 3 days of sailing and making Arctic Russia more competitive compared to other Arctic destinations.²²

On the supply side, there is evidence that other efforts also are being made to improve the attractiveness of Arctic Russia besides upgrading cruise port facilities (see Box 7.3). However, given the unresolved institutional issues and conflicts of interest between accommodating for visitors and security related to border control pointed out in the literature, it seems difficult to take out the economic potential, in particular what is related to international tourism.²³

Arctic US: Cruise is still the cornerstone in Alaska

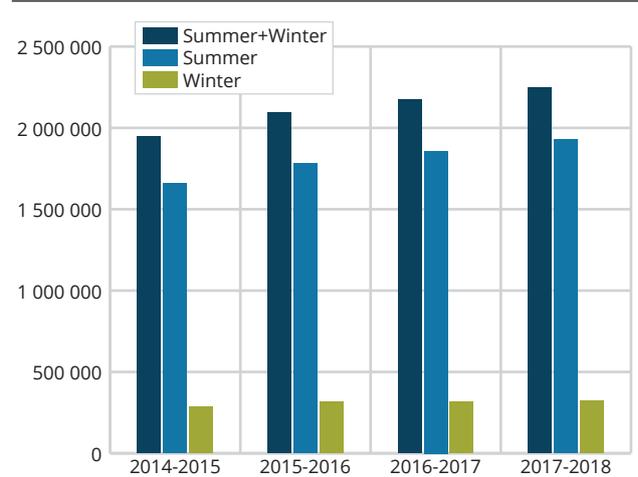
Although the state of Alaska in its entirety is considered an Arctic region, in terms of climate and geography there are at least two distinct parts. Southeast Alaska, called the Alaska panhandle, is the narrow coastal strip bordering British Columbia to the east. Unlike the rest of Alaska, average daytime temperature is above freezing during the winter months in this region. To put things in a European perspective, the panhandle goes from a latitude similar to Kiel in Germany to a latitude similar to Oslo in Norway, one of the popular ferry voyages connecting the European continent to Scandinavia.

As observed in Grimsrud (2015), tourism and travel have become the most important driver of economic growth in Alaska. Visitors typically arrive in summer as cruise passengers (Figure 7.29). From a circumpolar perspective, Alaska is the most important arctic region in terms of the number of overnight stays, and second to Iceland in terms of growth over the period 2008-2019 (Figure 7.1, see also Figure 7.28). However, it is for cruise tourism Alaska in particular excels as shown in Figure 7.2. This was true in 2010 and is still true in 2019, although the rest of the Arctic regions combined closed some of the gap during this period.

The typical cruise tourist to Alaska travels along the coast of the panhandle and stays south of the Gulf of Alaska. The most important cruise ports are Juneau, Ketchikan and Skagway with up to 1.3 million passengers visiting from late April to early October.²⁴ The number of cruise passengers visiting Juneau exceeds by far any cruise destination elsewhere in the Arctic and even in the north of Europe including popular cruise ports like Copenhagen and St. Petersburg. Hiking and wildlife viewing, including whale watching, are major attractions.

A smaller but increasing number of visitors go further north and west to ports closer to Anchorage. In 2018, there were 109 port calls by very large cruise vessels as far north as Seward or Whittier.²⁵ Most of the overall growth in cruise traffic in recent years might be explained by this expansion. An attractive feature of these cruises is that they may be combined with return flights, reducing sailing from two weeks to the 7 day ‘Glacier route’ cruise and offering much greater opportunities to market

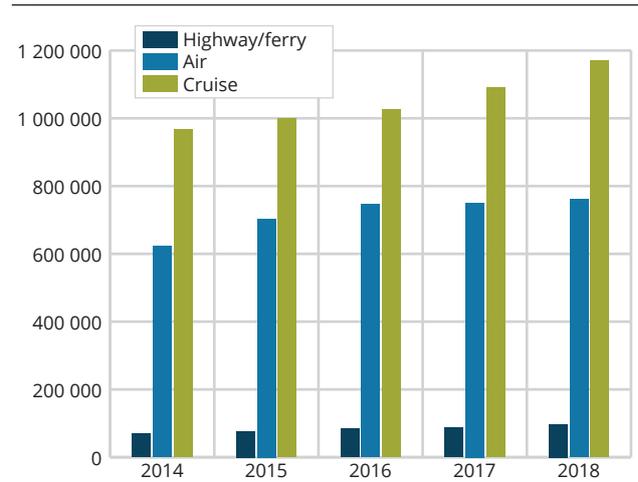
Figure 7.28. Visitors to Alaska during fiscal years 2014-15¹ to 2017-18



¹ 2014-15 numbers for summer season 2014 and winter season 2014-15 (and similar for other years).

Sources: McDowell Group 2018 “Alaska Visitor Volume Report Fall/Winter 2015-16, 2016-17, and 2017-18”. Prepared for Alaska Department of Commerce, Community, and Economic Development. August 2018. McDowell Group 2019 “Alaska Visitor Volume Report Summer 2018”. Prepared for Alaska Department of Commerce, Community, and Economic Development. February 2019.

Figure 7.29 Summer visitors to Alaska by means of travel



Source: McDowell Group 2019 “Alaska Visitor Volume Report Summer 2018”. Prepared for Alaska Department of Commerce, Community, and Economic Development. February 2019.

land packages to Denali National Park and other interior Alaska destinations. Since a cruise is a self-contained, prearranged tourist experience, the stimulus to the regional and local economy depends on onshore spending. A short port call is less important than a longer lasting landing, for example an extensive trip to an interior Alaska destination. Excursions like this have a long tradition in Alaska, starting with the development of motor coach and rail tours to the interior hinterland in the 1960s, supplementing the cruise experience.²⁶

For 2004 the economic impact of travel and tourism on the Alaska economy based on TSAs

have been estimated to 5.6 per cent of Alaska Gross State Product. By the US fiscal year 2012-13, this share had increased to 6.9 per cent²⁷ and further increased by about one percentage-point by 2017.²⁸

Arctic Canada – unexploited potential

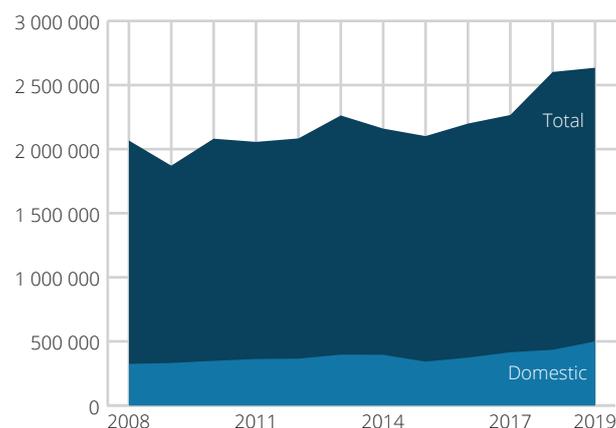
Arctic Canada comprises Yukon, Nunavut and The Northwest Territories. Figure 7.30 provides information on overnight stays for Arctic Canada that is broken down on domestic and foreign visitors. Initially, domestic overnight stays were relatively constant from 2008 but show a weak upward trend 2015-2019. The number of visits from foreigners has shown a larger variation but seems to lie at the heart of the increase in overnight stays recorded since 2017. The seasonal pattern of stays in Arctic Canada has changed little between 2010 and 2019 (Figure 7.31), with the winter months still witnessing small numbers of tourists. The largest foreign market in 2019 was the United Kingdom, although there has been little growth in visits during the last decade. China is becoming an increasingly important source of foreign visitors, both in current market share and in terms of growth between 2010 and 2019 (Figure 7.32). Mexico and India are also rapidly developing customer segments.

We now look at Yukon, Nunavut and NWT in more detail.

Yukon

The tourism sector in Yukon continued to grow in 2019. Over 500 000 travelers entered the territory, US citizens representing nearly a quarter, followed by Canadians and overseas visitors.²⁹ The US historically accounts for about 70 per cent of Yukon’s annual international border crossings.³⁰ Data for the first ten months of 2019 also showed growth in air arrivals at Whitehorse airport, up 7 per cent from the year before.³¹ From 2010 to 2019, the estimated annual overnight stays in Yukon have grown by 727 000 guest nights, see Figure 7.1. The most important factors behind the growth were favorable exchange rates, increased interest in Alaskan cruises (many of them are offering tours to Yukon), and favorable economic conditions in many of the markets. Tourism accounted for 2.7 per cent of gross domestic product in Yukon in 2014.³² Total visitor spending in Yukon reached 348 million CAD in 2018, nearly eight per cent over 2017.³³

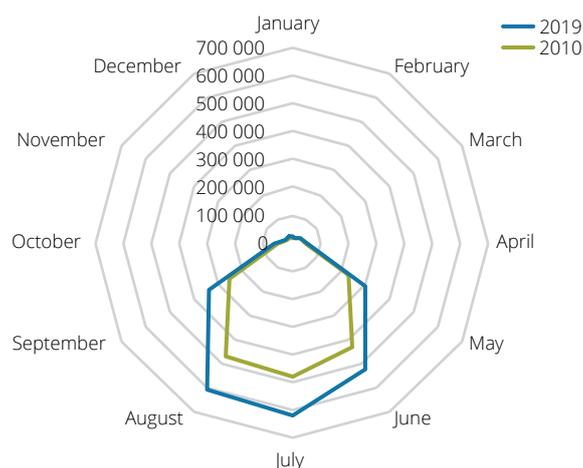
Figure 7.30. Share of domestic and foreign overnight stays in Arctic Canada. 2008-2019¹



¹ Statistics Canada does not register overnight stays. We have estimated number of overnight stays following Müller (2015): Yukon and Nunavut, border crossings x 5; NWT, total visitation x 5.

Source: Statistics Canada.

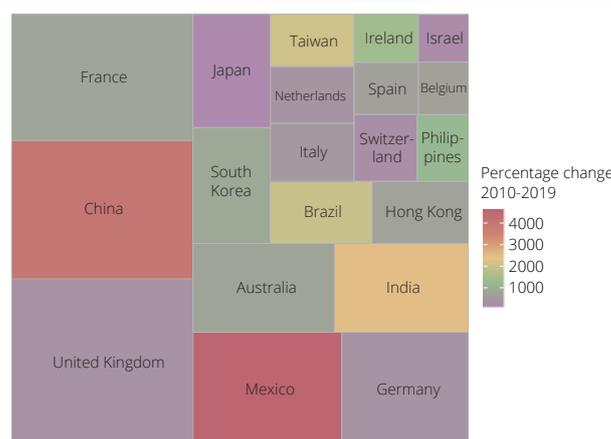
Figure 7.31. Seasonality measured by number of overnight stays by months. Arctic Canada (Yukon and Nunavut). 2010 and 2019¹



¹ Statistics Canada does not register overnight stays. We have estimated number of overnight stays following Müller (2015): Yukon and Nunavut, border crossings x 5; NWT, total visitation x 5.

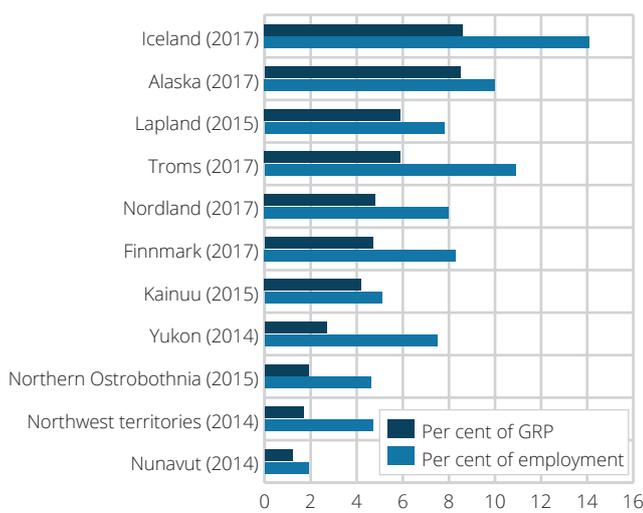
Source: Statistics Canada.

Figure 7.32. Top twenty foreign markets in 2019 and percentage change 2010-2019 in Arctic Canada. Non-resident travelers entering Canada, by country of residence except the US.



Source: Statistics Canada

Figure 7.33. Share of tourism in gross regional product (GRP) and employment for Arctic regions



Iceland: Statistics Iceland; Northern Finland: Statistics Finland; Northern Sweden: Statistics Sweden; Northern Norway: Statistics Norway; Arctic Canada: Statistics Canada; Greenland: Statistics Greenland; Alaska: Economic impact of Alaska’s visitor industry 2017: https://www.commerce.alaska.gov/web/Portals/6/pub/TourismResearch/VisitorImpacts2016-17Report11_2_18.pdf?ver=2018-11-14-120855-690

Nunavut

Canadian residents, including people who live in Nunavut, made about 134 thousand visits to Nunavut in the second and third quarters of 2018. Over two-thirds of all visits by Canadian residents were in the summer season. Residents from other provinces and territories made up slightly under one-third of all visits to Nunavut by Canadians. Visitors from outside of Canada made 7 800 visits to Nunavut (5.5 per cent of all visits to Nunavut).³⁴ Nunavut had 37 000 more overnight stays in 2019 than in 2010, see Figure 7.1. In Nunavut, 2 per cent of GRP is attributable to tourism (Figure 7.33).

In 2019, 13 ships conducted 23 voyages throughout Nunavut, carrying a total of approximately 4200 cruise passengers.³⁵ Against other Arctic cruise destinations, the amount of marine tourism in Canada’s Arctic is minimal. One of the primary barriers to development in Nunavut is that the territory does not have the kind of marine support infrastructure that Alaska, Greenland or Svalbard or Norway can offer.³⁶

Northwest Territories (NWT)

The 2018/19 fiscal year represented an all-time high for visits to NWT, with 120 000 travelers recorded. This is a 7 per cent increase from the previous year. Compared to 2010, the region now has 234 000 more yearly overnight stays (Figure 7.1). Winter tourism is developing, although numbers are still small. The tourism authorities report that it is particularly the number of visitors who come to see northern lights that is increasing; 34 900 visitors travelled to NWT to see the Aurora in the fiscal year 2018/2019, with most of them visiting the Yellowknife area.³⁷ This development has resulted in private sector investments to increase accommodations in Yellowknife in response to growing demand during peak Aurora seasons. The other regions of NWT have also benefited from this trend and car rental companies have experienced increased demand. The primary focus is the domestic market, which currently generates the largest number of visitors. However, marketing efforts focus on international markets, which are attractive because of higher spending per visitor.³⁸



Kasilof River. Photo: Davin Holen

Final remarks

The economic impact that tourism has on the Arctic region is summarized in Figure 7.33 which shows the most recent figures for the contribution of tourist industries to gross regional product and their share of regional employment.

In 2014, Alaska was the clear leader in the region with a 7 per cent contribution to gross regional product.³⁹ In the meantime, Iceland has caught up, increasing tourism's contribution to GRP from 4.5 per cent in 2013 to approximately 8 per cent in 2017. The same share is found in Alaska, but with a lower share of employees. The counties comprising mainland Arctic Norway have a roughly similar contribution to gross regional product in 2017 as in 2011, and the county of Troms has a relatively large employment share in the latest figures. Lapland increased its share of GRP from 3.5 per cent in 2006 to 5.6 per cent in 2015; this is on par with Troms, but Troms achieved this result with a lower share of employed resources. Kainuu has increased its contribution to GRP by about 1.5 percentage points since the last survey in 2006, and North Ostrobothnia is at the same level. Tourism in Arctic Canada contributes relatively little to the gross regional product; the number reported in Figure 7.18 is not comparable with the (previous) survey of 2006 due to a change in data collection and registration.



Husavik, North Iceland. Photo Gérard Duhaime, 2008

In 2019, forecasts for future development in the global tourism industry reflected a cautious optimism, with UNTWO predicting 3-4 per cent growth in international tourist arrivals in the world as a whole in 2020.⁴⁰ The onslaught of the COVID-19 pandemic saw an initial slowdown in tourist numbers since China banned travel in January 2020, and most other countries followed suit in March.

It is currently unclear to what extent tourism will be hit by the global economic downturn, with global GDP projected to fall between 6-7.75 per cent in 2020. A meta-analysis of international demand for tourism estimated that on average, the change in demand for tourism is 2.5 times the change in income, so that the projected fall in tourism de-

mand in 2020 will be 15-19.4 per cent.⁴¹ Since travel to Arctic regions may be regarded as "last chance" tourism due to for example global warming and the melting of Arctic glaciers, the effect might be mitigated by a post-pandemic rebound.

On the supply side, many of the firms that operate tourism services in the Arctic region are small and might have difficulty in surviving the current crisis. Widespread bankruptcies will reduce the amount of activities that are on offer, particularly critical for the Arctic regions, which rely heavily on adventures. Hence, it may take time to build up the demand and the supply sides of the tourist market. The recovery in the industry is expected to be led by domestic tourism, since travel restrictions will be eased internally first.

