

THE ECONOMY OF THE NORTH

ECONOR 2025

FINAL REPORT 12 MAY 2025

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Sustainable
Development
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THE ECONOMY OF THE NORTH – ECONOR 2025

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Disclaimers

This project was endorsed by the Arctic Council's Sustainable Development Working Group. This report was prepared by the project team and does not necessarily reflect the policy or positions of any Arctic State, Permanent Participant, or Observer of the Arctic Council.

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

The Economy of the North

ECONOR 2025

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Preface

The objective of *The Economy of the North – ECONOR 2025* is to present a comprehensive overview of the economy of the circumpolar Arctic, including the traditional nature-based economic activities of the Indigenous Peoples. The report has been produced as part of the ECONOR V project, endorsed by the Sustainable Development Working Group (SDWG) of the Arctic Council. The ECONOR V project was carried out with Norway as lead country, Canada and the United States as co-leads among the Arctic states, and Gwich'in Council International and the Saami Council as co-leads among the Permanent Participants.

The ECONOR V 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 workshops and meetings where development of the ECONOR V project took place. Additional financial support is provided by institutions participating in the ECONOR network of representatives of national statistical offices, academic researchers, Indigenous rightsholders, and other experts.

The Economy of the North – ECONOR 2025 is the result of contributions from the ECONOR network of experts and researchers from national statistical offices, academic institutions, and Indigenous Peoples' organizations 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 V report with data and statistical advice. The National accounts section has provided regional data and the presentation of Svalbard statistics, and the Population statistics section has provided the presentation of Sámi statistics.

The Economy of the North – ECONOR 2025 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 four ECONOR reports, *The Economy of the North*, *The Economy of the North 2008*, *The Economy of the North 2015* and *The Economy of the North – ECONOR 2020*, is still relatively unexplored, with challenges of statistical and conceptual nature, and with a need to develop partnerships. *The Economy of the North – ECONOR 2025* 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 Statistics Norway. Hanne Marit Dalen, Randi Johannessen, Lars Lindholt (1959-2025) and Live M. Rognerud of Statistics Norway also participated in the editorial group. Marit Vågdal of Statistics Norway did the technical and lay-out editing. *The Economy of the North – ECONOR 2025* and previous ECONOR reports are available at www.ssb.no. Statistics Norway thanks all the individuals, institutions and organizations having provided funding, support, data, analysis, texts, illustrations, and scientific and statistical advice for *The Economy of the North – ECONOR 2025*.

The following two disclaimers apply, by the Arctic Council and by Statistics Norway. The ECONOR V 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 2025 has been submitted to the Arctic Council for approval to become deliverable at the completion of the Norwegian chairship of the Arctic Council (2023-2025).

Statistics Norway, 12 May 2025
Linda Nøstbakken



Nuuk, Greenland. Photo: Tom Nicolaysen

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The Economy of the North ECONOR 2025: Highlights

Data on social and economic issues have not been easily available at the Arctic circumpolar level. The ECONOR projects have contributed to fill this gap by comprehensive overviews of Arctic economies. The fifth ECONOR report updates economic statistics and includes a wide set of socio-economic data to depict Arctic livelihoods, explore the value of Arctic natural resources, and bring forward knowledge of Indigenous Peoples' way of life between traditional activities and market economy.

Maps in Chapter 1 depict the Arctic regions of the Arctic states, and extending across borders, the land of the Indigenous Peoples whose organizations are Permanent Participants in Arctic Council: Aleut International Association, Arctic Athabaskan Council, Gwich'in Council International, Inuit Circumpolar Council, Russian Association of Indigenous Peoples of the North, and Saami Council.

Social and socio-economic indicators are presented in visual images to describe similarity and difference between regions, in terms of inequality and key elements in human welfare (Chapter 2). Social indicators convey crucial information beyond gross regional product (GRP), as distribution of income and public services matter to quality of life.

A bird's eye perspective of the Arctic is given with regional data, in relation to the non-Arctic part of Arctic states and circumpolar level (Chapter 3). As shown in the Circumpolar overview, on average for Arctic regions, and per capita, GRP is higher in Arctic regions than in non-Arctic regions, typical for economies based on natural resources, whereas disposable income of households is lower in Arctic regions (Fig. 4.43). ECONOR V covers a period with economic downturn caused by the Covid pandemic, followed by recovery. In the same period, natural resource prices have been increasing.

A regional chapter presents core tables and figures with a consistent set of data across regions (Chapter 4). Arctic Russia, Alaska and Northern Canada are the main producers of petroleum and other mineral mining. A major sector of Greenland's and Faroe Islands' economy is the fisheries industry, and in Arctic Norway aquaculture dominates the regional blue economy. In manufacturing industry, Arctic Sweden and Arctic Finland take the lead. With a diversified economy, Iceland also has a large tourism sector. Overall, the public sector has

an important role for providing health and education services in Arctic regions.

For many Arctic regions, employment and revenues from mineral extraction may be the pillar of the economy. Increased demand for land for energy and mineral extraction has sharpened conflicts over land use. Climate policy impacts for Arctic petroleum are presented in a model-based analysis (Chapter 5). A new Chapter 6 highlights gender perspectives on Arctic economies.

ECONOR V has aimed for stronger involvement of Indigenous Peoples, to provide knowledge on the economy of the Indigenous Peoples whose home is the Arctic. The Editors thank the Permanent Participants for their involvement in a new Chapter 7, with the aim to describe their relation with the land, traditional ways of life, and the market economy. Chapter 8 explores relations between traditional and market economies, mutually dependent for providing consumption and a way of life that represents continuity, sharing and connection to nature.

The economic importance of tourism is explored in Chapter 9, with focus on recovery from the Covid pandemic. Chapter 10 presents studies of costs of melting permafrost, and impacts of infrastructure development, especially on Sámi reindeer herding land. A new chapter 11 explores the relevance for the Arctic of the Sustainable Development Goals and indicators.

The ECONOR V project was led by Statistics Norway, CICERO Center for International Climate Research, and Université Laval, Quebec, in cooperation with the circumpolar ECONOR network of statisticians, academics, and Indigenous Knowledge holders. Endorsed by the Sustainable Development Working Group of Arctic Council, ECONOR V was led by Norway and co-led by Canada, the United States, Gwich'in Council International, and Saami Council.

The overarching aim of ECONOR V is to inform decision-making and policy that prioritize sustainability, equity, and cultural integrity. We hope that this overview of the Arctic economy will inspire work to further strengthen the information basis from where to assess the sustainability of Arctic communities in terms of livelihoods, natural wealth, and environmental challenges.

1. The Economy of the North – ECONOR 2025: 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 V 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.

In the Sixth Assessment Report of the IPCC Intergovernmental Panel on Climate Change, the Physical Science Basis report highlights the increasing climate change: “The Arctic is projected to experience the highest increase in the temperature of the coldest days, at about three times the rate of global warming (*high confidence*)”.¹ The warming is demonstrated in the devastating forest fires in the North American Arctic.

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 V 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 2025 report finalizes the ECONOR V project which has been headed by Statistics Norway, CICERO Center for International Climate Research, and Université Laval, Quebec, Canada, in cooperation with a circumpolar network of statisticians, academics, and contributors from Indigenous Peoples organizations that hold Permanent Participant status in the Arctic Council. The ECONOR projects have close cooperation with the Canadian circumpolar partnership Wealth of the Arctic Group of Experts (WAGE) (see Highlight 2.3). The purpose of this fifth report has been to update the economic statistics of the previous versions, The Economy of



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

Figure 1.1. Administrative areas of the circumpolar Arctic

Source: Compiled by Winfried K. Dallmann.

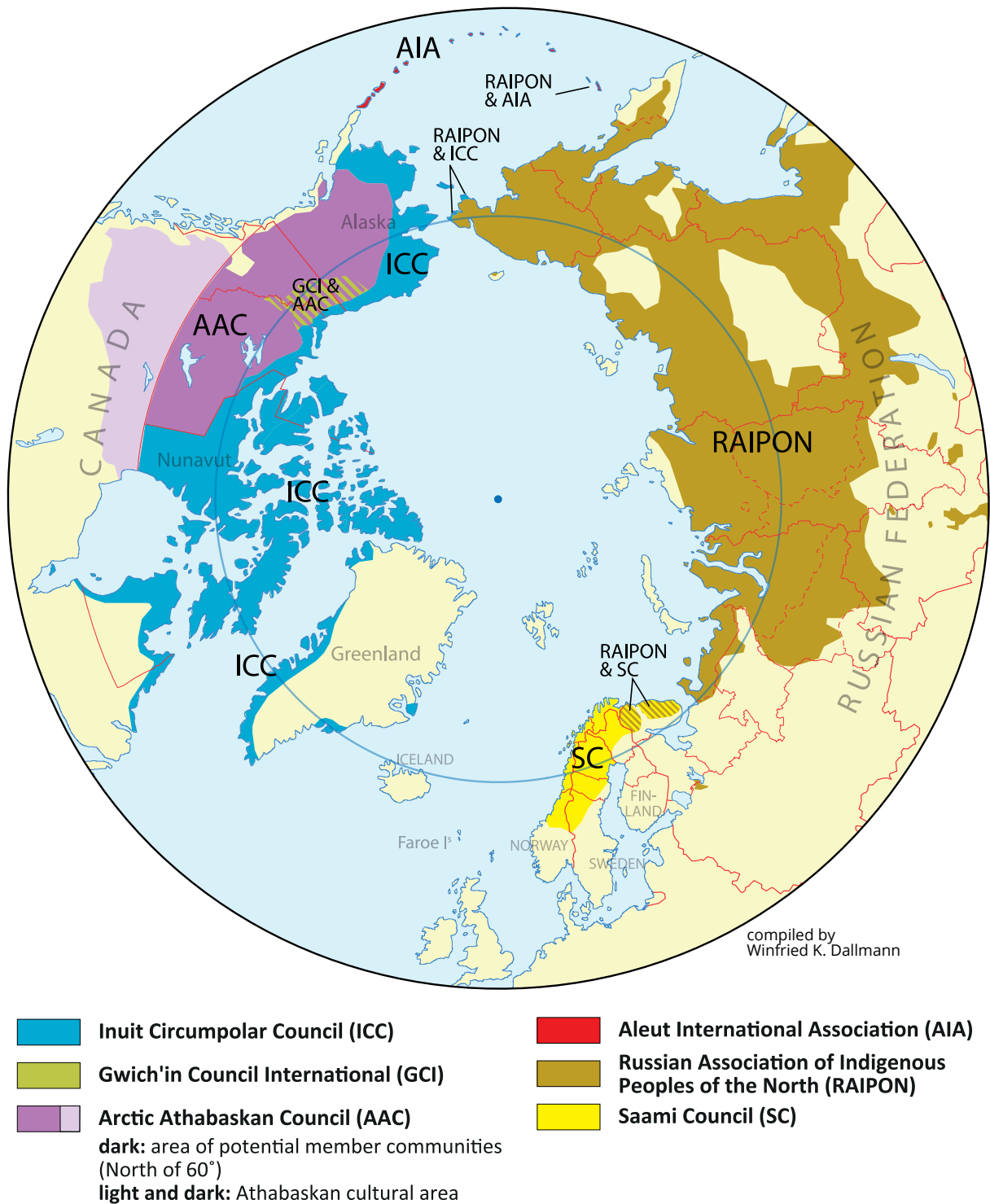
the North, published in 2006, The Economy of the North 2008, The Economy of the North 2015, and The Economy of the North 2020, and to include a wide set of socioeconomic variables to more clearly depict the livelihood of Arctic people.² Other objectives have been to shed light on the value of natural resources in the Arctic and to bring forward knowledge about how Indigenous Peoples manoeuvre between traditional economic activities based on land and sea and the market economy.

The Arctic Region as referred to in this report is depicted in the map in Figure 1.1. It covers Northern Russia with the Republics of Karelia and Komi, the Murmansk and Arkhangelsk Oblasts, the

Yamal-Nenets and Khanty-Mansi 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, and Nunavut.³ The European Arctic consists of Greenland, Faroe Islands, Iceland, 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-Mansi and Magadan do not belong

Figure 1.2. Permanent Participants of the Arctic Council



Source: Compiled by Winfried K. Dallmann.

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 2025 we present data for the regions previously de-

fined 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 1.2. They are the Aleut International Association, Arctic

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

According to the Arctic Council and the Arctic Human Development Report (AHDR) the population of the Arctic is about 4 million, in contrast to about 9.4 million according to the definition applied in ECONOR. The main reason for the large difference in the population figures between the Arctic Human Development Report (AHDR) and The Economy of the North (ECONOR) is that statistical data presented in ECONOR are based on available statistical data for administrative regions, which may extend south of the Arctic as delineated by the AHDR. For example, due to the availability of statistical data, all of the Republic of Sakha is included. Moreover, due to the focus of ECONOR on natural resources, its delineation of the Arctic includes Khanty-Mansi which is the largest Russian oil producing region, adjacent to oil and gas producing Yamal-Nenets.

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, Taymyr 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 per cent of the surface of

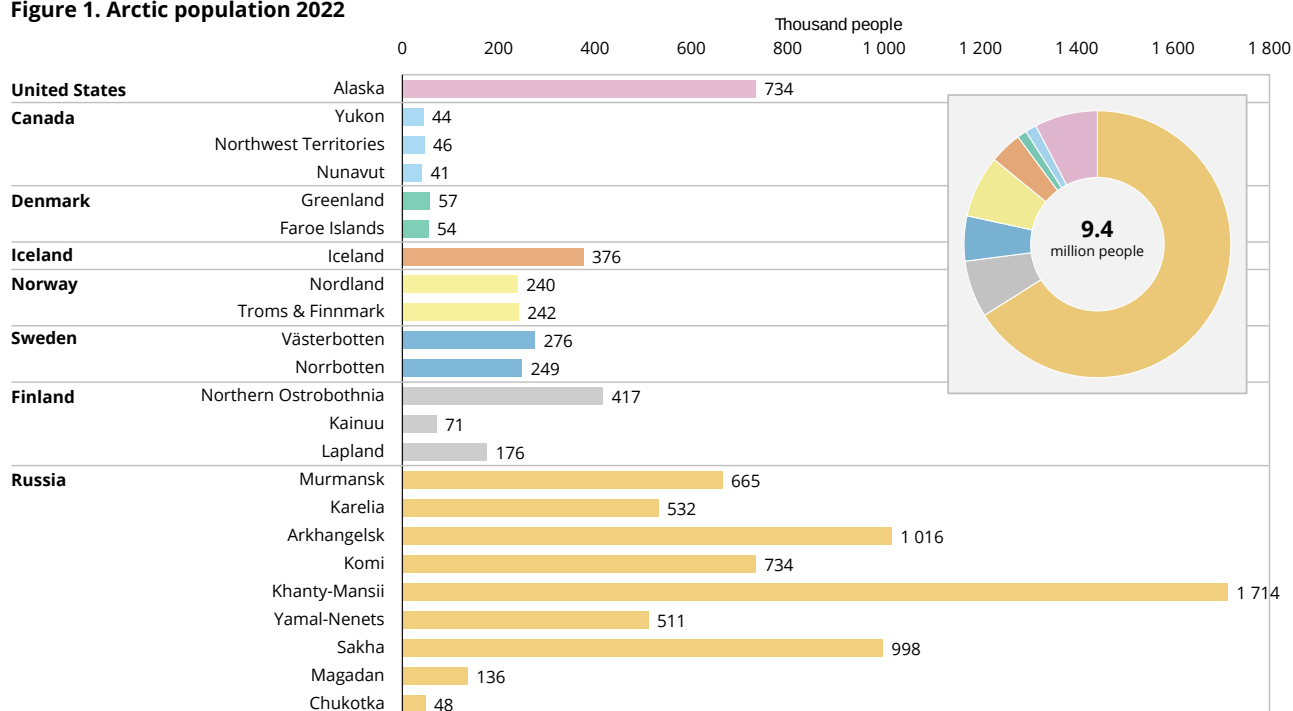
the Earth, a sizeable domain by any standards (AMAP 2002, Armstrong et al. 1978). But the human residents of this vast area number only about 4 million, of whom almost half are located within the Russian federation (AMAP 2002)” (AHDR 2004, p. 17-18).

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-Mansi Autonomous Okrugs, the Taymyr 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-Mansi 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 Taymyr autonomous okrug – have become parts of Krasnoyarsky Krai and Nenets autonomous okrug.

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. Arctic Council: Arctic Peoples.

Figure 1. Arctic population 2022



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 in 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 – ECONOR 2020*, the backdrop of this statistical work has shifted considerably. This updated report reflects a period with the Covid pandemic and partly recovery from the pandemic. Moreover, natural resource prices have been increasing, remaining at high levels around 2022, which is the most recent year we cover on a broad basis. The local tax revenues, royalties and wage income will increase in resource-rich regions of the Arctic. As resource income in several regions partly is transferred to owners outside the Arctic regions, rising resource income will also benefit stakeholders outside the Arctic.

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 indicators 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 matters 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.

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Faroe Islands. Photo: Åsne Vigran

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 Highlight V 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. Conflicts are also arising from challenges in the blue economy, with the management of marine resources (Highlight VII). 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 2040.⁴ 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 potential effects on the oil and gas extraction in the Arctic if the world manages to limit global temperature change to below 1.5 °C compared to pre-industrial levels, ultimately reducing global CO₂ emissions to or potentially below net zero around 2050.

A new Chapter 6 outlines gender perspectives on the Arctic economies, displaying circumpolar gender earnings gaps from the report Gender Equality in the Arctic and presenting gender distribution in Nordic primary industries. Attention is brought to inequalities in health care and to gender and discrimination in Greenland.

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.⁵ 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.

A new Chapter 7 is outlined in cooperation with the Indigenous Peoples organizations that are Permanent Participants to the Arctic Council. The chapter

aims to describe the relation with the land as basis for the traditional economic activities, as well as new economic activities in employment.

Chapter 8 on the interdependence of the traditional and market economies in the Arctic aims to give an overview of the importance of subsistence activities in different Arctic regions. With some notable exceptions, as in Alaska, subsistence activities are mostly invisible in official statistics. Chapter 8 provides information on subsistence activities in Alaska, Northern Canada, and Greenland, and on the economy of Sámi reindeer husbandry in Norway. Some results from the SLiCA – Survey of Living Conditions in the Arctic – project are reported.⁶ The economies of Arctic Indigenous Peoples are varied and complex and much has still not been covered in this report. Future ECONOR reports will attempt to address these gaps by strengthening the involvement of Indigenous Peoples to further describe from Indigenous perspectives how their livelihoods depend on nature-based activities and the market economy.

A circumpolar study of the economic importance of tourism is presented in Chapter 9, with focus on the path to recovery after the Covid pandemic. A study of impacts of tourism on Sámi sacred sites is presented.

Chapter 10 presents 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 accelerating, 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.

A new Chapter 11 discusses the Sustainable Development Goals (SDGs) in the Arctic context and points to challenges for localizing indicators for Arctic regions. The chapter also points to the weak involvement of Indigenous Peoples in the global process of SDG formation, and the need to position the Arctic in a possible Post-2030 Agenda.



Polar bear, Svalbard. Photo: Colourbox

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 Highlight 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 one at the national level. It may also occur that regional data are unavailable at detailed level due to statistical 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 Highlight IV. 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 IPCC, 2021: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Masson-Delmotte, V. et al. (eds.). Cambridge University Press.

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. Glomsrød, S., G. Duhaime and I. Aslaksen (2021): The Economy of the North 2020. Statistics Norway, SA 167.

³ In addition to the territories, Arctic Canada comprises Nunatsiavut in Labrador and Nunavik in Quebec.

⁴ IEA-International Energy Agency (2019): World energy outlook, OECD/IEA, Paris.

⁵ AHDR (Arctic Human Development Report) I and II. Arctic Council's Sustainable Development Working Group.

⁶ SLiCA- Survey of Living Conditions in the Arctic.

2. Socio-economic conditions and inequalities in the circumpolar Arctic

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Introduction

The *Economy of the North* (ECONOR) reports build on and continue the work started with the *Arctic Human Development Report*¹ and the *Arctic Social Indicators* (ASI) report² to uncover socio-economic inequalities across the circumpolar Arctic. This chapter builds on our previous efforts to measure and present specific socio-economic indicators across the circumpolar Arctic and see the data within their larger contexts. We also attempt to identify what factors may contribute to these outcomes.

In ECONOR 2020, we found that socio-economic conditions continue to be similar by geographical group (North America, Nordic Countries, Russian Federation), although there are some variances within these main patterns. Moreover, there are gaps between the groups, although some minor convergence was observed. In particular, we found these outcomes were likely linked to regional economic activity, political systems, and the provision of health and social services.

This chapter begins with a comparison of indicators for 2022 across regions and then observes changes between 2018 and 2022. The socio-economic

conditions and models are shaped by both regional economic activity and political structures, but also larger global factors including the COVID-19 pandemic and international conflicts, as well as the impact of global factors leading to increased inflation. We find that the socio-economic models persist, as do regional variations within the models.

Methods

This chapter presents demographic, social, and economic indicators across the circumpolar Arctic at the regional level for the administrative Arctic regions. Data for 2018 and 2022 were collected for the following indicators: 1) population and population growth, 2) female rate (proportion of women in the total population), 3) youth rate (proportion of children and youth 0-14 years of age in the total population), 4) demographic dependency (proportion of children and elders to adults), 5) life expectancy at birth, 6) infant mortality rate (before age 1), 7) tertiary educational attainment, 8) household (personal) disposable income per capita, 9) gross regional product (GRP) per capita; and 10) Gini coefficient (income inequality). Data are presented in several ways throughout the report, including tables, graphs, and maps.

Data were collected and analyzed for the following national and sub-national regions: Alaska (USA); Northwest Territories, Nunavut, and Yukon (Canada); Faroe Islands and Greenland (Kingdom of Denmark); Lapland, North Ostrobothnia, and Kainuu (Finland); Iceland; Nordland and Troms and Finnmark (Norway); Norrbotten and Västerbotten (Sweden); and Arkhangelsk, Chukotka, Karelia, Khanty-Mansi, Komi, Magadan, Murmansk, Sakha, and Yamal-Nenets (Russian Federation). As with the previous ECONOR report, data for Evenk and Taimyr are not available separated from Krasnoyarsk and are not included in this chapter.

Data were collected from the national statistical offices of the Arctic countries, and from other



Leftovers, Nunavut. Photo: Mary Stapleton

Highlight 2.1. The importance of disaggregated data*Anna Karlsdóttir*

The Gender Equality in the Arctic (GEA) III was published in 2021. The ten lead authors, who were active in writing the 6 main chapters, along with 96 other contributing authors noted that data on social and economic inequalities in the Arctic has become more sporadic and there seems to be paucity in some collection of statistical data. This brings challenges for analysis and comparisons, including in gauging social and economic inequalities. Existing data may perpetuate standardised and stereotypical reporting of gender. Persistent gaps in data availability and a lack of protocols for sharing data, has been flagged in previous reports, such as in the Arctic Human Development¹ reports and the Arctic Social Indicators² reports. The authors addressed a problem in the continued lack of gendered and intersectional data, including specific data for Indigenous populations and LGBTQIA2S+, which severely impedes efforts to adequately understand the dynamics of gender across the Arctic.

For example, young people, especially women, leave the Arctic for work or educational opportunities in urban areas south of the Arctic.³ For the women who do stay in the Arctic, they are more likely to hold public sector jobs available in the cities, and are underrepresented in natural resource management and business leadership positions.⁴ In Indigenous homelands, economic security relies on traditional subsistence economies, wage work and government transfers.⁵ Understanding gender roles in these mixed economies requires examining household and community levels.⁶

Consistent and comparable data are the very foundation for understanding realities and inequalities across regions, countries, sectors, genders, and peoples. Gender-disaggregated data are crucial for meaningful research and providing policymakers and decisionmakers with the knowledge and capacity to develop well-informed policies.

¹ Niels Einarsson et al., eds., Arctic Human Development Report (Akureyri, Iceland: Stefansson Arctic Institute, 2004).

² Joan Nyman Larsen, Peter Schweitzer, and Gail Fondahl, eds., Arctic Social Indicators (Copenhagen: Nordic Council of Ministers, 2010), https://library.arcticportal.org/712/1/Arctic_Social_Indicators_NCoM.pdf.

³ Timothy Heleniak, 'Migration and Population Change in the Russian Far North during the 1990s', in Migration in the Circumpolar North: Issues and Contexts, ed. Lee Huskey and Chris Southcott (Edmonton: University of Alberta Press, 2010), 57–91; A. Emelyanova, 'Population Projections of the Arctic by Levels of Education' (Laxenburg, Austria: International Institute for Applied Systems Analysis, 2017).

⁴ Anna Karlsdóttir and Hjördis Guðmundsdóttir, 'Ensuring Gender Equality in Nordic Blue Economy: Results from the Salmon and Equality Project' (Copenhagen: Nordic Council of Ministers, 2024), <http://dx.doi.org/10.6027/nord2024-004>; Gertrude Saxinger, 'Lured by Oil and Gas: Labour Mobility, Multi-Locality and Negotiating Normality & Extreme in the Russian Far North', The Extractive Industries and Society 3, no. 1 (1 January 2016): 50–59, <https://doi.org/10.1016/j.exis.2015.12.002>.

⁵ Chris Southcott et al., eds., Resources and Sustainable Development in the Arctic (London and New York: Routledge, 2018), <https://doi.org/10.4324/9781351019101>.

⁶ Magalie Quintal-Marineau and George W. Wenzel, 'Men Hunt, Women Share: Gender and Contemporary Inuit Subsistence Relations', in Towards a Broader View of Hunter-Gatherer Sharing, ed. Noa Lavi and David E. Friesem (Cambridge: McDonald Institute for Archaeological Research, University of Cambridge, 2019), 211–20.



The Faroe Islands. Photo: Ásne Vigran

sources, including the US Centers for Disease Control and Prevention (life expectancy and infant mortality rate), The Finnish Institute for Health and Welfare (infant mortality rate), World Bank Development Indicator (Iceland life expectancy), and World Bank (global female rate). Some data were also provided directly by the statistical agencies while the data for Russia were shared with us by our colleagues at CICERO. Data on Purchasing Power Parity (PPP) conversion were gathered from OECD. Data were collected at various points between September 2023 and November 12, 2024, and may not align with data in other chapters of this report based on date of collection.

As many northern regions have small populations, data collection, availability, and confidentiality can be a challenge. For instance, multiple year periods are used for a few regions/countries for life expectancy to account for this. Moreover, disaggregated data by sex/gender and for Indigenous Peoples is not always available. Methodological differences between countries also exist, as with the Gini coefficient. In some cases, data are also not available. Further details about the data are in Appendix A. Every effort was made to ensure international comparisons were possible, even if there were some slight differences in concepts, and ultimately, we were able to provide an overview of the socio-economic situation across the circumpolar Arctic.

Socio-economic data specified for women and men

The female rate in the population is an important socio-economic indicator for Arctic regions as it indicates the gender balance in Arctic communities. Differences in socio-economic conditions for men and women are often pronounced, and it is important to gain insight into these differences and

their impact on population structure and society. Both for regional and national statistics, data are generally disaggregated for women and men for the demographic and social indicators. For economic indicators related to production, such as Gross Regional Product, it is generally not possible to disaggregate data. The lack of comparable disaggregated data for women has been addressed in other studies,³ and is certainly a limitation when it comes to understanding socio-economic realities across the circumpolar regions (see Highlight 2.1).

Socio-economic data specified for Indigenous Peoples

Some demographic and socio-economic data for Indigenous Peoples are not available through all statistical agencies. While regional statistics are provided for the entire population, there are challenges in obtaining population data for Indigenous Peoples.⁴ The availability of data may be further

complicated by how statistics agencies identify Indigenous Peoples, as compared to how Indigenous Peoples self-identify. Moreover, the Indigenous Peoples' traditional lands do not follow the same boundaries as set out by statistics agencies. 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 Norway, Sweden, and Finland, ethnicity is not registered in the population data.

Circumpolar socio-economic analysis for 2022

The values for each indicator and region are shown in Table 2.1. Information about the indicators is found in table note 1 while table note 2 explains how the data for Troms and Finnmark have been treated, given their merger in 2020 and subsequent separation in 2024.

Table 2.1. Selected social and economic indicators.¹ Arctic regions. 2022²

Regions	Population	Population growth rate	Female rate	Youth rate	Demographic dependency	Life expectancy	Infant mortality	Tertiary education	Disposable income	GRP	Gini coefficient
	N	Per cent			Ratio	Years	Per 1 000 live births	Per cent	USD-PPP per cap		Ratio
Alaska	733 583	-0.1	47.4	20.1	0.51	74.5	6.6	36.5	62 303	89 596	0.428
Northwest Territories	45 605	0.3	48.4	19.3	0.41	75.4	10	22.2	41 768	104 956	0.287
Nunavut	40 526	1.5	48.8	30.7	0.54	71.7	18.4	10.6	24 992	100 714	0.331
Yukon	43 789	2.0	49.3	16.5	0.45	..	..	27.4	42 148	77 069	0.275
Faroe Islands	53 549	1.5	48.2	20.7	0.63	83.8	10.6	..	24 459	70 953	0.222
Lapland	175 795	-0.4	50.0	14.4	0.71	81.0	2.3	28.5	24 945	53 471	0.245
North Ostrobothnia	416 543	0.3	49.5	18.0	0.64	81.7	4.1	31.3	26 099	54 709	0.260
Kainuu	70 521	-0.9	49.2	13.4	0.78	80.0	0	26.2	25 200	48 826	0.247
Greenland	56 562	0.3	47.3	20.7	0.43	71.3	14.7	12.5	18 471	60 376	0.345
Iceland	376 248	1.9	48.7	18.6	0.50	82.2	1.4	35.2	29 611	72 939	0.242
Nordland	240 190	-0.3	49.2	15.7	0.60	82.4	2.4	30.3	32 375	64 061	0.220
Troms & Finnmark ³	241 736	-0.1	49.0	15.6	0.54	81.9	2.3	34.9	32 325	64 156	0.226
Norrbottnen	249 177	-0.1	48.6	15.3	0.67	81.6	2.4	18.4	28 666	79 286	0.265
Västerbotten	276 295	0.6	49.2	16.7	0.62	82.4	1.9	24.2	27 041	67 390	0.280
Arkhangelsk	1 016 030	-1.8	53.7	17.1	0.53	70.9	4.4	17.2	16 246	38 732	0.355
Chukotka	47 906	0.0	50.1	20.7	0.37	66.2	15.8	26.6	22 230	55 776	0.410
Karelia	532 384	-1.8	55.1	16.2	0.53	69.0	5.1	20.6	14 774	24 350	0.324
Khanty-Mansii	1 713 763	0.8	51.8	21.5	0.43	75.4	3.2	22.1	23 080	103 400	0.383
Komi	734 363	-2.0	53.7	17.7	0.48	69.9	4.0	17.5	13 693	44 005	0.353
Magadan	135 907	-1.2	51.3	17.3	0.41	68.5	3.4	27.3	22 899	147 155	0.397
Murmansk	665 240	-1.8	52.8	18.1	0.46	70.2	3.8	22.2	20 692	57 189	0.323
Sakha	997 833	0.8	51.6	22.7	0.47	72.7	4.0	23.2	17 264	67 216	0.404
Yamal-Nenets	511 244	0.0	51.3	21.9	0.39	74.8	3.5	26.6	24 955	111 427	0.440

¹ Population growth: average annual per cent; female rate: per cent share of women in total population (as compared to global average at 49.74 in 2022, from World Bank); youth rate: per cent share 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; disposable income: personal disposable income per capita in 2022 USD-PPP; GRP: gross regional product per capita in 2022 USD-PPP.

² See Appendix A for more details on the data.

³ In 2020, the counties Troms and Finnmark merged to become "Troms and Finnmark", although they separated again in 2024. Thus, the data in this table is for a merged "Troms and Finnmark" as this was still the situation in 2022.

Source: See Appendix B

Highlight 2.2. Exploring circumpolar socio-economic models using hierarchical clustering (dendrogram)*Sébastien Lévesque*

To support the comparative analysis of socio-economic conditions in circumpolar Arctic regions, we performed a hierarchical cluster analysis. This method groups regions that have similar indicator values into clusters, in a tree-like figure called a dendrogram.