Notes

- ¹ No minimum length of stay is imposed, but tourism has a maximum length of stay of one year according to “Tourism Satellite Account: Recommended Methodological Framework 2008”, United Nations Department of Economic and Social Affairs. https://www.oecd.org/cfe/tourism/TSA_EN.pdf
- ² See <https://www.unwto.org/tourism4sdgs>
- ³ See <https://www.unwto.org/sustainable-development>
- ⁴ Kristine Grimsrud, “Tourism in the Arctic: economic impacts”, in *The Economy of the North 2015*, p.137.
- ⁵ TSA is an accounting framework aimed at describing economic activity that is a result of tourism in quantitative terms. Although available for a large number of countries on an annual basis, data on a subnational level (Arctic regions) is unfortunately rarely available.
- ⁶ An overnight stay is each night a tourist (resident or non-resident) actually spends (sleeps or stays) in a tourist accommodation establishment or non-rented accommodation (Eurostat). Overnight stays accommodation offered through web based sharing platform solutions, like Airbnb, are not included in these statistics. Owing to different statistical measures, it is difficult to create a comprehensive picture of Arctic tourism. European statistical services use overnight stays as their main measure of magnitude of tourism. We have used same calculation method as Müller (2015) when estimating the number of overnight stays in Arctic regions in US and Canada (Müller, D.K. 2015. Issues in Arctic tourism. In B. Evensgård, J. Nymand Larsen, Paasche, Ø. (Eds.) *The New Arctic*, pp. 147-158, Cham: Springer. Data for Arctic Russia has not been available.
- ⁷ There was a fall in tourist numbers in 2019 but this has been partly outweighed by the fact that the average length of stay has increased by 4 per cent year-on-year from 2018 to 2019.
- ⁸ The size of the box indicates the share, and color indicates band of growth.
- ⁹ See the report by Arion Research suggesting the need to change consumer behaviour: <https://www.arionbanki.is/english/markets/research/research-more/2019/09/13/Tourism-in-Iceland-Modest-angle-of-attack/>
- ¹⁰ <https://www.levi.fi/en/info/general-information.html>
- ¹¹ <https://thebarentsobserver.com/en/industry/2015/11/santas-beds-are-fully-booked>
- ¹² The counties of Troms and Finnmark were merged on 1st January 2020.
- ¹³ Office of the Governor of Svalbard.
- ¹⁴ Grimsrud op. cit. Figure 8.10.
- ¹⁵ See Box 7.2 for attempts to improve the accessibility of Greenland to foreign visitors.
- ¹⁶ Müller, D.K. 2015. Issues in Arctic tourism. In B. Evensgård, J. Nymand Larsen, Paasche, Ø. (Eds.) *The New Arctic*, pp. 147-158, Cham: Springer
- ¹⁷ Sheresheva, M.Y. 2020. Coronavirus and tourism. *Population and Economics* 4(2): 72-76.
- ¹⁸ According to a survey from 2013, foreign visitors were much more satisfied visiting the Arkhangelsk region (90 per cent high) than the Murmansk region (40 per cent high). Agency of Tourism, cited by Lamers and Pashkevich, 2018. On the other side, port duties in Arkhangelsk were 3 to 4 times higher than in Murmansk and St. Petersburg.
- ¹⁹ Facilities in Arkhangelsk is also planned to be improved (Lamers and Pashkevich, 2018).
- ²⁰ <https://thebarentsobserver.com/en/travel/2018/02/murmansk-and-arkhangelsk-fail-attract-foreign-cruise-vessels>
- ²¹ <https://thebarentsobserver.com/en/travel/2019/07/russia-eyes-own-fleet-arctic-cruise-liners>
- ²² <https://thebarentsobserver.com/en/arctic-travel/2019/09/national-park-leader-eyes-mass-tourism-russian-arctic-calls-visa-free-regime>
- ²³ Pashkevich, A., Stjernström, O. 2014. Making Russian Arctic accessible for tourists: analysis of the institutional barriers. *Polar Geography* 37(2): 137-156. Lamers, M., Pashkevich, A. 2018. Short-circuiting cruise tourism practices along the Russian Barents Sea coast? The case of Arkhangelsk. *Current Issues in Tourism* 21(4): 440-454.
- ²⁴ The projection for 2019 was a 16 per cent increase over 2018 amounting to 175000 more passengers (<https://www.alaskajournal.com/2019-01-22/huge-leap-alaska-cruise-traffic-expected-2019>). Actual numbers turned out to be higher, about 200000. The projection in late 2019 for 2020 before the Corona situation arose, was an additional 6 per cent increase (<https://www.alaskapublic.org/2019/09/18/even-more-cruise-ships-are-coming-to-alaska-in-2020/>)
- ²⁵ <https://akcruise.org/2018/03/17-ships-will-cross-gulf-alaska/>
- ²⁶ Munro, J.M., Gill, W.G. 2006. The Alaska cruise industry. In R.K. Dowling (Ed.) *Cruise Ship Tourism*, pp. 145-159. Wallingford: CABI.
- ²⁷ Grimsrud op. cit. p. 144.
- ²⁸ See https://www.commerce.alaska.gov/web/Portals/6/pub/TourismResearch/VisitorImpacts2016-17Report11_2_18.pdf?ver=2018-11-14-120855-690
- ²⁹ Statistics Canada. Table 24-10-0041-01 International travellers entering or returning to Canada, by type of transport
- ³⁰ 2020-21 Fiscal and economic outlook – Government of Yukon: <https://yukon.ca/sites/yukon.ca/files/fin/fin-2020-21-budget-fiscal-economic-outlook.pdf>
- ³¹ Yukon Tourism Visitation Report Jan-Sep 2019: <https://yukon.ca/en/yukon-tourism-visitation-report-january-september-2019>
- ³² Statistics Canada, Table 24-10-0042-01.
- ³³ Tourism Yukon 2018 year-end report: <https://yukon.ca/en/tourism-yukon-2018-year-end-report>
- ³⁴ Annual Tourism Report 2018-2019: [https://assembly.nu.ca/sites/default/files/TD-209-5\(2\)-EN-2018-2019-Annual-Report-Tourism.pdf](https://assembly.nu.ca/sites/default/files/TD-209-5(2)-EN-2018-2019-Annual-Report-Tourism.pdf)
- ³⁵ Eye on the Arctic: <https://www.rcinet.ca/eye-on-the-arctic/2020/06/01/scrapped-2020-cruise-season-will-cost-communities-in-nunavut-canada-almost-1-million/>
- ³⁶ Northern Public Affairs: <http://www.northernpublicaffairs.ca/index/responsible-cruise-tourism-development-in-nunavut/>
- ³⁷ Northwest Territories Visitation and Spending: https://www.iti.gov.nt.ca/sites/iti/files/indicator_-_nwt_visitation_and_spending_-_5-year_to_2018-19_-_final.pdf
- ³⁸ Pursuing Spectacular Potential - Northwest Territories Tourism 2019/20 Marketing Plan: https://www.iti.gov.nt.ca/sites/iti/files/nwt_tourism_2019_20_marketing_plan.pdf
- ³⁹ Grimsrud op. cit. Figure 8.18..
- ⁴⁰ <https://webunwto.s3.eu-west-1.amazonaws.com/s3fs-public/2020-01/Barometro-Jan-2020-EN-pre.pdf>
- ⁴¹ Bo Peng, Haiyan Song, Geoffrey I. Crouch, and Stephen F. Witt, 2014. “A Meta-Analysis of International Tourism Demand Elasticities”, *Journal of Travel Research*, 1–23.

8. Transportation, infrastructure and permafrost degradation in the Arctic

Nadezhda Zamyatina, Ryan Macdonald, Alexander Pilyasov, Dmitry Streletskiy and Luis Suter

Historic background for transport in the Arctic

Nadezhda Zamyatina, Lomonosov Moscow state university

It is important to understand that, as a rule, “lonely” transport routes arose in response to some kind of emergency, which made it possible to side-step the economic inefficiency. For example, a number of highways were built during war times for strategic reasons. The railway to the city of Murmansk was built during the 1st World War, when a new outlet to the sea was required to replace the Baltic Sea, where the fighting was going on. During World War II it was necessary to improve communication with Alaska, which received a strategic position of an outpost in the war with Japan, leading to the Trans-Alaska Railway. Also in War II, the coal deposits in the Donbass were occupied and required accelerated development of coal deposits in the Pechora basin, leading to the railway line approaching the city of Vorkuta.

Another common type of conditions giving rise to new transport projects is the discovery of large mineral deposits. To rapidly get large volumes into economic circulation allows for a frontier effect that justifies the costs of building the highway. Often this frontier stage of territory development coincides with high prices for the corresponding resource. Hence, the first railways of Alaska and Yukon in Canada were built during the “gold rush”. Other examples are the Trans-Alaskan oil pipeline built shortly after the “oil crisis” of the 1970s, the Kolyma highway to the rich gold fields of Kolyma, as well as the roads and railways of Western Siberia, which were built quickly during the years when the richest oil and gas reserves of this region were developed, including the most recent development of the large natural gas fields on the Yamal Peninsula, where not only gas pipelines, but also a railway were extended.

Infrastructure in Northern Canada

Ryan Macdonald, Statistics Canada

There is limited infrastructure in Northern Canada, and this affects economic development, the cost of goods and services, and the cost of doing business. All weather road access is not available to many communities, and suitable housing is lacking in many instances.¹ Whitehorse, Yellowknife and Nunavut have reliable power generation connected to regional power grids (or micro grids in the case of Iqaluit) while in many cases remote communities rely on diesel power generation for electricity. Diesel generation reliance is more common in Nunavut than in Northwest Territories or Yukon.²

In terms of power grids, Yukon has the most developed power generation and transmission system followed by Northwest Territories and then Nunavut. The Yukon Electric Corporation is examining the use of thermal generation and solar arrays and has invested in liquefied natural gas facilities to replace diesel generators in Whitehorse.³ The Vuntut Gwitchin have also undertaken projects to reduce diesel generator use and have invested in a solar panel array for summer electricity generation. The implementation of the array has, however, been delayed due to the Covid-19 pandemic.⁴



The Tshiuetin train leaves Schefferville for Sept-Îles, Quebec. Photo Gérard Duhaime, 2011



Cargo container ship, Alaska. Photo: Colourbox

In Northwest Territories, the Northwest Territories Power Corporation maintains three sets of hydro generation and/or transmission systems: Snare system; Bluefish hydro; and, Taltson hydro. It has also invested in low-carbon and alternative energy production with the goal of reducing the environmental impacts associated with diesel generators.⁵ This includes an LNG plant in Inuvik and solar arrays in Fort Simpson, Colville Lake, Wrigley and Aklavik. In Nunavut, the Qulliq Energy Corporation (QEC) maintains micro grids in communities that run diesel generators for electricity needs.⁶ QEC has implemented a demonstration solar panel array in Iqaluit and plans to install a solar array in Kugluktuk.

Whitehorse and Yellowknife have all weather road connections which permits truck transportation for importing goods. This lowers the cost of transportation and increases the regularity with which goods, particularly bulky, heavy goods can be delivered. In Nunavut and many parts of Northwest Territories, shipping and travel are dependent on air and water, as there are no road connections, or only during periods with winter ice roads.

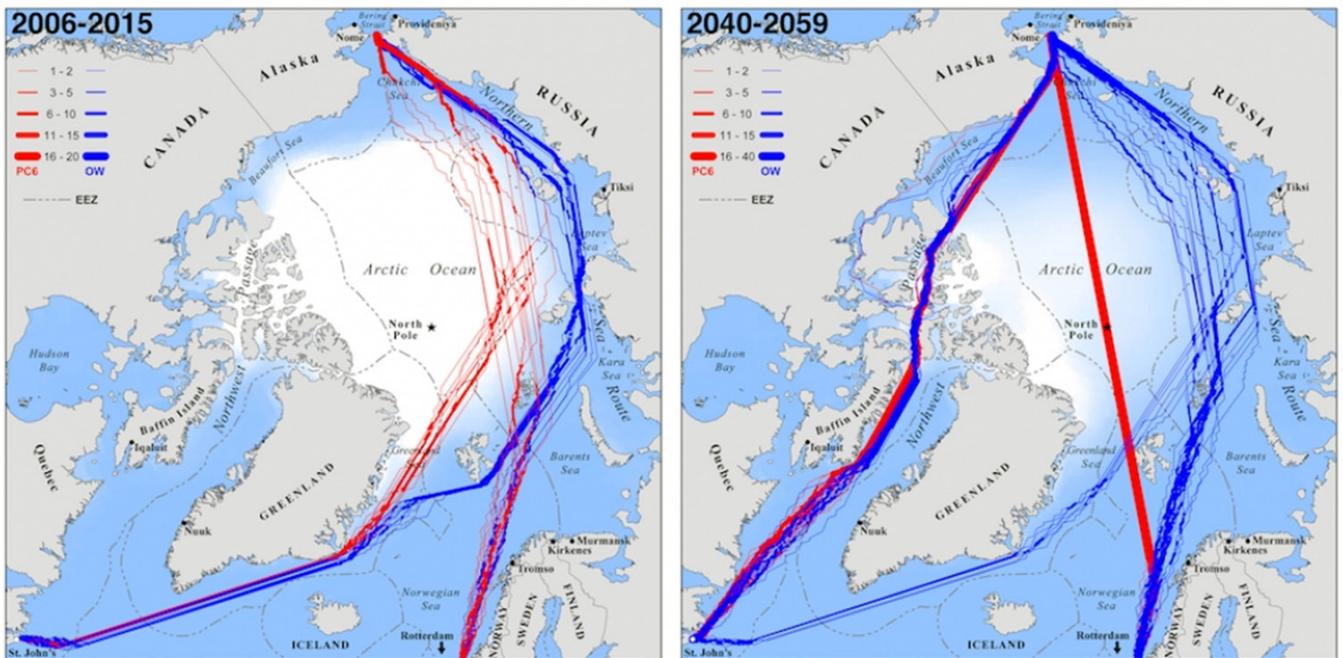
Planning new transport routes in the Arctic

Nadezhda Zamyatina

In the last decade, there has been a change in the thinking about large transport projects in the Arctic. The impetus for their development is no longer so much the development of large resource regions as international trade. In the new logic, new transport routes are called upon not to “open up” a particular resource region for development, as has happened over the past hundred-odd years, but to ensure remote economic regions the short connection to markets, primarily for intercontinental trade.

A striking example of the implementation of such a strategy is the prospect of a new railway to Kirkenes, providing access to the Northern Sea Route from Western Europe. In Russia, the prospects involve Belkomur, Barentskomur and a new port in Indiga, as well as the construction of a railway from Yakutsk to Tiksi.

In the light of the new paradigm, the view of the Northern Sea Route (NSR) is being transformed. Despite the fact that it is usually positioned as a



Transformation of trans-Arctic shipping under climate change.

Source: <http://www.climatecentral.org/news/study-shows-how-warming-may-transform-trans-arctic-shipping-15685>

route between the western and eastern outskirts of Eurasia, that is, transcontinental, the bulk of cargo for almost the entire existence of this route is carried out along a shorter route. Along the NSR, raw materials are exported from Siberia to Western Europe, first, timber, then copper and nickel, in the last decade LNG from Sabetta and oil from the Novoportovskoye field in Yamal. And only in recent years there has been a real transition from using the short western arm of the NSR primarily for exporting raw materials towards a truly transcontinental role of the entire ocean highway. On the one hand, this is facilitated by the warming of the climate, on the other hand, it is driven by the growing interest in the Arctic of China, which is actively developing Arctic shipping and has initiated a special program for the Arctic Silk Road.

In the future, however, as the ice melts in the central part of the Arctic Ocean, it is possible to organize intercontinental routes directly through the circumpolar regions at high latitudes.

The operation of transport in the Arctic gives rise to several specific groups of problems that complicate logistics and increase the cost of transportation.

The first group of problems is associated with the heterogeneity of conditions in space and time, which requires multiple reloads and a change of

transport modes. For example, when exporting oil through the Varandey terminal and from the Prirazlomnaya offshore oil platform, Arc6 ice class tankers are used at the initial leg of the route. Using them on the western leg in milder conditions is unprofitable, therefore, in the Murmansk region, oil is being transshipped to a floating tanker.

Similar problems arise when reloading from river vessels to sea vessels, from year-round roads to river transport for example, from the city of Ust-Kut. The port of Igarka emerged as a transshipment center for exported timber. It was delivered to Igarka by river in rafts, stored, and then loaded onto powerful sea vessels that could not climb upstream of the Yenisei River, to where the forest was cut. The city of Igarka grew up to serve this transshipment.⁷

The second group of problems is associated with the high cost of operating long highways running through a sparsely populated area. In some cases, economic inefficiency leads to the dismantling of highways. In the middle of the 20th century, railway tracks in the Magadan Region were dismantled, and so was a railway line to the Yamburg gas field in Western Siberia, at the beginning of the 21st century. Experts have great doubts about the economic efficiency of the railway laid by Gazprom to the Bovanenkovo gas field in Yamal.