The following indicators were included in the analysis: life expectancy, infant mortality, tertiary educational attainment, disposable income per capita, and Gini coefficient (income inequality).

The process begins by calculating the (dis)similarity between all pairs of observations using a measure of distance.¹ However, since the variables in the dataset were measured on different scales, they were first standardized by subtracting the average value across regions and dividing by the standard deviation. The resulting dissimilarities are stored in a dissimilarity matrix, which serves as the foundation for clustering. To determine how to merge groups at each step, the algorithm applies a linkage method, which defines how the distance between groups is calculated.² The algorithm

starts by treating each observation as its own group and progressively merges the most similar groups at each step, based on their dissimilarity values. This process continues until all observations are combined into a single group.

This is visualized in the dendrogram, where the spacing between branches represents the dissimilarity between groups at the point of their merger. A lower height in the dendrogram indicates that groups were more similar when merged, while a greater height reflects greater dissimilarity. In a dendrogram, the numerical values correspond to measures of dissimilarity or variance, which depend on the context of the data and the chosen clustering method.³ These values should not be interpreted in absolute terms. Instead, the focus lies on the relative positioning of the groups and the levels at which merges occur, as these reveal the hierarchical structure and relationships between clusters.

Compared to other methods, hierarchical clustering does not require specifying the number of groups, allowing for the qualitative interpretation of results. To support the analysis, we nevertheless conducted various tests to try to identify the number of clusters and the patterns that emerge from this dataset.⁴

¹ In this case, the Euclidean distance was used, a commonly applied method that quantifies how far apart two points are in a multi-dimensional space.

² Several methods were iteratively tested, and for each method, the silhouette score, the Dunn index and the dendrogram were examined. Ward's minimum variance method was chosen. This commonly used method also tends to produce more easily interpretable dendrogram and its use with Euclidean distance is recommended. See: Attila Gere, "Recommendations for validating hierarchical clustering in consumer sensory projects," *Current Research in Food Science* 6 (2023), Miyamoto et al., "Ward method of hierarchical clustering for non-Euclidean similarity measures," in 2015 7th International Conference of Soft Computing and Pattern Recognition (SoCPaR), 2015, 60-63.

³ With Ward's method, the values on the vertical axis represent the increase in total within-cluster variance (sum of squared differences from the centroids) resulting from merging two clusters. These values are expressed in variance units and depend on the standardized scale of the data.

⁴ Malika Charrad et al., "NbClust: An R package for determining the relevant number of clusters in a data set," *Journal of Statistical Software* 61, no 6 (2014), 1-36.

The Arctic population is not evenly distributed across the circumpolar region. The majority of Arctic residents live in Russia (68 per cent), followed by Alaska (7.8 per cent) and Finland (7.1 per cent). The least populated Arctic regions are the Faroe Islands (0.6 per cent), Greenland (0.6 per cent), and Canada (1.4 per cent) (see Table 2.1). The circumpolar Arctic population has increased overall, although not evenly across regions. For example, the population in Arctic regions is decreasing in Russia, Norway, Alaska, and Finland, while increasing in Sweden, Greenland, Canada, the Faroe Islands, and Iceland.

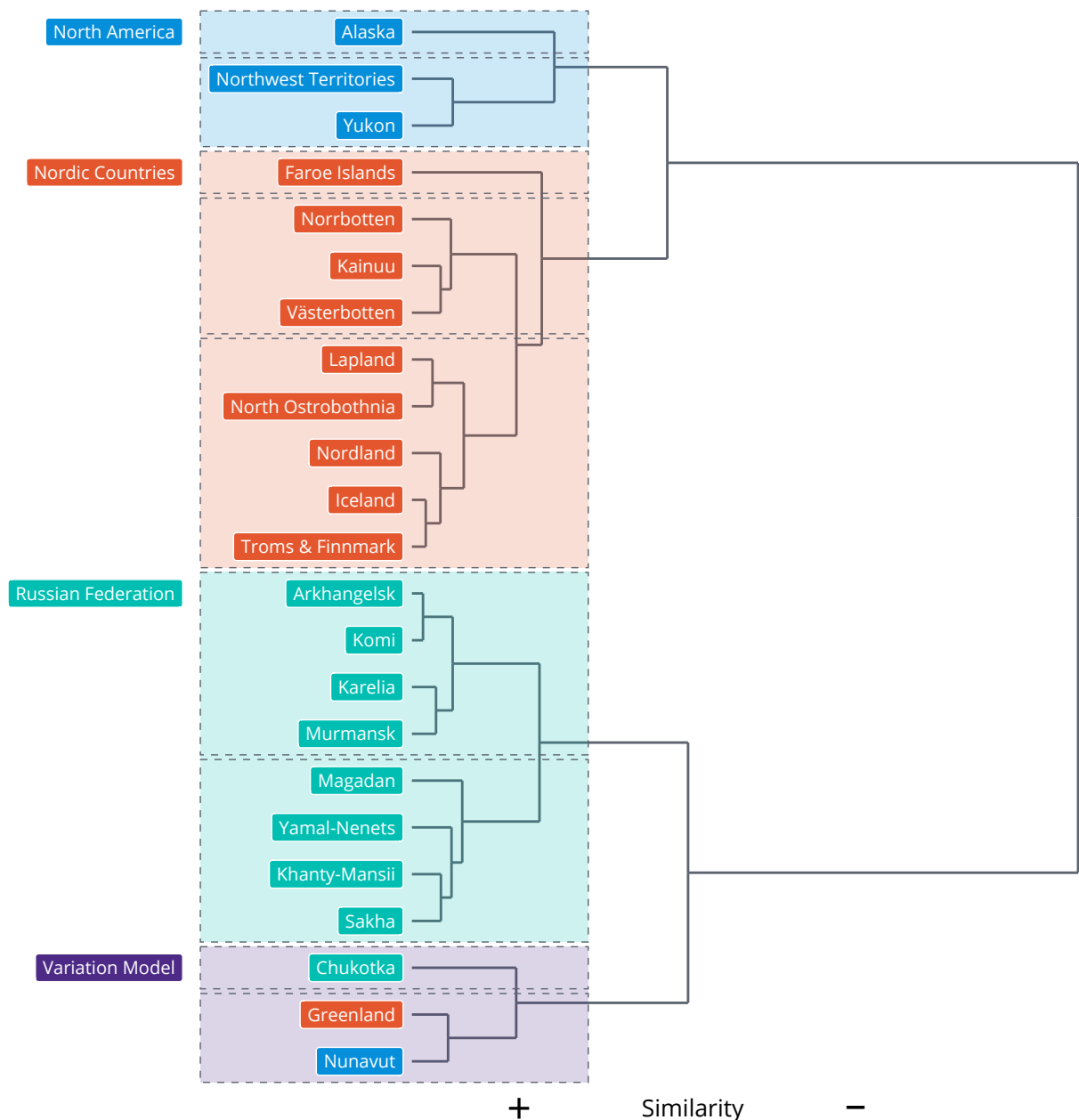
To have a clearer understanding of how the regions relate to one another, both across the circumpolar Arctic and within main regional groups, North America, the Nordic countries, and the Russian Federation, the findings from selected indicators, including life expectancy, infant mortality, tertiary educational attainment, disposable income per capita, and the Gini coefficient, were analyzed

(see Highlight 2.2 for further details) to create a circumpolar socio-economic model.⁵

The socio-economic model in Figure 2.1, presented as a dendrogram, results from the cluster analysis of the five selected indicators, thus illustrating the level of similarity between the Arctic regions. The grey lines, or "branches" of the dendrogram, that are shorter and closer on the left of the dendrogram indicate the regions and groups of regions that are more similar to one another. Conversely, the further we move to the right on the horizontal axis, the greater the differences between the groups emerge.

The outcome of this iterative regional clustering results in similar findings to previous ECONOR editions in that the regions cluster along main geographical groupings. This is shown clearly in Figure 2.1 as the vast majority of the first clusters formed in this way. Further clustering maintains

Figure 2.1 Circumpolar socio-economic models. 2022¹



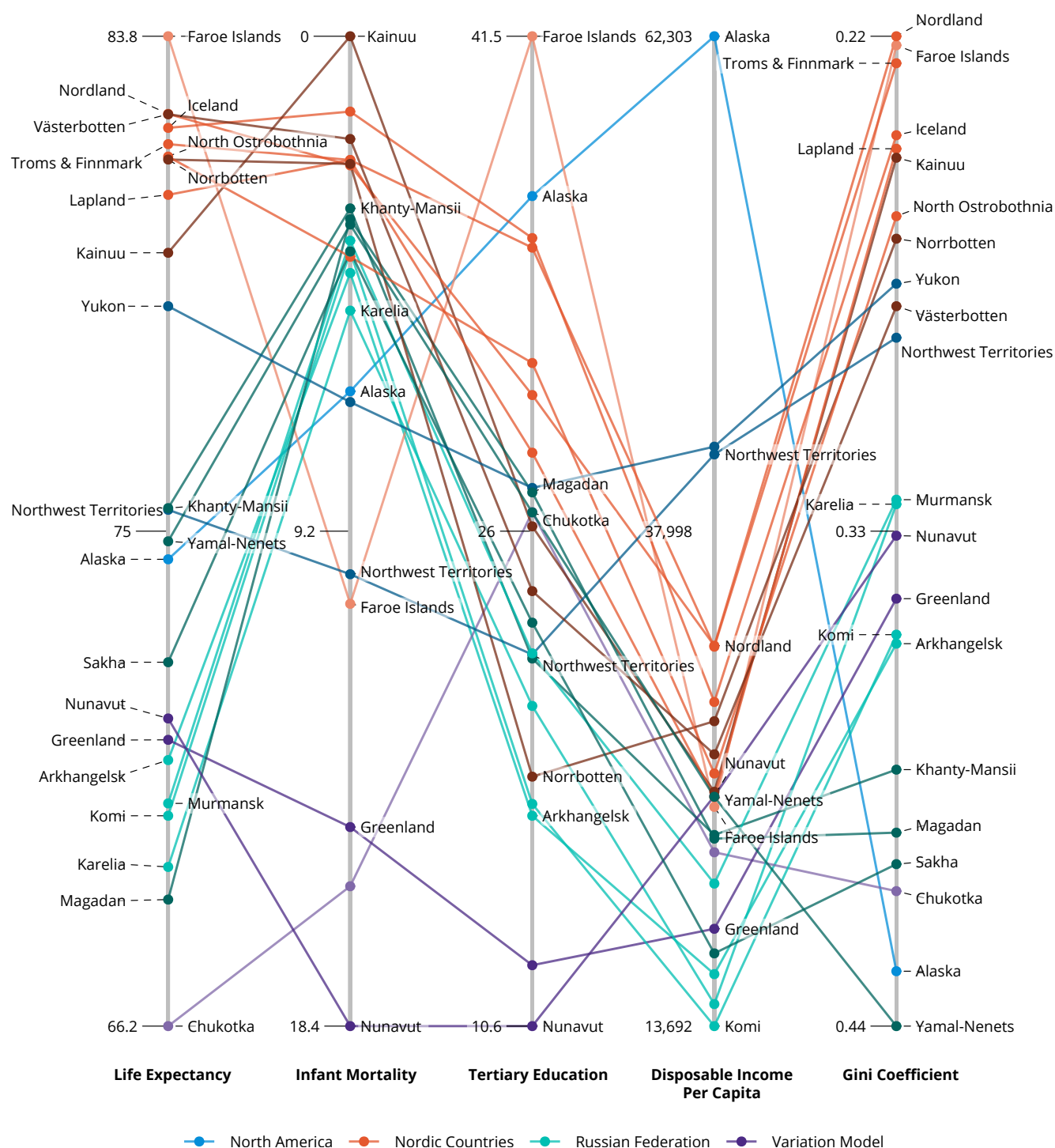
¹ The data for life expectancy and infant mortality in Yukon and tertiary educational attainment in the Faroe Islands are missing for 2022 (see Table 2.1). To complete the model, the authors used 2014-2016 life expectancy and 2016 infant mortality data for Yukon and 2011 education data for the Faroe Islands. The most current data are used where possible. See notes in Appendix A.

Source: See Appendix B

the three main models aligning with geographical groupings for North America (highlighted in blue), the Nordic countries (highlighted in orange), and the Russian Federation (highlighted in green). In other words, similar socio-economic conditions tend to be found within these three geographical groups. However, the clustering process placed Nunavut, Greenland, and Chukotka (highlighted in purple) into their own distinct group, indicating that these three regions diverge strongly enough from the general trend of their larger geographical group and should be considered separately. Thus,

these three regions are identified here as variation model. Previous ECONOR editions have also identified variations to the main model, although the pattern of variation will vary by indicators and indicator outcome for each year.⁶ Further examination of the dendrogram suggests that the socio-economic conditions in these regions align more closely with the Russian Federation than they do with other two groups.

Further testing suggests that there are nine clusters with significant internal coherence and these

Figure 2.2 Regions and indicators. 2022¹

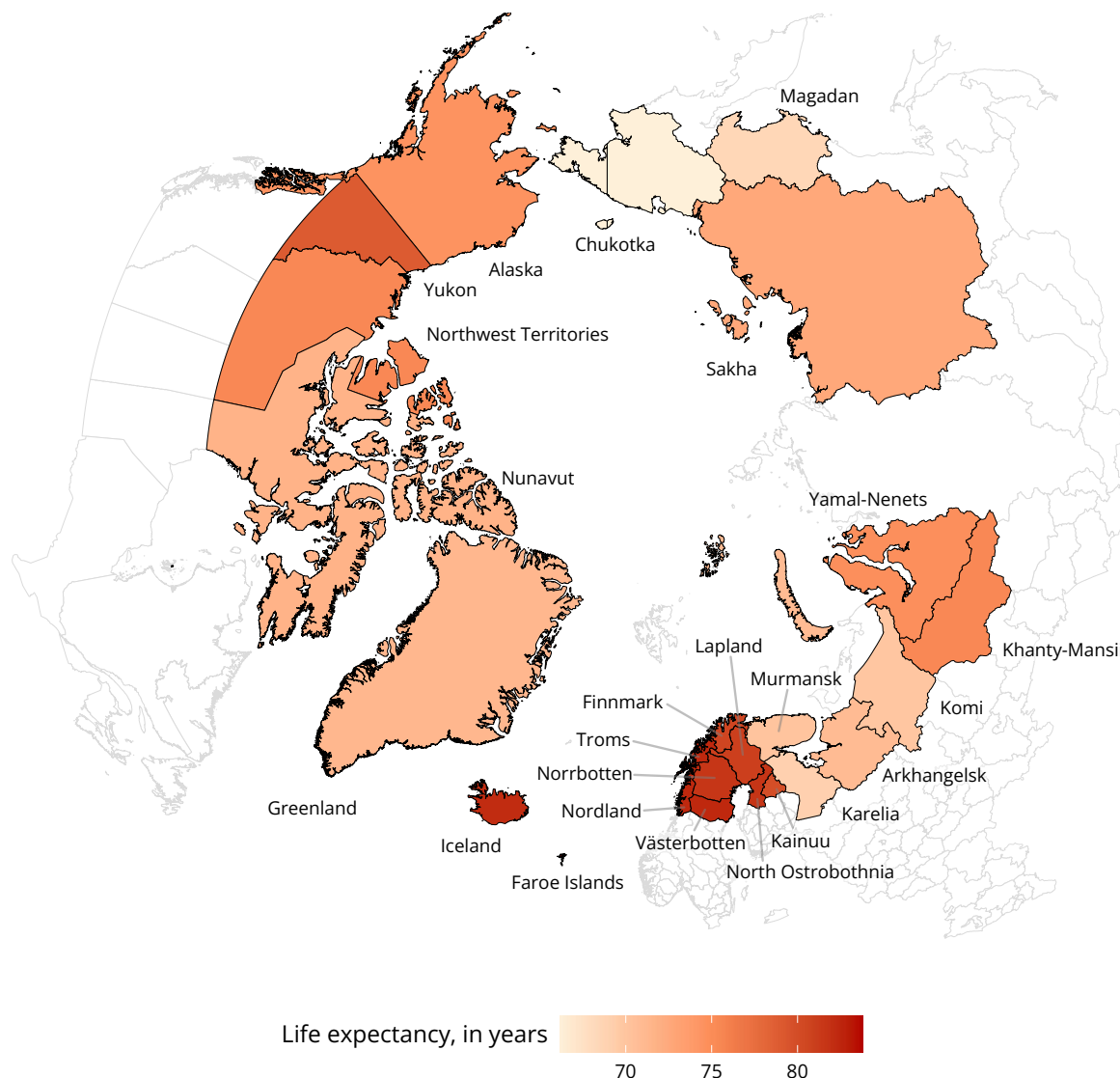
¹ For the Yukon, 2014-2016 life expectancy and 2016 infant mortality data are used in this figure, as is 2011 education data for the Faroe Islands due to data availability limitations. The most current data are used where possible. See notes in Appendix A.

Source: See Appendix B

subgroups, represented by dotted lines, effectively highlight the similarities and differences within the four models. Notably, Alaska and the Faroe Islands show a greater dissimilarity with the other regions in North America and the Nordic countries, respectively. In Russia, on the other hand, the regions tend to sub-group together according to a geographical divide between the four east-

ern regions and the four western regions. Finally, for the regions constituting the variation model, Nunavut and Greenland would have more similar socio-economic conditions compared to Chukotka.

The hierarchical clustering analysis allowed for the delineation of groups of Arctic regions with similar socioeconomic characteristics. To illustrate

Figure 2.3 Map of life expectancy by Arctic region, years. 2022¹

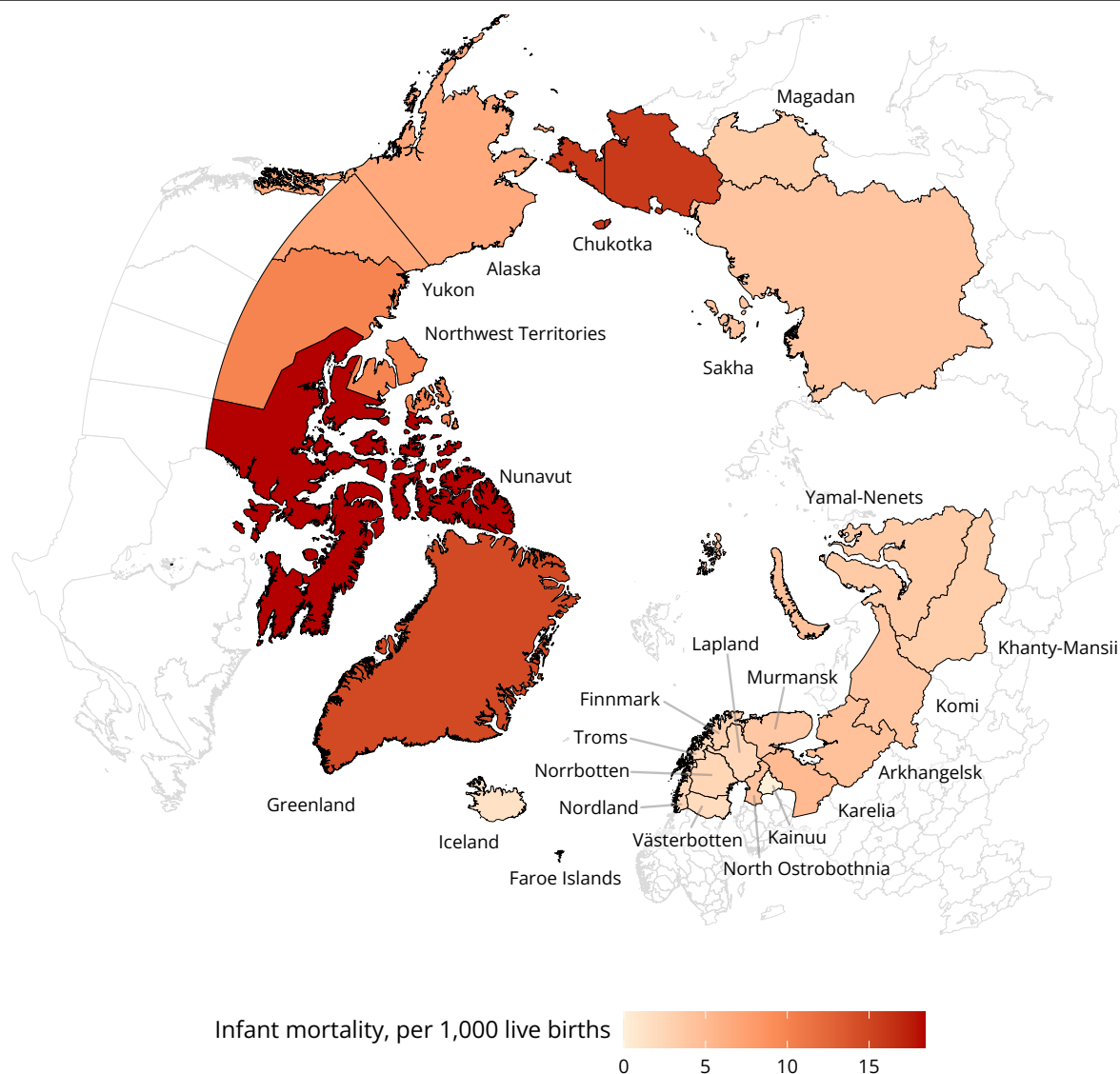
¹ Data for life expectancy in different regions are the most recent available data. See notes in Appendix A.

Source: See Appendix B

the differences observed according to the selected indicators, we use a parallel coordinate plot (Figure 2.2). Here, each indicator is represented as a vertical line, showing the region with the most favourable indicator value at the top and region with the least favourable indicator value at the bottom. In general, the highest values of the indicators are at the top, except for infant mortality and Gini coefficient, where low values are considered better outcomes. Each region is represented by a point on the vertical line, and the regions with the highest and lowest indicator values are labeled for each model. The points from each region are connected by a horizontal line, these lines are color coded according to four colors to represent the four main models, and these colors are varied in shades to

account for the nine subgroups presented in Figure 2.1. The comparative analysis of these lines, each characterizing a region, allows us to account for the observed differences between regions and geographical groups.

In Figure 2.2, the North American regions are not closely grouped together. We notably observe that Alaska tends to distinguish itself from the Northwest Territories and the Yukon, which themselves tend to be more similar. Moreover, the North American regions are also generally plotted in the mid- to high range on the parallel coordinates figure for each indicator, with disposable income per capita overall being the strongest indicator of this geographical group. In sum, this indicates that

Figure 2.4 Map of infant mortality by Arctic region, per 1 000 live births. 2022¹

¹ Data for infant mortality in different regions are the most recent available data. See notes in Appendix A.

Source: See Appendix B

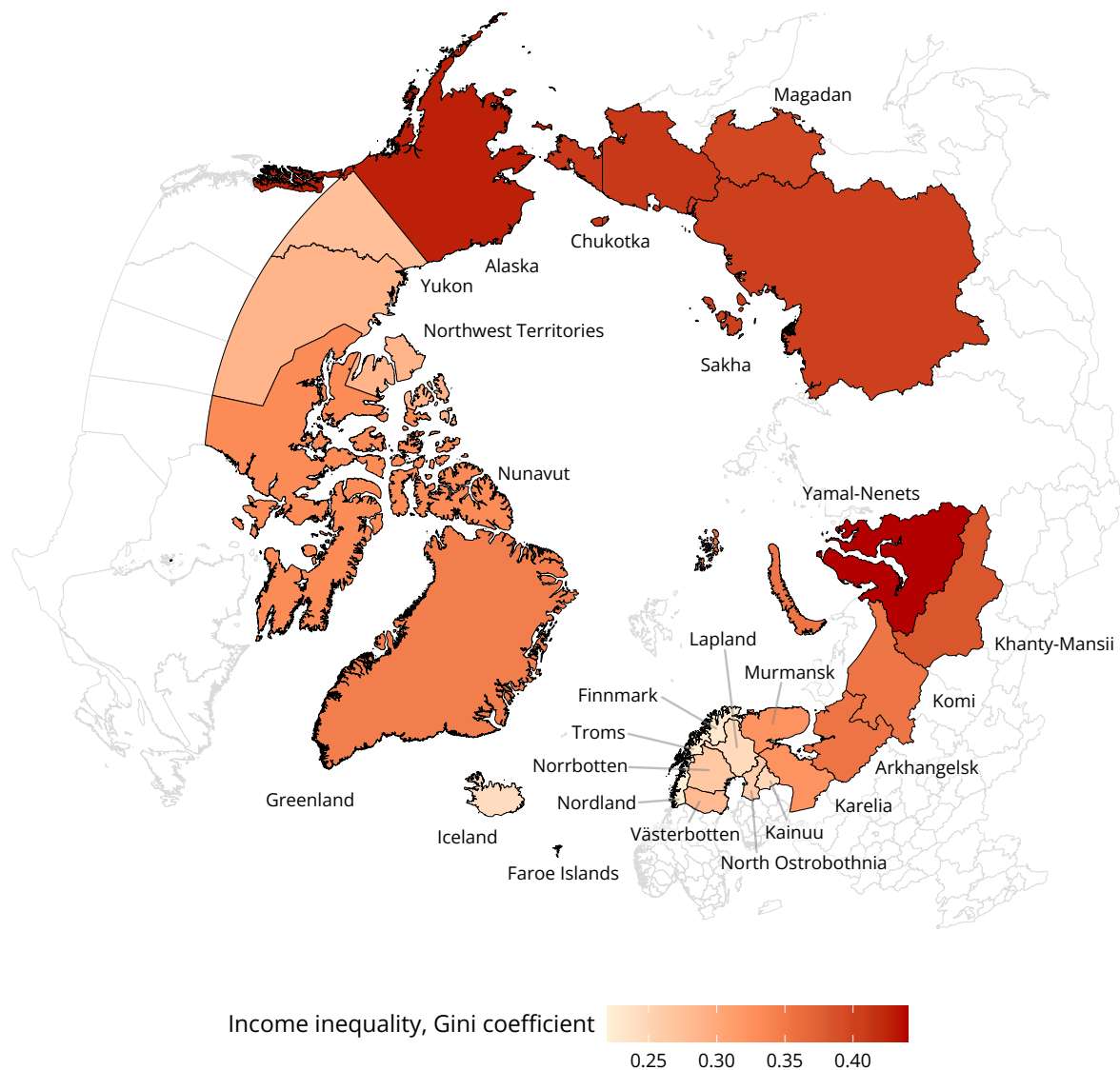
socio-economic conditions are favourable and that there is divergence between locations.

The situation in the Nordic regions is different from that in the North American regions. The Nordic regions are generally found above the middle value and are closest to the top, apart from disposable income per capita which is below the mid range and under the North American regions. Overall, the socio-economic situation in the Nordic regions is the most favourable in the circumpolar Arctic.

The Russian regions generally tend to experience lower life expectancy, tertiary educational attainment, and disposable income per capita, and higher income inequality (Gini coefficient), while

also achieving a lower infant mortality rate than the North American and Nordic regions. That said, the positioning of the Arctic Russian regions on each parallel coordinate is not always close together, indicating that the socio-economic outcomes vary across the Russian north. It is observed that, apart from income inequalities, socio-economic conditions tend to be slightly more favorable in the eastern Russian Arctic regions.

The variation model includes Nunavut, Greenland, and Chukotka. According to this model, however, Chukotka tends to deviate from the other two regions. This same pattern is also visible in Figure 2.2. For example, both Nunavut and Chukotka tend to be further away from their larger geographi-

Figure 2.5 Map of income inequality measured by the Gini coefficient, by Arctic region. 2022¹

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

Source: See Appendix B

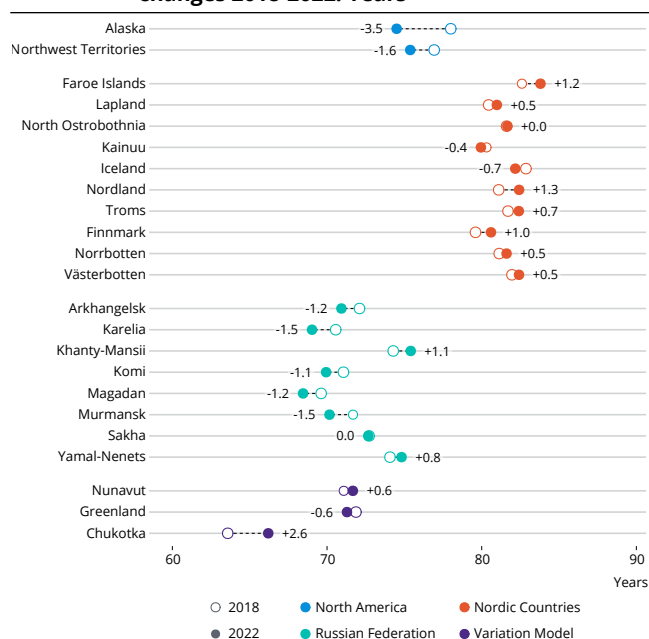
cal group and in proximity of one another on the vertical lines. Chukotka is also further away from the other Arctic Russian regions for infant mortality and life expectancy and in the proximity of Nunavut and Greenland for infant mortality.

Through maps of the circumpolar Arctic, Figures 2.3 to 2.5 aim to highlight the socioeconomic differences for the three main geographical groups using a selection of indicators. Figure 2.3 shows that life expectancy tends to be the highest in the Nordic regions. Figure 2.4 shows that the lowest infant mortality is primarily observed in the Nordic regions. Figure 2.5 shows that the Gini coefficient (income inequality) is lowest in the Nordic regions.

Circumpolar Change from 2018 to 2022

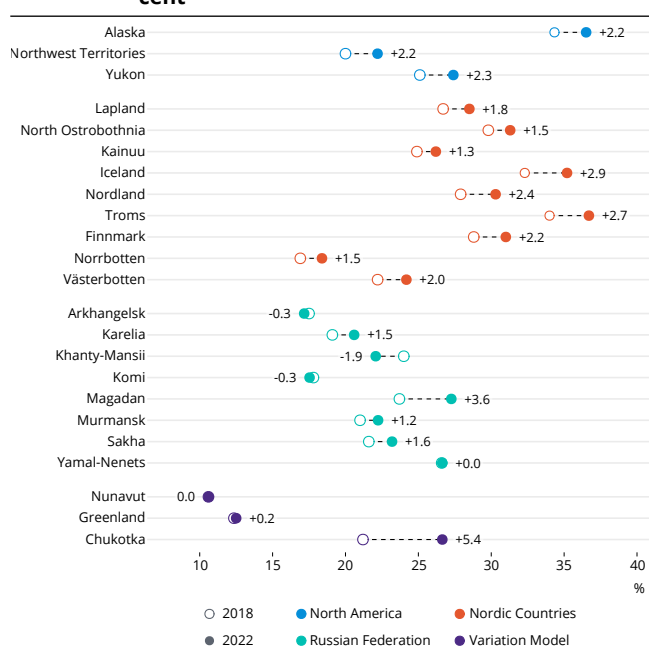
Annex 2.1 (at the end of this chapter) presents the change from 2018 to 2022 for all indicators. For the selected indicators used in the model, change is shown in dot plots (Figures 2.6-2.10), with the colour codes for the four models. In the dot plots, the value observed in 2018 is represented by a hollow dot, while the value observed in 2022 is represented by a solid dot.

Changes to life expectancy vary across and within main regional groups (Figure 2.6). For example, there were more regions in both the North American and Russian regional groups that experienced a decline in life expectancy than there were regions that experienced an increase. The largest increase

Figure 2.6 Life expectancy by Arctic regions, absolute changes 2018-2022. Years

¹ Separated 2022 data for Troms and Finnmark were provided by Statistics Norway and are only an estimate. Data for Yukon are not available. See notes in Appendix A

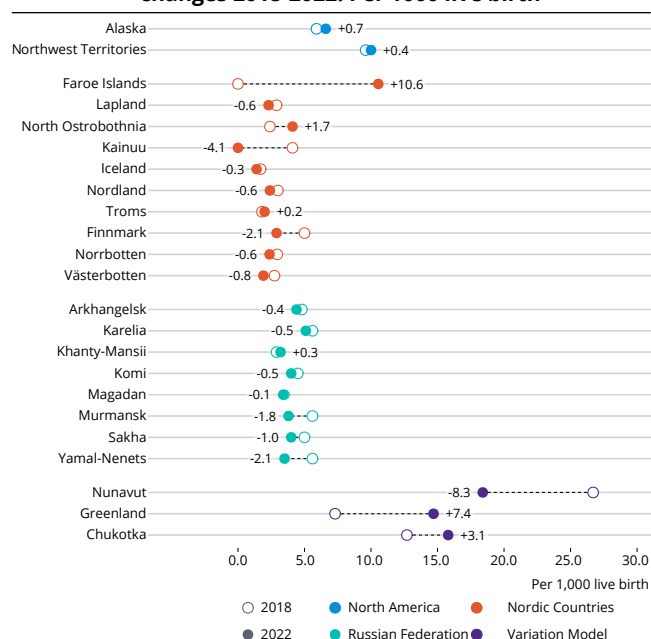
Source: See Appendix B

Figure 2.8 Share of population with tertiary education, by Arctic region, absolute changes 2018-2022. Per cent

¹ Separated 2022 data for Troms and Finnmark were provided by Statistics Norway and are only an estimate. Data for the Faroe Islands are not available. See notes in Appendix A.

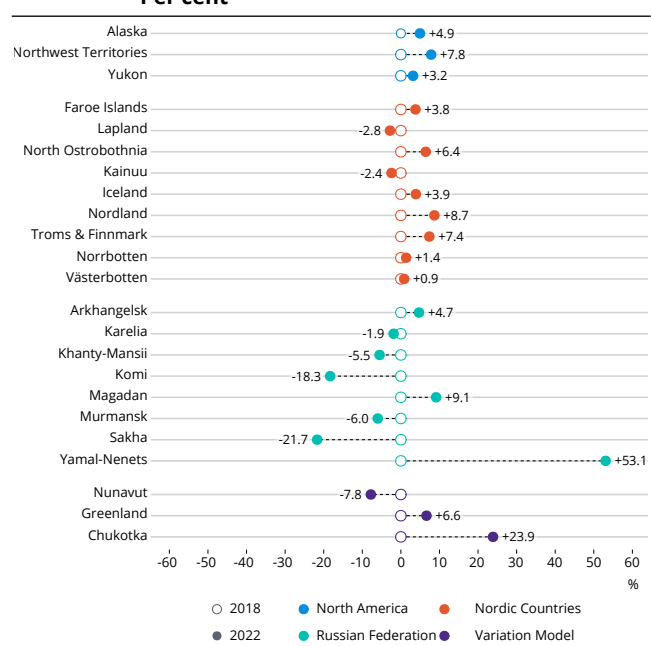
Source: See Appendix B

in life expectancy in the circumpolar Arctic was observed in Chukotka while the largest decline was observed in Alaska, closely followed by the Northwest Territories, Murmansk and Karelia. More Nordic regions experienced an increase in life expectancy than a decline.

Figure 2.7 Infant mortality rate by Arctic regions, absolute changes 2018-2022. Per 1000 live birth

¹ Separated 2022 data for Troms and Finnmark were provided by Statistics Norway and are only an estimate. Data for Yukon are not available. See notes in Appendix A.

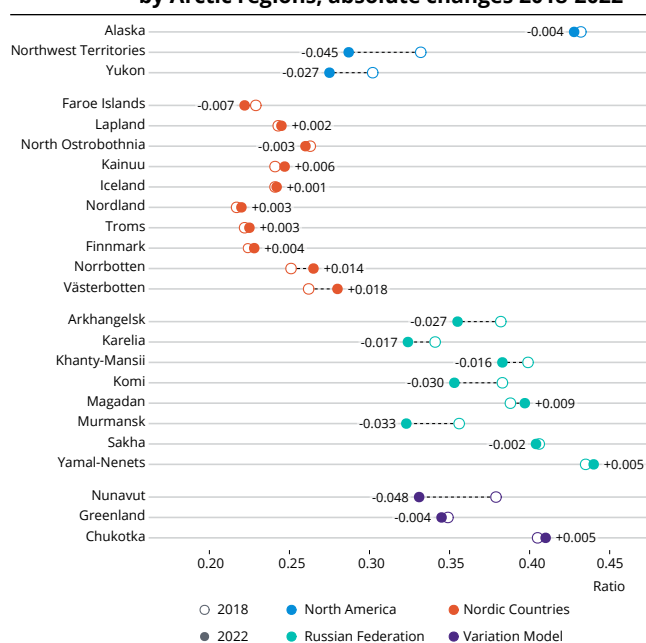
Source: See Appendix B

Figure 2.9 Disposable income per capita in 2022 USD-PPP by Arctic regions, relative changes 2018-2022. Per cent

¹ Data for Troms and Finnmark in 2022 could not be separated. Thus, data for 2018 were merged by an author and are an estimate. See notes in Appendix A.

Source: See Appendix B

Overall, infant mortality declined in more regions than it increased, and these variations for the majority of the regions are less than one in a thousand (Figure 2.7). The three regions of the variation model are among the regions where the most important variations have been observed. In

Figure 2.10 Income inequality measured by Gini coefficient by Arctic regions, absolute changes 2018-2022¹

¹ Separated 2022 data for Troms and Finnmark were provided by Statistics Norway and are only an estimate. See notes in Appendix A.
Source: See Appendix B

the Nordic geographical group, increases in infant mortality were observed in the Faroe Islands, North Ostrobothnia, and Troms. In the Russian geographical group, there was increased infant mortality in Khanty-Mansii. Overall, the rates of change were generally small, apart from in Nunavut, Faroe Islands, Greenland, Kainuu, and Chukotka. Regions with small populations, like the Faroe Islands, Greenland, or Nunavut, often experience significant variability in infant mortality rates from year to year. This is largely due to the small number of births, which makes these rates highly sensitive to even a slight change in the number of cases, rather than reflecting consistent trends.

The share of the population who have achieved a tertiary degree (Figure 2.8) increased in all regions in the North American and Nordic geographical groups. In Russia, six regions experienced no change or an increase in educational attainment. Chukotka experienced the largest circumpolar increase, followed by Magadan. At the same time, there is a decrease in three regions, with the largest in Khanty-Mansii, followed by Arkhangelsk and Komi.

In North America, the only region that has seen a relative decrease in its per capita disposable income (Figure 2.9) is Nunavut, which belongs to

the variation model. In the Nordic regions, the most important relative increases were observed in the Norwegian regions. Finally, the largest changes, both positive and negative, were observed in Russia. Here, Yamal-Nenets has the largest relative growth in disposable income per capita, not only in Russia, but within the entire circumpolar Arctic.

Income inequality measured by the Gini coefficient (Figure 2.10), declined in all regions in North America and the largest declines in the circumpolar Arctic were observed in Nunavut and the Northwest Territories. In contrast, the majority of regions in the Nordic countries experienced increased income inequality, with the largest increase observed in Västerbotten, although many of the increases in the Gini coefficient in the Nordic regions are marginal. Similar to North America, the majority of Russian regions also experienced a decline in income inequality, with the largest decline observed in Murmansk. However, despite the overall increase in income inequality in the Nordic regions and decrease in the Russian regions, income inequality remains the lowest in the Nordic geographical group and the highest in the Russian geographical group.

Change from 2018 to 2022 – Main findings across main geographical groups

When comparing 2022 and 2018, we see that the three main geographical groups did not experience the same patterns of socio-economic change with regards to the five selected indicators presented in Figures 2.6-2.10. That said, not every region within a main geographical group experienced the same change. These findings for each main geographical group are discussed further and are followed by a discussion on possible contributing factors.

North America

For North America, there is a divide in the observed changes between the regions that make up the main pattern and Nunavut as part of the variation model. For example, indicators for Alaska, the Northwest Territories, and Yukon tended to change in the same direction. Generally, these three regions saw improvements in tertiary educational attainment, disposable income per capita, and income inequality (lower Gini coefficient). At the same time, these regions also experienced decreases in life expectancy and increases in infant mortality rates.



Akureyri, Iceland. Photo: Gérard Duhaime

In contrast to these regions, Nunavut – a region of the variation model – experienced improvements in life expectancy and infant mortality rates. However, in Nunavut there was no change in tertiary education levels and a decline in disposable income per capita. Similar to the other regions, Nunavut also had decreased income inequality (lower Gini coefficient) and had the largest decrease in income inequality amongst the North American regions. What this indicates for Nunavut is that while the region's situation is not the same as their regional neighbours, the socio-economic indicators selected for this analysis (except for disposable income per capita) have generally improved from 2018 to 2022.

Nordic countries

The Nordic regions are similar to the North American regions in that the indicators tended to change in the same direction, with some exceptions. Overall, when comparing 2018 to 2022, most Nordic regions had improved life expectancy, infant mortality rates, tertiary educational attainment, and disposable income per capita. At the same time, most Nordic regions also experienced a slight increase in income inequality (higher Gini coefficient).

Greenland – a region of the variation model – experienced decreased life expectancy and increased infant mortality rates. On the other hand, Greenland had decreased income inequality (lower Gini coefficient). Like the many other Nordic regions, there was an increase to disposable income per capita, and there was increased tertiary educational attainment in Greenland, although very minor in comparison to other Nordic regions.

However, unlike North America where observed changes tended to be more homogeneous within the main pattern, changes are less uniform for Nordic countries. For instance, similar to Greenland, Kainuu and Iceland also had decreased life expectancy, the Faroe Islands, North Ostrobothnia, and Troms also had increased infant mortality, Kainuu and Lapland had a small decrease in disposable income per capita, and North Ostrobothnia and the Faroe Islands also had decreased income inequality (lower Gini coefficient). Nevertheless, unlike Greenland, these other regions did not deviate too much from the main model to be included in the variation model.

Russia

The Russian regions also tend to move in the same direction, although there are more regions in the Russian main geographical group that move in the opposite direction, as compared to the Nordic regions. Overall, when comparing 2022 to 2018 there were improvements in infant mortality, tertiary educational attainment, and income inequality (lower Gini coefficient) in most Russian regions. At the same time, there were some decreases in life expectancy and disposable income per capita in some regions.

With the exception of tertiary educational attainment, where Chukotka – a region in the variation model – had the largest increase, Chukotka moved in opposite direction as compared to the main model with improvements in life expectancy, and disposable income per capita. However, infant mortality rates and income inequality (higher Gini coefficient) also increased.

Similar to the Nordic main geographical group, Chukotka was not the only region in the Russian main geographical group to experience changes in the opposite direction than the main pattern of the Russian regions. For example, Khanty-Mansii and Yamal-Nenets also had increased life expectancy, Khanty-Mansii also had increased infant mortality, Yamal-Nenets, Magadan, and Arkhangelsk also had increased disposable income per capita, and Magadan and Yamal-Nenets also had increased income inequality (higher Gini coefficient). As with Greenland in the Nordic main region, these Russian regions align more with the Russian main pattern than they do with Chukotka.

Potential contributing factors

When interpreting the results, it is important to take into consideration differences in population size across the Arctic regions, as data for regions with smaller populations may have issues around reliability, confidentiality, etc. As well, shifts in smaller populations may be more amplified than in larger populations, especially for indicators such as infant mortality.⁷

In the previous edition of ECONOR, we suggested that the socio-economic outcomes in North America were likely influenced by the federalist political system(s) and economic activity primarily being driven by extractive resources and public sector employment. Similarly, socio-economic outcomes in the Nordic regions could be influenced by the Nordic Welfare Model and more developed transportation infrastructure than in North America, and that in the Russian North, national policies and fluctuations in oil and gas and other extractive industries can affect socio-economic outcomes.⁸ Certainly, much of this remains true.

Chapter 4 of this publication shows that the public sector and extractive resources remain top economic activities in North America. The Nordic Welfare Model, while experiencing different challenges in each country,⁹ remains important as it is built on “a high degree of trust between the citizens and trust in institutions”¹⁰ and attempts to adapt to changing circumstances as needed. As for oil and gas and other extractive resources, Table 2.1 shows that Yamal-Nenets and Khanty-Mansi, which are known for gas and oil, respectively, and Magadan, which is known for mining, have some of the highest GRPs, possibly contributing to higher disposable incomes per capita.

In addition to the above possible explanations for the socio-economic situations across the circumpolar Arctic, there are three other global events that may have had an impact on these outcomes: the COVID-19 pandemic, international conflicts, and the impact of global factors leading to increased inflation.

COVID-19 Pandemic

The COVID-19 pandemic was massive in scale and the Arctic was no exception. Indeed, “by January 1, 2023 there have been 2,677,457 positive COVID-19 cases and 29,492 deaths”¹¹ with both numbers

generally increasing in 2022 when compared to previous years.¹² Outcomes varied by wave and region, but overall Alaska and the northern regions in Sweden and in Russia tended to be hit the hardest in terms of health.¹³ Where there were low case and/or mortality rates in Indigenous communities, these outcomes have been attributed to the implementation of Indigenous knowledge and “health-care sovereignty”¹⁴ through localized actions.

The pandemic had economic consequences which varied by location throughout the pandemic. Indeed, in a study of impacts in the Nordic countries, Carlos Tapia and Nikolaos Tragotsis explain it well: “The interplay between the health protection measures adopted by institutions and individuals, social attitudes and consumption behaviours, together with preexisting economic vulnerabilities, materialised in the different economic repercussions observed in the regions”.¹⁵ While said in a Nordic context,¹⁶ the principle could be applied across the circumpolar region.

Global factors impacting on inflation

Large global factors, including the COVID-19 pandemic and international conflicts, have led to increased inflation worldwide, with impacts on socio-economic outcomes. The COVID-19 pandemic contributed to rising inflation in 2021 and 2022, through disruptions of supply and demand, while international conflicts ‘disrupted energy and food markets’¹⁷ resulting in increased prices. The impacts of global events on inflation may be different in northern regions than in other regions of the Arctic states. As pointed out by Larsen and Petrov, that ‘while local economies are subject to similar signals and disturbances from external economies, they respond differentially to regional and global changes.’¹⁸

Conclusion

Our analysis, through the main geographical models provided in Figure 2.1, confirms that the circumpolar region is not homogeneous and that the lived realities vary by the main geographical groups, North America, the Nordic countries, and the Russian Federation. Moreover, there are differences within these larger groups, evidenced through the variation model. This is generally consistent with the findings from previous ECONOR editions. While the socio-economic situations across the circumpolar Arctic have been influenced

Highlight 2.3. The WAGE (Wealth of the Arctic Group of Experts) Circumpolar Partnership*Marilaine Baribeau, Karen Everett, and Gérard Duhaime*

The WAGE Circumpolar Partnership and its research program “Arctic Economy and Social Transitions” has its origins in the ECONOR network and grew out of the convergence of academics and members of Indigenous and governmental organizations who wanted to respond to calls voiced at the Arctic Council and other organizations for states to address and enhance the understanding of the inequalities particularly affecting Indigenous Peoples and launch a fundamental transformation in the distribution of wealth produced in the Arctic.

The WAGE research program is currently just over the half-way mark and has funded 14 major research projects. WAGE also supports student and postdoctoral research on socio-economic inequalities in the Arctic through Excellence and Mobility grants, research assistantships, and the Circumpolar Arctic Summer School on Economic and Society (CASES).

To create opportunities to share members research findings and Partnership activities, WAGE offers knowledge mobilization activities, including a Round-table Series, Annual Science Meetings, participation in various international events, and publications on its website and on social networks. Visit <https://www.wage.ulaval.ca/> to learn more.

The WAGE Circumpolar Partnership is supported with a Partnership Grant from the Social Sciences and Humanities Research Council of Canada. The WAGE Circumpolar Partnership can also count on financial support from Crown-Indigenous Relations and Northern Affairs Canada. The WAGE Circumpolar Partnership is a major research initiative of the Louis-Edmond-Hamelin Chair affiliated with the University of the Arctic and directed by Université Laval in Canada.

Highlight 2.4. The Nunavik Price Indexes Project*Sébastien Lévesque and Gérard Duhaime*

The Nunavik Price Indexes Project¹ is a research partnership that aims to monitor the cost of living in Nunavik. Through data sharing agreements between Nunivaat Program (led by the Louis-Edmond-Hamelin Chair based at Université Laval), Nunavik grocery stores, and the Kativik Regional Government, this partnership has established sharing channels and procedures to leverage Nunavik point of sale data for research purposes.

Thus, a database has been developed to track price changes in Nunavik: updated monthly with sales data from partners, this database is also enriched with data from various sources, including price data from southern Quebec to establish comparisons, as well as various information to categorize and characterize the different products sold in Nunavik grocery stores. These data have allowed the development of price level indicators in Nunavik, for example, Nunavik-Quebec comparative indices to measure the price differential between Nunavik and southern Quebec, but also indices to track price changes over time in a manner similar to a consumer price index

This program enables the realization of analyses and the dissemination of indicators at a frequency that would be impossible without a research partnership of this nature. The valorization of this data offers great potential, both for research in various fields of study such as economics and nutrition, but especially for understanding and addressing the issues related to the high cost of living in Nunavik.

¹ Sébastien Lévesque and Gérard Duhaime, ‘Price Dynamics and the Impact of the Food and Other Essentials Program – Second Report of the Research Program to Evaluate the Cost-of-Living Reduction Measures in Nunavik’ (Québec City: Louis-Edmond-Hamelin Chair affiliated with the University of the Arctic, Université Laval, 2024)

by global events during the period from 2018 to 2022, domestic policies, regional economic activities, and social welfare systems continue to affect socio-economic conditions and inequalities across Arctic regions.

The period between 2018 and 2022 is too short to determine if new trends are emerging based on the observed changes, especially given the possible socio-economic consequences of global events that impacted differently between and within countries. Nevertheless, our analysis shows that differences continue to remain between the three geographical groups. While there is some convergence in some of the key indicators between the main geographical groups, in many cases this is due to decreased socio-economic conditions, declining circumstances in at least one geographical group.

As with previous editions of ECONOR, there are challenges regarding data availability, data comparability, and lack of data that illustrate the realities of different groups of the population, including Indigenous Peoples, within Arctic regions. While we were able to provide a socio-economic overview for 2022, more internationally comparable data are needed, particularly at the sub-national level, including data on public provision of health and educational services and regional price indices that express regional differences in cost of living and purchasing power.

Moreover, there is lack of data on the nature-based activities in the traditional way of life of Indigenous Peoples, and the interdependency of the monetary economy and the traditional way of life. It is difficult to assess the socio-economic conditions in

Annex 2.1. Changes in selected social and economic indicators. Arctic regions, changes between 2018 and 2022¹

Regions	Population	Female rate	Youth rate	Demographic dependency	Life expectancy	Infant mortality	Tertiary education	Disposable income	GRP	Gini coefficient
	N	Per cent			Years	Per 1 000 live births	Per cent	USD-PPP per cap		Ratio
Alaska	-1 556	-0.45	-0.83	0.03	-3.50	0.70	2.17	2 937	-3 200	-0.004
Northwest Territories	624	-0.03	-1.02	0.02	-1.55	0.40	2.20	3 037	-8 428	-0.045
Nunavut	2 383	0.16	-1.37	-0.02	0.59	-8.30	0.00	-2 109	12 078	-0.048
Yukon	3 270	0.24	-0.13	0.05	..	..	2.30	1 288	4 861	-0.027
Faroe Islands	3 093	-0.28	-0.39	0.00	1.20	10.55	..	892	3 287	-0.007
Lapland	-2 727	0.03	-0.62	0.05	0.53	-0.60	1.80	-724	2 802	0.002
North Ostrobothnia	4 382	0.00	-1.60	0.01	0.05	1.70	1.50	1 581	9 525	-0.003
Kainuu	-2 540	-0.49	-0.71	0.07	-0.36	-4.10	1.30	-627	5 576	0.006
Greenland	685	0.08	-0.35	0.01	-0.58	7.40	0.15	1 150	3 678	-0.004
Iceland	27 798	-0.35	-0.79	0.00	-0.69	-0.30	2.90	1 106	-1 416	0.001
Nordland	-3 145	-0.07	-0.81	0.03	1.32	-0.60	2.40	2 588	6 946	0.003
Troms & Finnmark ²								2 221	5 748	
Troms ²	1 108	0.03	-1.17	0.02	0.70	0.20	2.70			0.003
Finnmark ²	-2 038	0.10	-1.01	0.02	1.00	-2.10	2.20			0.004
Norrbotten	-1 320	-0.19	-0.14	0.02	0.48	-0.58	1.49	387	5 285	0.014
Västerbotten	6 141	-0.11	-0.14	0.01	0.46	-0.84	1.97	231	9 504	0.018
Arkhangelsk	-75 100	0.19	-0.30	0.05	-1.17	-0.40	-0.33	728	2 720	-0.027
Chukotka	-87	0.34	-1.08	0.01	2.62	3.10	5.44	4 286	5 778	0.005
Karelia	-39 470	0.27	-0.08	0.05	-1.53	-0.50	1.49	-283	4 105	-0.017
Khanty-Mansii	51 309	0.13	-0.49	0.04	1.13	0.30	-1.93	-1 348	-2 154	-0.016
Komi	-61 452	0.33	-0.38	0.05	-1.12	-0.50	-0.26	-3 072	5 626	-0.030
Magadan	-7 011	-0.06	-0.21	0.03	-1.17	-0.10	3.56	1 916	2 970	0.009
Murmansk	-49 470	0.21	0.45	0.04	-1.52	-1.80	1.24	-1 316	6 808	-0.033
Sakha	29 768	-0.22	-0.91	0.01	-0.05	-1.00	1.59	-4 785	1 199	-0.002
Yamal-Nenets	4	0.36	-0.08	0.04	0.75	-2.10	0.04	8 652	-4 571	0.005

¹ See the detailed notes for Table 2.1 and Appendix A regarding definitions and years.

² Given that Troms and Finnmark merged in 2020, data cannot be directly compared to 2018. Thus, where possible, Statistics Norway provided estimations for Troms and Finnmark separately to allow for these comparisons. While data for disposable income per capita and GRP per capita cannot be separated, an author on this chapter was able to combine them for 2018 to allow for comparisons.

Source: See Appendix B

the context of a broad circumpolar comparison. More data are needed to explore inequality within and across Arctic regions, and in particular data on wealth distribution. Initiatives such as ECONOR and the WAGE Circumpolar Partnership (Highlight 2.3) and the NUNAVIK project (Highlight 2.4), are important in addressing this knowledge gap. In future research and statistical work, including future ECONOR reports and the research partnership Wealth of the Arctic Group of Experts (WAGE), it is important to continue to improve the knowledge basis in order to explore the social and economic conditions and inequalities in the circumpolar Arctic.

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Statistics Sweden: Tomas Westling, Filip Dabergott

Notes

- ¹ Niels Einarsson et al., eds., *Arctic Human Development Report* (Akureyri, Iceland: Stefansson Arctic Institute, 2004); Joan Nymand Larsen and Gail Fondahl, eds., *Arctic Human Development Report: Regional Processes and Global Linkages* (Copenhagen: Nordic Council of Ministers, 2014).
- ² Joan Nymand Larsen, Peter Schweitzer, and Gail Fondahl, eds., *Arctic Social Indicators* (Copenhagen: Nordic Council of Ministers, 2010); Joan Nymand Larsen, Peter Schweitzer, and Andrey Petrov, eds., *Arctic Social Indicators. ASI II: Implementation* (Copenhagen: Nordic Council of Ministers, 2014).
- ³ Embla Eir Oddsdóttir and Hjalti Ómar Ágústsson, eds., *Pan-Arctic Report, Gender Equality in the Arctic, Phase 3* (Iceland: Iceland's Arctic Council Chairmanship and the Arctic Council Sustainable Development Working Group, with the Icelandic Arctic Cooperation Network, the Icelandic Directorate for Equality, and the Stefansson Arctic Institute., 2021).
- ⁴ 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).
- ⁵ Figures 2.1 and 2.2 replace the radar charts used in previous editions of ECONOR.
- ⁶ For example, see: Gérard Duhaime and Andrée Caron, 'Economic and Social Conditions of Arctic Regions', in *The Economy of the North 2008*, ed. Solveig Glomsrød and Iulie Aslaksen (Oslo-Kongsvinger: Statistics Norway, 2009), 11–23; Gérard Duhaime et al., 'Social and Economic Inequalities in the Circumpolar Arctic', in *The Economy of the North 2015*, ed. Solveig Glomsrød, Gérard Duhaime, and Iulie Aslaksen (Oslo-Kongsvinger: Statistics Norway, 2017), 11–23; G. Duhaime et al., 'Social and Economic Conditions and Inequalities in the Circumpolar Arctic', in *The Economy of the North: ECONOR 2020*, ed. Solveig Glomsrød, G. Duhaime, and Iulie Aslaksen (Oslo-Kongsvinger: Statistics Norway, 2021), 13–33.
- ⁷ Lawrence Hamilton, Peter Bjerregaard, and Birger Poppel, 'Health and Population', in *Arctic Social Indicators*, ed. Joan Nymand Larsen, Peter Schweitzer, and Gail Fondahl (Copenhagen: Nordic Council of Ministers, 2010), 29–45.
- ⁸ For further information, see: Duhaime et al., 'Social and Economic Conditions and Inequalities in the Circumpolar Arctic', 25–27.
- ⁹ Matilda Hellman, 'How Is the Nordic Welfare State Doing? Contemporary Public Constructs on Challenges and Achievements', *Nordisk Vålfärdsforskning | Nordic Welfare Research* 6, no. 3 (7 December 2021): 160–79, see table 3
- ¹⁰ Caroline de la Porte, Mads Dagnis Jensen, and Jon Kvist, 'Going Nordic—Can the Nordic Model Tackle Grand Challenges and Be a Beacon to Follow?', *Regulation & Governance* 17, no. 3 (1 July 2023): 604; see also: Amy Lakeman and Michael Jindra, 'Replicating the Nordic Welfare Model: Policy Prescriptions That Recognize the Cultural Antecedents of Solidarity', *International Journal of Sociology and Social Policy* ahead-of-print, no. ahead-of-print (1 January 2024).
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- ¹⁵ Carlos Tapia and Nikolaos Tragotsis, 'The Impact of Covid-19 on the Nordic Economies: Shock and Recovery', in *The State of the Nordic Region 2022*, ed. Gustaf Norlén et al. (Stockholm: Nordregio, 2022), 131.
- ¹⁶ For more information on the economic impact of the COVID-19 pandemic in the Nordic regions, see: *State of the Nordic Region 2022* chapters 5, 8, 9, 10, 11, and *State of the Nordic Region 2024* chapter 4. Gustaf Norlén, Timothy Heleniak, and Karen Refsgaard, eds., *State of the Nordic Region 2024* (Stockholm: Nordregio, 2024); Gustaf Norlén et al., eds., *State of the Nordic Region 2022* (Stockholm: Nordregio, 2022).
- ¹⁷ Oleksiy Kryvtsov, Jim MacGee, and Luis Uzeda, 'The 2021–22 Surge in Inflation' (Economic and Financial Research Department, Bank of Canada, 2023), 2
- ¹⁸ Joan Nymand Larsen and Andrey N. Petrov, 'The Economy of the Arctic', in *The Palgrave Handbook of Arctic Policy and Policies*, ed. K.S. Coates and C. Holroyd (Palgrave MacMillan, 2020), 79.

Appendix A: Notes on data

Population, female rate, youth rate, demographic dependency	
USA	Population estimates for July 1.
Canada	Population estimates for July 1.
Faroe Islands	Population for January.
Finland	Population for December 31.
Greenland	Population for January 1.
Iceland	Population for January 1.
Norway	Population for January 1.
Sweden	Population for January 1.
Russia	Population for January 1.
Life expectancy	
USA	Most current data are for 2021.
Canada	Data for three-year periods are provided. Data for 2016-2018 and 2020-2022 were selected. Data for Yukon is unavailable starting 2015-2017 thus data for 2014-2016 were used to create the model (Figures 2.1 and 2.2) and the map in Figure 2.3.
Faroe Islands	Data for two-year periods are provided. Data for 2017-2018 and 2021-2022 were selected with Lowess Smoothing to account for fluctuations in small populations.
Finland	Data for three-year periods are provided. Data for 2016-2018 and 2020-2022 were selected.
Greenland	Selected two-year data for 2018 and 2022.
Iceland	Data available as single year periods from the World Bank.
Norway	Data for five-year time periods are provided. Data for 2011-2015 and 2018-2022 were selected. Data available online for males and females separately. Statistics Norway confirmed the total life expectancy for each region that was calculated through weighted averages.
Sweden	Data for five-year periods are provided. Data for 2014-2018 and 2018-2022 were selected. Data available online for males and females separately. Weighted averages were used to calculate the total life expectancy for each region.
Russia	Data available as single year periods.
Infant mortality	
Canada	Data for Yukon unavailable starting 2017. Data for 2016 used to create the model (Figures 2.1 and 2.2) and the map in Figure 2.4.
Greenland	Rate calculated manually using upper and lower nexus data from the population accounts.
Norway	Data for five-year periods are provided. Data for 2011-2015 and 2018-2022 were selected.
Sweden	Infant mortality rate calculated manually using the data for the number of births and deaths in each region.
Tertiary educational attainment	
USA	Population aged 18-24: Bachelor's degree or higher. Population aged 25+: Associate, Bachelor, and Graduate or professional degree.
Canada	Ages 15+. 2021 Census: Bachelor's degree or higher. 2016 Census: University certificate; diploma or degree at bachelor level or above.
Faroe Islands	Tertiary educational attainment is discontinued after 2011 census. The 2011 data were used to create the model (Figures 2.1 and 2.2).
Finland	Ages 15+: Population with tertiary level qualification.
Greenland	Ages 16-74: ISCED 5-8. Rate calculated manually.
Iceland	Ages 16-74: ISCED 5-8.
Norway	Ages 16+: ISCED 5-8 provided by Statistics Norway.
Sweden	Ages 16-95: ISCED 5A+6.
Russia	Ages 6+ but rate calculated as a percentage of the population 16+. Data from the 2020 Census for высшее (higher) and includes бакалавриат (bachelor's degree), специалитет (specialization), and магистратура (master's programme). The 2010 census data for comparison was drawn Chapter 2, ECONOR. ¹
Disposable income	
Faroe Islands	Data for 2021.
Norway	2018 data for Troms and Finnmark was merged by one of the authors.
Gross Regional Product (GRP)	
Norway	2018 data for Troms and Finnmark was merged by one of the authors.
Gini coefficient	
USA	Does not state if equivalized or not.
Canada	Data for 2020 and 2015 for adjusted household after-tax income.
Faroe Islands	Does not state if equivalized or not.
Finland	Equivalized on disposable cash income using the Eurostat scale of 1.0-0.5-0.3.
Greenland	Equivalized disposable income.
Iceland	Disposable income, using the Eurostat system
Norway	Uses household equivalent income and the EU-scale.
Sweden	Equivalized disposable income.
Russia	Does not state if equivalized or not.

¹ Duhaime et al., 'Social and Economic Inequalities in the Circumpolar Arctic', 12.