Norilsk Nickel vessels at the port of Dudinka.
Photo by Zamyatina

The third group of problems is related to seasonality, as well as variability of weather conditions in the Arctic. Nuclear icebreakers capable of navigating ships through solid ice are very costly to operate. The high cost of their services led during the years of economic reform in Russia in the 1990s, to the fact that Arctic companies began to abandon their icebreaker assistance, preferring to build their own or charter vessels with the ice class Arc6 and Arc 7. In Russia, the pioneer was the company Norilsk Nickel, which has built five of its own vessels, equipped with an innovative AZIPOD engine, which allows to move both bow and stern forward, which helps in overcoming difficult ice conditions.

However, in some cases icebreakers are still in demand even by the most modern ships that can pass through ice up to 1.5-2.1 meters thick, while in the conditions of the NSR there is ice up to 3 meters, and in very rare cases - up to 4 meters. The problem of maintaining icebreakers, which are in demand from time to time, is very acute and in Russia, a fee has been introduced for using the infrastructure of the NSR, which is levied even when the direct assistance of an icebreaker is not required. To a large extent, this fee supports the maintaining of icebreakers.

Difficult climatic conditions make transportation in the Arctic not only a resource-intensive task, but also a science-intensive task, requiring the use of substantial scientific support and monitoring of climatic and environmental trends, weather and ice conditions, and ocean transport security systems.

Arctic transport: the circumpolar world and Russia

Nadezhda Zamyatina

Transport and, more broadly, ensuring mobility play a special and paradoxical role in the life and economic development of the Arctic. On the one hand, the modern Arctic economy, largely based on the export of raw materials, while importing food and everyday goods, fuel and materials, is highly dependent on transport. On the other hand, the provision of transport accessibility is faced with enormous natural difficulties with snow cover that makes it difficult to travel on roads, with permafrost and seasonal freezing and thawing of soils that break the asphalt road surface, and with freezing of waterways along seas, lakes and rivers in winter. Strictly speaking, the serious constraints on transport accessibility are precisely a key characteristic in making the Arctic a zone with special economic conditions.

The limited transport accessibility of the Arctic, however, must be historically considered. In earlier times, the Arctic and some adjacent, more southern territories were not “immobilized” by snow and ice as now, especially completely roadless areas, often connected only by air transport, or with the help of special all-terrain vehicles, implying that even if there is some possibility of transport, the high cost of transportation in fact means isolation. This is in contrast to earlier times, when it was invented a number of vehicles ideally suited to



Scientific searches for specific Arctic transport: a synthesis of traditional and innovative technologies.
Arctic design school. <https://www.facebook.com/ArcticDesignSchool/photos/>

travel under Arctic conditions. These are all sorts of sliding types of transport like skis and sledges, Inuit canoes and kayaks, keeping their buoyancy even during a coup, as well as reindeer and dog sleds. All of these transport modes are distinguished by an almost complete autonomy of movement in their native landscape – an autonomy unattainable by “civilized” modes of transport, dependent on transport infrastructure and points of refueling and service.⁸ However, local modes of transport, as a rule, have a low carrying capacity and cannot compete with industrial transport designed for other conditions. Understanding the history of the “off-road” transport of the Arctic is useful in the development of specialized modes of transport, closer to traditional Arctic modes of transport, in order to overcome impassability by reviving traditional Arctic modes of transportation.⁹

Three zones of transport accessibility

The modern Arctic is clearly divided into zones that are radically different in terms of transport accessibility. The first zone has a network of roads and railways and regular air traffic. This is a significant part of the Arctic regions of Norway, Sweden, Finland, the Russian Murmansk region, southern Alaska, and the southern regions of Arctic Canada. From an economic point of view, the uniqueness of these areas (in relation to more southern territories) is due to a relatively sparse network of settlements, but this difference from more southern regions is less than their difference from the climatically most severe areas of the high Arctic. In economic terms, the areas of the first zone can be attributed as “Arctic” more by tradition than based on modern conditions. Here, specialized modes of transport are scarcely in use, and weather conditions and seasonal changes have almost no effect on mobility.

On the other end of the scale we find the third zone, the most remote transport zone that can be called the “real” Arctic. This zone differs sharply from other regions in terms of living and economic conditions. This is a territory generally devoid of year-round ground transport links with other regions. Communication is carried out by air although at a very high cost, all year round, but flights with small aircrafts largely depend on weather conditions. Basically, in this zone the traffic is seasonal, in summer along rivers or in coastal waters, in winter along temporary ice



Damaged bridge near Murmansk interrupted railway communication with the regional capital

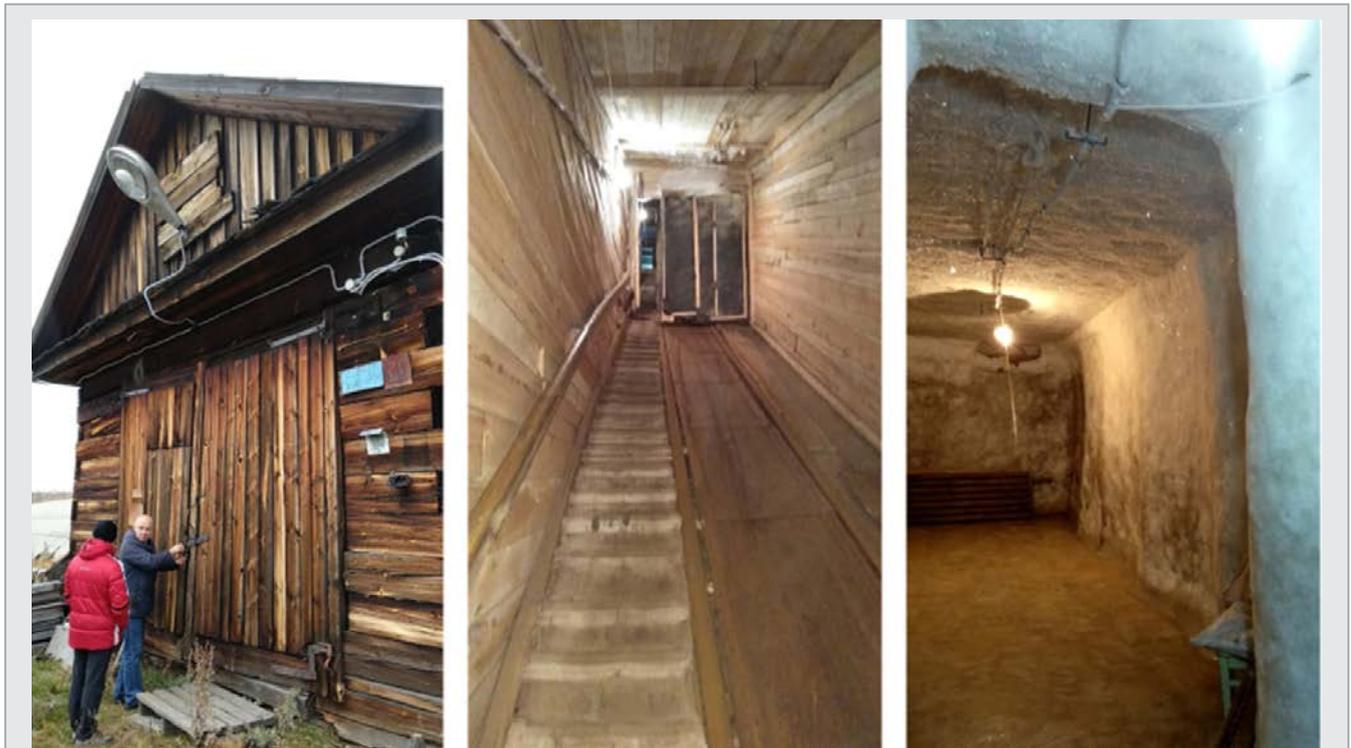
Source: <https://www.rzdnew.ru/2020/06/blog-post.html?view=mosaic>

roads, which are widespread mainly in Canada and Alaska. In Russia they are called winter roads, or zimnik, and as opposed to the Canadian analogue, they are not spilled with water, but simply “tamped” down with snow, i.e. a heavy grader rides through the snow, pressing it into a dense mass. Moving along winter roads requires the presence of people with relatively unique skills: as a rule, in a settlement with a population of several thousand people, there are no more than one or two dozen people capable of driving on winter roads. These “mobility providers” like pilots, airport employees and administrations enjoy a high social status even subject to cultural highlights, like in Chukotka in the far northeast of Russia, where a dance was dedicated to a real pilot, by a local Indigenous dance ensemble (the dance “Petrenko the Pilot Has Arrived”). In general, off-road transport links represent not only technical and economic aspects, but also a social and cultural component, which makes the task of ensuring mobility a complex one.

Difficulties in transport cause high prices of almost all imported goods in the off-road zone, for fuel, a significant part of food, and building materials. In



White Pass railway in Yukon territory from the time of the «gold rush». Photo: Nadezhda Zamyatina



An entrepreneur in the city of Igarka (Krasnoyarsk Territory, Russia) demonstrates a natural refrigerator - a glacier (lednik), in which the permafrost cold was used to cool food. In the middle of the 20th century, in the chambers of this glacier, the annual supply of food for the city, imported during the summer navigation, was stored. However, in modern conditions, the glacier is not used, since the ability to maintain a constant temperature does not meet modern sanitary standards. Photo: Nadezhda Zamyatina



The destruction of the railway, due to which there was, in fact, the transport blockade of Churchill.

Sources: <https://www.cbc.ca/news/canada/manitoba/omnitrax-demanded-fix-rail-line-1.4273012?cmp=rss>; <https://www.cbc.ca/player/play/984115779575>

Box 8.1. Challenge of logistics: The need to store an annual supply

"The problem of exploitation is, first of all, in logistics. If you order yourself something that you need for your activity, then you must clearly understand that it will come to you in a year and a half. A year is the minimum.

This raises the problem of illiquid assets. And it is a very serious problem, because you understand that you have to order something in reserve. You don't know what's going to break tomorrow ... We have 55% of units of something that have never been in demand by anyone in their life. And this is an incredible amount of nomenclature and everything else. "

From Nadezhda Zamyatina's interview with the Vice President of Kinross Gold in Russia for Industrial Safety and Environment.

some cases, prices are several times higher than in areas located several hundred kilometers to the south. This seriously complicates the development of most types of economic activity and lowers the standard of living.

To adapt to the high transportation costs preference is given to the most compact and easy-to-transport types of goods, for example, when developing housing for Alaska natives, specialists use a set of building materials that can be transported on one flight of a small plane.¹⁰ Another consequence is the need for long-term storage of goods as large volumes are required to lower the cost of transportation. However, storage facilities involve additional costs, for instance to store an annual supply of food or to have available a broad set of spare parts (Box 8.1).

Between the zone with a developed transport network and the off-road zone, there is a second zone of uncontested year-round transport. It is distinguished by long transport arteries connecting chains of sparsely located settlements, but these arteries are these settlements' only ground-based options for communication with the outside world. The difference from the third zone is not radical, however, the risk of interruption of transport communication with the outside world in the event of an accident on the transport network is higher, as for example the case in Canada, when the transport routes to the port of Churchill were washed out in 2018.

A similar situation happened in the spring of 2020 in the Murmansk region of Russia, when the bridge of the only railway leading to Murmansk was damaged. However, in this case the communication was not completely interrupted due to the preservation of the road.

A big problem is the maintenance of highways going through vast and sparsely populated areas. Maintenance requires clearing of snow, monitoring the condition, and repairing. In the Arctic, maintenance costs are high, so the question often arises about the efficiency of large transport routes. On the other hand, for decades, different countries have repeatedly considered the same projects, for example, a tunnel under the Bering Strait or a gas pipeline from the Mackenzie Delta. The issue of efficient new transport routes is one of the most difficult in the development of the Arctic.

Permafrost degradation impact on critical infrastructure in the circumpolar Arctic

Nadezhda Zamyatina

The Arctic is warming at more than twice the rate of the global average, hence the impact of climate change manifests itself most clearly at northern latitudes, with shrinking sea ice cover being one of the most highly visible and well-known effects.¹¹

Infrastructure and buildings in permafrost regions are thus exposed to risk. Preventing increased wear and direct damage to these constructions requires engineering knowledge, expertise, technology, and equipment. In some cases, permafrost is thawed prior to construction, however, more often attention is focused on protecting the permafrost, in order to ensure stability of structures. In permafrost regions, construction techniques are designed to decouple structures from the frozen ground, often accomplished by elevating the structures, such as the building in Figure 8.1, using pillars anchored in the permafrost.

This elevation of infrastructure to create ventilated crawl-spaces underneath buildings is frequently used method. The circulation of cold air between the building and the ground isolates the permafrost from the heat given off from the building and helps prevent permafrost thaw. In Russia's large Arctic cities, where multi-storey buildings traditionally dominate - and where the density of housing

helps reduce the use of motor-vehicles inside the city – the crawl-spaces are sometimes uncovered, leaving the structural bearing pillars exposed. More often, a facade which still promotes good ventilation is used.

Another common engineering measure for preserving permafrost is the use of thermosyphons, as pictured alongside the Trans-Alaska oil pipeline in Figure 8.2. Thermosyphons rely on convection and the phase-changes in fluids or gas to draw heat out of the ground and release it above ground. This method is also used to preserve the temperature of permafrost underneath buildings and urban structures, as illustrated in Figure 8.3 in Dudinka, Russia.

Despite these features, it is important to monitor the characteristics of the permafrost underneath structures and maintain the condition of structural foundations and protective features. Such activities are costly, but more efficient than repeatedly repairing damages caused by permafrost thaw.

In many cities which are built on permafrost, many urban space contain voids where there previously were buildings. Many of these had structural failures due to problems caused by permafrost thaw, which required them to be abandoned and/or demolished. A striking example is the multi-storey brick building of the Research Institute of Agriculture of the Far North (now Research Institute of Agriculture and Ecology of the Arctic) in



Figure 8.1a. The elevation of buildings (and other infrastructure) onto pillars allows for a ventilated layer between the structure and the ground, which helps protect against permafrost degradation: Igarka, Russia. Photo: Nadezhda Zamyatina

Norilsk, Russia, illustrated in Figure 8.4. The facade of the building was seriously deformed due shifting foundation pillars, which is in turn due in part to thawing permafrost. This building was demolished in 2018, so as not to pose a threat to human life resulting from the collapse of the structure.

There are several assessments of the impacts of permafrost degradation on critical infrastructure in the circumpolar Arctic.¹² In all models, there is strong agreement that permafrost will warm significantly across much of the Arctic, and impact significant amounts of infrastructure. More recent studies have also attempted to quantify the economic value of impacted infrastructure. In the following we present some published results on the value of infrastructure and buildings projected to be impacted by permafrost degradation in the circumpolar Arctic, from the recent article in *Polar Geography* by Suter, Streletskiy and Shiklomanov.¹³



Figure 8.1b. The elevation of buildings (and other infrastructure) onto pillars allows for a ventilated layer between the structure and the ground, which helps protect against permafrost degradation: Norilsk, Russia. Photo: Nadezhda Zamyatina.



Figure 8.2. Thermosyphons alongside the Trans-Alaskan pipeline draw heat out of the ground and help keep permafrost temperatures low enough to support the above-ground structure. Alaska pipeline (2019). Photo: Nadezhda Zamyatina



Figure 8.3. In Russia, thermosyphons are also often used to protect buildings, in combination with elevating structures on piles, such as with this building in the city of Dudinka (2018). Photo: Nadezhda Zamyatina



Figure 8.4. Building damaged by permafrost degradation, Norilsk, Russia. (Photo from 2013, now the building is dismantled). Photo: Nadezhda Zamyatina

Detail of façade: Building damaged by permafrost degradation, Norilsk, Russia. (Photo from 2013, now the building is dismantled). Photo: Nadezhda Zamyatina

Climate change impacts on permafrost

Dmitry Streletskiy, Luis Suter and Nadezhda Zamyatina

The study by Suter, Streletskiy and Shiklomanov utilized climate inputs from an ensemble of six models included in the CMIP5 project of the World Climate Research Programme.¹⁴ The decade of 2006–2015 is used as a baseline of current climatic conditions, and 2050–2059 represents the climate scenario of the near future, within the expected lifespan of present infrastructure. Changes in permafrost temperature were assessed for two scenarios relevant to infrastructure stability. In the first scenario, it is assumed that snow and vegetation are removed, as would be the situation around buildings and on roads and railroads. In the second scenario, it is assumed that snow and some vegetation are present, representing close to natural conditions, as would be the situation around above-ground pipelines.

In all models within the ensemble used, it is projected that permafrost will warm significantly across much of the Arctic. In the scenario of natural conditions (where snow and vegetation are undisturbed) the average ground temperature increase is expected to be 3.7°C (ranging from 1.3° to 5°C), about 0.1°C lower than the scenario with snow removed. When snow and vegetation are absent, the projected average of the model ensemble is an increase of 3.8°C (ranging from 1.6° to 6.5°C). All the models show that the most significant warming will take place in the High Arctic, and that the areas with the largest increases in ground temperature will be in continental Siberia, northeast Alaska, and Yukon.