Appendix B: Data sources for Chapter 2

USA

Bureau of Economic Analysis. SASUMMARY State annual summary statistics: personal income, GDP, consumer spending, price indexes, and employment

Centers for Disease Control and Prevention (National Center for Health Statistics). Life Expectancy at Birth by State

Centers for Disease Control and Prevention (CDC Wonder). Underlying Cause of Death, 1999-2020 Results

Centers for Disease Control and Prevention (CDC Wonder). Underlying Cause of Death, 2018-2022, Single Race Results

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

U.S. Census Bureau. Annual Estimates of the Resident Population for Selected Age Groups by Sex for Alaska: April 1, 2020 to July 1, 2022

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Rosstat. Население По Возрасту, Полу И Уровню Образования По Субъектам Российской Федерации. Population by Age, Sex and Education Level by Constituent Entities of the Russian Federation

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Rosstat. "Численность населения по полу и возрасту по субъектам Российской Федерации на 1 января 2018 года". Population by sex and age by subjects of the Russian Federation as of January 1, 2018

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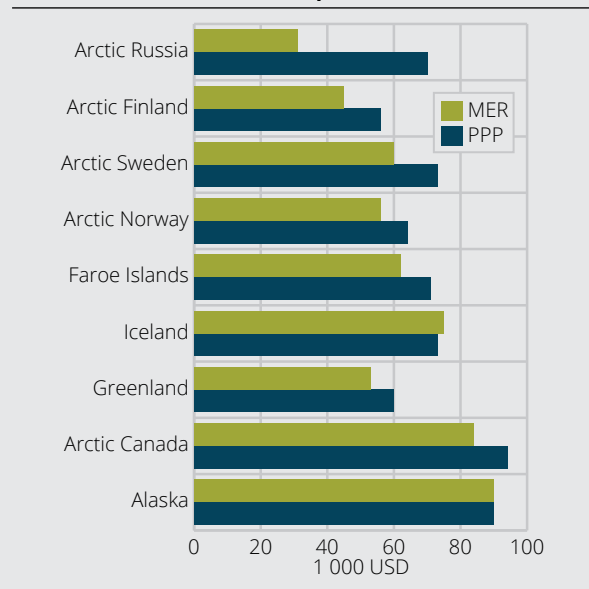
The main purpose of this report is to provide an overview of the economic activity in the Arctic regions. A major challenge has therefore been to compare and add up the value of production and income of regions in different countries. Since price levels vary across countries and regions, a conversion based on market exchange rates (MERs) will normally not appropriately reflect the production and income levels. To adjust for price level differences, purchasing power parities (PPPs) have been applied. However, as illustrated below, a conversion based on PPPs is not without challenges.

Chapter 3 provides an overview of the economic activity in the circumpolar region. Based on a PPP conversion of US dollar, it is estimated that the gross product of the circumpolar Arctic in 2022 was 666 billion USD-PPP, corresponding to 0.4 per cent of the world economy. The Arctic regions of Russia alone accounted for 447 billion USD-PPP, or 67 per cent of the total.

Gross product (value added) converted by PPPs is a proxy for income, and hence of the capacity to consume. In that respect, income levels in the Arctic vary from a low of 56 000 USD-PPP per capita in Northern Finland to a high of 94 000 USD-PPP per capita in Canada (see Figure 3.7).

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 PPPs. Alternatively, the national currency data could have been converted by market exchange rates (MERs). The choice of conversion factor can have a big impact. For example, when PPPs are applied, regional GDP per capita in Russian Arctic is almost the same as in the Arctic regions of the Scandinavian countries. But when MERs are applied, the income level in Arctic Russia appears much lower (see Figure 1). Furthermore, the Russian share of the Arctic gross product would have been estimated to 50 per cent using MERs, compared to 67 per cent using PPPs (see Figure 2).

Figure 1. GDP per capita by Arctic region 2022. 1 000 USD at 2022 prices



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

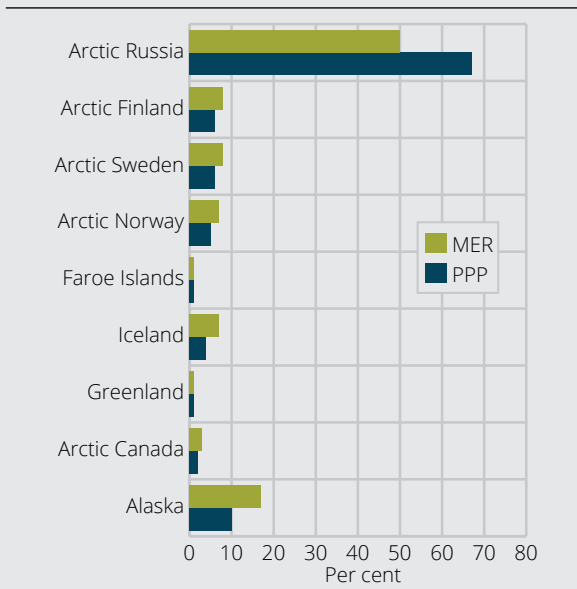
In most studies comparing income levels across different countries, the PPP-based conversion is preferred to MERs. PPPs eliminate the price level differences and restate incomes at a common price level. In addition, PPPs are assumed to be less volatile than MERs. In this report, we have applied PPPs developed by the International Comparison Program (ICP) and the OECD-Eurostat PPP-program.

PPPs for the national economies are used in this report, since regional-specific PPPs or ICPs for the Arctic regions within each country are not available. This produces a bias if there are substantial price level differences within a country. There are indications that the price level in Arctic regions might be somewhat higher than in the rest of the respective Arctic states.

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.

¹ Bjart Holtmark, Statistics Norway, contributed this text for the first ECONOR report, now edited with advice from Lars Svenneby, Statistics Norway. Data are updated.

Figure 2. Arctic Region share of total circumpolar GDP 2022. Per cent



Finnmark is the northernmost county in Norway, with about 75 000 inhabitants. The county is characterized by ethnic diversity. The Sámi have a core settlement area in the interior region of Finnmark, especially in the municipalities of Kautokeino and Karasjok. However, many Sámi also live in other parts of Finnmark, and in other counties.

Historically, social and demographic statistics have shown that Finnmark is a region with challenging living conditions. More than 150 years ago, Eilert Sundt, priest and social scientist, showed that a church district in western Finnmark had the highest mortality of all church districts in Norway.² Today, Finnmark still ranks as the county with the highest mortality rate. In 1982, Asbjørn Aase, professor of geography at the University of Trondheim, published a pioneering work in the geography of living conditions in Norway, titled “Living conditions in Finnmark. A sociostatistical analysis”. A summary was published in the *International Journal of Sociology*.³ Aase gave a broader and more thorough picture of welfare in Finnmark than ever before, based on official register data and a survey done by Statistics Norway.

The conclusion of the report was that Finnmark was a clear case of multiple deprivation. The results pointed to “..unusually problematic..” living conditions. Finnmark was a case of “extreme marginality”, which partly explained the living conditions: Remoteness from the national core area, an economy dependent on natural resources, harsh climatic conditions and a large ethnic minority. However, the worst living conditions were not found in the Sámi districts, but in the coastal, fishing areas. The most serious problems were related to high mortality and morbidity. Finnmark had the highest unemployment rate in the country, and an exceptionally high proportion of the population received disability benefits. Income and educational levels were low, and rates of violent crime high. In addition, there were signs of a below average quality of life (depressive symptoms, satisfaction with life). On the other hand, several indicators gave a more positive picture, such as interactions with friends and neighbors, and organizational activities. Social relations emerged as particularly good in one of the Sámi core areas (Kautokeino).

How is the situation today, more than 40 years later? Although Finnmark still ranks as the county with the highest mortality rate, differences are smaller today. Among men, life expectancy at birth is 2.3 years shorter than the national average, down from a difference of 3.3 years in the first half of the 1990s. For women, the difference is somewhat smaller (1.6 years) but has remained largely unchanged. Life expectancy for women in Sámi core areas are at (Kautokeino), or higher (Karasjok), than the national average for women.

Other improvements are evident, including education, and the share of pupils/apprentices who have completed upper secondary education within five/six years, has increased far more in Finnmark than the national average. In the labour market, unemployment levels are closer to the national level than before, and a lower share than the national average receives disability benefits, work assessment allowance and similar benefits. Although income levels are generally lower than in Norway as a whole, the share of the population below a commonly used poverty level⁴ is smaller than the national average.

Improvements in the living conditions are by and large similar in Sámi core areas (Kautokeino, Karasjok) and Finnmark as a whole. Sometimes they are better. For example, the completion rates in upper secondary education have increased by more than 20 percentage points in four municipalities from 2012-14 to 2020-22, including Karasjok. Also, there is somewhat less income poverty in Kautokeino than before, in contrast to the national increase. However, income poverty in Kautokeino is still above the national average (2.6 percentage points).

It is less common to live alone in the Sámi core areas, but otherwise, social relations do not seem to be better in Finnmark and the Sámi core areas than in the rest of the country. Fewer young people are active in organizations, and dissatisfaction with meeting places for the young is widespread in Kautokeino and Karasjok. Differences in loneliness are small, but the level of loneliness is above average in Kautokeino, according to a 2019 survey.

In general, subjective quality of life in Finnmark and the Sámi core areas is at the same level as in Norway as a whole. However, young people in Finnmark are less satisfied with their local environment than the young in other parts of the country, particularly with public transport.

In conclusion, Finnmark has seen marked improvements in the level of living since the study by Aase more than 40 years ago. Satisfaction with life in general is at the same level as in the country at large. Evidently, there are still problems. The population is declining, in contrast to other counties. Hopefully, a more positive image of living conditions and quality of life in this part of Norway, might contribute to changing the trend.

¹ This text is a summary of Barstad, A. (2024). Statistikk om levekårene i Finnmark og for samer fra 1982 til 2024. P. 23-36 in *Samiske tall forteller 16*. Sámi allaskuvla.

² Sundt, E. (1975): *Om dødeligheden i Norge*. Oslo: Gyldendal Norsk Forlag

³ Aase, A. (1986). Living Conditions in a Marginal Region: The Case of Finnmark. *International Journal of Sociology*, 16 (3/4), 221-232.

⁴ Persons belonging to households with annual after-tax income per consumption unit below 60 per cent of the national median income, averaged over a period of three years..

Highlight III. 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 Kven (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. 2022

	All of Norway	STN-area ¹	Other areas in North Norway ²
Income from work	870 700	722 900	806 900
Employee income	840 800	682 200	775 700
Net income from self-employment	341 200	333 700	366 200
Property income	57 000	22 700	37 700
Taxable transfers	321 200	349 100	328 000
Social security benefits	354 300	353 400	356 100
Unemployment benefit	52 300	60 700	45 900
Compensation for illness leave	65 400	80 500	73 400
Tax-free transfers	39 700	37 600	37 500
Child allowances	26 600	26 700	26 400
Dwelling support	23 000	15 500	18 700
Social assistance	60 300	33 500	43 900
Total income	970 300	837 900	913 800
Total assessed taxes and negative transfers	264 100	191 100	234 000
After-tax income	712 500	654 700	684 600

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 Instituhta (Nordic Sámi Institute) to develop a permanent framework for development, production and dissemination of Sámi statistics. Since the central population register does not include 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, 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 in the STN area has generally been declining since 1990. By 1 January 2024, the population in this area was about 53 200, which is about 12 000 less than in 1990. This reflects that the STN area consists predominantly of rural areas, characterized by net outmigration and an aging population. However, in 2023 for the first

time since 1990, there was a substantial increase in the number of residents in the STN area, mainly as a result of increased immigration from abroad.

Table 1 shows the income account for households in the STN area in 2022, 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 8 per cent lower than for other northern areas and about 14 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 all of Norway. Taxable transfers were higher in the STN area. Average unemployment benefit in the STN area is higher than the average for other northern areas and all of Norway. Child allowance is at the same level on average for recipients in the STN area as for other areas in northern Norway and all of Norway. Average after-tax (disposable) household income for the STN area was about 4 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 9.4 million people (see Highlight 1.1), less than the 10 million threshold which qualifies a city to be called a megacity according to the UN definition. 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 three northern territories of Canada have a population density of 0.03 persons per square kilometer,¹ in stark contrast to densely populated areas, for example the European Union with a population density of 109 persons per square kilometer.²

The outsider's view of the Arctic as remote and uninhabitable is gradually modified. People worldwide have come closer to the Arctic as tourists and trading partners whereas the Arctic peoples reach the rest of the world through better communications and opening up of northern sea routes. The new economic opportunities change the Arctic rapidly, accompanying opportunities lost through climate change.

For the Arctic, the term global warming is an understatement, as the temperature rise in the Arctic has been nearly four times faster than the increase in average global temperature since 1979³. The

rapid warming is due to the disappearing ice cover, resulting in strong heat reflection from ice and snow replaced with absorbed heat by the dark open ocean. Nature is affected, and so are the Arctic societies, both directly by climate change and indirectly via stricter climate policies, as fossil energy has been an important export commodity for several Arctic regions.

Variations in the regional endowments of natural resources lead to considerable differences 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. It provides a circumpolar outlook and compares 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 Council⁴ are included among the Arctic economies. The Arctic regions of

Highlight 3.1. The harmonization of economic values across regions

In national statistics, 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 Highlight I). Thus, GRP and DIH are converted to unified purchasing power parity (PPP) values and expressed in USD 2022 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 and the Faroe Islands are available only at current prices. To get the volume growth of the regional economy the GRP of the years 2012-2022 are converted into USD 2022 prices by using the implicit price index series.

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 accounts.⁵

Eight countries have regions belonging to the Arctic economies: Canada, the United States, Denmark, Finland, Iceland, Norway, Sweden and Russia. Greenland and the Faroe Islands are represented in this chapter alongside Arctic states corresponding to their extensive Self-Governance Arrangements within the Kingdom of Denmark. Greenland and the Faroe Islands have self-governance in most policy areas, including the 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, the disposable income of households (DIH) per capita is included to indicate the 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 households' incomes from wages, net interest and dividends, plus net transfers from other sectors. Most 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.

The Indigenous Peoples and other local 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 a lack of data. This might represent a bias in the comparison between Arctic and non-Arctic regions within Arctic states.

Note that the provision of public services might further improve livelihood and welfare but differ among the Arctic regions. Governments provide substantial services in education and health care, and the total value of household consumption can exceed the conventional estimate of household disposable income. In an assessment for Arctic Canada and Iceland, the disposable income of

households including these services is estimated (see Highlight 4.2).

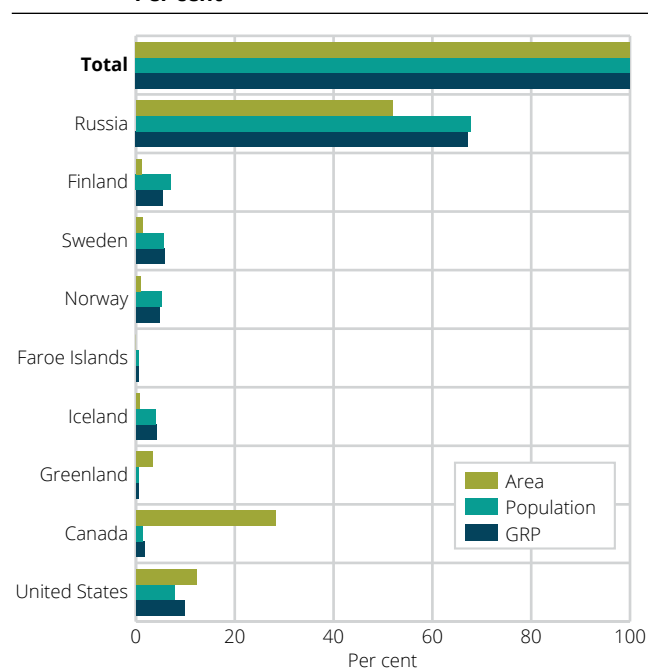
The data used in this chapter are based mainly on the regional accounts released by the statistical offices of the Arctic countries. The regional data are converted from local currencies to USD in purchasing power parities (PPP). Highlight 3.1 explains the reason for using PPP rather than market exchange 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 the Arctic economies

At circumpolar level the Arctic regions with 0.1 per cent of the world population generated as much as 0.4 per cent of global gross domestic product (GDP) in 2022. The Arctic covers as much as 8 per cent of the global surface area.

Figure 3.1 illustrates the role of the Arctic states within the entire Arctic. The Russian Arctic covers slightly more than half of the total Arctic land area. In 2022 the Arctic Russian income (GRP) amounts to 67 per cent of the total Arctic economy and its population share is similarly high (68 per cent). Canada has the second largest share of the Arctic land area (28 per cent) but has disproportionately

Figure 3.1. Arctic surface area, population and GRP of Arctic states as share of the Arctic total. 2022. Per cent



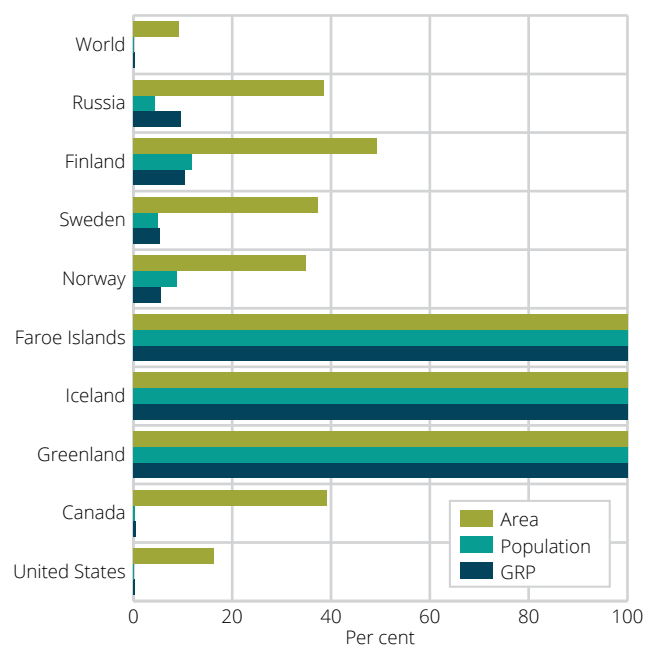
low population and a share in the economy of the Arctic at less than two per cent.

The second largest economy is Alaska, the only Arctic region of the United States, with nearly 10 per cent of the Arctic GRP. Only minor shares of the Arctic land are left for the other regions, with Greenland as the largest, covering 3 per cent of the 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 the Arctic population and GRP are relatively larger.

Russia, Fenno-Scandinavia (Finland, Sweden and Norway) and Iceland have higher shares of the Arctic population than of land area. Iceland and Arctic Sweden have slightly higher shares of the Arctic GRP than of population, whereas Russia and other Arctic regions of Fenno-Scandinavia all have slightly lower shares of the Arctic GRP than of population. Arctic Canada is so sparsely populated that its shares in the Arctic population and GDP are dwarfed when compared with the share of Arctic Canada's territory.

Figure 3.2 looks into the position of Arctic regions within their respective Arctic states. The Russian Arctic has a higher share of Russia's GDP than of population, whereas Arctic Finland and Arctic Norway generate smaller shares of national GDP

Figure 3.2. Arctic region share of surface area, population and GRP of corresponding country. 2022. Per cent



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 2012-2022 the Arctic population as a whole has decreased by 3 per cent (Figure 3.3). The Russian Arctic with by far the largest population among the Arctic regions had a decline of about 6 per cent, the greatest decline among the Arctic regions. Greenland and Finland were the only other regions with population decline (0.3 and 0.2 per cent, respectively). Behind Iceland with 18 per cent growth, Arctic Canada and Fareo Islands followed suit with 13 and 11 per cent growth during 2012-2022. In Arctic Sweden the population increased by 3 per cent whereas Alaska showed minor population growth of 0.1 per cent over the period.

The largest population increase of 18 per cent in Iceland is a result of generous policy towards families with children. However, in 2023, the total fertility rate of Icelandic women was 1.59 and has not been lower since measurements began.⁶ Total fertility rate, or the number of children per woman in childbearing age, continued a declining trend only interrupted by an increase of 1.9 in 2021 at the time of the COVID19 pandemic. The share of

Figure 3.3. Population growth. Arctic and non-Arctic regions by country. 2012-2022. Per cent

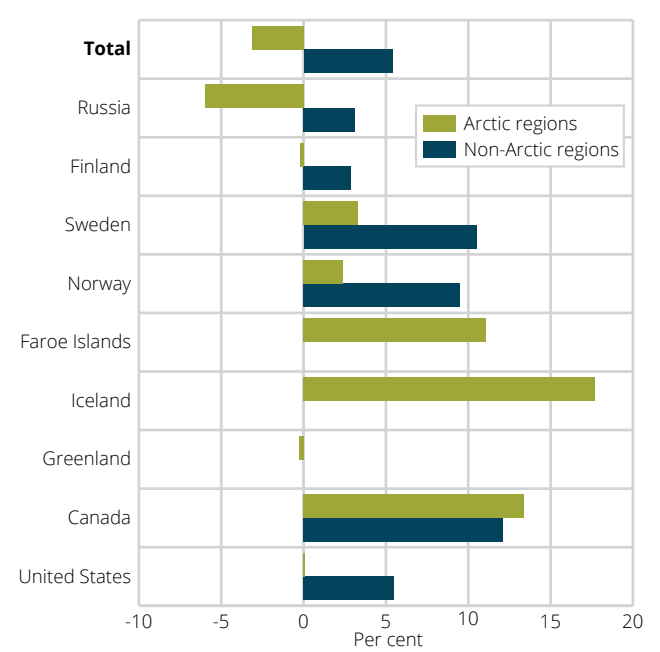
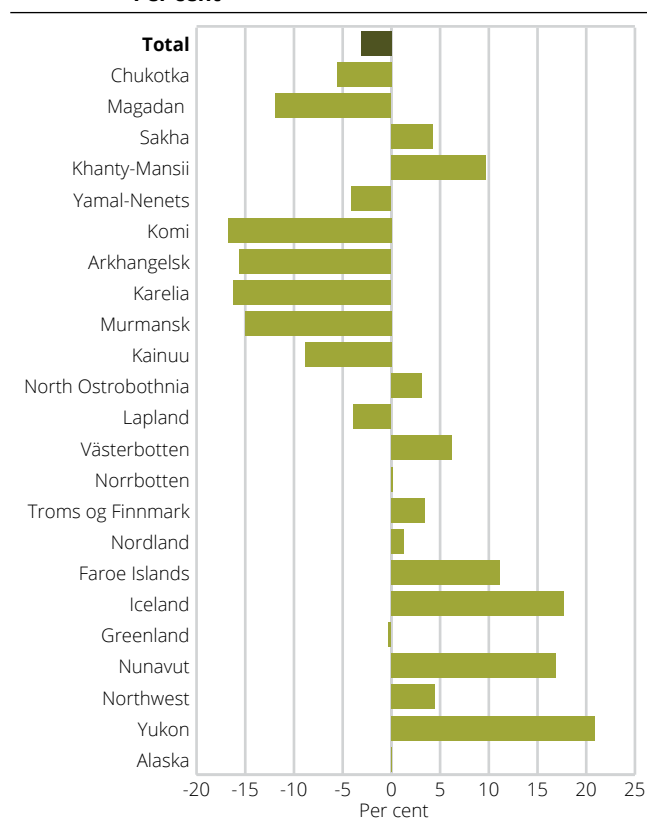


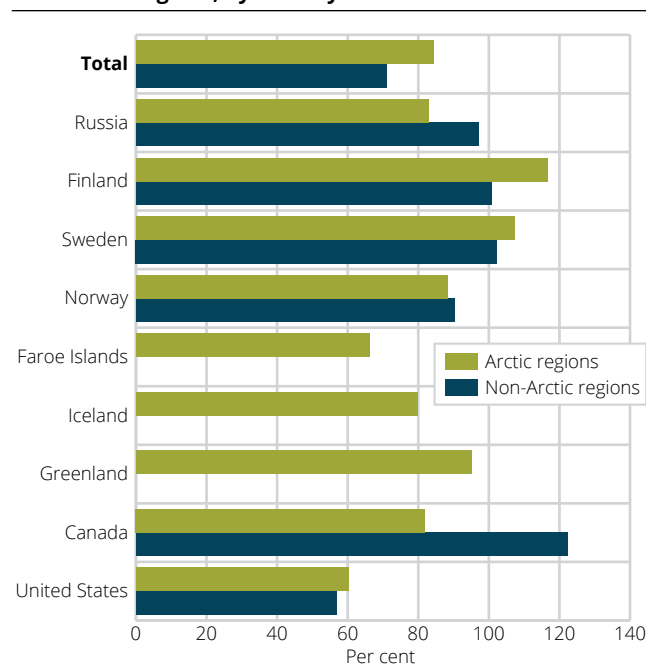
Figure 3.4. Population growth by Arctic region. 2012-2022. Per cent

women employed was above 70 per cent in 2023,⁷ and almost all children are in daycare (around 90 per cent).

Arctic Norway, supposed to have similar daycare and employment opportunities for women has a much lower population growth than Iceland. This indicates that there are still limited opportunities for jobs and daycare in the region as the population in Arctic 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 except Canada had higher population growth in non-Arctic than in Arctic regions from 2012 to 2022.

Figure 3.4 shows population growth during 2012-2022 by Arctic sub-region, revealing substantial variation in population development within Arctic regions. In Arctic Russia the only two sub-regions with population growth were the petroleum-rich region of Khanty-Mansii (9.7 per cent) and to a

Figure 3.5. Dependency ratio in Arctic and non-Arctic regions, by country. 2022. Per cent

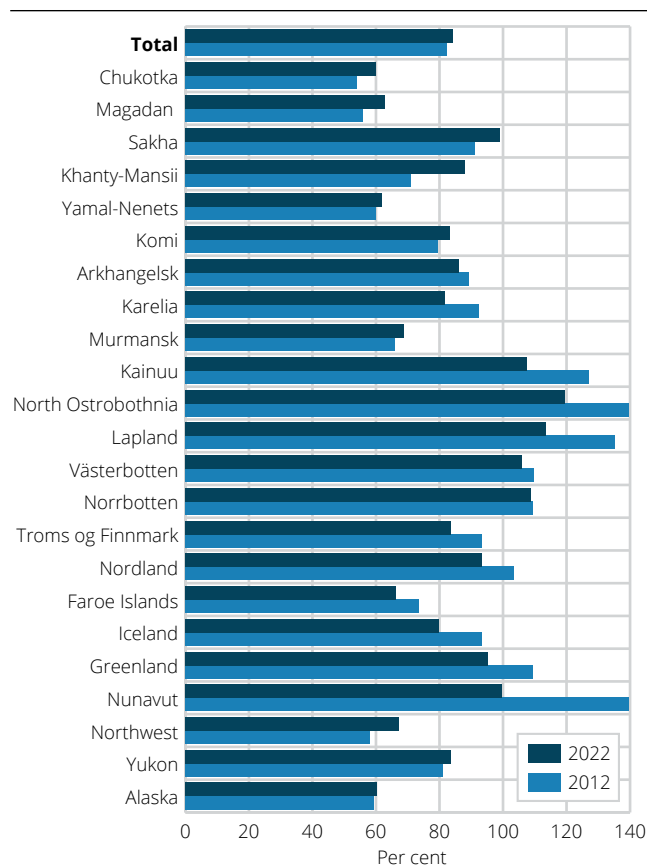
smaller extent, Sakha (4.3 per cent). Other Arctic Russian sub-regions faced population decline of 3.1-16.8 per cent, with the largest decline in the Republic of Komi.

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 (8.9 per cent). Arctic sub-regions in Norway and Sweden had population growth in the range of 0.2 to 6.2 per cent, and Greenland had a marginal decline of 0.3 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, the elderly, the disabled, students, the unemployed, and, especially relevant in the Arctic, people involved only 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

Figure 3.6. Dependency ratio, by Arctic sub-region. 2012 and 2022. Per cent

instance temporarily or seasonally employed in resource extraction with their families outside the region, tends to reduce the dependency ratio.

Figure 3.5 shows that in Canada and Russia the Arctic regions have lower dependency ratios than their non-Arctic regions. The use of seasonal and migrant labor 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 Canada. Arctic regions of Finland and Sweden have higher dependency ratios than in the non-Arctic parts of the countries. In both the United States and Norway, the Arctic and non-Arctic regions had almost equal dependency ratios.

The dependency ratios in 2012 and 2022 in Arctic sub-regions are shown in Figure 3.6. 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-Mansi and Yamal-Nenets, have fairly low

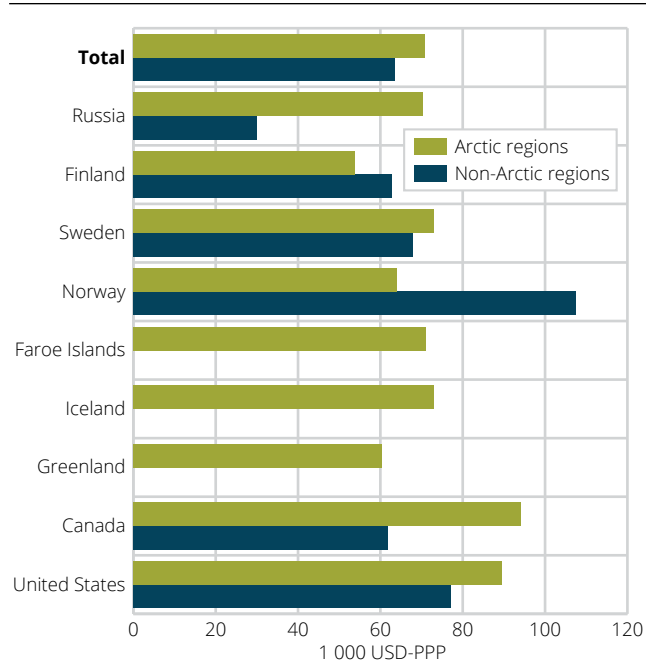
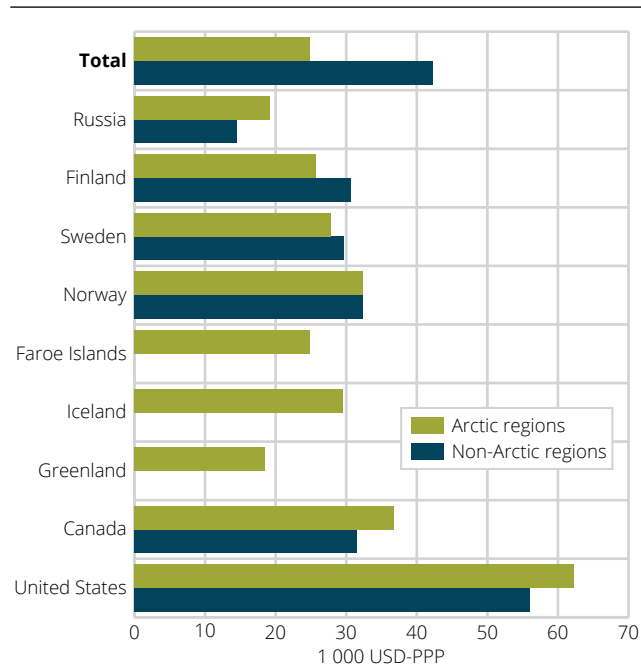
dependency ratios, indicating the use of seasonal/temporary labour. So is the case with the Northwest Territories of Canada with diamond production. However, in all these sub-regions, the dependency ratio has been increasing during 2012-2022.

In 2022, the highest dependency ratio is found in Northern Ostrobothnia, with 1.2 additional persons to support for every employed person. Then follows Lapland, Norrbotten, Kainuu, Västerbotten, and Nunavut. For the Arctic as a whole, there is a small increase in dependency ratio from 2012 to 2022. There is an increase in all Arctic Russian sub-regions, except Karelia and Arkhangelsk. The same increasing trend is also found in Alaska and Arctic Canada, except for Nunavut. All the other Arctic regions in Finland, Sweden, Norway, Iceland, the Faroe Islands, and Greenland and Lapland have reduced dependency ratios.

The economies of the Arctic

Figure 3.7 shows GRP per capita of the Arctic regions and non-Arctic counterparts in 2022. For the Arctic as a whole, GRP per capita is larger in the Arctic than in the non-Arctic regions. This aspect is clearly visible in the mineral-exporting Arctic regions of Russia, Canada, and the United States. In Northern Russia, with its huge petroleum and other mineral production, the GRP per capita is more than double the non-Arctic level in 2022. Canada has the highest GRP per capita among the Arctic regions, closely followed by Alaska. 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 Iceland and Faroe Islands and less than the non-Arctic part of Norway. Norway has a substantial offshore petroleum production but mainly in non-Arctic regions. Although there is petroleum production in the Arctic region of Norway, this extraction takes place offshore and the income from all offshore production is by statistical convention assigned to a virtual "region."

Figure 3.8 shifts the focus from GRP or value generation at the 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.

Figure 3.7. Gross regional product (GRP) per capita, by Arctic region. 2022. 1 000 USD-PPP**Figure 3.8. Disposable income of households per capita, by Arctic region. 2022. 1 000 USD-PPP**

On average for the Arctic, DIH per capita is substantially higher in the non-Arctic regions of the countries. In contrast, the three dominating mineral and petroleum 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. Greenland has the lowest disposable income level among Arctic regions, closely followed by Arctic Russia.

Figure 3.9 compares GRP per capita and DIH per capita, in Arctic sub-regions. Alaska has the highest DIH per capita followed by Yukon, Northwest Territories, Nordland, and Troms og Finnmark. 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 3.10 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) from 2012 to 2022. At the circumpolar level the growth rate of Arctic regions (0.8 per cent) has been lower than in the non-Arctic regions of the Arctic states (2.1 per cent). The highest growth occurred in Faroe Islands (4.9 per cent), benefiting from increasing fish prices, followed by Iceland with 3.2 per cent annual growth. Finland, Norway and Canada had the highest Arctic growth rate after Iceland. The United States had a negative growth in the Arctic region and a positive growth in non-Arctic regions

At sub-regional level, Alaska experienced annual average reductions in GRP by 1.3 per cent from 2012 to 2022 (Figure 3.11), largely due to low oil prices and limited stimulation from government spending. Komi and Khanty-Mansii in Russia also saw reductions in GRP at a lower rate of around 0.3 per cent. The largest GRP annual growth of over 3 per cent is found in Nunavut, Faroe Islands, Chukotka, Iceland and North Ostrobothnia.

The growth in Northern Canada was unevenly allocated among sub-regions, with high growth above all in Nunavut, considerably higher than in Yukon, in contrast to a much lower growth in Northwest Territories. In Arctic Finland, Northern Ostrobothnia showed relatively strong growth of 3.2 per cent per year, whereas the regions of Kainuu and Lapland sustained a more moderate annual growth of 2.2 per cent.

Figure 3.9. Gross regional product (GRP) per capita and disposable income of households (DIH) per capita, by Arctic sub-regions. 2022. 1 000 USD-PPP

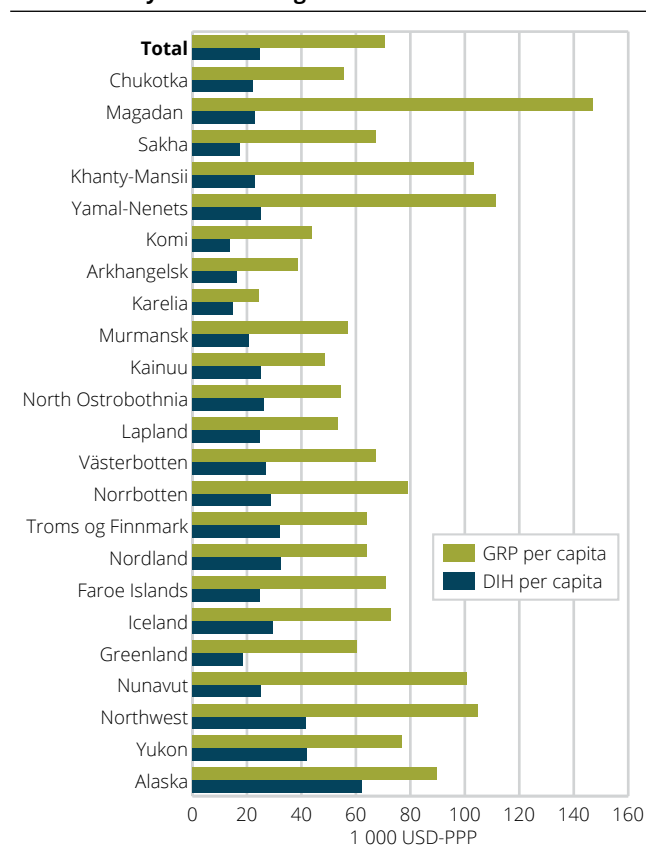


Figure 3.10. Average annual economic growth of Arctic and non-Arctic regions, by country. 2012-2022. Per cent

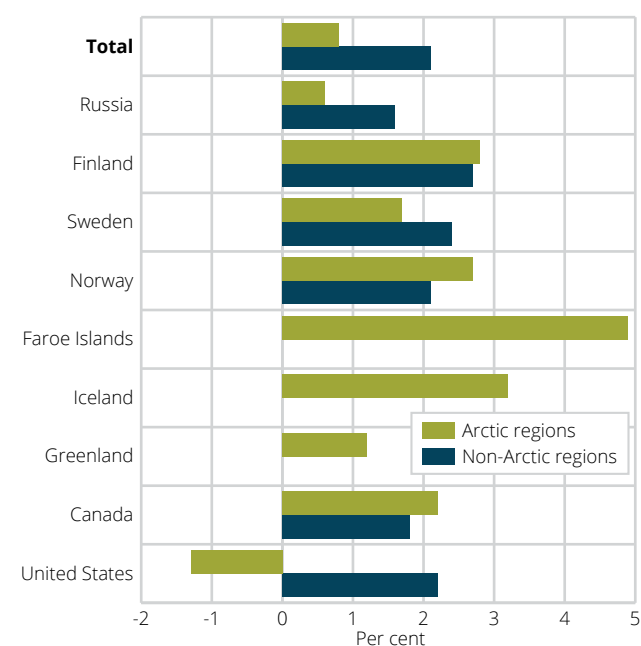
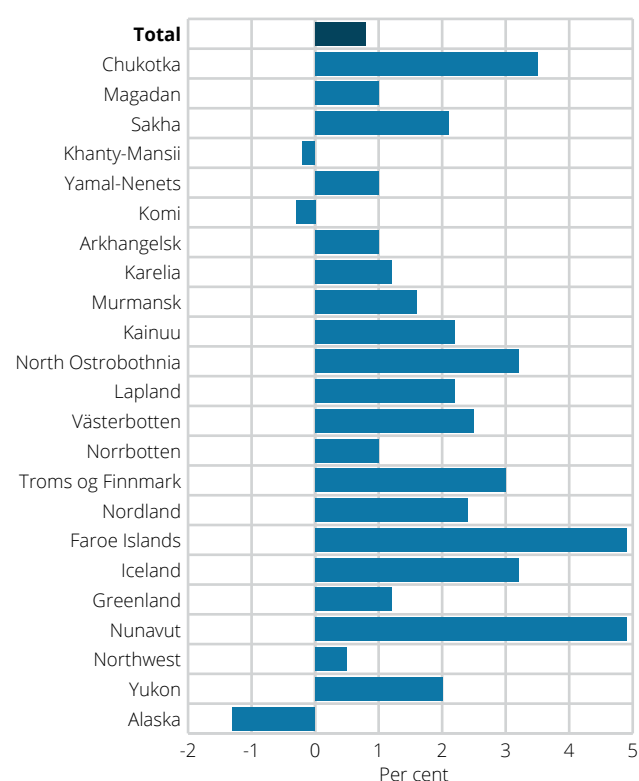


Figure 3.11. Average annual economic growth, by Arctic sub-region. 2012-2022. Per cent



Notes

¹ Statistics Canada, 2021 Census of population.

² Eurostat: Population density 2021.

³ Rantanen, M., A. Y. Karpechko, A. Lipponen, K. Nordling, O. Hyvärinen, K. Ruosteenoja, T. Vihma and A. Laaksonen (2022). The Arctic has warmed nearly four times faster than the globe since 1979. *Communications Earth & Environment* 3(1): 168.

⁴ <https://barents-council.org>.

⁵ Regional accounts for Nunavik have, however, been compiled for 1938, 1991, 1998 and 2003, and are available at Nunivaat.org. See also Duhaime, G. and V. Robichaud, 2007. *Economic Portrait of Nunavik 2003*. Québec, Canada Research Chair on Comparative Aboriginal Condition.

⁶ <https://statice.is/publications/news-archive/inhabitants/births-2023/>

⁷ World Bank. Iceland | Featured Indicators. <https://liveprod.worldbank.org/en/economies/iceland>. Accessed 8 Dec. 2024.

Highlight IV: Evaluating Gross Domestic Product estimates for Arctic regions

Gross Domestic Product (GDP) is the total value of final goods and services produced within a region during a specified period. It is a crucial measure of economic activity, alongside employment and personal income. GDP reflects how much output a region produces, and the income generated from that production. Therefore, GDP is equivalent to Value Added (VA), which is the economic contribution to the factors of production, labor and capital. The sum of value-added equals both the value of output and the income to factors of production, meaning total income equals total output.

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

GDP is generally measured in local currency, so comparing economic activity between countries requires conversion to a common base, typically using either the currency exchange rate or the purchasing power parity exchange rate.¹ The choice depends on the comparison's objective. The former compares international purchasing power, while the latter measures domestic purchasing power of the average producer or consumer within the countries.

Analysts using GDP to measure economic performance must consider its well-known shortcomings, such as the exclusion of non-market transactions (e.g., childcare, homemaker production), failure to distinguish between economic "goods" and "bads" (e.g., GDP increases after an environmental disaster), exclusion of leisure and quality of life, disregarding environmental and social sustainability of production, and lack of income distribution measurement.

In many countries, GDP is also calculated at a regional level, allowing comparisons within a country and between regions in different countries. However, regional GDP calculations have unique challenges, especially in small and remote regions, such as in the Arctic.

1. **Residency:** GDP measures production value within a region, regardless of labor or capital residence. Gross National Product (GNP) measures production by the residence of labor and capital owners but lacks a regional equivalent, at least in the U.S. GDP can misrepresent income in small, remote regions with significant non-resident labor, such as commuters or seasonal workers, or capital ownership, whereby profit from production could leave the region. Thus, income to residents of the region could be less than the value of production measured by GDP. The opposite is possible when income from investment funds accrues from production outside the region.
2. **Federal assistance:** Federal assistance for public service provision in remote regions can inflate regional GDP by including public sector spending, even though it does not represent an increase in the region's productive capacity.
3. **Location:** 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 instance, oil production on Alaska's North Slope depends on inputs located in Alaska and in the headquarters of oil companies outside the state. In this case, allocating the resource rent, i.e. the value of output more than what is required to compensate capital and labor, between regions will be somewhat arbitrary. Production in one region may be reported in another region, e.g. when seafood from the ocean adjacent to Alaska is harvested by boats headquartered outside the state and reported in the GDP of other regions.
4. **Valuing subsistence activities:** Subsistence activities, such as the nature-based economic activities of Indigenous Peoples, common in remote regions of the Arctic, may be excluded or valued differently in GDP accounts. The valuation of these non-market activities can be done by comparing to

¹ Countries may differ in prices used to present output figures. Among the alternatives are market prices (including 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.

² Text is edited by Statistics Norway in 2025

similar market-priced items (replacement value), valuing outputs at input costs, or using a “willingness to pay” measure.

5. **Price variation:** Price volatility in primary commodity-producing regions, like Alaska’s oil industry, affects GDP comparisons. The value added in these regions can be volatile due to market price changes, making comparisons sensitive to the year of comparison.
6. **Data collection:** Data collection in small, remote economies faces challenges, impacting GDP estimate precision. The small size of regional economies results in less precision in estimates based on sampling, and remoteness contributes to imprecision due to challenges associated with travel and weather conditions.



Photo: Photos.com



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

4. Arctic economies within the Arctic nations

Solveig Glomsrød and Taoyuan Wei

Contributors: Mark Brown, Randi Johannessen, Lars Lindholt, Þórólfur Matthíasson, Brett Watson and Cara Williams

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 a 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. Global warming and climate policy are changing 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 as new activities have increased their footprint in the economic statistics, e.g. wind energy and data-centers.

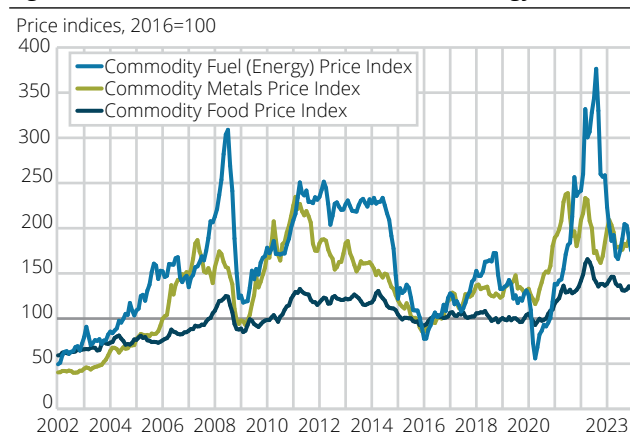
The ECONOR projects have followed the Arctic economies from 2002 to 2022, seeing peaks and downhill in world resource prices. The previous version of this report – The Economy of the North ECONOR 2020 – covered regional economic characteristics during the years 2015-2018, and a longer growth perspective capturing the turbulence around the financial crisis and the recovery. The current report compares the situation of 2019

before the covid-19 pandemic took hold, with 2022 levels, the year when the prices for energy and other minerals increased considerably.

Fish prices (Figure 4.2) show some similarities with the development of the commodity food price index 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.

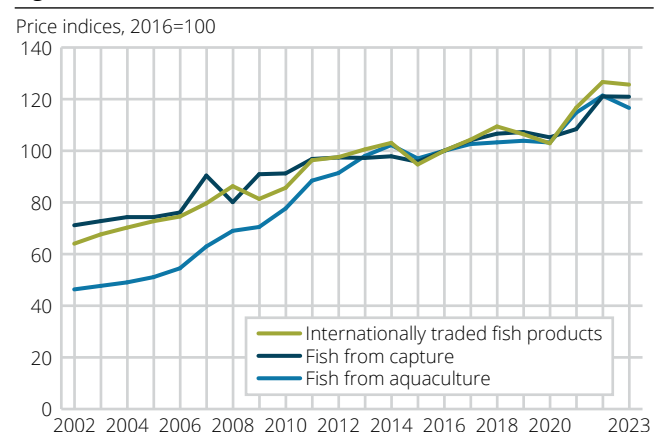
For each of the Arctic regions this chapter contains a core table showing gross regional product (GRP or GDP of nations) in current prices (local currency basic prices, i.e. net of taxes and subsidies) and the contribution to GRP by industry. Standardized figures present GRP by main industry category, GRP volume index and real growth rate 2000-2022 and disposable income of households (DIH). GRP per capita and DIH per capita are presented in purchaser price parities (USD PPP) to facilitate comparison across Arctic states. Core tables and figures generally refer to the years 2019 and 2022. The data for the Arctic regions are based on National statistics. Data sources by region are listed in Highlight 4.3.

Figure 4.1. Price indices of food, metals and energy. 2002-2023

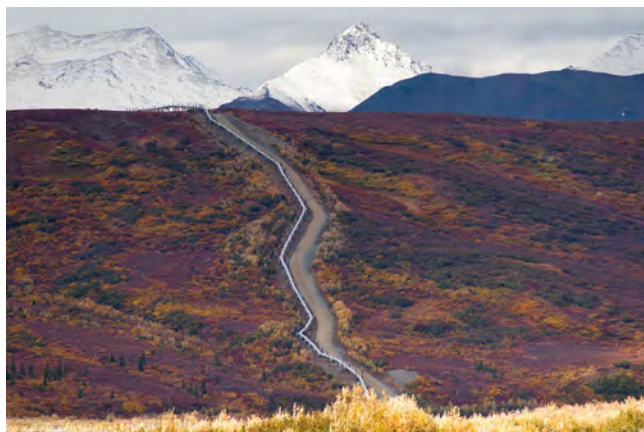


Source: Primary Commodity Price System (PCPS) (01/05/2024)

Figure 4.2. Price indices for fish. 2002-2023. 2016=100



Source: OECD-FAO Agricultural Outlook 2022-2031



Trans-Alaska Pipeline. Photo: Colourbox

Alaska

In January 2024 Alaska had 740 133 inhabitants and about half the population lives within the Anchorage region. The state had net migration losses for the 11th consecutive year in 2023.

The petroleum industry is the backbone of the economy, together with mining, fisheries and tourism, implying that global markets are decisive for income and growth. The giant oil field of Prudhoe Bay has long been in the decline phase and real economic growth has overall been negative after 2012. However, the downward trend may be reversed by the approval of the large Willow project, located in the National Petroleum Reserve and expected to produce up to 750 million barrels of oil over 30 years.¹ Further, funding for a huge LNG project is about to come in place, involving a gas pipeline from the North Slope to a liquefaction plant and harbor in Nikiski in the south.

Economic structure

Table 4.1 compares the industrial structure of Alaska in 2022 with that of 2019, the year before the outbreak of the Covid 19-pandemic. The income in Oil and gas extraction doubled over this period, whereas the economy at large grew 21 per cent. The large increase in petroleum income should be seen on background of the war in Ukraine and associated surge in energy and mineral prices in 2022. That year the Oil and gas industry including Support activities came out as the largest private activity of the economy, contributing 12.4 per cent to GRP. Income in Pipeline transportation of oil increased by 33 per cent, raising its share in GRP from 8.3 to 9.2 per cent in 2022. Income in Pipeline transportation varies less than in oil

Table 4.1. Value added¹ by industry. Alaska. 2019 and 2022

	2019		2022	
	Mill. USD	Per cent	Mill. USD	Per cent
Agriculture, forestry, fishing and hunting	349	0.7	340	0.6
Oil and gas extraction and support activities	3 839	7.6	7 602	12.4
Mining (except oil and gas)	1 374	2.7	2 092	3.4
Utilities	725	1.4	926	1.5
Construction	2 751	5.5	2 787	4.6
Wood products	41	0.1	51	0.1
Food, including seafood	783	1.6	875	1.4
Petroleum and coal products	373	0.7	440	0.7
Other Manufacturing	227	0.5	244	0.4
Wholesale and Retail trade	3 289	6.5	3 812	6.2
Pipeline transportation	4 193	8.3	5 590	9.2
Other transportation	2 535	5.0	3 303	5.4
Accommodation and food services	1 593	3.2	1 945	3.2
Finance and insurance	1 300	2.6	1 256	2.1
Real estate and rental and leasing	4 926	9.8	5 991	9.8
Public administration and defense	11 528	22.9	11 996	19.6
Educational services	199	0.4	214	0.3
Health care and social assistance	4 469	8.9	5 077	8.3
Other service activities	5 820	11.6	6 539	10.7
Total	50 312	100.0	61 081	100.0

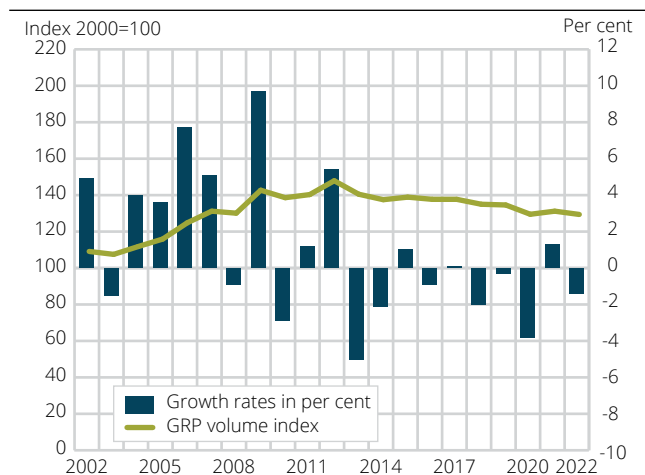
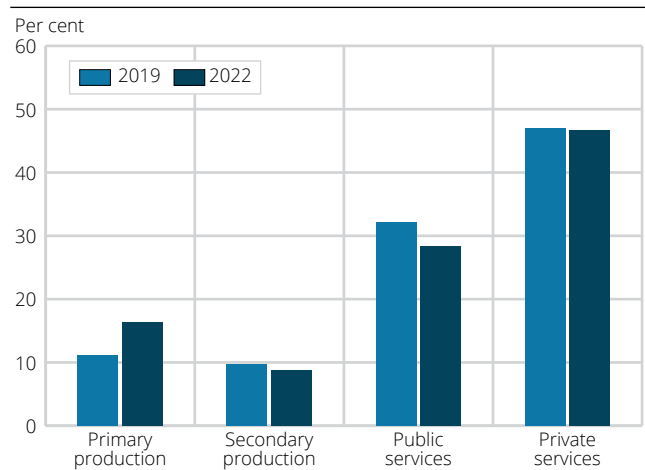
¹ At basic prices net of taxes and subsidies.

extraction as low capacity utilization means longer flow time and higher unit cost.²

Altogether, the petroleum cluster with extraction, support activities and pipeline transportation contributed 21.6 per cent to GRP in 2022, up from 16 per cent in 2019. Value added in support activities declined by nearly a quarter from 2019 to 2022. Different components within the petroleum cluster have different tax rates and a reallocation among these businesses affects the tax revenue from oil and gas. Total petroleum tax revenue was at a historically low level 2015-2021 but markedly higher in the fiscal years 2022-2023.³

Mining other than Oil and gas is another pillar of the economy that has struggled but raised income by 50 per cent from 2019 to 2022 in line with surging mineral prices, contributing 3.4 per cent to GRP in 2022.

Military spending is wholly financed by federal authorities and only affects GRP and tax income of Alaska through demand of goods and services. The Construction industry saw marginal growth, reflecting general low growth and an ageing population setting a relatively slow path for housing demand. However, Construction is likely to pick up in the

Figure 4.3. GRP volume index and growth rate. Alaska. 2002-2022**Figure 4.4. Value added by main industry (at current price). Alaska. Per cent of GRP. 2019 and 2022¹**

¹ Support activities for mining is included in Primary production.

next 3-5 years as major development occurs on the North Slope and Federal infrastructure spending accelerates from the 2021 Infrastructure Investment and Jobs Act.

Manufacturing has a modest position in the economy with 2.6 per cent of total income in 2022, down from 2.9 in 2019. The dominant activity is food processing, which largely is seafood processing, growing at 12 per cent, lagging behind the economy at large at 20 per cent growth. The food processing industry largely shouldered the 25 per cent growth in total manufacturing. Seafood processing accounted for two thirds of the state's manufacturing employment in 2022.⁴

Among services, Wholesale and retail trade increased by 16 per cent from 2019 to 2022, slightly less than the whole economy.

Transportation is dominated by Pipeline transportation but Air transportation driven by cargo traffic showed the highest growth at 43 per cent during 2019-2022. As of 2023, Ted Stevens International Airport became the 3rd busiest cargo airport in the world, stemming from its central location between Asia, Europe, and North America.

With 20 per cent growth 2019-2022 the Real estate activities closely tracked the development of GRP, providing 9.8 per cent of total income in 2022 as in 2019. The considerably smaller Finance and insurance sector saw no growth during the period.

Accommodation and food services grew in line with the total economy from 2019 to 2022 when re-establishing the pre-pandemic level of 3.2 per cent share in the economy. This sector relies on both domestic and tourist demand, both heavily exposed to the pandemic closedown. Still, the industry kept track with the general economic growth and the number of cruise visitors in 2023 and in 2024 were record high and well above pre-pandemic level (see section on Tourism).

The activity hardly increased in Public administration and defense (including Federal civilian services and State and local services), reducing its share in the economy from 22.9 per cent in 2019 to 19.6 per cent in 2022. Education grew by less than half the rate of the economy, shrinking its share of GRP from 0.4 to 0.3 per cent. Health care and social services also grew less than GRP, reducing its share in GRP from 8.9 to 8.3 per cent. Growth in nominal healthcare spending has occurred because Alaska expanded its provision of Medicaid services as part of the Federal Affordable Care Act in 2015. The increase might also reflect the rising number of seniors 65 years plus.

Economic growth

Population growth can work as a driver of economic growth as well as being result of a booming economy. Alaska saw both these mechanisms at work at the time of exploration at Prudhoe Bay and the construction of the Alaska pipeline when young working age people flew in and the economic boom encouraged population growth. Hence, the population has been young for a while, however, the working age population has been in decline in parallel with the falling trend in the oil industry. Two new large projects, the Willow oil field and a

realization of the huge LNG and gas pipeline project are likely to attract labor from outside Alaska again, better balancing the workforce and the rest of the population.

As Alaska is relying on mineral extraction for most of its income, the state is sensitive to shifts in global demand and business cycles in general. Figure 4.3 shows real economic growth 2000-2022, where 2012 marks a clear shift, with relatively high growth rates towards 2012 while the following years had a negative annual growth rate of 0.74 per cent on average.

The shift in growth mode points to a structural challenge associated with oil dependency and limited domestic demand from a less dynamic population 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. 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 structural composition and shifts between main production sectors as indicated by their share of the economy. Note that in this figure Services to petroleum and other mining is part of primary industries, rather than part of private services.

Primary production by the extractive industries is the only main sector to take a higher share of total income in 2022 than in 2019, raising value added from 11.1 to 16.4 per cent of GRP.

Secondary industries of Utilities, Construction and Manufacturing combined, declined by around 1 percentage point to 8.7 per cent of GRP.

The largest relative decline was in public services reducing value added as share of GRP from 32.2 to 28.3 per cent. Private services had a minor reduction in value added as share of GRP.

In 2022, GRP per capita was higher in Alaska than in non-Arctic states of the USA due to the high income of resource industries (Figure 4.5). Disposable income of households (DIH) per capita is also somewhat higher in Alaska, partly because there is no state income tax, and partly reflecting the

Figure 4.5. Gross regional product (GRP) per capita and Disposable income of households (DIH) per capita. United States. 2022. 1 000 USD-PPP

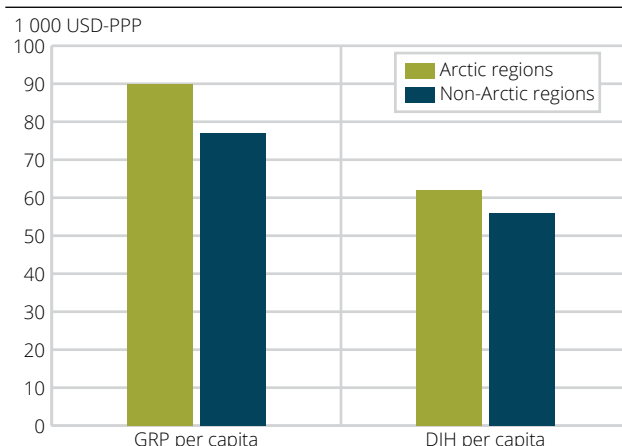
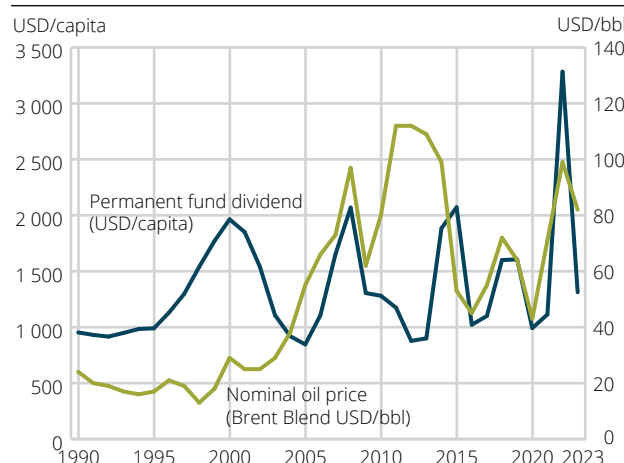


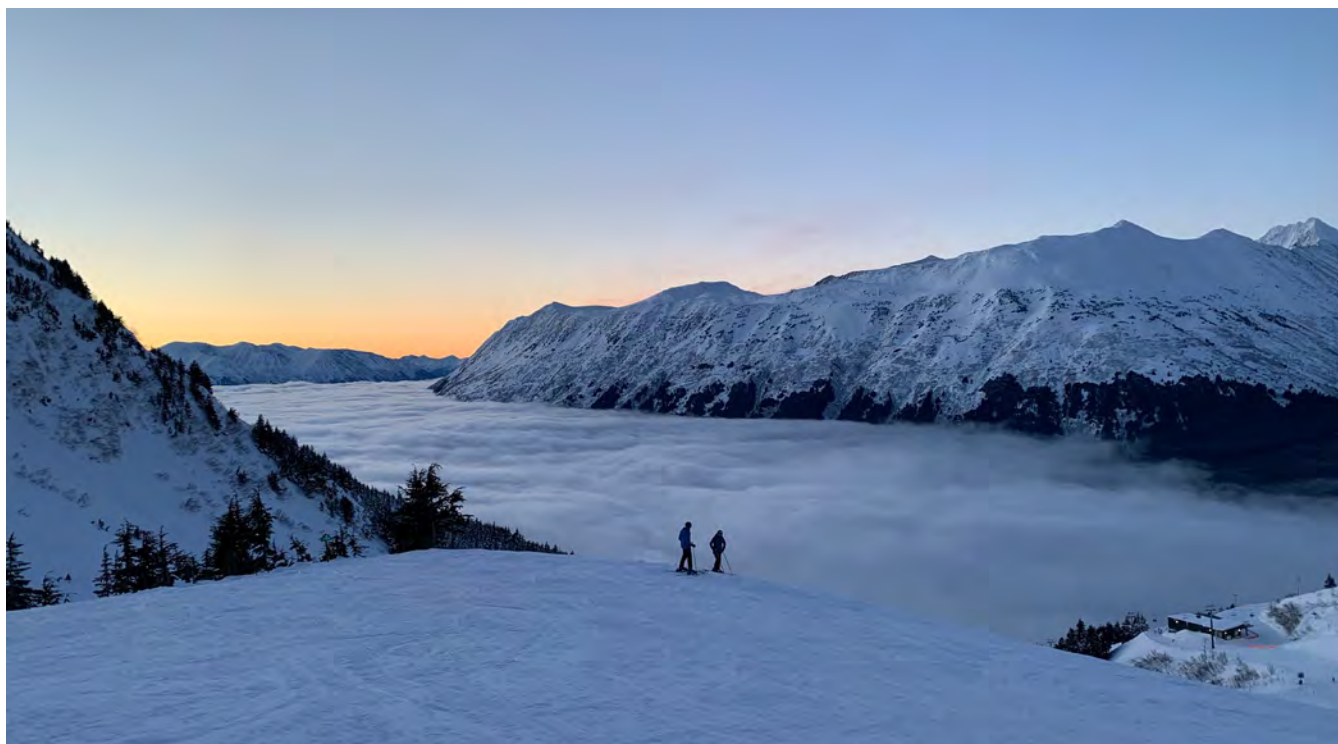
Figure 4.6. Alaska permanent fund dividend. 1990-2023. USD per capita. USD/bbl



Source: 1. State of Alaska. Department of Revenue Permanent Fund Dividend. <https://pfd.alaska.gov/Division-Info/summary-of-dividend-applications-payments>.
2. IMF. The Primary Commodity Price System. <https://data.imf.org/?sk=471DDEF8-D8A7-499A-81BA-5B332C01F8B9>.

higher cost of living up north and a higher wage level in extractive industries. Further, the Alaska Permanent Fund Dividend program provides annual cash transfers, adding to the disposable income level and reducing income differences, as every person including children receives the same amount. In 2022 the dividend was record high at USD 3 284, followed by USD 1 312 in 2023 and USD 1 702 in 2024 (Figure 4.6). In 2024 the value of the Permanent Fund reached USD 80 billion.⁵

Over a 50 years period the Permanent Fund Dividend has reduced inequality in income distribution but still the Gini-coefficient was reduced modestly by 0.02 during these decades. Poverty reduction has been larger for Indigenous Peoples whose pov-



Recreation in Alaska. Photo: Davin Holen

erty ratio fell from 28 to 22 per cent so that 10 per cent of children rather than 15 per cent have to live in poor families. However, since 2000 the real value of the individual dividends has declined, and the poverty impact been modified.⁶ In 2023, Alaska had a Gini coefficient at 0.42, one of the lowest income differences among states of the USA.

Alaska's petroleum income of royalties and taxes is expected to be markedly lower in the fiscal years 2024 and 2025 than in 2023. Federal government has been another source of income through direct expenditures and transfers to management of public lands, services to Alaska natives and military activities. Direct federal expenditures to Alaska also include transfers to individuals including pensions and health care through Medicare and Medicaid.