The study found that the average reduction of bearing capacity of structural pillars under the natural conditions scenario is 41 per cent, with a maximum reduction of 69 per cent. The spatial distribution of changes in this key variable show that more southerly areas of the Arctic, around the edges of the permafrost covered region are more significantly impacted. Generally, the southern areas of Siberia, Canada, Alaska, Yukon, Yamal-Nenets, which are covered by permafrost regions are particularly impacted by a reduction in bearing capacity. In central Siberia, permafrost is projected to remain slightly more stable. The highest projected decreases in bearing capacity

are in Eastern Siberia, Northwest Alaska, Northeast Canada, and Chukotka. Some areas that currently have near-surface permafrost, especially in interior Alaska, may even become permafrost-free by 2059.

Cost estimates of permafrost degradation

Dmitry Streletskiy, Luis Suter and Nadezhda Zamyatina

The study by Suter, Streletskiy and Shiklomanov assessed the costs associated with the increased maintenance and shortened planned lifespan of Arctic infrastructure at circumpolar scale, based on an infrastructure lifecycle cost model.¹⁵ Planned lifecycle costs were projected to increase by about 27 per cent, or about US dollars (USD) 15.47 billion, by 2059, due to the increased wear and tear on Arctic infrastructure resulting in shorter infrastructure life-span. The largest increase in lifecycle costs was found to impact pipelines, with more than a 60 per cent increase on planned costs. Lifecycle costs for roads, railways, airports, and ports were projected to increase by more than 40 per cent, and for buildings by about 12 per cent.

Increases in road lifecycle costs accounted for the largest share of the total estimated lifecycle costs, about 39 per cent of the total lifecycle cost across all infrastructure types. The lifecycle costs related to buildings accounted for 22 per cent of the total. Pipelines, railroads, and airports combined to account for 35 per cent of total lifecycle cost increases, with ports accounting for the remaining 4 per cent. However, the study noted that damage to ports is very likely to be underestimated, as the model did not account for the impact of coastal erosion.

The geographic distribution of the increased lifecycle costs were concentrated, with the largest in Russia, where the by far the most infrastructure. Russia's incurred about 43 per cent of total increase in lifecycle cost across the circumpolar region, with at least USD 6.63 billion by 2059,



Snowmobiles on display at Northern Store in Nunavik, Québec. Photo Gérard Duhaime, 2011

followed by Canada with USD 4.33 billion and Alaska with USD 2.56 billion. In Russia, buildings are at the greatest cost factored risk, while in North America, mainly roads and airports are impacted. This reflects historic development trends, with Russia having concentrated populations in urban areas, while Arctic regions in Canada and Alaska are more characterized by smaller, more dispersed settlements.

Aside from rising lifecycle costs, which are the ongoing costs resulting from increased maintenance needs and shortening of planned infrastructure lifespan, the study also quantified the value of infrastructure which would need to be completely abandoned or demolished and replaced due to irreparable damage. The projected value of such damaged infrastructure across the circumpolar Arctic is USD 21.6 billion dollars by 2059. This represents about 15 per cent of the total value of infrastructure assets quantified in the study. Impacts are projected to be highest in Russia, where about 32 per cent of Arctic infrastructure is at risk of being damaged, followed by 22 per cent in Alaska and 19 per cent in Canada. Within other Arctic countries, no substantial direct damages related to permafrost thaw were found. At a regional level, the value of damaged infrastructure was highest in Sakha Republic, Alaska, Yukon, Northwest Territories, Krasnoyarsk Krai, and Yamal-Nenets Autonomous Okrug.

By 2059, combined value of lifecycle cost increases and damaged infrastructure are projected to be over USD 6 billion in Sakha Republic and Alaska, and about USD 4 billion for Yamal-Nenets. In Yukon and Krasnoyarsk Krai the combined costs are USD 3.9 billion and USD 3.2 billion, respectively.

Relative to gross regional product (GRP), the combined lifecycle costs and direct damages were highest in Yukon, where the value was about 3.7 per cent of annual GRP from now until 2059. In the Northwest Territories, the combined costs accounted for 1.5 per cent of annual GRP, and for 1 per cent of annual GRP in Nunavut. In Russia, Magadan and Sakha Republic are particularly impacted, with the combined costs accounting for 1 per cent to 1.4 per cent of annual GRP. Yamal-Nenets, Komi Republic, and Krasnoyarsk are also impacted, with about 0.3 per cent of annual GRP needed to cover costs related to permafrost degradation.

The results can be compared with a study by Streletskiy and co-authors, which assessed that thawing permafrost in Russia impacted infrastructure worth over USD 100 billion, based on data from the Russian Federal Statistical Services.¹⁶ The value of infrastructure in the study by Suter and co-authors was based instead on an infrastructure inventory compiled from open data sources, and had itself noted that the total value of infrastructure in the Russian Arctic, and across the Arctic was underestimated. Another study by Porfiriev and co-authors include indirect costs of climate change impacts, such as the release of methane into the atmosphere from thawing permafrost, amounting to total projected cost of USD 160 trillion by 2100, or about USD 1.9 trillion annually across the Arctic region. For some Russian Arctic regions, increased costs may amount to 5 to 6 per cent of annual GRP.¹⁷ The difference between the studies indicates significant gaps in availability of Arctic infrastructure data, especially in areas where geospatial data are difficult to obtain. Data on spatial location and value of buildings and other structures are not available in a common format across the Arctic. Improved estimates of the projected costs of permafrost degradation impacts are important, to ensure that government and industry funding is available to cover these costs.

New resource projects in the Russian Arctic, entrepreneurship, and the cargo base for the Northern Sea Route

Alexander Pilyasov, Lomonosov Moscow state university

In order to enhance the knowledge about extractive industries in the Russian Arctic, a register of selected large projects, in the period since 2007, has been developed.¹⁸ This includes new projects and upgrades of old facilities based on new technologies, for projects involving investments of at least 500 million rubles. Another criterion for selecting projects was their potential to form a cargo base for the Northern Sea Route (NSR), contributing to activate the marine transport route for development of the Russian Arctic. In total, 23 projects already implemented or planned for the near future were included in the register.¹⁹ More than 40 per cent of these projects are concentrated in the Yamal-Nenets Autonomous Okrug and Taimyr.

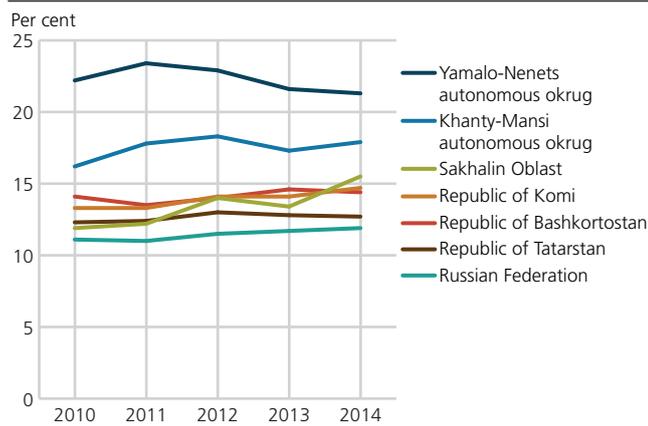


Akureyri, North Iceland. Photo Gérard Duhaime, 2008

Climate change and new technological opportunities generate a shift in logistics for Arctic extractive resource projects that previously relied on the southern overland export scheme, by road, rail or pipeline. More recently, the Northern Sea Route export scheme is becoming an option, using specialized vessels with reinforced ice class certification, with or without partial support by icebreakers. The maritime Arctic is exposed to new climatic dynamics with rapid decrease in ice cover along the Northern Sea Route. This strengthens the attractiveness to investors of the maritime Arctic transport scheme.

The last three decades have demonstrated the emergence of complex marine logistics in the Russian Arctic, with development of ports, terminals, docking hubs, and coastal support bases. The new offshore logistic scheme requires reconfiguration of old export hubs, creating a network of new transshipment points and changes of schemes for extraction and processing of resources. The new marine production and transport model for development of Arctic resources is, as a rule, floating and mobile, based on platforms or artificial islands, serving as economic hubs localized for achieving synergies by combining various production and processing stages.

Figure 8.5. Share of construction firms in the total number of small enterprises. Per cent



Source: Rosstat. Collection «Small and Medium Business in Russia» for selected years.

Key elements of Arctic maritime logistics typically include a year-round berth, which often has a significant share in project costs; ships of reinforced ice-class or ordinary ships conditional upon use of expensive icebreakers; and obligatory trial shipments and flights for adapting the logistics system to unexpected, but inevitable, Arctic weather and ice conditions. Project operations generally seek to minimize the use of expensive icebreakers, by relying on their own fleet of reinforced ice-class vessels, or as in the Pavlovsky lead-zinc mining project on Novaya Zemlya in Archangelsk Oblast, by adapting the export scheme to seasonal transportation of mined ore.

In recent years, the new scheme for organization of production and transportation has been realized in several development projects in the Russian Arctic. Examples are the Prirazlomnaya platform in Nenets Autonomous Okrug, the Sabetta port and liquefied natural gas (LNG) plant in Yamal, the Varandey terminal in Nenets Autonomous Okrug, and the gold deposit Kupol in Chukotka Autonomous Okrug. On artificial islands in Kola Bay is the Center for Construction of Large-Capacity Offshore Structures, a marine shipyard with co-location of

factories that will manufacture offshore structures for producing, storing and shipping LNG and provide repair and maintenance of marine equipment.

The key feature of this approach to resource projects is the emphasis on co-localization and compactness of placement of production and social facilities, in order to “not spread over the surface”. The platform approach relies on water transport, also by connecting the Northern Sea Route and river transport. Russian Arctic resource corporations aim to deliver material for their new resource projects in the coastal Arctic partly by Siberian rivers, not only via Arctic seas and the Northern Sea Route.

Large companies operating in the Arctic strive to obtain a synergy effect from common use of infrastructure between hubs. One example is Kinross Gold, that in 2007 began to develop the Kupol gold deposit and in 2010 acquired the Dvoynoye deposit, located 100 km to the north. Extracted ore from the Dvoynoye deposit is processed at the Kupol Mill, delivered daily along the specially built Kupol-Dvoynoye road, open year-round, and then processed gold is delivered by plane to Moscow.

Gazpromneft aims to utilize this synergy effect so that the flagship Novoportovskoye field in Yamal in the future will form a cluster when surrounded by other fields of the company. The next stage in the development is the launch of the Yamal Gas project, the creation of infrastructure for transportation of gas from fields on the Yamal Peninsula. The gas infrastructure will make it possible to combine up to 15 fields in Yamal and develop a new oil and gas province based on the Novoportovskoye field.

Rosneft plans to reduce operating and capital expenditures through synergy effects, firstly, by making the Vankor oil field in Krasnoyarsk krai a

Table 8.1. Indicators of entrepreneurship in regions of the Russian Arctic: Number of small enterprises, turnover and share of part-time workers. 2017 and 2018

	Number of small enterprises per 1 000 people	Turnover in small enterprises (including micro-enterprises and individual entrepreneurs), billion rubles.		Share of part-time workers in small businesses (without micro-enterprises), per cent
		2017	2018	
Murmansk Oblast	22.9	214.7	7	
Yamal-Nenets Autonomous Okrug	30.6	170.7	15	
Nenets Autonomous Okrug	28,3	7.8	20	
Chukotka Autonomous Okrug	25.4	9.0	15	

Source: Pilyasov, A.N. 2020. Entrepreneurship in the Arctic

base for testing advanced technologies in challenging areas of oil production, with subsequent replication by other facilities in the Vankor cluster. Secondly, Rosneft combines several fields (Vankorskoye, Lodochnoe, Tagulskoye and Suzunskoye) into a single cluster for integration of transport, production and energy infrastructure. These effects can become even more powerful when JSC Neftegazholding joins the group of Payakhsky oil fields, in Krasnoyarsk krai, with the Vankor cluster and combines the facilities into a joint project Vostok Oil. The project involves construction of an oil pipeline between the Vankor and Payakhskaya fields, to allow transporting the products of all fields of this industrial region through an oil terminal along the Northern Sea Route.

The resource projects generate a large demand for construction services. In the Russian Arctic, many construction firms are small enterprises. The share of construction firms in the total number of small enterprises in the Yamal-Nenets Autonomous Okrug is the highest among all oil and gas territories of Russia and is significantly higher than the average for Russia (Figure 8.5).

Entrepreneurial activity in the Russian Arctic is often assessed by the number of small enterprises.²⁰ These enterprises often have a large share of part-time workers. Yamal-Nenets Autonomous Okrug has the largest number of small enterprises per 1 000 people. Murmansk region has the largest turnover, given the production profile and capital intensity of the predominant fishing enterprises. Nenets Autonomous Okrug has the largest share of part-time workers (Table 8.1).

Notes

¹ Polar Knowledge Canada. 2019. Northern Housing Policy Recommendations. National Aboriginal Economic Development Board. 2016. Recommendations on Northern Infrastructure to Support Economic Development. Gatineau, Quebec.

² Northwest Territories Power Corporation (NTPC). 2020. Qulliq Energy Corporation 2020. Yukon Electric Corporation 2020.

³ Yukon Electric Corporation 2020.

⁴ <https://www.cbc.ca/news/canada/north/old-crow-yukon-solar-power-array-1.5654514>

⁵ Northwest Territories Power Corporation 2020.

⁶ Qulliq Energy Corporation 2020.

⁷ Zamiatina N. Yu. 2020. Igarka as a frontier: Lessons from the pioneer of the Northern sea route. *Journal of Siberian Federal University. Humanities & social sciences*, 13(5): 783–799.

⁸ In the Russian Arctic, an exception from the need for refueling is nuclear-powered icebreakers.

⁹ Usenyuk S., Garin N., Rogova, A., Mukhina, A. Invisible Sustainability: Learning from the Arctic. 2013. *International Journal of Social Sustainability in Economic, Social and Cultural Context*, 73-86. Usenyuk, S., Dudeck, S., Garin, N. 2015. The Making of a Home in a Changing Northern Context: an ethnographic account of contemporary housing practices among Russian reindeer nomads *Polar Journal*, 5 (1), 170–202.

¹⁰ Cold Climate Housing Research Center (CCHRC) <http://cchrc.org/>

¹¹ Note Pörtner, H.-O., D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegría, M. Nicolai, A. Okem, J. Petzold, B. Rama, N.M. Weyer (eds.) (2019): IPCC Special Report on the Ocean and Cryosphere in a Changing Climate. IPCC.

¹² Suter, L., D. Streletskiy & N. Shiklomanov (2019): Assessment of the cost of climate change impacts on critical infrastructure in the circumpolar Arctic, *Polar Geography*. Streletskiy, D., Suter, L., Shiklomanov, N., Porfiriev, B. & Eliseev, D. (2019). Assessment of climate change impacts on buildings, structures and infrastructure in the Russian regions on permafrost. *Environmental Research Letters*. 14. Vasiliev, A., Drozdov, D., Gravis, A., Malkova, G., Nyland, K. & Streletskiy, D. (2020). Permafrost degradation in the Western Russian Arctic. *Environmental Research Letters*. 15. Biskaborn, B.K., Smith, S.L., Noetzli, J. et al. 2029. Permafrost is warming at a global scale. *Nat Commun* 10, 264. Kislov, A. V, V. I. Grebenets, V. M. Evstigneev et al. 2011. Effects of possible climate warming in the 21st century for northern Eurasia. *Vestnik Moskovskogo Unviersiteta, Seriya Geografiya*. no. 3, p. 3–8. Grebenets V. I., Streletskiy D., Shiklomanov N. 2012. Geotechnical safety issues in the cities of polar regions. *GEOGRAPHY, ENVIRONMENT, SUSTAINABILITY*. 3 (5), 104–119.

¹³ Suter, L., D. Streletskiy & N. Shiklomanov (2019): Assessment of the cost of climate change impacts on critical infrastructure in the circumpolar Arctic, *Polar Geography*,

¹⁴ World Climate Research Programme (WCRP). (2011). Coupled model intercomparison project – phase 5. Special Issue of the CLIVAR Exchanges Newsletter, No. 56, 15 (2).

¹⁵ Larsen, P. H., Goldsmith, S., Smith, O., Wilson, M. L., Strzepek, K., Chinowsky, P., & Saylor, B. (2008). Estimating future costs for Alaska public infrastructure at risk from climate change. *Global Environmental Change*, 18(3), 442–457.

¹⁶ Streletskiy, D. A., Suter, L. J., Shiklomanov, N. I., Porfiriev, B. N., & Eliseev, D. O. (2019). Assessmen of climate change impacts on buildings, structures and infrastructure in the Russian regions on permafrost. *Environmental Research Letters*, 14(2).