From the fiscal year 2018-2019 the Legislature opened for using fund earnings not only for paying dividends but to support state government public services.⁷ A 2020 Ballot initiative to increase oil production taxes failed by a 58-42 margin.⁸

Petroleum and low carbon energy

Alaska's shares of proven US oil and gas reserves are around 7 and 2 per cent, respectively.⁹ However, Alaska has huge undiscovered petroleum resources corresponding to around 30 percent of total US undiscovered resources. The discoveries

of the Willow reserves in the National Petroleum Reserve Alaska (NPR) on the North Slope would, if successful, reverse the projected decline in oil production for many years ahead. Alaska's oil production in 2023 was only 20 per cent of the production in 1988, the year of peak production from Prudhoe Bay.

Exploration activities in the three North Slope regions are controlled by the federal government through the National Petroleum Reserve Alaska (NPR), Arctic National Wildlife Refuge (ANWR), and the Alaska Outer Continental shelf (OCS). Exploration activities in these areas have all met resistance from environmental groups, claiming the projects might affect climate and damage wildlife. The ANWR is a transboundary area. Canada has opposed development in ANWR due to potential impacts to the Porcupine caribou herd, which migrates annually between Canada (Yukon and Northwest Territories) and the United States (Alaska), and to Indigenous Peoples that depend on it. To inform policy for management of the wildlife refuge, from an economic perspective, new numbers for the value of traditional hunting and trapping would be valuable.

However, in 2023 the US government approved the Willow-project, one of the largest oil developments in the USA for decades. The decision was highly



Bull Moose, Alaska. Photo: Davin Holen

controversial and contradicted an earlier pledge by President Biden, announcing no more drilling on federal lands. The approval opened for three drilling sites rather than the five sites applied for, seen by some as a compromise with environmental groups.¹⁰ The majority of Native leaders were in support of the Willow project,¹¹ which would be the equivalent of adding two new coal-fired power plants to the U.S. electricity system every year.

In 2024, the Biden Administration Department of Energy (DOE) authorized the Alaska LNG project to export liquefied natural gas.¹² After more than a decade of planning and negotiations the government represented by Alaska Gasline Development Corporation (AGDC) on January 10th 2025 signed a deal with the Glenfarne Group to develop a natural gas pipeline and liquefied natural gas facilities for the proposed USD 44 billion Alaska LNG project, taking natural gas 800 miles through a new pipeline from the North Slope to a new liquefaction plant at Nikiski in the south, North America's longest serving LNG export location. In phase 1, the pipeline will bring North Slope natural gas to Interior and Southcentral Alaska, resolving the challenge of dwindling natural gas reserves of the

Cook Inlet basin, which produces gas for much of the electricity and all heating in the most populous region in and around Anchorage.

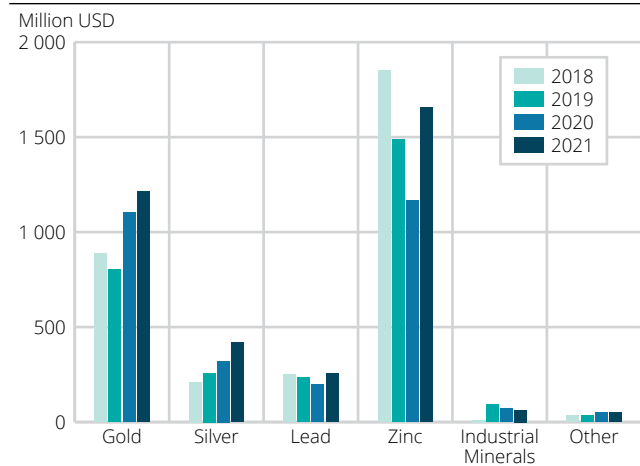
For the time being, gas on the North Slope supplies heat and electricity to communities in the region while supporting oil field operations and power the transportation of crude oil along the pipeline. The new gas pipeline will also serve users in Central and Southern Alaska.

The Prudhoe Bay and Point Thomson fields anchor the LNG project on the North Slope. These fields will produce, on average, about 3.5 billion cubic feet of gas per day.

Alaska is also in the position to meet low carbon energy demand. There is a vision for natural gas export via hydrogen production. The Alaska Hydrogen Working Group was formed in 2022 to address the increasing interest in hydrogen, produced from a vast renewable energy potential (green hydrogen) as well as from natural gas combined with carbon capture and storage (blue hydrogen). Natural gas-based hydrogen with carbon capture and storage is a low carbon technology, where carbon storage is facilitated by the abundance of depleted oil and gas reservoirs in Alaska.

There is hardly any commercially relevant renewable energy source that Alaska is not richly endowed with. The barriers to commercialization are related to the widely dispersed population and cost of infrastructure and transmission of energy. Potentials for wind, solar, hydro, geothermal and biomass abound.

The quality of a wind resource is crucial to a project, but important factors also include turbine foundation costs, the length of transmission lines and other site-specific variables. Alaska's best wind resources are largely located in the western and coastal regions. The huge drop in cost of solar photovoltaic (PV) power has facilitated community projects such as Solarize Anchorage and Solarize Fairbanks, rapidly increasing residential rooftop solar PV in Alaska. Efficiency of solar generation in northern regions is boosted by clear skies, cool temperatures, dry air and reflective snow. In 2022 the grid mix of Alaska consisted of wind 2.4 per cent, hydro 28 per cent, and solar 0.2 per cent.¹³

Figure 4.7. Mineral production of Alaska. 2018-2021. Million USD

Source: 1. Table 10 in Twelker, Evan, Werdon, M.B., and Athey, J.E., 2022, Alaska's Mineral Industry 2020: Alaska Division of Geological & Geophysical Surveys Special Report 76, 75 p. <https://doi.org/10.14509/30848>
 2. Table 15 in Szumigala, D.J., 2024, Alaska's mineral industry 2021: Alaska Division of Geological & Geophysical Surveys Special Report 77, 97 p. <https://doi.org/10.14509/31272>

Mining

The value added in other mining than petroleum increased 52 per cent from 2019 to 2022 (Table 4.1). Alaska is home to six major operating mines – five metal mines and one coal mine used to supply power generators in the interior. The dominant minerals in terms of production value are zinc and gold (Figure 4.7). The production value of zinc decreased markedly from 2018 to 2020 but rapidly turned the trend by 2021. The value of gold production increased during 2019-2021. The production value of silver was lower and rising, whereas production of lead was stable, and production of other minerals tended to be marginal. In 2020, the mining industry supported 9 600 jobs in Alaska and USD 890 million in wages.

A new study carried out by Alaska-based McKinley Research Group found that mining and minerals exploration contributed over USD 2.5 billion to Alaska's economy during 2023. This contribution includes more than USD 1 billion in wages to residents from over 90 Alaska communities, USD 235 million paid to Alaska Native corporations, and nearly USD 190 million in state and local government taxes and royalties.

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 US. Processing occurs both onshore in Alaska and elsewhere and on large pro-

cessing vessels. The salmon and shellfish harvests are managed by the state while the halibut and groundfish fisheries are managed by the federal government.

In 2022 the fisheries landed 2.2 billion tons at a value of USD 2.0 billion, processed and marketed at USD 5.2 billion at first wholesale.¹⁴ The volume landed in Alaska surpasses that in the rest of the U.S. combined. Salmon dominated landed value with 40 per cent, while pollock landed 60 per cent of volume.

The seafood industry employed 24 300 workers in harvesting and 20 000 in processing, corresponding to 18 000 full time jobs, down from 37 000 in 2019,¹⁵ including 17 000 Alaskans from more than 142 communities. Within harvesting 53 per cent of skippers, crew and active fishing permit owners were Alaska residents.

There has been an increasing share of non-resident workers in the seafood industry, reaching 82 per cent in 2023, particularly in processing as there has been insufficient recruitment to keep up with retirements in harvesting and visa constraints in seafood processing. To many rural Alaska communities, the seafood industry is among the largest sources of employment, income, and tax revenue – and the largest source of tax revenue for 11 municipal governments in 2022.

More than 10 per cent of federal commercial fishery quotas in the Bering Sea and Aleutian Islands are allocated to Community Development Quotas (CDQ) in Western Alaska to support economic development and achieve sustainable and diversified local economies.

In 2023 a combination of factors led Alaska fisheries into a crisis when the commercial harvest of all salmon species was valued at USD 398.6 million, a 45 per cent decrease from 2022, and largely an impact of lower international market prices. The seafood industry lost USD 1.8 billion in income at first wholesale level. The Alaska fishing industry saw a 50 percent decline in profitability during 2021-2023. A series of marine heat waves in the Gulf of Alaska and in the Bering Sea seriously reduced salmon and crab stocks. On top of the climate driven impact came factors like high fuel costs, hesitant demand from the US in the wake of

the pandemic and increased international competition. Several Russian fisheries have earned Marine Stewardship Council certification and use the trade name “Alaska pollock” in marketing.

Alaska lost almost 7 000 harvest-related jobs from 2022 to 2023. The number of employees in seafood processing was down from 20 000 in 2022 to 8 500 in 2023, in both cases a dramatic shift after years of recruitment difficulties. Nonresidents made up 82.3 per cent of the seafood processing workforce in 2023.

The downturn has affected the economic viability of the seafood industry, and had social and cultural impacts, particularly in small and mostly Native communities that rely heavily on fishing for food security and traditional life. It adds to the crisis that there is no federal revenue insurance like the kind of insurance provided to US farmers from the US Department of Agriculture. According to a NOAA report, beyond the economy, the crisis casts doubt on prospects for the future.¹⁶ Fish farming is not allowed in Alaska to protect against genetic pollution of the wild salmon and environmental pollution impacts of fish farming.

Jobs in harvesting of other groundfish species, mainly pollock and cod, fell 6.1 percent in 2023, when these fisheries had recovered some of their gradual past losses. The number of jobs in seafood processing increased from 2022 to 2023, breaking with a long-term decline since 2011. The seafood processing industry has had a substantial increase in total wage expenditure, however, the hourly rates for seafood processing workers have long been among the lowest in Alaska, with a median wage level of USD 17.08 in 2023 for “meat, poultry, and fish cutters and trimmers,” one of the largest processing occupations.¹⁷

Tourism

Nature and wildlife materializing in spectacular sceneries and outdoor life opportunities are the important drivers of tourism in Alaska, mainly through cruise passengers or visitors for outdoor recreation. After a decade of steady growth, the number of visitors arriving on large cruise ships peaked at 1 330 600 in 2019, before collapsing in 2020 when the pandemic took hold. The number of cruise visitors at 1 660 000 in 2023 and 1 640 000 in 2024 were record high and well above the pre-pandemic level, after zero port visits in 2020, a modest recovery in 2021 and a less than complete rebound in 2022.¹⁸ In the fiscal year 2022-2023 Alaska received 3 million visitors, higher than ever before both with respect to the summer season and for the whole year. On average, visitors to Alaska spent USD 1 434 per person per visit. Food accounted for USD 300 per person per trip, followed by lodging (USD 274), shopping (USD 256) and activities/entertainment (USD 250).¹⁹

The Outdoor Recreation Satellite Account, U.S. and States 2023 showed that outdoor recreation added USD 3.1 billion to Alaska’s economy, primarily from lodging and transportation, including travels to and from Alaska. In 2023, the outdoor recreation sector in Alaska saw significant growth, with employment rising by 7.5 per cent. The sector supported 7.5 percent of total employment and contributed 4.6 to Alaska’s GDP.

Notes

¹ https://en.wikipedia.org/wiki/Willow_project

² <https://alaska-pipe.com/historic-throughput/>

³ <https://tax.alaska.gov/programs/programs/reports/RSB.aspx?Year=2024&Type=Fall>

⁴ <https://www.alaskaseafood.org/wp-content/uploads/Seafood-Economic-Impacts-2022.pdf>

⁵ <https://apfc.org/annual-report-2024/>

⁶ Berman, M. (2024). A rising tide that lifts all boats: Long-term effects of the Alaska Permanent Fund Dividend on poverty. *Poverty & Public Policy*, 16, 126–145.

⁷ <https://apfc.org/who-we-are/history-of-the-alaska-permanent-fund/timeline/>

⁸ [https://ballotpedia.org/Alaska_Ballot_Measure_1,_North_Slope_Oil_Production_Tax_Increase_Initiative_\(2020\)](https://ballotpedia.org/Alaska_Ballot_Measure_1,_North_Slope_Oil_Production_Tax_Increase_Initiative_(2020))

⁹ <https://www.eia.gov/state/print.php?sid=AK>

¹⁰ https://www.theguardian.com/us-news/commentisfree/2023/mar/13/biden-alaska-willow-project-oil-pipelines-climate-crisis?_hsenc=p2ANqtz-970GxNpuWmzyOXJVLfQ7Y67W6H09yaq-IXuZaNge_LODkxjldGPZT3pKL59YGUF3T25u5t

¹¹ <https://apnews.com/article/biden-alaska-state-government-lisa-murkowski-dan-sullivan-4561689ea2a43a873aaf88482f9fa-d4a>

¹² <https://agdc.us/wp-content/uploads/2023/04/Final-DOE-Amended-Order.pdf>

¹³ <https://windexchange.energy.gov/>

¹⁴ <https://www.fisheries.noaa.gov/foss/f?p=215:200:11753984651872>

¹⁵ <https://www.alaskaseafood.org/resource/economic-value-report-january-2022/>

¹⁶ <https://alaskapublic.org/news/2024-10-11/alaskas-seafood-industry-lost-1-8-billion-last-year-noaa-report-says>

¹⁷ https://www.bls.gov/oes/current/oes_11260.htm

¹⁸ <https://akcruise.org/economy/alaska-cruise-history/>

¹⁹ <https://www.alaskatia.org/sites/default/files/2024-09/Alaska%20Visitor%20Volume%20Report%202023-24%207.12.24%20rev%20FINAL.pdf>



The Canadian North

Northern Canada covers about 28 per cent of the total Arctic surface area and has about 1 per cent of the total Arctic population. The population of Northern Canada was 132 594 in 2024. The combination of devolution to territorial governments and the conclusion of multiple modern treaties with Indigenous governments across the North has created an environment in which Indigenous governments' capacities in the abovementioned areas have been significantly improved. Climate change is making an ever-stronger footprint, through permafrost thawing, eroding coastlines, and impacts on infrastructure, while new options for harbors and seaways emerge.¹

Economic structure

Table 4.2 compares the economy of Northern Canada in the pre-pandemic year 2019 with the situation in 2022, after a recovery largely had taken place. Despite of the crisis brought about by the pandemic the GRP of Northern Canada grew by 7 per cent from 2019 to 2022.

Mining and quarrying is the dominant industry in Northern Canada, generating 20.6 per cent of total GRP in 2022, up from 16.9 per cent in 2019. Value added increased by nearly 30 per cent, contributing largely to the restoration of the income level after the pandemic.

The oil and gas industry hardly saw volume growth towards 2022, however, prices and the value of production increased, but the industries' share in total value added fell from 1.6 to 1.1 per cent.

Within private services, Wholesale trade, Retail trade and Transportation and warehousing all saw negative growth partly reflecting the loss of jobs and income in tourism. Within trade, Wholesale trade showed the largest decline whereas Retail trade saw a minor fall in income.

Construction declined by 8 per cent. Real estate and leasing, the largest among private services, saw particularly low growth, reducing its share in

Table 4.2. Value added¹ by industry. Arctic Canada. 2019 and 2022

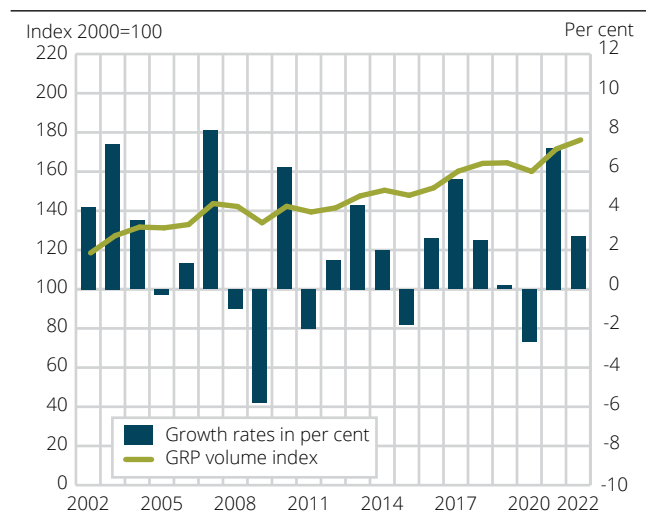
	2019		2022	
	Mill. CAD	Per cent	Mill. CAD	Per cent
Agriculture, forestry and logging	29	0.3	31	0.3
Fishing, hunting and trapping	41	0.4	34	0.3
Oil and gas extraction	167	1.6	126	1.1
Mining and quarrying	1 775	16.9	2 297	20.6
Electricity generation, transmission and distribution	153	1.4	161	1.4
Natural gas distribution, water	31	0.3	33	0.3
Construction	999	9.5	922	8.3
Manufacturing	50	0.5	55	0.5
Wholesale trade	197	1.9	128	1.1
Retail trade	458	4.4	455	4.1
Transportation and warehousing	441	4.2	383	3.4
Information and cultural industries	322	3.1	295	2.6
Finance and insurance	244	2.3	256	2.3
Real estate and leasing	1 153	11.0	1 170	10.5
Professional, scientific and technical services	238	2.3	239	2.1
Management of companies and enterprises	19	0.2	5	0.0
Administrative and support, waste management	161	1.5	158	1.4
Educational services	637	6.1	687	6.2
Health care and social assistance	823	7.8	993	8.9
Arts, entertainment and recreation	30	0.3	20	0.2
Accommodation and food services	257	2.4	243	2.2
Other services (except public administration)	146	1.4	172	1.5
Public administration	2 147	20.4	2 284	20.5
Total	10 519	100.0	11 293	100.0

¹ At 2017 chained basic price. Regional data for value added by industry for 2022 were not available in current prices. Table 4.2 shows estimated data from Statistics Canada <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610040201>. According to Statistics Canada, estimated data in chained prices for 2022 are based on volume indices by industry combined with chained prices for 2017. The sum of shares in value added by industry may not add up exactly to 100 per cent.

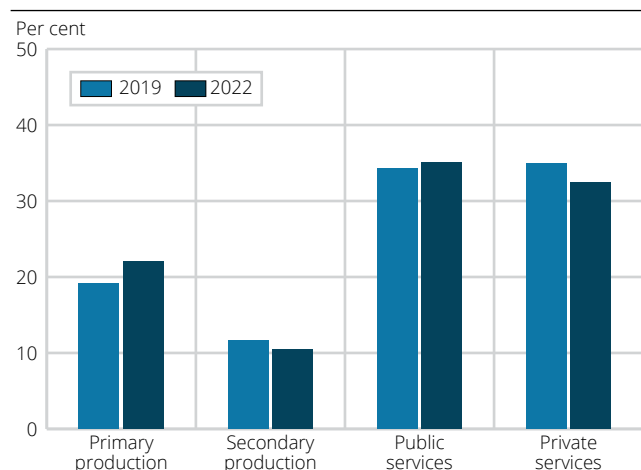
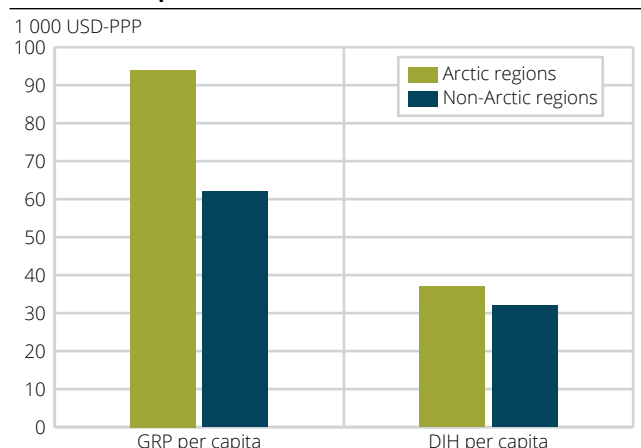
total income from 11.0 to 10.5 per cent. All private services except Other services failed in keeping up with income growth in the economy at large.

Besides income in Transportation, income in Accommodation and food services also declined, both industries being sensitive to the close downs during the pandemic, as well as to decline in trade activity. Transportation also suffered from high energy and raw material prices.

Public administration generated a similar share of income to Mining and quarrying in 2022, sustaining its share in total value added over the period.

Figure 4.8. GRP volume index and growth rate¹. Arctic Canada. 2002-2022

¹ Based on expenditure-based GDP at market price.

Figure 4.9. Value added by main industry (at 2017 chained basic price). Arctic Canada. Per cent of GRP. 2019 and 2022**Figure 4.10. Gross regional product (GRP) per capita and Disposable income of households (DIH) per capita. Canada. 2022. 1 000 USD-PPP**

Health care and social assistance responded to the needs during the pandemic, with value added increasing by 21 per cent from 2019 to 2022. Educational services matched the growth in the economy at large, contributing 6.2 per cent to total income in 2022. Note that both Health and Education (Table 4.2) are activities with both private and public provision of these services

Economic growth

Growth in income measured in current prices as in Table 4.2 reflects both changes in prices and volume of production. To see the development in scale of production we look at a hypothetical development where prices are fixed and higher income indicates the growth in volume of goods and services produced, as shown in Figure 4.8.

The economy of Northern Canada has followed a rising trend shown by the steadily increasing GRP volume index. However, the annual average real growth rate shows considerable variability. Among years with mostly positive growth there are particularly three events with negative growth. The fall in income in 2008 and more drastic in 2009 relates to the global financial crisis. A second and minor decline occurred during 2014-2015 when the oil price fell by 47 per cent. A third decline occurred in 2020 as the peak year of the covid-19 pandemic caused the largest negative growth since 2009, at 2.5 per cent.

A marked recovery took place in 2021. Both Mining and Oil and gas saw a rebound in 2021 with 7.5 per cent real growth and later 2.5 per cent in 2022 from worldwide surge in energy and mineral prices in the wake of the war in Ukraine. The extraordinarily high growth rates in the early 2000s reflect the strong income growth in the emerging diamond industry.

Primary production involved in resource extraction increased its share in total income markedly from 19 to 22 per cent as the war in Ukraine boosted prices internationally. Secondary industries are goods producing activities like construction, manufacturing and utilities, which almost sustained their position during 2019-2022.

A reorientation took place within services, as public services increased its role in response to pandemic requirements, while private services were

Highlight 4.1. Honouring the Truth, Reconciling for the Future: Canada's residential school system

The opening words of the Report of the Truth and Reconciliation Commission of Canada are quoted:

Canada's residential school system for Aboriginal children was an education system in name only for much of its existence. [...] The schools were in existence for well over 100 years, and many successive generations of children from the same communities and families endured the experience of them. That experience was hidden for most of Canada's history, until Survivors of the system were finally able to find the strength, courage, and support to bring their experiences to light in several thousand court cases that ultimately led to the largest class-action lawsuit in Canada's history.

The Truth and Reconciliation Commission of Canada was a commission like no other in Canada. [...] The Commission heard from more than 6,000 witnesses, most of whom survived the experience of living in the schools as students. [...] Children were abused, physically and sexually, and they died in the schools in numbers that would not have been tolerated in any school system anywhere in the country, or in the world.

For over a century, the central goals of Canada's Aboriginal policy were to [...] cause Aboriginal peoples to cease to exist as distinct legal, social, cultural, religious, and racial entities in Canada. The establishment and operation of residential schools were a central element of this policy, which can best be described as "cultural genocide." [...] Cultural genocide is the destruction of those structures and practices that allow the group to continue as a group.

In 1883, the federal government moved to establish three, large, residential schools for First Nation children in western Canada. In the following years, the system grew dramatically. According to the Indian Affairs annual report

for 1930, there were eighty residential schools in operation across the country.¹ The Indian Residential Schools Settlement Agreement provided compensation to students who attended 139 residential schools and residences.² The federal government has estimated that at least 150,000 First Nation, Métis, and Inuit students passed through the system.³

Many children were fed a substandard diet and given a substandard education, and worked too hard. For far too long, they died in tragically high numbers. Discipline was harsh and unregulated; abuse was rife and unreported.

The number of students who died at Canada's residential schools is not likely ever to be known in full. The most serious gap in information arises from the incompleteness of the documentary record. Many records have simply been destroyed. [...] A January 2015 statistical analysis of the Named Register for the period from 1867 to 2000 identified 2,040 deaths. The same analysis of a combination of the Named and Unnamed registers identified 3,201 reported deaths. [...] As can be seen, until the 1950s Aboriginal children in residential schools died at a far higher rate than school-aged children in the general population. [...] As late as the 1941–45 period, the Named and Unnamed Combined residential school death rate was 4.90 times higher than the general death rate. [...] Tuberculosis accounted for just less than 50% of the recorded deaths.

Source: Quoted from Preface, Introduction (p. 1 and 3) and The History (p. 43, 90, 92, 93) of the Summary of the Final Report of the Truth and Reconciliation Commission of Canada, <https://nctr.ca/records/reports/>

¹ Canada, Annual Report of the Department of Indian Affairs, 1898, 444.

² TRC, NRA, Library and Archives Canada – Edmonton, 4700-10-435, volume 1, 9/87–12/88, NAC, Edmonton, Sheila Carr-Stewart to Jim Twigg, 14 January 1988. [MRY-008208]

³ Canada, Annual Report of the Department of Indian Affairs, 1890, 82; Canada, Annual Report of the Department of Indian Affairs, 1891, 180.



Fires in Northwest Territories. Photo: NWT Fire.

Highlight 4.2. Adjusting Disposable income of households for consumption of public services

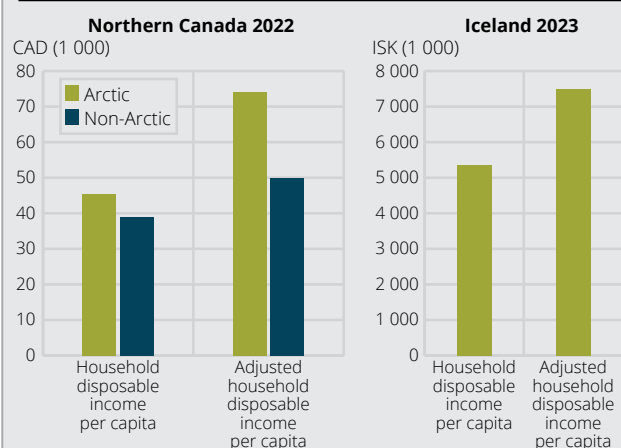
Disposable income of households per capita is often used as a measure of household material well-being because it represents, on average, how much consumption a household can undertake without having to sell assets or take on debt. However, disposable income of households does not include the value of nature-based (subsistence) activities, which can be an important source of food in Arctic communities. Estimates for the value of these activities in Arctic regions are not available.

Moreover, in regions where governments provide important services, particularly education and health care, the total value of consumption in households can exceed the private disposable income. This occurs when the government pays for services like health and education, or when transfers from the non-Arctic regions of the Arctic countries, are used to support government programs.

In general, estimates for the value of government provided services to households are not available for Arctic regions. However, for Northern Canadian and Iceland, a measure called adjusted disposable income of households that includes services provided by the government, can be calculated. This adjustment raises the value of household income and household consumption equally. On a per-capita basis, adjusted disposable income of households was CAD 74 230 in Northern Canada in 2022, over 60 per cent higher than conventional disposable income of households and about 50 per cent above the CAD 49 887 adjusted disposable income of household in non-Arctic Canada.

In Iceland, adjusted disposable income of households per capita was ISK 7 496 thousand in 2023, about 40 per cent higher than conventional disposable income of households. The differences between adjusted and conventional disposable income have been almost constant in relative terms since 2010 in Northern Canada and Iceland.

Conventional and adjusted Disposable Income of Households (DIH) per capita. Northern Canada 2022 (CAD 1 000) and Iceland 2023 (ISK 1 000)



shrinking. Hence, the pandemic set a footprint by increasing public services from 34.3 per cent to 35.1 per cent of GRP, against a decline in private services from 34.9 to 32.5 per cent of GRP. The shift in activity and income from private to public services reflects the larger role of public health service in dealing with the needs during the pandemic.

Note that in Figure 4.9 the public sector is a special aggregation of Public administration and defense as well as the publicly financed portion of economic activity in Education and Health care and social assistance. The public share of Education and Health services is 15.1 per cent. As a result, the public sector in total accounted for 35.1 per cent of Arctic Canada's GRP in 2022, larger than any individual industry and larger than the entire goods producing part of the economy.

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

GRP per capita and disposable income of households per capita in Northern Canada are both higher than in Southern Canada (Figure 4.10). In 2022, GRP per capita in Northern Canada was 94 000 USD-PPP, 50 per cent higher than GRP per capita in Southern Canada. This reflects price and wage differentials and also reflects the different industry structure in Northern Canada. Prices for goods and services in Northern Canada are generally higher than in Southern Canada due to long transport distances as well as more limited infrastructure. This is particularly true for Nunavut where communities are not connected by all-weather roads. Further, the Northern Canadian economy is also more focused on mineral extraction and public services provision than the south, both activities with relatively high wage rates.

Disposable income of households per capita at 37 000 USD-PPP in Northern Canada in 2022 was also higher than in Southern Canada where disposable income of households per capita was 16 per

cent less at 32 000 USD-PPP. Besides disposable income, households also benefit from in-kind public services through education and health. An example of adjusting the DIH for public services is shown for Northern Canada in Highlight 4.2.

As with GDP per capita, the relatively higher values for DIH in Northern Canada also comes from a higher wage level above all in extractive industries.

Petroleum and mining

Diamond production stands out as an important source of income in Northwest Territories (NWT) where around 90 per cent of all Canadian diamonds are extracted (Figure 4.11).

Extraction of diamonds in NWT took off in 1998 and between 2010 and 2013 production hovered around 10 million carat per year. Production peaked in 2017-18 at approximately 20 million carat and has since fallen to around 15 million carat between 2020 and 2023.

The value of diamond production had an early peak in 2004 at around CAD 2 billion and has since then oscillated between CAD 1.5 billion and 2 billion towards 2023, reaching a value marginally above the 2004 peak in nominal terms.

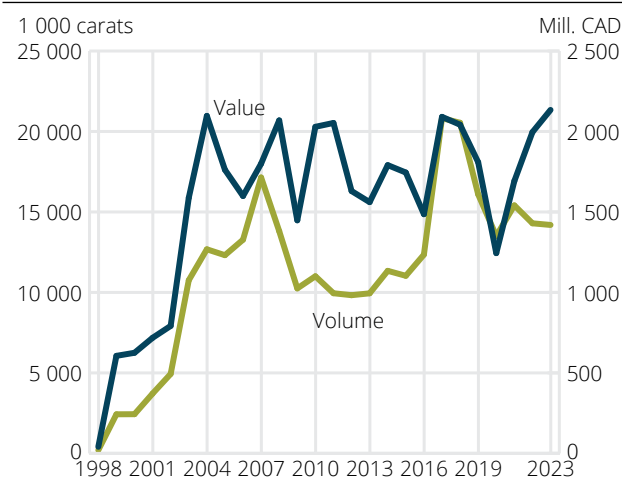
The recent decrease in extraction is expected to continue. The Diavik diamond mine is expected to close in early 2026 after being a pillar of the economy of NWT, employing over 1 000 people and producing an average of 6-7 million carats of gem-quality diamonds annually.²

The future scale of diamond extraction will depend on the capacity to develop underwater horizontal drilling technology at the Ekati mine, having limited horizons for its open pit and underground mining is expected to decline after 2025. New technology might prolong its lifetime by at least 10 years.³

Oil production has fallen steadily since 1998, down to almost zero in 2017-2018, when the Norman Wells pipeline was closed due to permafrost thawing around a pipeline crossing of the Mackenzie River.⁴

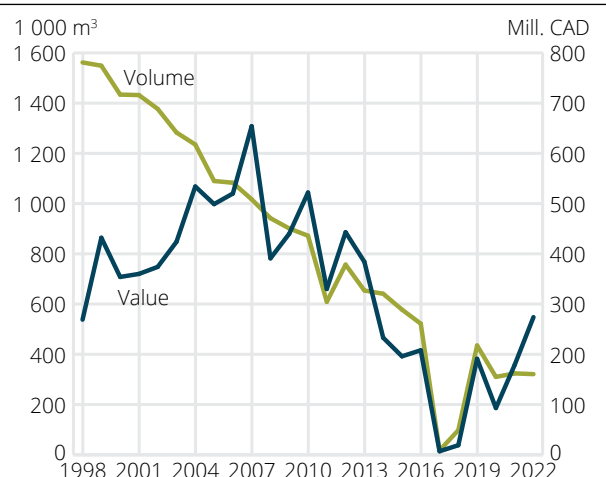
The majority owner, Exxon Mobile, applied for extending the life of the Norman Wells oil and gas facility for 10 years. Plans for upgrading have

Figure 4.11. Diamond production. Arctic Canada. 1998-2023



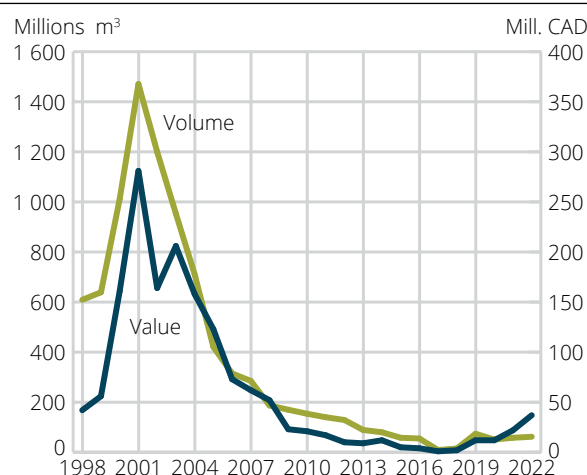
Source: Natural Resources Canada. Annual Statistics of Mineral Production.