¹⁷ Porfiriev, B. N., Voronina, S. A., Semikashev, V. V., Terentev, N. E., Eliseev, D. O., & Naumova, Y. V. (2017). Consequences of climate change for economic Growth and development of individual Sectors of the economy of the Russian Arctic. *Arctic: Ecology and Economics*, 4(28), 4–17.

¹⁸ The register of ongoing and prepared Arctic projects for new development is presented here: Pilyasov A.N., Putilova E.S. 2020. New projects for the development of the Russian Arctic: space matters! Arctic and North, publishing house of NArFU (Arkhangelsk), 38 (1), 21-43. Pilyasov A.N., Putilova Ye.S. 2020. Novyye proyekty osvoyeniya rossiyskoy Arktiki: prostranstvo znachimo! Arktika i Sever, izdatel'stvo SAFU (Arkhangelsk), 38 (1), 21-43. Pilyasov A.N. 2020. Courage of economic decisions and modern development of the Russian Arctic. Arctic and North, publishing house of NArFU (Arkhangelsk), 40, 82-106. Pilyasov A.N. 2020. Smelost' khozyaystvennykh resheniy i sovremennoye osvoyeniye rossiyskoy Arktiki. Arktika i Sever, izdatel'stvo SAFU (Arkhangelsk), 40,82-106.

¹⁹ Many of the projects are included in the category «Realization of the mineral, raw materials and logistic potential of the Arctic», prepared by the Ministry of Natural Resources and Environment of the Russian Federation in 2019

²⁰ Pilyasov, A.N. 2020. Entrepreneurship in the Arctic. Moscow: URSS.

Box X: Change in biodiversity and the loss of reindeer pastureland in Finnmark, Norway. An example of the use of GLOBIO3 as a decision support tool in the Arctic¹

Livelihoods depending on Arctic biodiversity are increasingly under the impacts by threats to biodiversity from development of buildings, infrastructure, and industry and climate change impacts. This represents a challenge to the adaptive capacity and resilience of nature-based communities. Reindeer herding based on natural pastures is a livelihood for more than 20 indigenous Peoples in the circumpolar Arctic. Reindeer husbandry is practiced in Norway, Sweden, Finland, Russia, Mongolia, China, Alaska, Canada and Greenland and involves about 100 000 herders and 2.5 million semi-domesticated reindeer.

Reindeer pastures have been exposed to loss and fragmentation of land and climate change. To study present and future impacts of land-use change and climate change on reindeer herding land, the GLOBIO3 model was applied for Finnmark. Finnmark is a core area for Sámi reindeer herding in Norway. The model incorporates impact of pressure from land use change, infrastructure development, fragmentation, climate change, and nitrogen deposition (which is excluded from this study).

The current GLOBIO3 model was developed by the Netherlands Environmental Assessment Agency (PBL). GLOBIO3 expresses the state of biodiversity by a natural intactness indicator, Mean Species Abundance (MSA), defined as average abundance of species in the current situation compared to their abundance in the original or reference state.

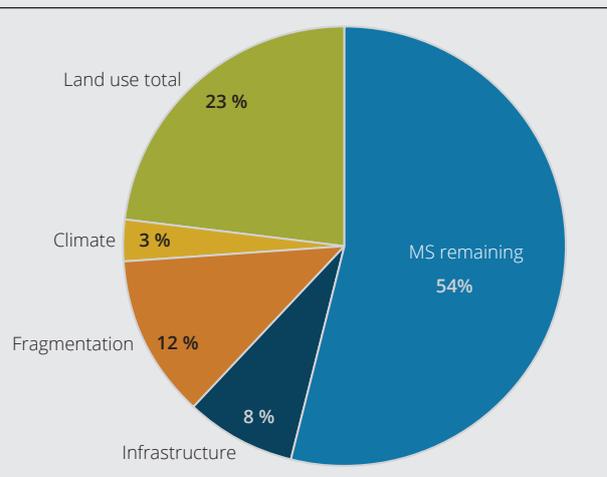
The GLOBIO3 study of Finnmark was made in collaboration with the Nomadic Herders Sápmi project. The study incorporated local information, both local spatial data, local expert knowledge and reindeer owners' traditional knowledge on the use of pastures.

To study the future impact on biodiversity in Finnmark with GLOBIO3, a future development scenario was constructed based on development plans from municipal zoning plans and local environmental reports. The scenario assumes that all plans have been realized by the year 2030. The scenario also includes an increase in annual mean temperature of +7 C° in the Arctic regions. Although this temperature increase may not occur before 2070 it is chosen to analyse the impact of climate change in the long term.

Results of the study show that climate will be the largest contributor to additional biodiversity loss. Given a lower, and more realistic temperature increase for the year 2030 (e.g. + 4 C°), the infrastructural, urban, and mining developments will have a larger impact than climate change, both in total and locally. Hence, the relative impact of the drivers should be interpreted in light of their perceived realism in the future scenario.

From figure 1 we see that the total remaining biodiversity (MSA) in Finnmark in 2011 as estimated by GLOBIO3 and the relative biodiversity loss caused by different

Figure 1. Share of remaining biodiversity and biodiversity loss per pressure for Finnmark, 2011



pressure types. The analysis shows that the remaining biodiversity in Finnmark is 54 per cent of the intact situation. The largest biodiversity loss is caused by new land use (23 per cent), followed by fragmentation of land (12 per cent), infrastructural constructions (8 per cent), and climate change (3 per cent). Although the impact of new infrastructure might seem relatively small for entire Finnmark, the local impact can be remarkably high.

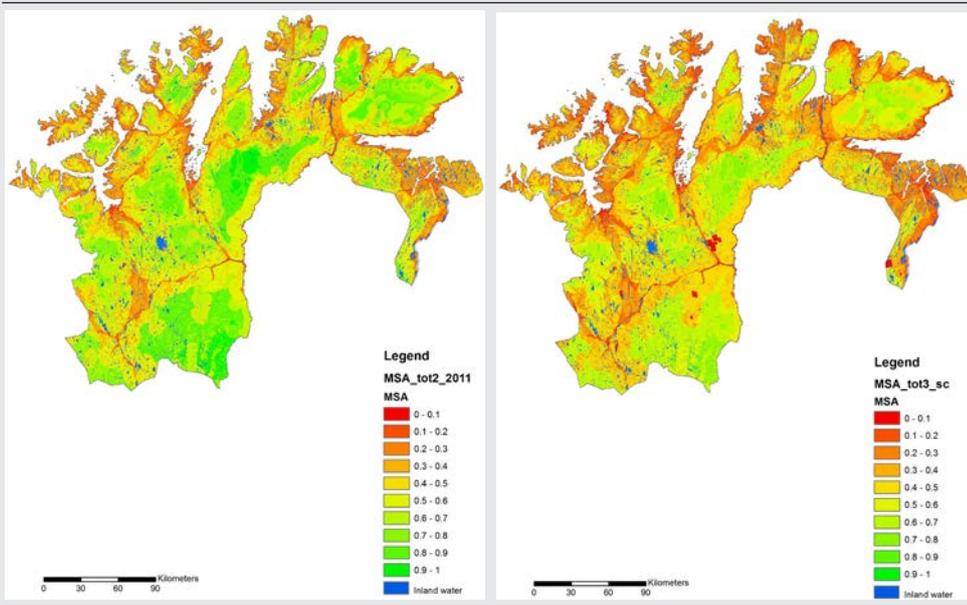
Figure 2 shows current and future MSA maps for Finnmark. The overall loss of biodiversity from the current situation to the 2030 scenario for Finnmark amounts to 10 percent, from 0.53 to 0.43. Climate change is the largest contributor to the additional loss, but locally large losses mainly occur because of infrastructural, urban, and mining development.

Reindeer husbandry depends on the availability of suitable pastureland. Reindeer herds use ancient migration routes to move from one seasonal pasture area to the other. Physical changes due to urban expansion, increased mine exploration and construction of new infrastructure are not only causing loss of biodiversity but also loss of pastureland and forced changes of reindeer migration routes. Infrastructural changes close to or in important calving grounds and migration routes will severely disturb the reindeer's possibility to breed, graze and migrate.

Figure 3 shows the total impact from a change in MSA on current and future biodiversity in Finnmark within calving grounds and migration routes. The average MSA value of calving grounds in 2011 is 0.5. This means that 50 per cent of the original biodiversity on the calving grounds is already lost. The average MSA of the calving grounds is expected to be reduced with another 10 per cent to 0.4 within 2030. The loss in biodiversity along the migration routes is also significant with a reduction of MSA from 0.57 in 2011 to 0.46 in 2030. As these numbers are average biodiversity loss, much higher and lower losses may occur locally.

¹ This text builds on Chapter 9 in the forthcoming book *Adaptation and Resilience to Changing Arctic: Taking Knowledge to Action in Reindeer Husbandry*, Springer 2021, and the *ECONOR III* report, *The Economy of the North 2015*, Chapter 9.

Figure 2. Current (2011) versus projected total MSA in 2030 for Finnmark



Traditional knowledge expresses the interrelated issues of managing pastureland and managing the herd. The traditional organization in reindeer herding reflects a knowledge-based adaptation to use of seasonal pastures to build resilience. Strategies include flexible use of seasonal pastures and diversity in herd structure. Traditionally it was the overall condition of the herd that mattered. Acknowledging traditional knowledge in governance requires an understanding of the landscape to reflect relations between nature and people.

At a GLOBIO3 workshop in Skáidi, Finnmark the researchers met with Sámi reindeer owners to discuss the relation between what the maps showed and what they saw as the real situation in the reindeer areas. The reindeer owners observed the biodiversity impact in their areas and discussed the pressures behind them and the possible consequences. Serious threats can directly be located on the maps by the reindeer owners. As planned developments are mapped as part of the biodiversity modelling the maps can be used to facilitate discussions between politicians, planners, and reindeer owners. Success depends on a full involvement with rights holders and inclusion of their traditional knowledge in discussions about possible outcomes and alternatives.

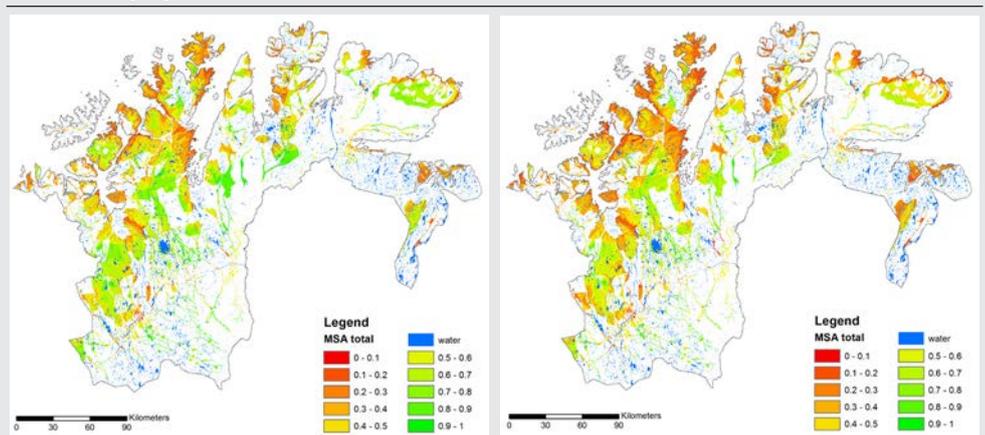
An important lesson gained from these dialogues is that the biodiversity loss should be interpreted with caution. The maps are clearly a warning that planned developments may be detrimental to biodiversity in pastureland. Severely affected areas should not be considered completely lost because as they could still be important for migration and grazing at certain times of the year.

The Convention on Biological Diversity (CBD) and The Norwegian Nature Diversity Act call for the application of traditional and experience-based knowledge of nature use such as Sámi use of nature in the contribution to achieve sustainable use and protection of biodiversity. Sámi reindeer herding in Norway is framed as the economic basis for carrying Sámi culture.

Climate calculations are based on global data with limited information on Arctic species. Typical Arctic aspects that are currently not yet dealt with in GLOBIO3 are impacts of permafrost thawing and the increased occurrence of ice on snow. The latter has a major impact on reindeer pastures.

For future research, it is suggested to develop a specific reindeer model in GLOBIO3 with focus on calving ground and migration impediments, drawing on similar experiences in Sweden. This will provide a reindeer monitoring system as proposed by the special rapporteur to the Permanent Forum on Indigenous Issues. To test the value of the models as decision support tools they should be implemented in policy cases at municipal and county level. Knowledge of cumulative impacts and potential future consequences of climate and socio-economic drivers achieved through modeling and including the traditional knowledge of reindeer owners, may provide a tool to assist in planning future developments and advancing strategies for adaptation and resilience.

Figure 3. MSA total for calving grounds and migration routes in Finnmark for 2011 and projected future scenario



Box XI: Sustainability in the Barents region measured with indicators from the United Nations Sustainable Development Goals (SDG) framework

Business Index North (BIN) is a recurring report to assess conditions for business development in the Northern regions.¹ BIN provides comparable socio-economic information and analysis for a wide range of actors interested in the Arctic, such as political and economic actors, academia and media. The latest BIN report focused on sustainable development in 14 northern regions of Norway, Sweden, Finland and North-West Russia² using indicators for the United Nations (UN) Sustainable Development Goals (SDGs). BIN used 30 indicators selected from the UN SDGs framework under criteria of data availability and relevance for Arctic socio-economic conditions.



Our analysis revealed that for 34 per cent of the SDG indicators the situation is about the same for the Arctic and non-Arctic regions of the countries, and about 45 per cent of the indicators describe a situation in the North worse than that prevailing in the respective countries as a whole. In case of only 21 per cent of the used SDG indicators, the situation in the North is better than average for the respective countries.

Below we present several indicators from the recent BIN report and illustrate how they can be used for the assessment of challenges to sustainable development in the Arctic regions. For this presentation we selected indicators associated with social, economic and environmental sustainability. In the case of Northern Norway, numbers for Finnmark and Troms are presented separately as they appeared in the statistics up to 2019, prior to their merger since 1 January 2020.

Social sustainability challenges

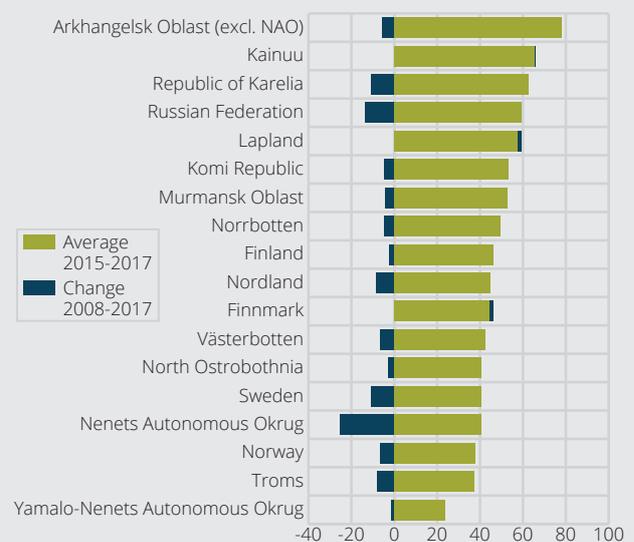
There are considerable discrepancies in achieving the goal of health and wellbeing for the Arctic population. In the following we present the indicators of death rates (Figure 1) and risk of poverty rate (Figure 2). Already high death rates due to chronic diseases (heart, respiratory) and cancer create vulnerabilities and potentially higher death rates in a population in case of a pandemic like COVID-19.

By measuring total death rates attributable to chronic diseases (heart, respiratory), cancer and to mental health problems, indicated by rate of suicides, we observe that in the Arctic regions of Norway, Finland and Sweden total death rate equalled 47.7 per 10 000 of population. In contrast, death rates for Sweden, Norway and Finland as a whole were markedly lower at 41.4 per 10 000 of population, measured as averages during the period 2015-2017. In Russia, total death rate was 59.1 with wide discrepancies among regions. In Yamalo-Nenets Autonomous Okrug the death rate was 26.1 compared to Arkhangelsk Oblast (without Nenets Autonomous Okrug)³, where it amounted to 75. The reason for this large difference may be that Yamal-Nenets is a region with a huge investment programme in oil and gas and infrastructure, with a relatively young population of in-migrated labour.

The statistics presented on figure 2 (at-risk-of-poverty-rate) reveals large proportions of people with living standards below the standard for the respective nation as a whole. In times of pandemic these groups are exposed to increased pressure.

The at-risk-of-poverty rate is the share of people in population with an equivalised disposable income (after taxes and social transfer) below the at-risk-of-poverty income threshold, which is set at 60 per cent of the national median equivalised disposable income.⁴ As defined by Eurostat, the equivalised disposable income is the total income of a household, after tax and other deductions, divided by the number of household members converted into equalised adults; household members are equalised by weighting each according to their age, using the so-called modified OECD equivalence scale.⁵

Figure 1. Total death rate due to coronary heart disease, cancer, chronic respiratory diseases and suicides, average rate for 2015-2017 and change 2008-2017 BIN regions



Data sources: Statistics Finland, Norwegian Institute of Public Health, The National Board of Health and Welfare (Sweden), Rosstat (Russia)

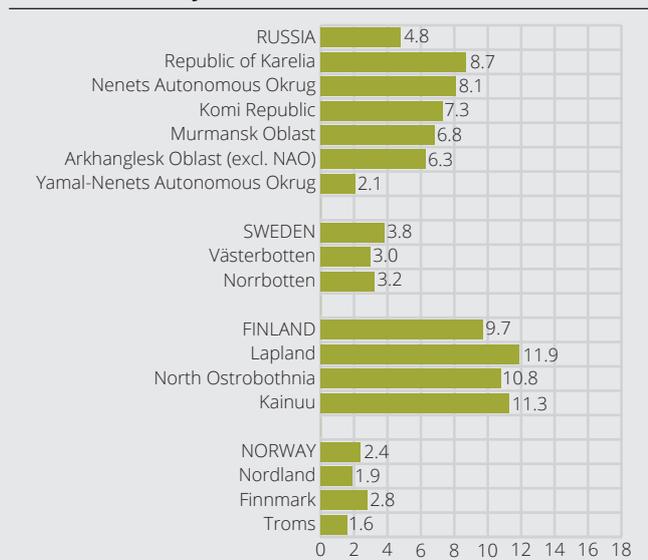
The average at-risk-of-poverty rate in the BIN Nordic regions in 2017 was 12.1 per cent, slightly lower than in Norway, Sweden, Finland as a whole. Regional variation is wide. In Finland, all BIN regions have a higher at-risk of poverty rate than the national average. Conversely, in Norway the BIN regions are on average slightly less exposed to risk of poverty than the national average. At-risk-of-poverty rate in the BIN Russian regions on average was about 23 per cent in 2017. In the Russian BIN regions, proportion of people exposed to risk of poverty is twice as high as in the Nordic BIN regions. It is noteworthy that risk of poverty decreased in most of the BIN Russian regions from 2013 to 2017. In Finnmark (Norway) the risk of poverty increased in this period.

Economic sustainability challenges

In this section we present the following indicators: unemployment rate as challenge to economic sustainability (related to the SDG8: Decent work and economic Growth), number of patent applications per 10 000 inhabitants as marker of innovative activity, and commercialization of knowledge (related to SDG9: Industry, Innovation and Infrastructure), and electricity balance in relation to the SDG7: Affordable Clean Energy.

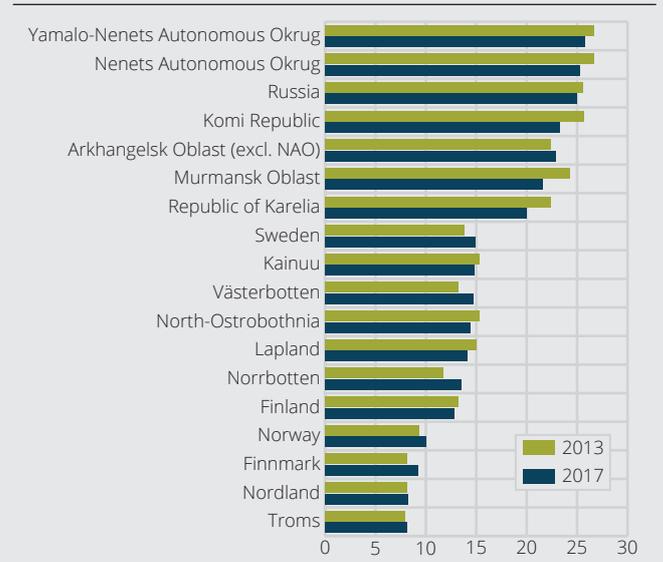
High unemployment results in a loss of income for individuals, increased pressure for government spending on social benefits and a reduction in tax revenue. Figures 3 and 4 present unemployment rates for 2018 (year average) and those by summer 2020. Comparing the two figures we can see that unemployment rate has grown from 2018 to 2020 throughout the whole BIN area and in the respective countries. This indicates negative effect

Figure 3. Unemployment rates 2018 based on workforce survey. Per cent



Data sources: Statistics Norway, Swedish Public Employment Service, Statistics Finland, Rosstat. Nordic data are based on workforce survey (2018) and unemployment register (2020). Russian data for both 2018 and 2020 are based on survey using method of World Labour Organization. 2020 data for Sweden, Russia and Finland are from June, 2020 data for Norway are from September 2020.

Figure 2. At risk of poverty rates 2013 and 2017. BIN regions. Per cent

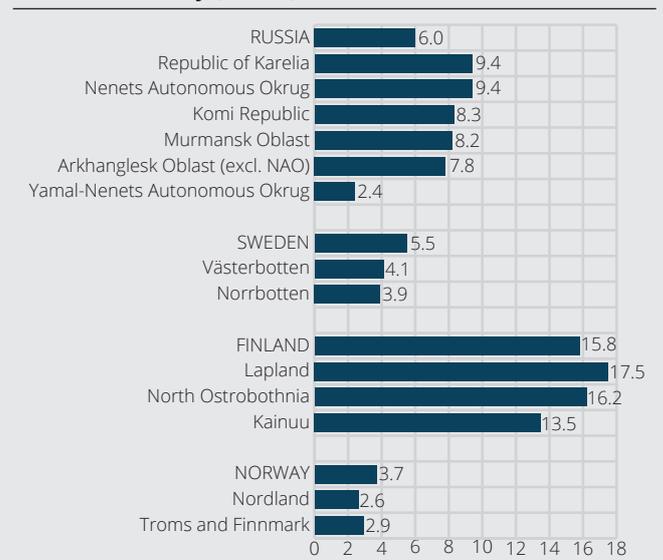


Data sources: Eurostat and Rosstat.

of the covid-19. However, data for 2020 are not directly comparable with data for 2018 for the Nordic countries as they are calculated based on different methods of data collection (workforce survey in 2018 and unemployment register in 2020).

The impact of COVID-19 on unemployment in June 2020 is most pronounced in the regions of Northern Finland, with an average 4.4 per cent increase in unemploy-

Figure 4. Unemployment rates 2020 based on unemployment register (Nordics) and WLO survey (Russia). Per cent



Data sources: Statistics Norway, Swedish Public Employment Service, Statistics Finland, Rosstat. Nordic data are based on workforce survey (2018) and unemployment register (2020). Russian data for both 2018 and 2020 are based on survey using method of World Labour Organization. 2020 data for Sweden, Russia and Finland are from June, 2020 data for Norway are from September 2020.

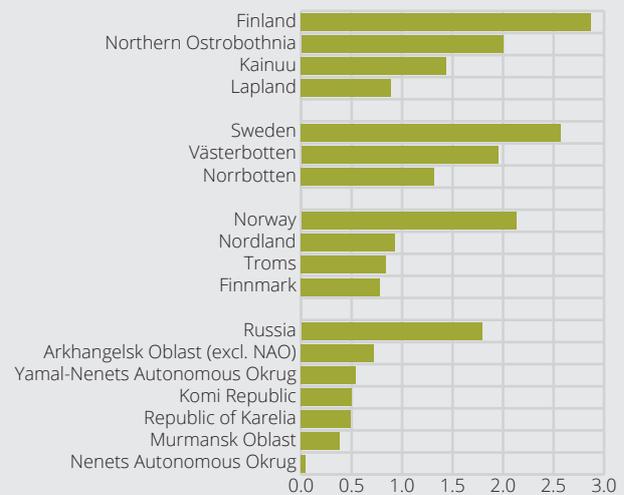
ment from 2018. The region of Lapland had an increase of 5.6 per cent compared to 2018, resulting in almost every sixth person being unemployed. Originally high unemployment rates in Finland are due to structural unemployment arising after the recession of the 1990s after the disruption of the Soviet economy. The impact of COVID-19 in Norwegian and Swedish BIN regions is less pronounced, with an average increase of 0.7 per cent in the Norwegian BIN regions and 0.9 per cent in the Swedish BIN regions. The Russian BIN regions except for the Yamalo-Nenets Autonomous Okrug had a 1.2 per cent increase in unemployment, while the Yamal-Nenets Autonomous Okrug was not impacted, showing only a slight increase of 0.3 per cent in 2020 from what was already the lowest level of 2.1 per cent unemployment in the Russian BIN area in 2018. This reflects the persistent activity in oil and gas development in the region. The differences in magnitudes of the impact of COVID-19 on unemployment are due to regionally inherent industrial structure, different government support schemes and differences in socio-economic conditions before the pandemic.

New challenges associated with the pandemic require new solutions. The ability to innovate and to develop knowledge economy infrastructure is becoming even more critical for regional development. Knowledge-based economies sustain growth through technological advantage, access to information and know-how; to a lesser extent it depends on natural resources and physical means of production located in the region. In particular, patenting is an important indicator of innovative activity in the commercialisation of new knowledge.

Figure 5 shows the average number of patent applications per 10 000 capita submitted to national intellectual property rights authorities. On a national basis, Finland has the highest level of patenting activity followed by Sweden, Norway and Russia. Among the BIN regions, North Ostrobothnia and Västerbotten demonstrate the highest patenting activity. Since the statistics shown are based on the applicant's (owner of the invention) address, a large number of inventions made in the regions of Norrbotten and North Ostrobothnia by local inventors are included in numbers outside the Northern regions for Sweden and Finland (such as inventions owned respectively by Eriksson and Nokia). Apart from Norrbotten, Västerbotten and North Ostrobothnia, the other BIN regions demonstrate very low levels of patenting activity at less than half of their respective national averages. This limits the integration of the regions into the knowledge-based economy.

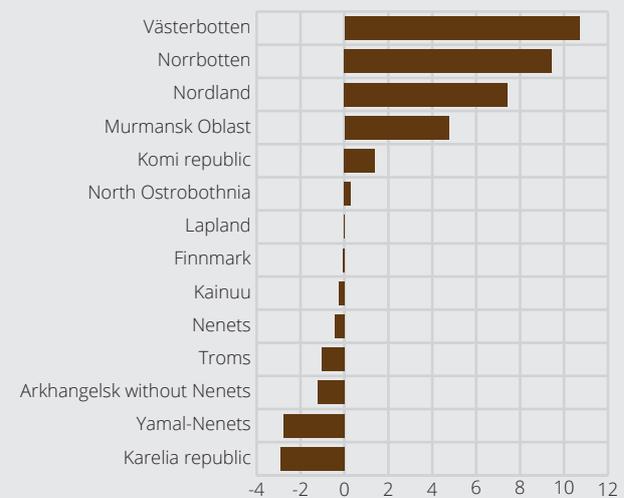
The SDG 7: Affordable clean energy assumes by 2030 ensure universal access to affordable, reliable and modern energy services. One of key indicators here is electricity production from wind and hydropower in TWh and as share of energy mix. Abundance of electricity in the BIN regions can potentially make them attractive for establishing energy-intensive industries, such as steel-making and battery cell production. In figure 6 we present electricity balance as difference between electricity produced and consumed in the BIN regions.

Figure 5. Number of patent applications per 10 000 inhabitants, BIN regions, yearly average 2008-2018



Data sources: Swedish Intellectual Property Office, Finnish Patent and Registration Office, Norwegian Industrial Property Office, Rosstat. For Russia annual averages are calculated for the period 2013-2018; Annual averages for the Nordic countries are calculated for the period 2008-2017.

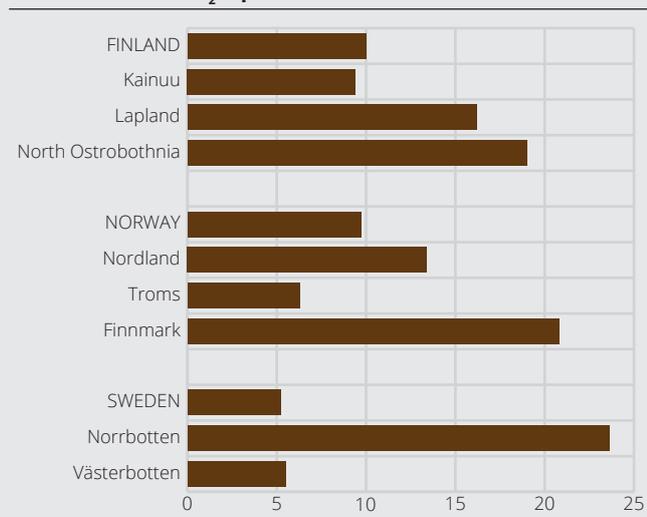
Figure 6. Electricity balance 2018, TWh (difference between electricity produced and consumed)



Data sources: Statistics Finland, Statistics Norway, Statistics Sweden, Rosstat

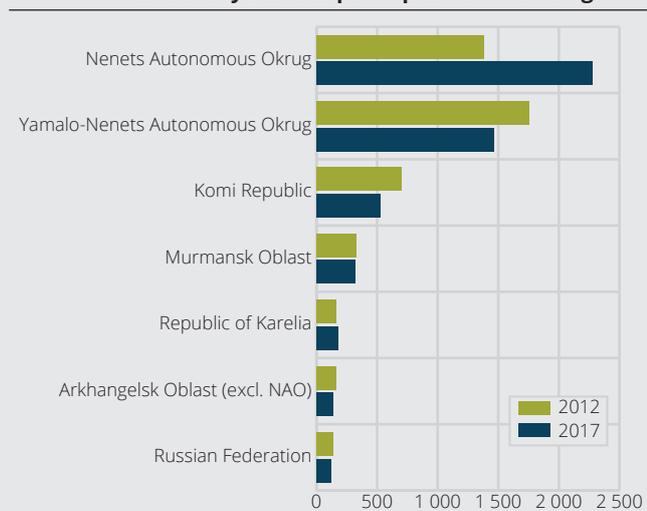
Figure 6 demonstrates that several BIN regions have a substantial surplus of electricity, for instance, Västerbotten, Norrbotten, Nordland, Murmansk. The electricity is however accumulated from various sources. Northern Norway and Northern Sweden generate about 90 per cent of electricity using hydro-power. Northern Finland relies on a mix of hydro (around 50 per cent), thermal and wind power. As for Murmansk Oblast, about 46 per cent of electricity produced originates from nuclear power, while 45 per cent is hydropower and the rest is thermal power. Among these sources of electricity energy, only hydro power can be considered as clean. Even wind power is questionable as it destroys ecosystems by fragmentation of habitats and impacts on

Figure 7. Emissions of greenhouse gases per capita. 2017. Ton CO₂ equivalents



Data sources: Statistics Finland, SSB, Statistics Sweden. A carbon dioxide equivalent or CO₂ equivalent is a metric measure used to compare the emissions from various greenhouse gases on the basis of their global-warming potential (GWP), by converting amounts of other gases to the equivalent amount of carbon dioxide with the same global warming potential (Eurostat).

Figure 8. Emissions to air in Russia. Pollutants from stationary sources per capita. 2012-2017. Kg



Data source: Rosstat

wildlife through increased death rate of avian creatures such as birds and bats. We can see that the High North regions even with abundant electricity has a way to go in improving their energy mix. Regions that have an electricity deficit should address energy security issues and adopt strategies for installing capacity for generating renewable energy.

Environmental sustainability challenges

In this section we focus on climate and emissions with less attention to other issues of environmental sustainability. Getting detailed and comparable environmental data is a challenge which limits researchers' possibilities for calculation and analysis of corresponding SDG indicators.

Figure 7 shows emissions of greenhouse gases (GHG) per capita in the BIN Nordic regions. Industry accounts on average for 75 per cent of all GHG emissions. Energy-intensive industries explain high emissions per capita, for example, in Norrbotten and North Ostrobothnia (steel-making, which also uses coal and coke in the process) and relatively low population density. For instance, 90 per cent of the EU's iron ore extraction takes place in the Norrbotten region, while only 2.4 per cent of Sweden's population live there. The population density is very low in Norrbotten with just 2.6 people per square km, while in the whole of Sweden it is 25.1. Relatively high numbers in Finnmark are caused by relatively low number of population, but also the oil and gas industry.

The EU countries signed a Euro 750 billion recovery package to alleviate the consequences of the COVID-19 pandemic, aiming to contribute to a green, digital and resilient recovery of the economy. Specially reserved funding for northern sparsely populated areas may result in the greening of the northern economy and a reduction of CO₂ and other GHG emissions in the long term. In Arctic Sweden, proactive steps are being taken in addressing high CO₂ emission as part of steel production. In 2020, the Swedish companies SSAB, LKAB and Vattenfall launched a globally unique pilot HYBRIT plant to produce fossil-free iron. Moreover, FREYR green battery production plant in Mo i Rana demonstrates the Arctic regions' ambition to create pioneering solutions in addressing the climate change challenge.

One should note that despite potential low carbon footprint of battery production in the Arctic, batteries themselves have environmental drawbacks as they contain toxic and in some cases flammable materials. As for the mining industry, its environmental sustainability can and should be improved, but this industry will always be associated with challenges for eco-systems. Sustainability discussion would inevitable involve the discussion of trade-offs between social, economic and environmental issues.