Figure 4.12. Oil production. Arctic Canada. 1998-2022

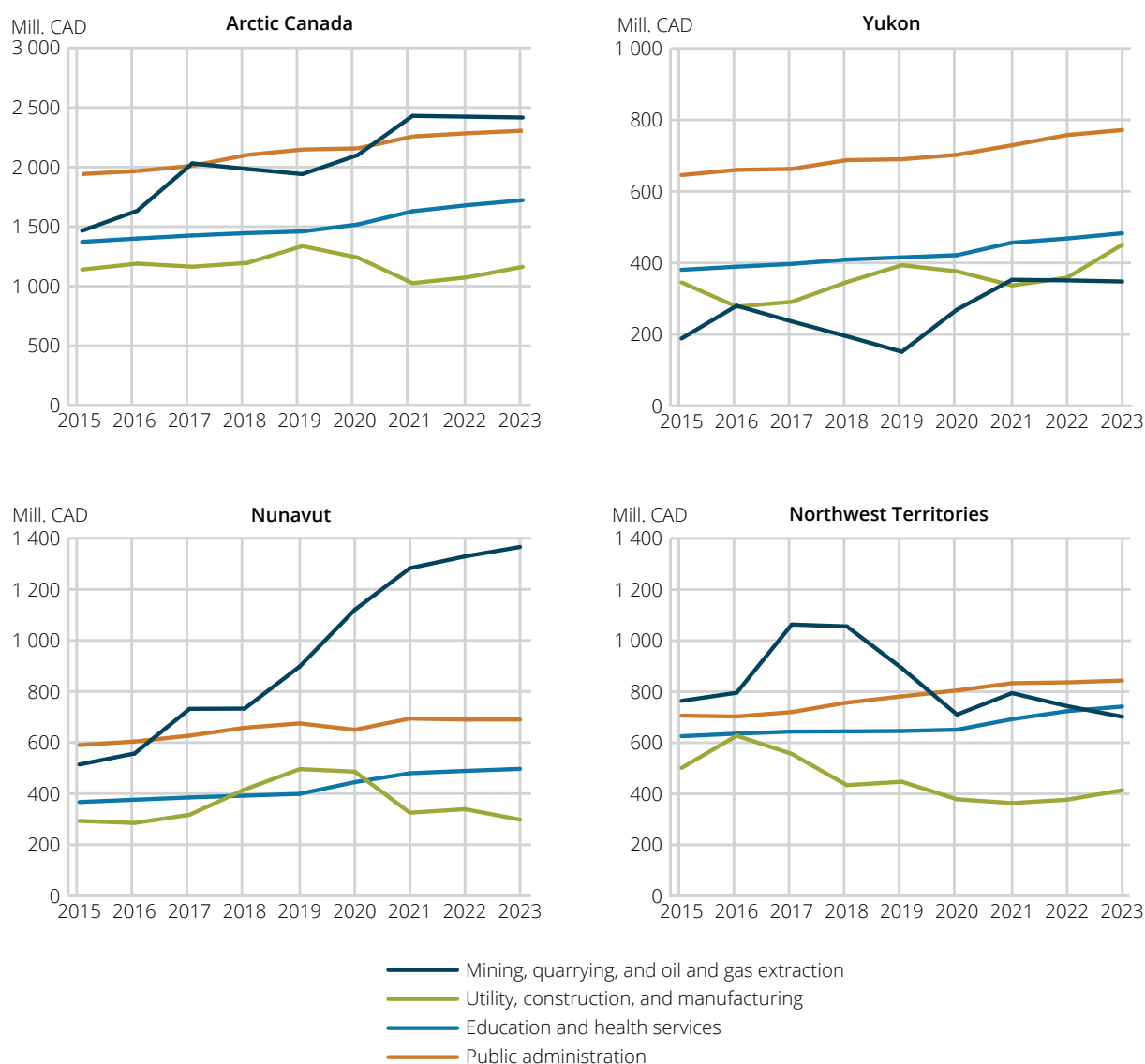


Source: Canadian Association of Petroleum Producers.

Figure 4.13. Natural gas production. Arctic Canada. 1998-2022



Source: Canadian Association of Petroleum Producers.

Figure 4.14. Value added in selected industries at 2017 chained basic price. Arctic Canada. 2015-2023. Mill. CAD

been put on hold by the Canada Energy Regulator, pending an environmental assessment. Awaiting the assessment, the production facility continues operating.⁵

The Sahtu Secretariat, representing the region's Sahtu Dene and Métis Indigenous government and part of the regional government, requested an environmental assessment of the plan, as horizontal direct drilling (HDD) is a new technology in a continually changing river environment along the Mackenzie River.⁶ Researchers studying permafrost in the Northwest Territories say it is thawing at an alarming rate, with parts of the territory losing about a meter a year.⁷ Future operations both in short and long term depend on the capacity to secure new and old infrastructure in an environment of thawing permafrost.

The Sahtu Secretariat also required a separate environmental assessment of the overall oil and gas infrastructure at Norman Wells, having concerns about climate change and the stability of oil and gas infrastructure at the operation site, asking if it makes sense to accept any risk of an aging oil field supplying less than 1 per cent of Canada's conventional light crude production. Four Indigenous governments supported the Sahtu Secretariat's claim for an environmental assessment, while the Town of Norman Wells and the Northwest Territories government supported the owner's application to stop the assessment.⁸

In 2016 the Canadian government ordered a moratorium on new offshore oil and gas licenses in Arctic Canadian waters, declaring all Canadian Arctic waters as indefinitely off limits to future off-

shore Arctic oil and gas licensing. The moratorium is to be reviewed every 5 years. The Government of Canada will co-develop a science-based review, incorporating traditional and local knowledge and socio-economic assessments, to assess the moratorium and negotiate a revenue-sharing arrangement with the territorial governments. The current extension prolongs the moratorium to 2028.⁹

The northern territories

In January 2024, Canada and the Government of Nunavut signed a devolution agreement transferring the control of huge areas of land and water with rich natural resources from the Federal government to the Government of Nunavut. Yukon was the first territory in Canada to sign a devolution agreement in 2003, whereas the devolution agreement of Northwest territories was signed in 2013.

These agreements ensure the territories the right to receive royalties from resource extraction previously taken by the federal government. While Nunavut has obtained the full right to royalties, NWT may receive 50 per cent of royalties up to a cap of 5 per cent of the respective territorial budget. The Government of NWT shares up to 25 percent of its portion of resource revenues with participating Indigenous governments. Similarly, Yukon receives 50 per cent of royalties, up to 5 per cent of government expenditures.¹⁰

In all three territories the agreement was signed by the federal and territorial governments and representatives of Indigenous Peoples' organizations. These agreements might have high economic importance to the territories as Northern Canada is rich in mineral deposits and energy sources. These resource and management agreements between the federal government and territories together with increased administrative capabilities of the territories gives a visible impact on the footprint upon political processes with respect to resource extraction, nature conservation and long-term preferences for development.

Canada's Arctic and Northern Policy Framework has as its Goal 3 to support the growth of the northern and Arctic economy into "Strong, sustainable, diversified and inclusive local and regional economies".¹¹

Table 4.3. Basic Indicators. Arctic Canada. 2022

	Yukon	Northwest Territories	Nunavut
Population (thousand person)	43.9	44.6	40.5
GRP at basic prices ¹ (mill. CAD)	3 930	5 574	4 753
Real GRP annual growth rate 2012-2022	2.0	0.5	4.9
Share of Arctic Canada GRP (per cent)	27.6	39.1	33.3
Per cent of territorial government revenue from federal transfers	77.5	66.7	86.1

¹ Calculated at current price by expenditure approach.

The three Northern Territories combined accounted for 0.3 per cent of the total Canadian population and about 0.5 per cent of Canada's GDP in 2022. These sparsely populated territories have smaller private sector economies than those of the provinces of Southern Canada and dispersed populations in Northern Canada make service delivery expensive. Transfers from the Federal Government constitute an important source of territorial government revenue. In 2022, federal transfers accounted for 86.1 per cent of total public revenues in Nunavut, 77.5 per cent in Yukon and 66.7 per cent in Northwest Territories (Table 4.3).

Across the territories, Nunavut had the strongest growth between 2012 and 2022, with 4.9 per cent average annual real economic growth, while Yukon was second with 2.0 per cent and Northwest territories had the weakest annual real economic growth at 0.5 per cent (Table 4.3).

Tourism was one of the first industries to feel the impact of the COVID-19 pandemic. At the end of March 2020, around 90 per cent of tourism businesses in the NWT reported significant negative impacts from the COVID-19 pandemic. Over three quarters of these businesses had already taken some type of action such as closures, reducing staff hours or services, and/or laying-off employees.

Being sparsely populated the territories face high costs and challenges in increasing and developing cleaner energy supply. The territories depend on diesel for the supply of electricity. Diesel use is prevalent particularly in small communities in all territories. However, many renewable energy pilots and projects are emerging, partly replacing diesel in remote communities. Bioenergy has become a source of heating, especially in public buildings.



The Federal government provides funding and incentives for clean energy through the Clean Energy for Rural and Remote Communities Program.

The territories are in charge of their own resource and energy future; hence, Indigenous Peoples and local people might ensure that development aligns with sustainability and their preferences with respect to land use and resources.

The Northwest Territories (NWT)

The Northwest Territories had the highest GRP and GRP per capita among the territories in 2022, reflecting the high income from mining, above all from diamonds. However, the annual real growth rate of NWT was the lowest among territories.

NWT produces approximately 90 per cent of Canada's diamonds, with Canada being the third largest producer globally.¹² In 2022, the employment of NWT residents in the diamond industry corresponded to 1 094 person-years. Since 2019, all three diamond mines have voluntarily reported the number of female employees at around 15 per cent.¹³

NWT has vast undeveloped oil and gas reserves that could possibly hold as much as a third of Canada's reserves of light crude oil and natural gas. Norman Wells is the only oil and gas production site in NWT with production spread across nine natural and artificial islands in the Mackenzie River. There are no refineries, and crude oil production corresponding to 0.1 per cent of Canada's production is transported south by the Norman Wells pipeline.¹⁴

There has been no exploration drilling since 2015 and no new wells are planned or operating in NWT apart from Norman Wells, or in federal waters of the Beaufort Sea.

The Line 490 project for upgrading Norman Wells would reopen an area that has been out of production since some pipes were damaged in 2022. The majority owner Exxon Mobile has applied to extend the life of Norman Wells oil and gas facility, using horizontal directional drilling (HDD). The Sahtu Secretariat representing the region's Sahtu Dene and Métis population requested an environmental assessment of the

Line 490 project, as HDD is a new technology in a “continually changing river environment”, requiring close scrutiny.¹⁵ The L490 project for upgrading has been put on hold by the Canada Energy Regulator, pending the environmental assessment.¹⁶

By bringing the entire Norman Wells operation through an environmental assessment, the Sahtu Secretariat questions the need for the century-old oil field to continue operating.¹⁷

The Mackenzie Valley Highway has been a Government of NWT priority for years. Sahtu communities have urged the building of an all-season highway to the south to ensure supplies and improve communication. The federal government has promised to support the project. Further, defence spending in the North could open a new source of funding for the road project.¹⁸

Electricity is mainly based on petroleum (47 per cent), with 36 per cent from hydro, 3 per cent from wind and 14 per cent from natural gas. NWT does not have a territorial electricity grid, however, eight communities around the Great Slave Lake use hydroelectricity provided by two regional grids. The large majority of the remaining 25 communities rely on diesel generated power.

End use of energy consists of 45 per cent to industrial use, 14 per cent to commercial sector and 7 per cent to private households. Within transportation, 76 per cent of fuel is petroleum, 18 per cent from natural gas and 6 per cent electricity.¹⁹

Nunavut

Nunavut came out with the second highest GRP per capita in 2022 after strong growth largely driven by mining as Agnico Eagle gold mine and Mary River Iron Mines scaled up production. Mining stands out with a marked growth in income; income during 2021-2023 more than doubled that of 2015, facilitating a significant increase in investment and exploration. However, lack of infrastructure makes it more difficult to develop new mines in Nunavut than in other parts of Canada.

In 2022, Baffinland iron mines corporation received a federal permit to increase production followed up by another request to double that level of production to 12 million tons. The request was

rejected by federal authorities due to concerns about potentially negative environmental impacts on wildlife, vegetation and water, as well as socio-economic impact on the Inuit.²⁰

In December 2022, Baffinland provided a draft submission to the Qikiqtani Inuit Association (QIA) for a Sustaining Operations Proposal (SOP), with the aim to provide uninterrupted work at Mary River Mine for the foreseeable future. The federal government approved the SOP, following review and incorporation of feedback from the Qikiqtani Inuit Association and other parties.²¹

The mining industry employs workers from other parts of Canada due to a lack of specific mining skills within the resident population and due to the remoteness of the mine sites.

Mining is exposed to business cycles as well as regulations and emptied reserves. To prepare for downscaling, the industry is running programs to educate miners to prepare for work in other positions, for instance training for heavy vehicle driving or carpentry.²²

Practically all electricity production is based on petroleum. 47 per cent of total energy is used for transportation, 35 per cent for industrial use, 12 per cent for commercial use and 7 per cent by households. Final energy use is based on refined petroleum (78 per cent) and electricity (22 per cent).²³ Nunavut has no petroleum production.

Yukon

The territory had annual average real growth rate of 2.0 per cent during 2012-2022. Strong demand for labor continued in 2023, with both the number of people employed and the size of the labour force surpassing the previous record highs of 2022. For several years, the unemployment rate in Yukon has been significantly lower than the national average.²⁴

Following a downturn in 2019, income from mining recovered before plateauing and slightly declining during 2021-2023 (Figure 4.14).

In 2023, the operator abandoned the copper-gold mine site of Minto Mine, and the government took over. Since that time, the government has been working with the Selkirk First Nation to protect

the people, property and environment in the area, activating recoverable funds from the security held by the government for the mining site.²⁵ The mining industry in Yukon has made significant strides in balancing economic growth with environmental and social responsibilities.

After struggling to keep up with the economic trend, utilities, construction and manufacturing increased somewhat, possibly stimulated by a major reconstruction and upgrading of the infrastructure at Erik Nielsen Whitehorse International Airport, which began in 2023 and will continue through 2026.

Yukon has no petroleum production. As much as 72 per cent of electricity is from hydro, roughly 16 per cent from natural gas, and 11 per cent from petroleum in 2020. Half of total energy is used for transportation.

Most of the electricity continues to be renewable (hydro). The water flow is markedly lower in winter than in summer and Yukon develops other sources that are less influenced by seasonal factors. Through the Micro-generation Program, residents can install solar panels and sell surplus electricity to the grid. About 5 megawatts of solar power capacity are connected to Yukon's main grid. The program provides up to CAD 5 000 for small-scale renewable energy systems. For solar hot-water heating there is a 20 per cent subsidy on material costs up to CAD 1 200.

The construction of Beaver Creek Solar Farm Project currently in development might offset 55 per cent of the community's diesel use for electricity production, bringing Yukon's greenhouse gas emissions from transportation, heating and electricity, closer to the goal of a 45 per cent reduction compared to 2010 levels.

Notes

- ¹ For the distinction between Arctic Canada and the Canadian North, see e. g. the Arctic and Northern Policy Framework, <https://www.rcaanc-cirnac.gc.ca/eng/1560523306861/1560523330587>
- ² <https://www.mining.com/rio-tinto-offers-early-termination-to-diavik-employees-to-save-costs/>
- ³ <https://burgundydiamonds.com/press-release/ekati-diamond-mine-and-ihc-mining-jointly-developing-innovative-underwater-remote-mining-system/>
- ⁴ https://www.gem.wiki/Norman_Wells_Oil_Pipeline#cite_note-enbridge-3
- ⁵ <https://pgjonline.com/news/2024/october/canada-halts-imperial-s-norman-wells-oil-permit-extension-over-pipeline-environmental-concerns>
- ⁶ <https://cabinradio.ca/202725/news/sahtu/norman-wells/sahtu-secretariat-refers-imperial-oil-to-environmental-assessment/>
- ⁷ <https://www.cbc.ca/news/canada/north/researchers-say-n-w-t-permafrost-is-thawing-at-a-dramatic-rate-1.2900813>
- ⁸ <https://www.cbc.ca/news/canada/north/parties-submit-positions-imperial-oil-environmental-assessment-1.7381953>
- ⁹ <https://gazette.gc.ca/rp-pr/p2/2023/2023-12-20/html/sor-dors268-eng.html>
- ¹⁰ <https://www.canada.ca/en/news/archive/2012/08/responsible-resource-development-north.html>
- ¹¹ <https://www.rcaanc-cirnac.gc.ca/eng/1560523306861/1560523330587#s6>
- ¹² <https://www.miningnorth.com/chamber-news/103808>
- ¹³ <https://www.iti.gov.nt.ca/sites/iti/files/1377-SEA-Report-2022-WEB.pdf>
- ¹⁴ <https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/provincial-territorial-energy-profiles/provincial-territorial-energy-profiles-northwest-territories.html>
- ¹⁵ <https://cabinradio.ca/202725/news/sahtu/norman-wells/sahtu-secretariat-refers-imperial-oil-to-environmental-assessment/>
- ¹⁶ <https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/provincial-territorial-energy-profiles/provincial-territorial-energy-profiles-northwest-territories.html>
- ¹⁷ <https://cabinradio.ca/204265/news/economy/mining/imperial-oil-faces-multiple-environmental-assessments/>
- ¹⁸ <https://cabinradio.ca/204300/news/travel/community-sessions-scheduled-for-mackenzie-valley-highway/>
- ¹⁹ <https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/provincial-territorial-energy-profiles/provincial-territorial-energy-profiles-northwest-territories.html>
- ²⁰ <https://globalnews.ca/news/9284795/nunavut-iron-mines-request/>
- ²¹ <https://www.baffinland.com/operation/sustaining-operations-proposal/>
- ²² <https://www.agnicoeagle.com/English/the-eagle-blog/blog-news-details/2019/Build-a-skill-build-a-future/default.aspx>
- ²³ <https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/provincial-territorial-energy-profiles/provincial-territorial-energy-profiles-nunavut.html#s1>
- ²⁴ <https://yukon.ca/sites/default/files/fin/fin-2024-25-fiscal-and-economic-outlook.pdf>
- ²⁵ <https://yukon.ca/sites/default/files/fin/fin-2024-25-fiscal-and-economic-outlook.pdf>



Faroe Islands

Faroe Islands is a self-governing nation within the Kingdom of Denmark, with legislative and administrative sovereignty in a wide range of areas, including management of natural resources and the environment. Faroe Islands extends over an archipelago of 18 islands in the Northeast Atlantic Ocean and is highly dependent on export of fish products.

The population counted 54 403 people in 2024. There has been positive, but low population growth around 0.3 per cent in recent years, including net immigration. The total rate of fertility fell below 2.0 for the first time in 2022.

Total income increased by 5 per cent on annual average from 2019 to 2022, rebounding from the peak pandemic year of 2019 and supported by a marked increase in fish prices. Above all, the aquaculture industry contributed to this growth by raising income by 44 per cent and its share of GRP from 7.7 per cent to 9.6 per cent over the period. Aquaculture showed the highest growth among all industries and is rapidly closing the income gap to the still dominating ocean fisheries. Wild fisheries roughly sustained their 2019 share in GRP at 11.3 per cent.

The manufacture of Food and beverages, mostly consisting of fish processing, also showed growth above average, raising its share in total income from 7.5 to 7.8 per cent. The fishery cluster of wild species fisheries, aquaculture and fish processing thus continues to dominate the economy, with 28.7 per cent of total income in 2022.

Table 4.4. Value added¹ by industry. Faroe Islands. 2019 and 2022

	2019		2022	
	Mill. DKK	Per cent	Mill. DKK	Per cent
Fishing	2 216	11.4	2 539	11.3
Aquaculture	1 498	7.7	2 160	9.6
Agriculture, mining and quarrying	34	0.2	41	0.2
Manufacture of food products and beverages	1 453	7.5	1 744	7.8
Other industry, excluding energy	816	4.2	870	3.9
Electricity, gas and water supply	423	2.2	410	1.8
Construction	1 439	7.4	1 484	6.6
Wholesale and retail trade, hotels and restaurants	1 992	10.3	2 351	10.5
Transportation and storage	1 538	7.9	1 697	7.6
Information and communication	483	2.5	556	2.5
Financial intermediation, including insurance and pension funding	702	3.6	718	3.2
Real-estate and renting	1 805	9.3	1 988	8.9
Public administration	887	4.6	983	4.4
Education	980	5.1	1 120	5.0
Health and social work	2 040	10.5	2 429	10.8
Other service activities	1 083	5.6	1 327	5.9
Total	19 386	100.0	22 417	100.0

¹ At basic prices net of taxes and subsidies.

Other manufacturing than Food and beverages continues to generate about 3.9 per cent of income, including hydraulics and engineering, construction materials and textiles.

Electricity, gas and water supply is the only industry with lower income in 2022 than in 2019, despite an increase in electricity production. The decline is related to administered electricity prices, lagging behind general inflation and in particular the high cost of fuel in 2022 as 50 per cent of electricity is based on fossil fuel. Around 90 per cent of electricity is generated by SEV, a company owned by all municipalities. Faroe Islands is not connected to international electricity markets.

The Construction industry peaked in 2020 but declined to about 10 per cent below that level in 2022 as the large subsea tunnel works approached completion, reducing its share in total income from 7.4 in 2019 to 6.6 per cent.

Within private services, both Trade and Accommodation and food services increased somewhat more than GRP, reflecting a rebound in tourism after the pandemic (see Chapter 9).



Tórshavn. Photo: Ásne Vigran

The activity in Transportation services grew less than average and reduced its share in total income from 7.9 per cent to 7.6 per cent, taking in all the challenges from the collapse in tourism, strong increase in fuel prices, reduction in demand from improved connectivity and from construction activity itself, as tunnel works progressed. Eventually, the two new tunnels, completed in 2023, connect several of the towns, reducing travel time by more than a half for a large share of the population, trade, and industry.

Financial services, but also Real estate and renting saw diminishing income shares towards 2022.

Public administration grew somewhat less than the economy at large, so did activity in Education, although less pronounced. Health and social work increased activity from 10.5 per cent of GRP in 2019 to 10.8 per cent in 2022, facing rising needs during the pandemic and an increasing share of elderly in the population.

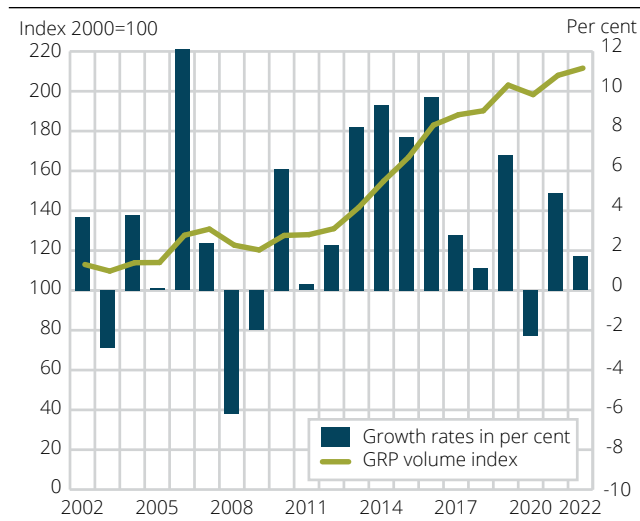
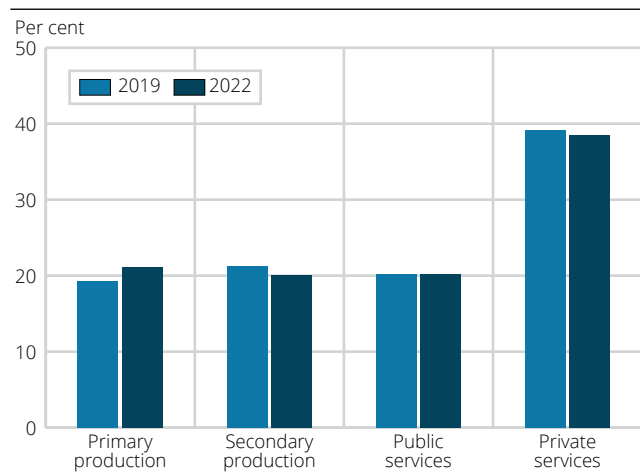
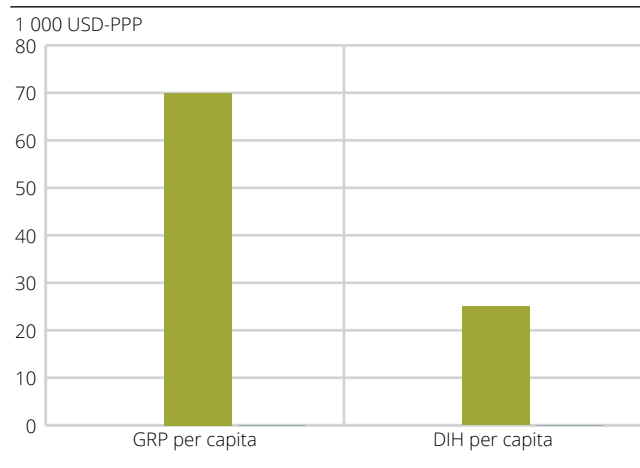
After the financial crisis 2008-2009 real growth adjusted for inflation has generally been high, up to 8-10 per cent during 2013-2016 when export value of farmed salmon took off while low fuel prices

benefitted the fishing fleet and energy sector. Then real economic growth became variable but mostly positive, except for a 2 per cent decline in 2020, when tourism collapsed.

The tunnel projects 2016-2023 were the largest construction projects ever carried out in Faroe Islands. A publicly owned special purpose limited company was established to carry out the project and construction works were financed with government means, which will be repaid by toll charges.

Faroe Islands receive an annual block grant from Denmark, amounting to an annual average DKK 642 million (USD 96 million) during 2016-2022, around 3 per cent of GRP. In common understanding, as a step to wider independence, the governments of Denmark and the Faroe Islands agreed to reduce the block grant by DKK 25 million to DKK 617 mill in 2023, and to continue with similar annual reductions towards 2026. GDP per capita in Faroe Islands and Denmark are at a similar level.¹

The Faroe Islands have the lowest unemployment rate in Europe, falling below 1 per cent in 2022-2023. Unemployment for Faroese women is exceptionally low. The ratio of people of working

Figure 4.15. GRP volume index and growth rate. Faroe Islands. 2002-2022**Figure 4.16. Value added by main industry. Faroe Islands. Per cent of GRP. 2019 and 2022****Figure 4.17. Gross regional product (GRP) per capita and Disposable income of households (DIH) per capita. Faroe Islands. 2021. 1 000 USD-PPP**

age (20 years) to people above state pension age has steadily decreased and is expected to continue to decrease in the future.²

In nominal terms the economy has been booming, driven by high income from fisheries and high investments, but stressed by inflation. Wage increases in fishing industries have been particularly high as they link to the value of catches, otherwise at an average level.

Wages in fisheries and fish farming increased by 37 per cent between 2012 and 2022, against 25 per cent in the rest of the economy, on average 3.2 and 2.2 per cent, respectively, per year.³

The industry structure in 2022 largely remained as in 2019, except for a minor increase in primary production due to high growth in fisheries and above all in aquaculture, and a decline in share of total income from secondary industries (Construction, Electricity, gas and water supply and Manufacturing), and less pronounced in private services.

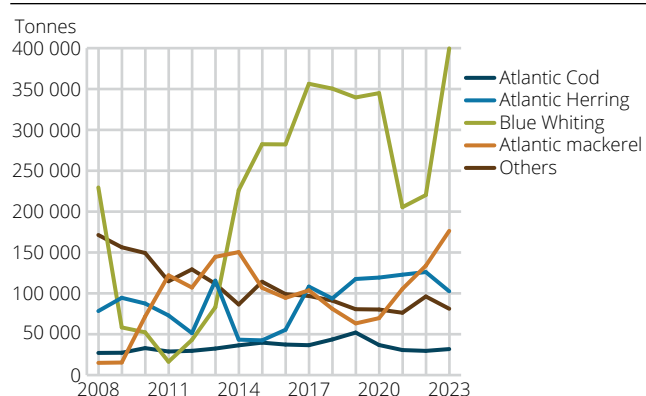
The GRP per capita is nearly three times the size of disposable income of households per capita. Note that Education and Health expenditures are mostly publicly financed and represent an in-kind income of households that is not included in the DIH as represented in Figure 4.17. The share of population at risk of poverty was 7.6 per cent in 2022, among persons 67 plus the rate was 16.8 per cent for women, 10.4 per cent for men. In 2022, the share of wages in GRP was 53.0 per cent, the lowest during 1998-2022.

Natural resources

Faroe Islands is surrounded by productive oceans and the fishery cluster is the backbone of the economy, generating 28.7 per cent of total income in 2022 and 93.6 per cent of total export value in 2023. A variety of fish stocks are harvested in Faroese waters, and in other nations' economic zones through fisheries agreements.

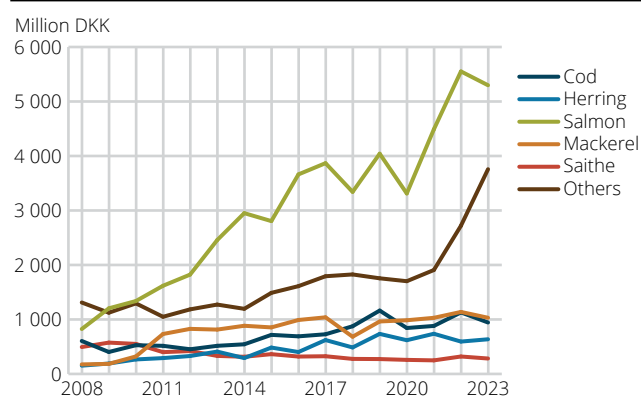
Northeast Arctic cod (Atlantic cod) is a valuable species; however, the stock and catches have declined in recent years. Fish quotas declined from 52 thousand tonnes in 2019 to 29 thousand tonnes in 2023 (Figure 4.18). As the stock size of Northeast Arctic cod is critically low, catches will be further limited in 2025. Faroe Islands demersal fisheries of

Figure 4.18. Fish harvest by main species. Faroe Islands. 2008-2023. Tonnes



<https://statbank.hagstova.fo:443/sq/3bffa16-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. 2008-2023. 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/

cod, saith and haddock are certified by the Marine Stewardship Council (MSC).⁴

Blue whiting has been the dominating catch in terms of volume. After a dramatic decline around 2011, Norway, Iceland, Faroe Islands and the coastal countries of the EU agreed to re-establish a sustainable stock. A new decline occurred during 2020-2021 which was interrupted by a steep increase from 2022 to a record high level in 2023. Blue Whiting is mainly used for fish meal and fish oil, contributing modestly to the value of fish export. The stock of Atlantic mackerel was critically low in 2009, but due to regulation stock and catches recovered. In 2022-2023 there was a declining trend in demersal catches whereas catches of mackerel took off.