Figure 8 presents emissions to air in Russia measured as pollutants from stationary sources. For Russia in general, about half of the pollutants into the atmosphere are released from stationary sources. The pollutants include solids, gaseous and liquid substances: sulphur dioxide, nitrogen oxides, carbon monoxide, hydrocarbons, volatile organic connections, other gaseous and liquid substances. The Yamalo-Nenets Okrug and the Nenets Autonomous Okrug have the highest emissions due to the hydro-carbon projects in the area.

¹ <https://businessindexnorth.com>

² The regions are referred to in the text as BIN regions or in total as BIN area.

³ Nenets Autonomous Okrug (NAO) is a part of Arkhangelsk Oblast. In the statistics presentations they are often separated.

⁴ https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:At-risk-of-poverty_rate

⁵ https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Equivalent_disposable_income



Highway running through Alaska wilderness/Crestock

9. Concluding remarks

Solveig Glomsrød, Gérard Duhaime and Iulie Aslaksen

The purpose of the ECONOR IV project has been to give a comprehensive overview of the economy in the Arctic, including a snapshot of the subsistence economy of the Indigenous Peoples and local people of the region. To achieve this goal, we have utilized data from the statistical agencies of the Arctic nations and from other sources when relevant. The overview of the Arctic economy provided by this report in terms of scale, composition and structure may help policy makers and communities to better see the position of various stakeholders, the large-scale commercial interests, the local and central governments, the Indigenous Peoples, and the citizens of the Arctic as a whole.

There are large differences in the levels of gross regional product (GRP) per capita among the Arctic regions and nations. However, in natural resource-based economies, using data for GRP, or GDP at national level, to evaluate the wealth or well-being of the population can be especially misleading. Since a large part of GRP in such economies comprises return to fixed capital and resource rents that can be taken out of the region as income, it is difficult to assess what share of GRP is actually available in the region for consumption and investments. Moreover, transfers within Arctic states tend to modify the gaps in disposable income per capita between the Arctic and non-Arctic regions. Hence, data for disposable income of households per capita are included, to give a better picture of consumption possibilities. The change in income during 2015-2018 is discussed, and a broad set of socioeconomic and social indicators contributes to a better picture of well-being, livelihood, and public services from regional and national government.

In the Arctic, with its population of Indigenous Peoples, subsistence activities are very important for providing local food, as well as maintaining social relationships and cultural values. Subsistence activities contribute to consumption over and above what is recorded in the national accounts. As more attention is brought to the intertwined

nature of the market economy and subsistence economy and its importance for the well-being of Arctic Indigenous Peoples, an important challenge for analysts and policy-makers is the lack of systematic monitoring of the subsistence activities.

To improve the understanding of the subsistence activities in the Arctic economies, future ECONOR projects will aim to strengthen partnerships with the Indigenous Peoples represented in the Arctic Council, to achieve more insight of concepts of subsistence and food security that have different meanings in different cultural perspectives. More knowledge is needed on Indigenous roles in Arctic economies. Indigenous economies are not only subsistence, as documented for example in the work by the National Indigenous Economic Development Board in Canada, and by numerous Indigenous-led economic development corporations in the Arctic. Acknowledging and exploring the increasing role and prominence of Indigenous-led economic development can be addressed in future ECONOR reports.

A crucial question that we have not been able to answer in this report is to what extent climate change and other environmental impacts, such as from long range transported pollution, will limit the possibilities for subsistence activities in the Arctic. Since environmental impacts of economic activity are not explicitly included in GDP, it is a challenge to develop environmental statistics and indicators that can be applied complementarily with economic indicators.

Many tasks are remaining for Arctic statistical agencies and researchers in order to compile economic, environmental and social statistics for the Arctic regions. There is a clear potential for establishing a wider set of data and economic, social and environmental indicators for the circumpolar Arctic. Based on the experiences from the ECONOR projects, we see in particular a need to emphasize a direct focus on the 2030 Agenda for sustainable development

goals in future ECONOR projects. In particular, one can aim to:

- Continue dialogue with statistical agencies of Arctic nations in order to enhance statistical cooperation and establish an institutional basis for providing statistical information on the economy, livelihood and environmental impacts in the circumpolar Arctic.
- Develop partnership with the Indigenous Peoples represented in the Arctic Council to strengthen a common understanding of the conditions for nature-based livelihoods and to develop a better understanding of the role of wages and other forms of income in supporting Indigenous economies.
- Improve statistical indicators to give a better knowledge of social conditions, well-being, and inequalities in Arctic regions. Continue to link the national account based industry data with environmental and climate data to facilitate a comprehensive analysis aligned with the 2030 Agenda for sustainable development.
- Improve indicators of disposable income of households by adjusting for in-kind transfers of services from public sector, as carried out in a pilot study by Canada in this report.
- Provide regionally based price indices for Arctic regions for improved assessments of livelihoods.
- Present time series for core economic indicators in diagrams, to visualize development trends
- Harmonize and present statistics communicating progress in the green transition, aligned with Sustainable Development Goals.
- Establish statistical indicators relevant for Sustainable Development Goals that set out a wide range of economic, social, cultural, and environmental objectives.
- Facilitate research on how climate change and biodiversity loss will affect the Arctic economy and socio-economic conditions by formatting statistics, such as providing spatial (gridded) data on population, capital assets and nature-based activities, to make socio-economic and economic data compatible with output from regionally downscaled climate models and ecosystem accounting.
- Establish statistical indicators for the subsistence economy of Indigenous Peoples and local residents of the Arctic, to document the importance of nature-based livelihoods for economy, well-being, nutrition and culture. Indicators for subsistence activities could be developed as supplementary accounts (satellite accounts) to the national accounts. Discussions should take place with Indigenous Peoples Organizations about how these indicators might be developed. Indicators for the subsistence economy could improve assessments of impacts of climate change and trans-boundary pollution on nature-based livelihoods and well-being, and of progress towards Sustainable Development Goals.

The list above does not aim to be complete, and there are certainly more areas that need further study. Taking into account the limited availability of economic statistics and analysis of the circumpolar Arctic before the ECONOR projects, there are many tasks that deserve further efforts. *The Economy of the North – ECONOR 2020* has updated the earlier versions of the ECONOR reports and demonstrated the potential for both regularly updating of the statistics and expanded coverage of topics. A strong focus on documenting progress towards the 2030 Agenda for sustainable development goals, in terms of livelihoods, natural wealth management and environmental challenges, and strengthening partnerships in circumpolar cooperation for future ECONOR reports, can be regarded as a synthesis of the main findings from the ECONOR IV project.



Kindergarden, Nuuk, Greenland. Photo: Birger Poppel

List of authors and other contributors

Chapter	Author	Institution	Country
List of authors:			
1, 6, 9, Box X	Iulie Aslaksen	Statistics Norway	Norway
1, 3, 4, 5, 9, Box I	Solveig Glomsrød	CICERO	Norway
1, 2, 9	G�rard Duhaime	Universit� Laval	Canada
2	Karen Everett	Universit� Laval	Canada
2	Andr�e Caron	Universit� Laval	Canada
2	S�bastien L�vesque	Universit� Laval	Canada
2	Marileine Baribeau	Universit� Laval	Canada
2, 3, 4, Box I	Taoyuan Wei	CICERO	Norway
Box II	Anders S�nsteb�	Statistics Norway	Norway
4, 5, Box IV, Box VII	Lars Lindholt	Statistics Norway	Norway
4, 6, 8	Ryan Macdonald	Statistics Canada	Canada
4	Th�r�lfur Matth�sson	University of Iceland	Iceland
4, Box III	Scott Goldsmith	University of Alaska	USA
Box V	Jan Henrik Wang	Statistics Norway	Norway
Box V	Jakob Kalko	Statistics Norway	Norway
Box V	Mikael Sandberg	Statistics Norway	Norway
Box V	Hege Raaberg Bekkevold	Statistics Norway	Norway
Box VI	Edita Zahirovic	Statistics Norway	Norway
Box VIII	Andrey N. Petrov	University of Northern Iowa	USA
Box VIII	Maria S. Tysiachniouk	Centre for Independent Social Research, St. Petersburg	Russia
Box IX	Gertrude Saxinger	Austrian Polar Research Institute	Austria
6	Inuit Circumpolar Council	Inuit Circumpolar Council (ICC)	Canada
6	Gwich'in Council International	Gwich'in Council International (GCI)	Canada
6	Davin Holen	University of Alaska	USA
6	Hanna H. Harrison	University of Guelph	Canada
6	David Natcher	University of Saskatchewan	Canada
6	Susanna Gartler	University of Vienna	Austria
6, 8	Alexander Pilyasov	Lomonosov Moscow state university	Russia
6	Valeriy Kibenko	Arctic Research Center of the Yamal-Nenets Autonomous Okrug, West Siberian Branch of Russian Academy of Sciences Russia	Russia
6	Ravdna Biret Marja E. Sara	S�mi University of Applied Sciences, University of the Arctic, Eal�t Institute/International Centre for Reindeer Husbandry (ICR)	Norway
6	Risten M.N. Buljo	University of the Arctic, Eal�t Institute/International Centre for Reindeer Husbandry (ICR)	Norway
6	Ellen Inga Turi	University of the Arctic, Eal�t Institute/International Centre for Reindeer Husbandry (ICR)	Norway
6	Anders Oskal	International Centre for Reindeer Husbandry (ICR)	Norway
6, Box X	Svein D. Mathiesen	University of the Arctic, Eal�t Institute/International Centre for Reindeer Husbandry (ICR)	Norway
6	Birger Poppel	Ilisimatusarfik, University of Greenland	Greenland
6	MarieKathrine Poppel	Ilisimatusarfik, University of Greenland	Greenland
7	Derek J. Clark	Arctic University of Norway (UiT)	Norway
7	Mikko Moilanen	Arctic University of Norway (UiT)	Norway
7	Stein �stbye	Arctic University of Norway (UiT)	Norway
8	Nadezhda Zamyatina	Lomonosov Moscow state university	Russia
8	Dmitry Streletskiy	George Washington University	USA
8	Luis Suter	George Washington University	USA
Box X	Wilbert van Rooij	Plansup	Netherlands
Box X	Philip Burgess	University of the Arctic, Eal�t Institute, International Centre for Reindeer Husbandry (ICR)	Norway
Box X	Per Arild Garn�sjordet	Statistics Norway	Norway
Box XI	Alexandra Middleton	Oulu Business School	Finland
Box XI	Andrey Mineev	Nord University Business School / High North Center	Norway
Box XI	Erlend Bullv�g	Nord University Business School	Norway
Box XI	Sissel Ovesen	Bod� Science Park	Norway

List of authors and other contributors (cont.)

Chapter	Author	Institution	Country
List of other contributors providing data and statistical and scientific advice:			
3,6 (maps)	Winfried K. Dallmann	Arctic University of Norway (UiT)	Norway
4	Björn R. Gudmundsson	Statistics Iceland	Iceland
4	Jukka Muukkonen	Statistics Finland	Finland
4	Dolan Haddad	Statistics Sweden	Sweden
4	Josefine Rosshem	Statistics Sweden	Sweden
4	Gilli Wardum	Statistics Faroe Islands	Faroe Islands
4	Najaaraq Christiansen	Statistics Greenland	Greenland
4	Anders Blaabjerg	Statistics Greenland	Greenland
4	Magnus Helliesen	Statistics Norway	Norway
Box I	Bjart Holtsmark	Statistics Norway	Norway
Div.	Petter R. Koren	Editorial adviser	Norway
All	Siri E. Boquist	Statistics Norway: Photo editor	Norway
All	Marit Vågdal	Statistics Norway: Lay-out editor	Norway

Acknowledgement of use of photos

We thank photographer *Knut Espen Solberg* for the cover photo, and we thank *Association of Nenets People "Yasavey"*, *Malinda Bruce*, *Gérard Duhaime*, *Mads Fægteborg*, *Davin Holen*, *Tom Nicolaysen*, *Birger Poppel*, *Michelle Ravenmoon*, *Hunter T. Snyder*, *Mary Stapleton*, *Åsne Vigran*, *Mikhail Yashchenko* and *Nadezhda Zamyatina* for sharing their photos as contribution to ECONOR.

List of figures

Chapter 2

Figure 2.1. North America model, main pattern. 2018	18
Figure 2.2. Nordic model, main pattern. 2018	18
Figure 2.3. Nordic model, main pattern. 2018 (cont.)	18
Figure 2.4. Russian Federation model, main pattern. 2018	18
Figure 2.5. North America model, variation. 2018	18
Figure 2.6. Nordic model, variation. 2018	18
Figure 2.7. Russian Federation model, variation. 2018	19
Figure 2.8. Russian Federation model, variation. 2018 (cont.)	19
Figure 2.9. Map of circumpolar Arctic life expectancy, in years. 2018	20
Figure 2.10. Map of circumpolar Arctic infant mortality, per 1 000 live births. 2018	21
Figure 2.11. Map of circumpolar Arctic income inequality measured by the Gini coefficient. 2018	22
Figure 2.12. Population by Arctic regions, relative changes 2012-2018. Per cent	23
Figure 2.13. Youth rate by Arctic regions, absolute changes 2012-2018. Percentage point	23
Figure 2.14. Life expectancy by Arctic regions, absolute changes 2012-2018. Years	23
Figure 2.15. Infant mortality by Arctic regions, absolute changes 2012-2018. Per 1 000 live births	23
Figure 2.16. Female rate by Arctic regions, absolute changes 2012-2018. Percentage point	24
Figure 2.17. Disposable income in 2018 USD-PPP per capita by Arctic regions, relative changes 2012-2018. Per cent	24
Figure 2.18. Gross regional product in 2018 USD-PPP per capita by Arctic regions, relative changes 2012-2018. Per cent	24
Figure 2.19. Income inequality measured by Gini coefficient by Arctic regions, absolute changes 2012-2018	24

Box I

Figure 1. GDP per capita by Arctic region 2018. 1 000 USD at 2018 prices	35
Figure 2. Arctic Region share of total circumpolar GDP 2018. Per cent	35

Chapter 3

Figure 3.1. Administrative areas of the circumpolar Arctic	40
Figure 3.2. Arctic surface area, population and GRP of Arctic states as share of the Arctic total. 2018. Per cent	41
Figure 3.3. Arctic region share of surface area, population and GRP of corresponding country. 2018. Per cent	41
Figure 3.4. Population growth. Arctic and non-Arctic regions by country. 2012-2018. Per cent	42
Figure 3.5. Population growth by Arctic region. 2012-2018. Per cent	42
Figure 3.6. Dependency ratio in Arctic and non-Arctic regions, by country. 2018. Per cent	43
Figure 3.7. Dependency ratio, by Arctic sub-region. 2012 and 2018. Per cent	43
Figure 3.8. Gross regional product (GRP) per capita, by Arctic region. 2018. 1 000 USD-PPP	44
Figure 3.9. Disposable income of households per capita, by Arctic region. 2018. 1 000 USD-PPP	44
Figure 3.10. Gross regional product (GRP) per capita and disposable income of households (DIH) per capita, by Arctic sub-regions. 2018. 1 000 USD-PPP	45
Figure 3.11. Average annual economic growth of Arctic and non-Arctic regions, by country. 2012-2018. Per cent	45
Figure 3.12. Average annual economic growth, by Arctic sub-region. 2012-2018. Per cent	46

Chapter 4

Figure 4.1. Price indices of food, metals and energy. 2002-2020	51
Figure 4.2. Price indices for fish. 2002-2020	51
Figure 4.3. GRP volume index and growth rate. Alaska. 2000-2018	54
Figure 4.4. Value added by main industry (at current price). Alaska. Per cent of GRP. 2015 and 2018	54
Figure 4.5. Gross regional product (GRP) per capita and Disposable Income for Households (DIH) per capita. United States. 2018. 1 000 USD-PPP ..	55
Figure 4.6. Alaska permanent fund dividend	55
Figure 4.7. Mineral production of Alaska. 2016-2018	57
Figure 4.8. GRP volume index and growth rate. Arctic Canada. 2000-2019	61
Figure 4.9. Value added by main industry. Arctic Canada. Per cent of GRP. 2015 and 2017	61
Figure 4.10. Gross regional product (GRP) per capita and Disposable Income of Households (DIH) per capita. Arctic Canada. 2018. 1 000 USD-PPP ..	61

Box 4.2

Conventional and adjusted Disposable Income of Households (DIH) per capita. Canada. 2017. Canadian dollars (CAD)	62
Figure 4.11. Diamond production. Arctic Canada. 1998-2019	64
Figure 4.12. Oil production. Arctic Canada. 1998-2019	64
Figure 4.13. Natural gas production. Arctic Canada. 1998-2019	64
Figure 4.14. Value added in selected industries. Arctic Canada. 2012-2017. Mill. CAD	65
Figure 4.15. GRP volume index and growth rate. Faroe Islands. 2000-2018	67
Figure 4.16. Value added by main industry. Faroe Islands. Per cent of GRP. 2015 and 2018	67
Figure 4.17. Gross regional product (GRP) per capita and Disposable Income for Households (DIH) per capita. Faroe Islands. 2018. 1 000 USD-PPP ..	67
Figure 4.18. Fish harvest by main species. Faroe Islands. 2008-2018	68
Figure 4.19. Export of fish products by species. 2008-2020. Million DKK	68
Figure 4.20. GRP volume index and growth rate. Arctic Finland. 2000-2018	69
Figure 4.21. Value added by main industry. Arctic Finland. Per cent of GRP. 2015 and 2018	70
Figure 4.22. Gross regional product (GRP) per capita and Disposable Income of Households (DIH). Arctic Finland. 2018. 1 000 USD-PPP	70

Figure 4.23. GRP volume index and growth rate. Greenland. 2000-2018	72
Figure 4.24. Value added by main industry. Greenland. Per cent of GRP. 2015 and 2018.....	73
Figure 4.25. Gross regional product (GRP) per capita and Disposable Income for Households (DIH) per capita. Greenland. 2018. 1 000 USD-PPP	73
Figure 4.26. Catch of fish and shellfish. Tonnes	74
Figure 4.27. Export of fish and shellfish. Greenland	74
Figure 4.28. GRP volume index and growth rate. Iceland. 2000-2018	76
Figure 4.29. Value added by main industry (at current price). Iceland. Per cent of GRP. 2015 and 2018	77
Figure 4.30. Gross regional product (GRP) per capita and Disposable Income for Households (DIH) per capita. Iceland. 2018. 1 000 USD-PPP.....	77
Figure 4.31. Catch by species. Iceland. Tonnes.....	79
Figure 4.32. Export of marine products by species. Iceland. Million ISK.....	79
Box 4.3	
Figure 1. Actual concentration of quotas by firms Iceland 1990-2013 (regular quotas) and 2000-2013 (hook-and-line quotas)	81
Figure 4.33. GRP volume index and growth rate. Arctic Norway. 2000-2018	83
Figure 4.34. Value added by main industry. Arctic Norway. Per cent of GRP. 2015 and 2018	83
Figure 4.35. Gross regional product (GRP) per capita and Disposable Income for Households (DIH) per capita. Arctic Norway. 2018. 1 000 USD-PPP	84
Figure 4.36. GRP index and growth rate. Arctic Russia. 2000-2018	85
Figure 4.37. Value added by main industry. Arctic Russia. Per cent of GRP. 2015 and 2018	86
Figure 4.38. Gross regional product (GRP) per capita and Disposable Income of Households (DIH) per capita. Arctic Russia. 2018. 1 000 USD-PPP	86
Figure 4.39. Russian oil production. 2000-2016	87
Figure 4.40. Russian gas production. 2000-2016.....	87
Figure 4.41. Value added in petroleum and other mining in Arctic Russia in current rubles. Annual growth rates 2015-2018. Per cent	88
Figure 4.42. GRP volume index and growth rate. Arctic Sweden. 2000-2018	90
Figure 4.43. Value added by main industry. Arctic Sweden. Per cent of GRP. 2015 and 2018	90
Figure 4.44. Gross regional product (GRP) per capita and Disposable Income for Households (DIH) per capita. Sweden. 2018. 1 000 USD-PPP	90
Figure 4.45. Gross regional product (GRP) per capita and Disposable Income for Households (DIH) per capita. Total. 2018. 1 000 USD-PPP	91
Box IV	
Figure 1. Average decomposition of value added in the Norwegian oil and gas sector. Million NOK	93
Figure 2. Five-year average resource rents from the renewable natural resources in Norway. NOK (2019-prices)/capita	93
Box V	
Figure 1. Protected areas of Svalbard	94
Figure 2. Persons in settlements on Svalbard. 1 January.....	95
Figure 3. Age distribution in the Norwegian settlement on Svalbard and on the mainland. 1 January 2015. Per cent	95
Figure 4. Shipped coal from Svalbard. Tonnes.....	96
Figure 5. Number of guest nights in accommodation establishments on Svalbard, by nationality.....	97
Figure 6. Research person-days in Ny-Ålesund, including field days, support and logistics activity	97
Figure 7. Students at the University Centre in Svalbard (UNIS).....	97
Box VI	
Figure 1. Ocean management area in Norway for the Barents Sea and Lofoten and related land areas.....	98
Chapter 5	
Figure 5.1. Oil price assumption. 2012-USD/boe.....	103
Figure 5.2. Arctic oil production. Reference scenario and increased rate of return scenario. Mtoe.....	104
Figure 5.3. Regional distribution of West Arctic oil production. Reference scenario and increased rate of return scenario. Mtoe.....	104
Figure 5.4. Arctic gas production. Reference scenario and increased rate of return scenario. Mtoe	106
Figure 5.5. Regional distribution of West Arctic gas production. Reference scenario and increased rate of return scenario. Mtoe	106
Box VII	
Figure 1. Arctic share of global coal and iron and ferro-alloy mineral extraction. Per cent. 2002, 2011 and 2015	110
Figure 2. Arctic share of global non-ferrous mineral extraction. Per cent. 2002, 2011 and 2015.....	111
Figure 3. Arctic share of precious metal ores and industrial mineral extraction. Per cent. 2002, 2011 and 2015	111
Chapter 6	
Figure 6.1. Permanent Participants of the Arctic Council.....	123
Figure 6.2. Range of the Porcupine Caribou herd in Gwich'in territory.....	125
Figure 6.3. Harvest of wild foods in Alaska by management sector. 2017	127
Figure 6.4. Figure 6.4. Wild foods harvest as share of edible weight by rural residents. Alaska, 2017. Per cent	128
Figure 6.5. Composition of the harvest of wild resources in Alaska, by region. Per cent based on pounds edible weight. 2017	128
Figure 6.6. Per capita harvest of wild resources in rural Alaska by region, 2017. Pounds edible weight	129
Figure 6.7. Harvest of wild resources by region. Alaska. Pounds usable weight per person per year	129
Figure 6.8. Location of personal use salmon 'dip net' fisheries in Southcentral Alaska	132
Figure 6.9. Population growth rates, share of Indigenous population, age and tertiary education. Yukon, Northwest Territories and Nunavut. 2011-2016. Per cent.....	135
Figure 6.10. Labour market characteristics of communities in Yukon, Northwest Territories and Nunavut	136
Figure 6.11. Indigenous Peoples of the Russian North, Siberia and Far East. Compiled and drawn by W. Dallmann	139
Figure 6.12. Number of reindeer and production of reindeer meat. Reindeer husbandry in the Russian Arctic. 2016	141
Figure 6.13. Dominance of "tundra radio", i.e. word of mouth from other families in all communication methods of reindeer herders-entrepreneurs of the Yamal district. 2017.....	142

Figure 6.14. Number of reindeer in reindeer husbandry in Norway, by region. 31 March 2019	145
Figure 6.15. Circumpolar reindeer pastoralism	146
Figure 6.16. Most important ways women in Greenland contribute to the household, by age group. Per cent. 2004-2006.....	147
Figure 6.17. Most important ways men in Greenland contribute to the household, by age group. Per cent. 2004-2006.....	147

Chapter 7

Figure 7.1. Overnight stays in the Arctic 2008-2019 and change in annual overnight stays	156
Figure 7.2. Number of cruise passengers in main destinations in the Arctic. 2010-2019	156
Figure 7.3. International arrivals to Iceland by mode of transport. 2015-2019	158
Figure 7.4. Hotel capacity and occupancy rate. Iceland. January 2015-January 2020	158
Figure 7.5. Domestic and foreign overnight stays in Iceland. 2008-2019	159
Figure 7.6. Seasonality measured by number of overnight stays by months. Iceland. 2010 and 2019	159
Figure 7.7. Employment related to tourism in Iceland. January 2014-January 2020.....	159
Figure 7.8. Top twenty foreign markets in 2019 and percentage change 2010-2019 in Iceland. Overnight stays	159
Figure 7.9. Hotel capacity and occupancy rates. Arctic Sweden. 2010-2019	160
Figure 7.10. Share of domestic and foreign overnight stays 2010-2019 in Arctic Sweden.....	160
Figure 7.11. Seasonality measured by number of overnight stays by months. Arctic Sweden. 2010 and 2019	160
Figure 7.12. Top twenty foreign markets in 2019 and percentage change 2010-2019 in Arctic Sweden. Overnight stays	160
Figure 7.13. Hotel capacity and occupancy rates. Arctic Finland. 2010-2019	161
Figure 7.14. Employment in tourism industries. Arctic Finland. 2013-2015	161
Figure 7.15. Share of domestic and foreign overnight stays in Arctic Finland. 2010-2019	161
Figure 7.16. Top twenty foreign markets in 2019 and percentage change 2010-2019 in Arctic Finland. Overnight stays	162
Figure 7.17. Seasonality measured by number of overnight stays by months. Arctic Finland. 2010 and 2019	162
Figure 7.18. Hotel capacity and occupancy rates, Northern Norway and Svalbard. 2010-2019	163
Figure 7.19. Share of domestic and foreign overnight stays in Arctic Norway. 2010-2019	163
Figure 7.20. Top twenty foreign markets in 2019 and percentage change 2010-2019 in Arctic Norway. Overnight stays.....	163
Figure 7.21. Seasonality measured by number of overnight stays by months. Arctic Norway. 2010 and 2019.....	163
Figure 7.22. Employed persons in the tourism industry in Arctic Norway. 2013-2017	163
Figure 7.23. Number of international visitors to Greenland. 2014-2019	164
Figure 7.24. Share of domestic and foreign overnight stays in Greenland. 2010-2019.....	164
Figure 7.25. Seasonality measured by number of overnight stays by months. Greenland. 2010 and 2019	164
Figure 7.26. Top twenty foreign markets in 2019 and percentage change 2010-2019 in Greenland. Overnight stays	164
Figure 7.27. Available tours in Arctic Russia 2015.....	165
Figure 7.28. Visitors to Alaska during fiscal years 2014-15 to 2017-18.....	166
Figure 7.29. Summer visitors to Alaska by means of travel.....	166
Figure 7.30. Share of domestic and foreign overnight stays in Arctic Canada. 2008-2019	167
Figure 7.31. Seasonality measured by number of overnight stays by months. Arctic Canada (Yukon and Nunavut). 2010 and 2019.....	167
Figure 7.32. Top twenty foreign markets in 2019 and percentage change 2010-2019 in Arctic Canada. Non-resident travelers entering Canada, by country of residence except the US.....	167
Figure 7.33. Share of tourism in gross regional product (GRP) and employment for Arctic regions.....	168

Chapter 8

Figure 8.1a. The elevation of buildings (and other infrastructure) onto pillars allows for a ventilated layer between the structure and the ground, which helps protect against permafrost degradation: Igarka, Russia.	178
Figure 8.1b. The elevation of buildings (and other infrastructure) onto pillars allows for a ventilated layer between the structure and the ground, which helps protect against permafrost degradation: Norilsk, Russia.	178
Figure 8.2. Thermosyphons alongside the Trans-Alaskan pipeline draw heat out of the ground and help keep permafrost temperatures low enough to support the above-ground structure. Alaska pipeline (2019)	179
Figure 8.3. In Russia, thermosyphons are also often used to protect buildings, in combination with elevating structures on piles, such as with this building in the city of Dudinka (2018).	179
Figure 8.4. A building damaged by permafrost degradation, Norilsk, Russia. (Photo from 2013, now the building is dismantled).	179
Figure 8.5. Share of construction firms in the total number of small enterprises. Per cent.....	182

Box X

Figure 1. Share of remaining biodiversity and biodiversity loss per pressure for Finnmark. 2011	184
Figure 2. Current (2011) versus projected total MSA in 2030 for Finnmark.....	185
Figure 3. MSA total for calving grounds and migration routes in Finnmark for 2011 and projected future scenario	185

Box XI

Figure 1. Total death rate due to coronary heart disease, cancer, chronic respiratory diseases and suicides, average rate for 2015–2017 and change 2008–2017 BIN regions	186
Figure 2. At risk of poverty rates 2013 and 2017. BIN regions. Per cent.....	187
Figure 3. Unemployment rates 2018 based on workforce survey. Per cent.....	187
Figure 4. Unemployment rates 2020 based on unemployment register (Nordics) and WLO survey (Russia). Per cent.....	187
Figure 5. Number of patent applications per 10 000 inhabitants, BIN regions, yearly average 2008-2018.....	188
Figure 6. Electricity balance 2018, TWh (difference between electricity produced and consumed)	188
Figure 7. Emissions of greenhouse gases per capita. 2017. Ton CO2 equivalents	189
Figure 8. Emissions to air in Russia. Pollutants from stationary sources per capita.2012-2017. Kg.....	189

List of tables

Chapter 2

Table 2.1. Selected social and economic indicators ¹ and composite index ² . Arctic regions. 2018.....	16
Table 2.2. Arctic regions distribution by socio-economic model. 2018.....	16
Annex 2.1. Changes in selected social and economic indicators and composite index. Arctic regions, changes between 2012 and 2018.....	31

Box II

Table 1. Income account for households. All of Norway, STN-area, and north of Saltfjellet. Average for households that have the income category. NOK. 2017.....	36
---	----

Chapter 4

Table 4.1. Value added by industry. Alaska. 2015 and 2018.....	53
Table 4.2. Value added by industry. Arctic Canada. 2015 and 2017.....	60
Table 4.3. Basic Indicators. Northern Canada. 2017.....	63
Table 4.4. Value added by industry. Faroe Islands. 2015 and 2018.....	66
Table 4.5. Value added by industry. Arctic Finland. 2015 and 2018.....	69
Table 4.6. Value added by industry. Greenland. 2015 and 2018.....	72
Table 4.7. Fisheries in Greenland. Value added 2012-2018. Mill. DKK.....	72
Table 4.8. Value added by industry. Iceland. 2015 and 2018.....	76
Table 4.9. Value added by industry. Arctic Norway. 2015 and 2018.....	82
Table 4.10. Value added by industry. Arctic Russia. 2015 and 2018.....	85
Table 4.11. GRP by sub-regions of Arctic Russia. 2012, 2015 and 2018.....	88
Table 4.12. Value added by industry. Arctic Sweden. 2015 and 2018.....	89

Box V

Table 1. Main economic figures for the Norwegian settlements on Svalbard in 2019 (SIC2007).....	96
---	----

Box VI

Table 1. Sectoral and geographical delineation of ocean based sectors.....	99
Table 2. Value added in ocean based sectors. Norway and ocean management area. Billion NOK (current value) and per cent.....	99
Table 3. Employment in ocean based sectors. Norway and ocean management area. 1 000 persons and per cent.....	99

Chapter 5

Table 5.1. Change in accumulated oil production 2020-2050. Increased rate of return scenario. Deviation from reference scenario. Per cent.....	104
Table 5.2. Increase in accumulated gas production 2020-2050. Increased rate of return scenario. Deviation from reference scenario. Per cent.....	106

Box VII

Table 1. Change in volume of coal and iron and ferro-alloy mineral extraction in the Arctic from 2002 to 2015. Per cent.....	110
Table 2. Change in volume of non-ferrous mineral extraction in the Arctic from 2002 to 2015. Per cent.....	111
Table 3. Change in the volume of precious metal ores and industrial mineral extraction in the Arctic from 2002 to 2015. Per cent.....	111

Chapter 6

Table 6.1. Wild food harvests in Alaska: Nutritional and replacement values.....	131
Table 6.2. Select Population Characteristics of Northern Canada.....	135
Table 6.3. Main industries and economic activities: Canada, Yukon, Northwest Territories and Nunavut; 2016 or most recent year available.....	136
Table 6.4. Aboriginal peoples survey, harvesting activities by Aboriginal identity, Number of persons, 15 years and over. 2017.....	137
Table 6.5. Number of reindeer in enterprises of different categories as of 01.01.2016. Russian Arctic. 1 000 heads.....	139
Table 6.6. Institutional structure of the Yamal-Nenets Autonomous Okrug (YANAO) reindeer husbandry as of 1.01.2017. Number and per cent.....	141
Table 6.7. Composition of total income in reindeer husbandry in Norway. 2014 and 2018.....	143
Table 6.8. Incomes from related activities in reindeer husbandry in Norway. 2018. 1 000 NOK.....	143
Table 6.9. Siida share costs in reindeer husbandry in Norway. 2018. 1 000 NOK.....	144
Table 6.10. Share of female and male siida share leaders with wage or self-employment income outside reindeer husbandry. 2018. Per cent.....	144
Table 6.11. Share of female and male spouses with wage or self-employment income outside reindeer husbandry. 2018. Per cent.....	144
Table 6.12. Number of compensated reindeer in reindeer husbandry in Norway, by region and by cause of loss to predators and traffic accidents. 2018.....	145

Chapter 7

Table 7.1. Tourism industries.....	155
------------------------------------	-----

Chapter 8

Table 8.1. Indicators of entrepreneurship in regions of the Russian Arctic: Number of small enterprises, turnover and share of part-time workers. 2017 and 2018.....	182
--	-----