Figure 4.19 shows the value of fish export by main species during 2008-2022. Income of Faroe Is-

lands has always relied on export of fish products, however, over the last decade the export value of farmed salmon has increasingly dwarfed the contributions of traditional wild fish species. Still the total value of wild fish products jointly make up 56 per cent of total fish export.

Farmed salmon represents by far the largest export value. 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 export value of salmon has increased almost every year since 2008 contributing 44 per cent to the total export value of fish products by 2023, far more than any other fish species.

The salmon industry practices production of large smolt to reduce the time in the sea to raise robustness of the young fish.⁵ Fish health is suffering from lice, and to improve fish health, the observed on-site level of salmon lice directly affects the allowed capacity of the cage.⁶ Salmon lice on farmed fish are counted biweekly by a third party and reported electronically no later than one day after counting.⁷ Environmental threats by aquaculture include emissions of dissolved nutrients, particulate organic matter, pollutants, and chemicals

The high revenues in fish farming have brought attention to the fact that a surplus above normal return to investment (resource rent) originates in the use of limited and natural resources belonging to the whole population. A progressive tax on resource rent was introduced by the Faroese government in 2023. The tax rates were scaled from 2.5 per cent to a maximum of 20 percent, depending on the gap between the actual and normal rate of return to investments. In 2025 the tax was revised, by lowering the maximum tax rate from 20 to 7.5 per cent, while introducing an additional corporate tax of 12 per cent for salmon farming at sea.

Faroe Islands is primarily fossil based but renewable energy is increasingly being phased in.

In 2022, Fishing vessels consumed nearly 30 per cent of total oil consumption with other vessels second largest at 20 per cent. Whereas land transportation with 12 per cent of oil consumption can electrify with existing technology, this option is not readily applicable for ocean transport and fish-

ing. However, new and emerging technology using ammonia as fuel might offer a future low carbon solution for fishing and ocean transport vessels.⁸

Ammonia is produced from hydrogen, which is considered green if generated by renewable electricity, of which Faroe Islands has a large potential.

In 2023, half of all electricity was based on fossil fuels, whereas hydropower and wind contributed by 22 and 27 per cent respectively. Wind power increased rapidly after 2020,⁹ and the Faroese Environmental Agency has launched an onshore wind power tender seeking up to 30 MW on the island of Sandoy. This is the first wind power tender in the Faroe Islands since 2021.

A new development towards greener energy is the first experimental tidal power plant in the strait of Vestmannaund, with technology suitable for areas with low-flow tidal streams and ocean currents. The first kWh was delivered to the Faroese grid in December 2020.¹⁰

Faroe Islands have no opportunity to balance supply and demand of electricity through connections to international grids and have limited capacity for using hydro dams as batteries. The dominant producer of electricity is SEV, owned by the municipalities of Faroe Islands.

In accordance with the 2015 Paris Agreement, the Faroe Islands are committed to setting ambitious targets for the reduction of greenhouse gases. The government is aiming for 100 per cent green electricity by 2030, a huge step from today when about half of electricity production is fossil based, using 15 per cent of current oil consumption. Public charging stations for electric vehicles are accessible in Tórshavn and on all the main islands. In early 2024 there were 1800 electric vehicles in Faroe Islands.

The Faroe Islands has no petroleum production but is open to oil and gas extraction if profitable reserves are found in their economic zone. Faroe Islands is part of the Kingdom of Denmark but does not align with Denmark and Greenland in joining the Beyond oil and gas alliance pledging to phase out petroleum production.¹¹ Exploration drilling has taken place since the first license round in 2000 without success. Although commercially

viable discoveries have not been made the Faroese economy has benefited from demand for supply services and as partner in oil and gas joint ventures offshore Norway, Ireland, and United Kingdom.

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 Islands' maritime border. After a 5th oil and gas licensing round in 2019, there is an open call for exploration licenses in areas that previously have been announced.¹²

Faroe Islands offer unique landscapes. Nature sells, and tourism has become an important customer. The number of visitors collapsed in 2020 when the pandemic reduced the number of visitors to 20 per cent of 2019 level. A strong rebound raised the number of visitors to 12 per cent above 2019 level by 2022, when foreign tourists purchased goods and services for DKK 900 million, up 15 per cent from 2021, with employment at 646 full-time jobs, a 30 per cent increase from the year before. Of about 100 000 visitors in 2022, 70 per cent came by air and 30 per cent by sea.¹³

Notes

¹ <https://www.government.fo/en/news/news/faroese-parliament-agrees-25-million-dkk-reduction-of-danish-block-grant-in-2023>

² <https://www.nationalbanken.dk/media/t02pehrh/demographic-headwinds-increase-the-need-for-fiscal-adjustment-in-the-faroe-islands.pdf>

³ <https://www.nationalbanken.dk/media/v2rfyoz0/economic-upturn-and-growing-reform-needs.pdf>

⁴ <https://fisheries.msc.org/en/fisheries/fisf-faroe-islands-north-east-arctic-cod-haddock-and-saithe/>

⁵ <https://www.ices.dk/news-and-events/news-archive/news/Pages/FaroesAO.aspx>

⁶ <https://www.ices.dk/news-and-events/news-archive/news/Pages/FaroesAO.aspx>

⁷ https://ices-library.figshare.com/articles/report/Workshop_on_the_Faroes_Ecoregion_Aquaculture_Overview_WKFaroesAO/_21551541?file=39490384

⁸ <https://www.mhi.com/news/24041002.html>

⁹ <https://hagstova.fo/en/environment/energy/electricity-production-sev>

¹⁰ <https://beyondoilandgasalliance.org/>, <https://www.offshore-mag.com/renewable-energy/article/14304961/minesto-tidal-energy-kite-delivers-first-electricity-to-faroe-islands-grid>

¹¹ <https://unric.org/en/denmark-sweden-and-greenland-in-a-new-global-alliance-to-seek-an-end-to-oil-and-gas-production/>

¹² https://jf.fo/wp-content/uploads/2019/08/General_Guidance_FO.pdf

¹³ https://issuu.com/visitfaroeislands/docs/a82583-vfi-rsfr_grei-ing2022-en-spread



Arctic Finland

Northern Finland consists of the sub-regions Lapland, Kainuu and Northern Ostrobothnia, covering almost half of Finland's total area, and with a total population of 664 519 as of 1 January 2024. Northern Finland differs from other Arctic regions in that the manufacturing industry is advanced and integrated in the global economy, led by electrical and electronic engineering and metal products. The former large-scale mobile phone production has been replaced by electronic network technology.

From 2019 to 2022 total value added or Gross Regional Product (GRP) measured at basic prices increased by 20 per cent. Among goods producing industries, Mining and Metal production, are core activities.

Table 4.5 shows the structure of the economy in 2019 and 2022. Highest income growth occurred in the Wood and wood products industry, doubling income during 2019-2022, followed by Mining and quarrying, raising income by 60 per cent.

Agriculture and hunting is a small activity at around 1 per cent of GRP. Forestry and fishing, where forestry dominates hardly increased income, thereby decreasing its share in GRP from 2.9 to 2.5 per cent. However, Wood and wood products doubled income and raised its share in GRP from 1.0 to 1.7 per cent, also reflecting the role of advanced bio-processing in the industry.

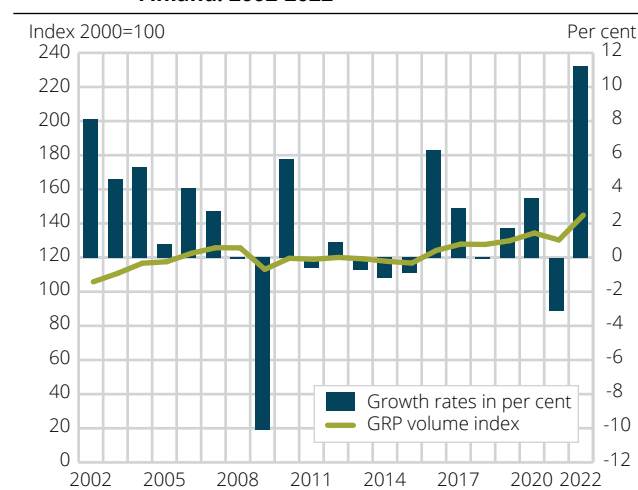
Following an international trend, the income in Paper and printing industry declined by 32 per cent, driven along the downward spiral of newspapers and other printed matters being replaced by screen technology. As with other industries, the

Table 4.5. Value added¹ by industry. Arctic Finland. 2019 and 2022

	2019		2022	
	Mill. euro	Per cent	Mill. euro	Per cent
Agriculture and hunting activities	191	0.9	249	1.0
Forestry and fishing	593	2.9	625	2.5
Mining and quarrying	531	2.6	849	3.4
Wood and wood products	214	1.0	428	1.7
Paper and printing	300	1.4	204	0.8
Metal	2 002	9.7	2 791	11.3
Other manufacturing	756	3.6	893	3.6
Utilities	862	4.2	1 265	5.1
Construction	1 801	8.7	1 997	8.1
Wholesale and retail trade	1 397	6.7	1 594	6.4
Transportation and storage	866	4.2	931	3.8
Accommodation and food services	437	2.1	465	1.9
Information and communication	555	2.7	882	3.6
Financial and insurance	314	1.5	446	1.8
Real estate services	301	1.4	309	1.2
Rental and operation of dwellings	2 347	11.3	2 866	11.6
Professional, scientific and technical activities	911	4.4	928	3.7
Administrative and support services	674	3.3	717	2.9
Public administration and defence; compulsory social security	1 263	6.1	1 433	5.8
Education	1 353	6.5	1 509	6.1
Health care and social work services	2 457	11.9	2 777	11.2
Other service activities	604	2.9	625	2.5
Total	20 728	100.0	24 782	100.0

¹ At basic prices net of taxes and subsidies.

Figure 4.20. GRP volume index and growth rate. Arctic Finland. 2002-2022



pandemic also made a dent in activity and income.¹ Metal industry is the dominating goods producing industry, contributing as much as 11.3 per cent to GRP in 2022 after growing nearly 40 per cent from 2019.

Construction contributed to GRP with a share of 8.1 per cent in 2022. The increase from 2019 was almost 11 per cent. Information and communication

Figure 4.21. Value added by main industry (at current price). Arctic Finland. Per cent of GRP. 2019 and 2022

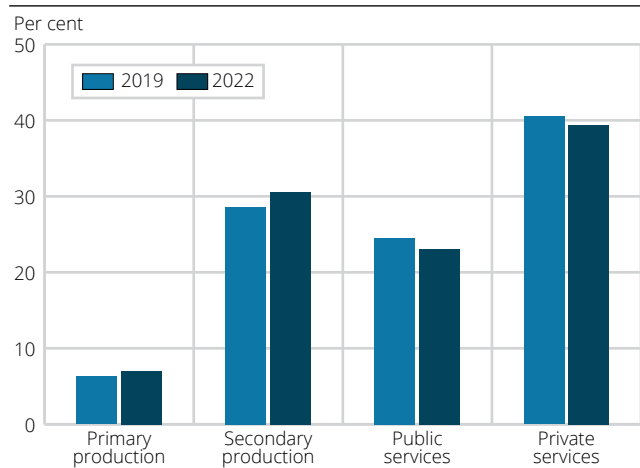
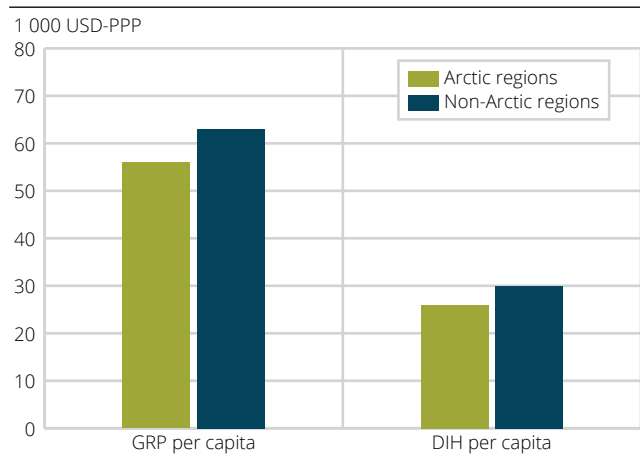


Figure 4.22. Gross regional product (GRP) per capita and Disposable income of households (DIH) per capita. Finland. 2022. 1 000 USD-PPP



and Financial and insurance industries increased income by about 60 and 42 per cent respectively.

The electronic business shows marked statistical footprints in Information and communication industries and Other manufacturing. Other manufacturing sustained its contribution to GRP at 3.6 per cent in 2022, whereas Information and communication services showed strong growth at nearly 60 per cent, raising its contribution to GRP from 2.7 to 3.6 per cent.

Both Transportation and Accommodation and food services faced significant decline during the pandemic years of 2020 and 2021 but saw a rebound of their activities with nominal income growth at 7.5 and 6.5 per cent respectively from 2019 to 2022, still markedly behind general economic

growth. Their decline in 2020 and 2021 was most likely due to the pandemic, although the winter tourist flights caught up to pre-pandemic levels by the end of 2021.²

Figure 4.20 shows real growth in GRP from 2002 to 2022 measured in fixed prices, thus reflecting annual volume growth or real growth in GRP. After the significant decrease in real GRP due to the financial crises in 2008-2009 and a bounce back in 2010, the annual growth was marginal and even negative until 2015. From 2016 to 2020, the economy grew, except for 2018. The real GRP faced a decrease of 3 per cent in 2021, mostly from a huge decline in Lapland's tourism and in the metal industry. Figure 4.20 shows a significant growth of 11.2 per cent for the GRP volume in 2022.

Figure 4.21 shows a slight increase in the primary production share of GRP. Primary industries include extractive industries, and the increase is mostly due to an increase in Mining. The share for secondary production also increased slightly, due to high growth in manufacturing of wood and wood products and metal production. The shares of GRP for Private services and Public services both faced a small decline from 2019 to 2022.

Figure 4.22 compares GRP (total regional income) per capita and disposable income of households (DIH) per capita in Arctic and Non-Arctic Finland. Both these indicators are lower in the Arctic region than in the rest of Finland. The difference in DIH per capita is relatively larger than the difference in GRP per capita.

Rooted in nature and highly innovative

The economy of Northern Finland is somewhat untypical in comparison with economies of other Arctic regions. It is based on natural resources but has built an industrial sector that serves the global market with products from biomass clusters and chemical industry nourished by advanced technology. Northern Finland has its high-tech hub around Oulu, with a history back to the early 2000s when Nokia was a world leading mobile phone producer. Overcoming a collapse in Nokia's phone market, Northern Ostrobothnia has revitalized and recreated an important electronic engineering industry, specializing in telecommunications and electronics, releasing its strategy towards 2035 "Chips from the North"³ in 2024 to take steps towards being an im-

portant semiconductor supplier by 2035. In 2025, Nokia will establish a new campus in Oulu, and the University of Oulu is home to the 6G Flagship research program.

Energy and mining

Arctic Finland has a huge wind power potential. In 2024, as much as 39 per cent of national wind power capacity was in Northern Ostrobothnia, with 9 per cent and 3 per cent respectively in Lapland and Kainuu. So far, wind sites are mostly on land, however, awaiting regulations and property tax clarification, investments in offshore wind power are expected in the Baltic Sea. In 2022 nearly 60 per cent Finland's electricity from total wind power at 11.5 TWh originated in Lapland and North Ostrobothnia.⁴ Solar power is increasing rapidly, and Northern Ostrobothnia had 19 per cent of total accumulated capacity in 2024 when counting plants with a minimum capacity of 1 MW.⁵

Finland has five operating nuclear reactors providing about one third of its electricity but there are no operational nuclear power plants in Northern Finland. The Hanhikivi nuclear power plant project, which was planned for North Ostrobothnia, was cancelled in 2022.⁶

Lapland is the hub of Finland's mining and quarrying. Lapland's share of the total revenue of Finnish mining and quarrying is about 25 per cent.

Arctic Renewable Energy is a solar power development company based in Lapland, whose mission is to develop large-scale solar parks for sale to the electrical grid or to large consumers in Arctic regions and especially in western Lapland. The company's first solar park is scheduled for completion in 2026.

Tourism

The growth of the tourism industry in Arctic Finland, especially in Lapland, has been based on the winter season and related recreational services in international tourism demand. Until 2019, tourism accounted for 2.7 per cent of Finland's GDP.⁷ Due to the pandemic and the related restrictions, the share fell to a low point of 1.4 per cent in 2020 but recovered to 1.8 per cent in 2022.⁸

More than 2.5 million visitors were registered in 2023 in Arctic Finland as a whole, an increase of



42 per cent since 2020. Most of this increase took place in Lapland where the number of visitors exceeded pre-pandemic level.⁹

Notes

¹ <https://acimga.it/wp-content/uploads/2021/01/intergraf-Gen-naio-2021.pdf>

² <https://stat.fi/en/statistics/matk>

³ <https://teknologiateollisuus.fi/wp-content/uploads/2024/07/Chips-from-the-North-Semiconductor-Strategy-for-Finland-1.pdf>

⁴ <https://suomenuusiutuvat.fi/media/wind-power-stats-fin-2024-1.pdf>

⁵ <https://suomenuusiutuvat.fi/media/wind-power-stats-fin-2024-1.pdf>

⁶ https://www.gem.wiki/Hanhikivi_nuclear_power_plant

⁷ <https://tem.fi/en/finnish-tourism-in-numbers#:~:text=Until%202019%2C%20tourism%20accounted%20for%202.7%20per%20cent,but%20recovered%20to%201.8%20per%20cent%20in%202022.>

⁸ <https://tem.fi/en/finnish-tourism-in-numbers>

⁹ https://pxdata.stat.fi/PXWeb/pxweb/en/StatFin/StatFin__matk/statfin_matk_pxt_11j1.px



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 areas mentioned in the Self-Government Act, such as natural resources, education, health, fisheries, environment, and climate. It also includes a framework for Greenland's participation in foreign policy issues.¹ From 2019 to 2021 GRP increased by 0.8 per cent. Greenland has huge renewable energy potential and sees valuable opportunities in indirect export of energy.

As of 1 January 2025, the population of Greenland was estimated to be 56 542 people. Population growth has been low or negative after 1990, with falling birth rates and variable but net emigration. The total fertility rate in 2023 was 1.78.² Fisheries are the backbone of the economy, with ocean fisheries bringing income of DKK 2 billion, and additional DKK 1 billion from coastal and other fisheries.

The economy of Greenland relies heavily on fisheries and tourism, but was somewhat less affected than other regions, with growth close to 1 per cent in 2020, the peak pandemic year.³

Table 4.6. Value added¹ by industry. Greenland. 2019 and 2021

	2019		2021	
	Mill. DKK	Per cent	Mill. DKK	Per cent
Agriculture, fishing, hunting, etc.	334	1.7	315	1.6
Coastal fisheries	911	4.7	785	4.1
Offshore fisheries	2 001	10.4	2 062	10.6
Other fisheries	447	2.3	395	2.0
Extraction of raw materials	128	0.7	128	0.7
Manufacturing	664	3.5	381	2.0
Utilities	413	2.1	469	2.4
Construction	2 222	11.6	2 079	10.7
Wholesale and retail trade	1 889	9.8	1 862	9.6
Transportation	1 508	7.8	1 524	7.9
Accommodation and food services	362	1.9	324	1.7
Finance and insurance	252	1.3	262	1.4
Real estate and rental services	1 255	6.5	1 440	7.4
Public administration	1 871	9.7	2 017	10.4
Education	1 022	5.3	1 091	5.6
Health services	818	4.3	871	4.5
Social services	1 434	7.5	1 573	8.1
Other services	1 690	8.8	1 802	9.3
Total	19 221	100.0	19 380	100.0

¹ At basic prices net of taxes and subsidies.

In 2021 Ocean fisheries alone generated income corresponding to 10.6 per cent of GRP, mainly from deep sea prawns fisheries, whereas Coastal and Other fisheries landed values of 6.1 per cent of GRP. Fish processing further adds value to the economy, being the dominating part of Manufacturing at 2.0 per cent of GRP. Altogether the fishery cluster generated 18.7 per cent of total income.

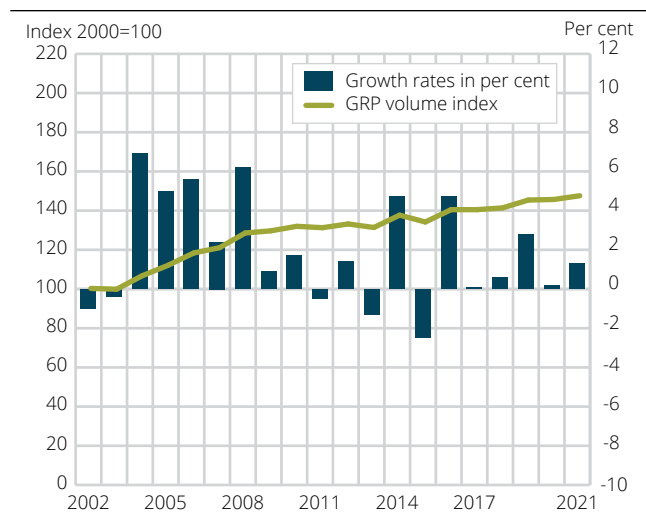
Whereas minerals in Greenland have met great international interest, the enthusiasm has not raised the scale of the industry to a similar extent. The climate is harsh and transportation demanding. Mining and quarrying sustained its income level and the share of GRP at 0.7 per cent from 2019 to 2021.

Income in Manufacturing fell by 43 per cent from 3.5 to 2.0 per cent of total income, reflecting a decline in export value of prawns and halibut (Figure 4.27) largely due to lower prices as the volumes of catches were stable during 2019-2021.

Table 4.7. Fisheries in Greenland. Value added¹ 2012-2021. Mill. DKK

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Inshore fishing	759	685	782	707	865	867	870	911	813	785
Offshore fisheries	1 105	975	1 329	1 482	1 724	2 034	1 969	2 001	1 991	2 062
Other Fishing	257	240	285	335	453	388	400	447	408	395
Total	2 121	1 900	2 396	2 523	3 041	3 288	3 238	3 359	3 212	3 242

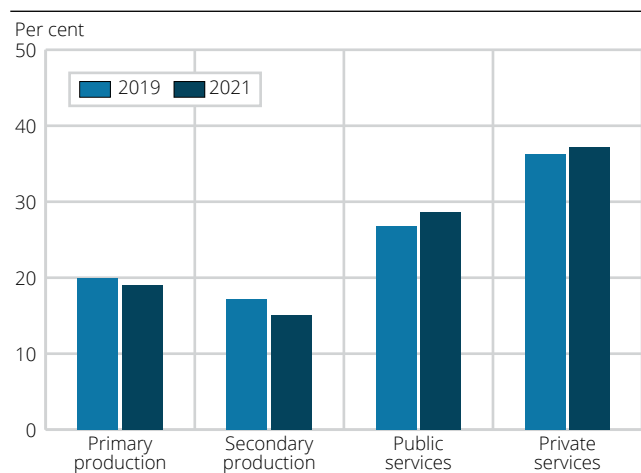
¹ At basic prices net of taxes and subsidies.

Figure 4.23. GRP volume index and growth rate. Greenland. 2002-2021

Construction is the largest among private industries with income at 10.7 per cent of GRP in 2021, on a par with income in Ocean fisheries. Construction saw lower activity in 2021 at 10.7 per cent of the economy against 11.6 per cent in 2019.

Utilities including production of electricity, water supply and renovation increased by 14 per cent over the period, the second largest growth after Real estate and rental services, with 2021 income 15 per cent above 2019 level.

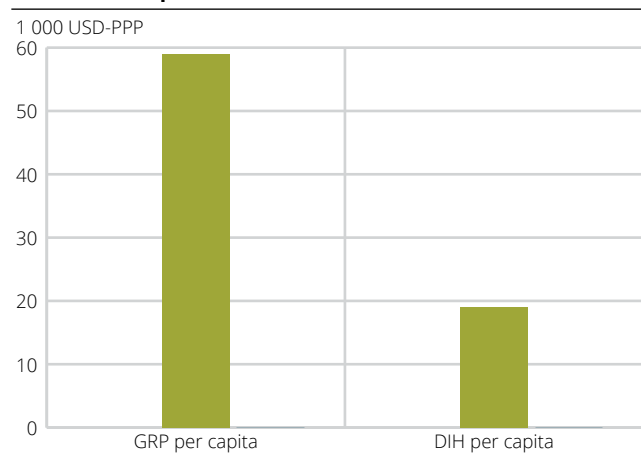
Accommodation and food services are serving both local people and tourists. In 2021, income was 10 per cent below 2019 level, not yet recovered from the strict lock downs and travel constraints during 2020, the peak year of the pandemic.

Figure 4.24. Value added by main industry (at current price). Greenland. Per cent of GRP. 2019 and 2021

Public administration increased by 8 per cent, raising its share of the total economy from 9.7 to 10.4 per cent. Education kept track of overall economic growth. Health services grew somewhat less than GRP, whereas Social services rose by 10 per cent, climbing from 7.5 to 8.1 per cent of GRP during 2019-2021.

When growth measured in current prices is adjusted for inflation, we find the change in scale of production or real economic growth (Figure 4.23). Real growth has been modest after 2016, with positive but marginal growth in 2020, followed by 1.3 per cent growth in 2021, a year with favorable seafood prices.

The block grant to Greenland was DKK 4.3 billion in 2024.⁴

Figure 4.25. Gross regional product (GRP) per capita and Disposable income of households (DIH) per capita. Greenland. 2021. 1 000 USD-PPP

The economy has been operating near full capacity, and after the pandemic the economy was above all stressed by the large construction works at airports and other infrastructure.

Figure 4.24 sums up the economic changes in terms of shifts between main industry categories. The picture is clear in that goods producing industries saw reduced income while private as well as public services increased activity and income, still responding to substantial needs in 2021, when not yet fully recovered from the pandemic. Value added in Primary production fell somewhat from 2019 to 2021, mainly as a result of decline in agriculture and Coastal and Other fisheries, whereas Ocean

fisheries achieved marginal growth and income in mining kept constant.

Public services cover health, social services and education, of which all increased their activity levels, in particular social services in response to the pandemic.

Figure 4.25 compares GRP per capita with disposable income of households (DIH) per capita. GRP per capita was three times the level of DIH per capita. Note, however, that disposable income does not include the in-kind benefits through public health, social services and educational services, which represent 18.2 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 and Iceland in Highlight 4.2.

The Risk of poverty rate is calculated as the proportion of the population with an income below a certain share of median income, in this case 60 per cent. The ratio for Greenland was 8.8 per cent in 2022 and has been increasing since 2015.⁵

Fisheries

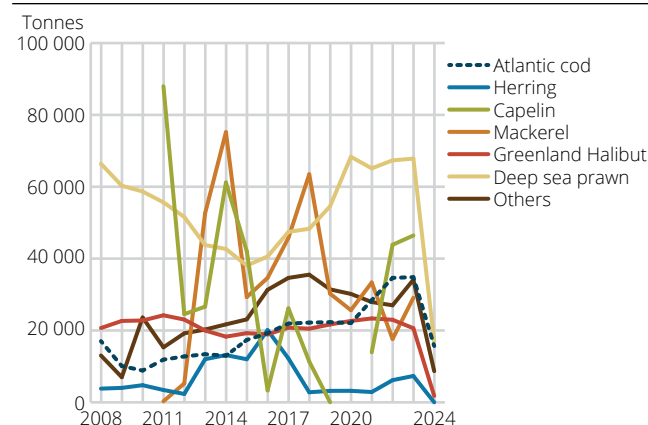
In 2021 fisheries accounted for 16.7 per cent of GDP and 96.1 per cent of total export value. Ocean fisheries of deepwater prawns is the dominant income source, followed by Greenland halibut and Atlantic cod. Prices on seafood have been favorable in recent years, however resources like Atlantic cod are critically low and quotas are being reduced.

Greenland has introduced a resource tax on their fisheries to ensure that profit in fisheries above normal return on capital shall benefit the whole society. The tax rate increases with the market price.

A further re-organization of Greenland's fisheries became law in 2024, requiring fishing companies active in Greenland waters to be based in Greenland and to operate with tradeable individual species quotas. The upper levels to quota ownership are determined for each species to limit centralization of the fishing industry. The law opens for a 10-year transition period.⁶

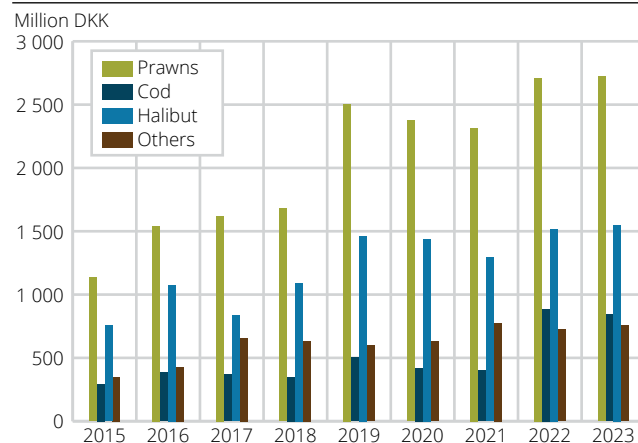
Prawn fisheries have been MSC certified as sustainable, which is a requirement for selling to many of the large purchasers of fish and shellfish.

Figure 4.26. Catch of fish and shellfish. Greenland. 2008-2024. Tonnes



Source: https://bank.stat.gl/pxweb/en/Greenland/Greenland_FI_F10/FIX008.px/

Figure 4.27. Export of fish and shellfish. Greenland. 2015-2023. Mill. DKK



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

Currently, large segments of coastal fisheries are not sustainable. The recommendations of the Greenland Fisheries Commission will ensure more sustainable fisheries for long-term strengthening of the industry.⁷

Tourism

Accessibility has increased markedly and the arrivals by air counted 87 989 in 2019, a peak year after a long positive trend. Although arrivals declined by about two thirds during the pandemic, arrivals bounced back to 96 800 in 2023. Arrivals by cruise vessels were 47 000 in 2019 and zero the following two years but was nearly back on track in 2022 and jumped further to 64 per cent above 2019 level in 2023. The expenditures by foreign tourists amounted to DKK 1.9 billion in 2023. Around 1000 persons are employed in tourism related businesses.

The growing scale of tourism is an opportunity for economic growth but also represents social



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

and economic challenges. In 2024, Visit Greenland conducted an online survey among Greenlandic citizens, showing that the population still had a positive view of tourism as in 2019, 2021, and 2022. However, there is also concern and dissatisfaction with the increasing number of cruise guests coming to the country.⁸ From 2024 the government introduced a port and passenger tax on visits by cruise vessels, and a maintenance and environment fee on visits to settlements and nature sites.⁹

Greenland has invested DKK 5 billion (USD 720 million) into developing three international airports that will expand or replace existing terminals and upgrade runways to handle large intercontinental flights. The first upgraded airport opened in Nuuk in November 2024.

Minerals

Greenland has significant potential for many valuable minerals but few operating mines so far. Mineral extraction is governed by Greenland, receiving the full economic returns. However, the Danish government transfer – the block grant – will be reduced by 50 per cent of annual mining revenue above DKK 75 million.¹⁰

The Nalunaq gold mine operated by Amaroq Minerals started production in 2024, after the discovery of high-grade gold at its Eagle Nest Exploration Project. Located at the Citronen Fjord in the far north of Greenland, the Citronen Fjord mine is one of the largest potential lead and zinc mines in

Greenland, and is currently developed by Ironbark Zink. The Kvanefjeld project of critical minerals and uranium was rejected by the Greenland government in 2021, based on risk of fatal environmental damage. Later that year the Parliament passed a new law blocking plans for the project.

In 2023 the Australian mining company Energy Transition Minerals, the parent company of Greenland Minerals, started arbitration proceedings against the Governments of Greenland and Denmark, to confirm its rights to mine the Kvanefjeld resource or alternatively a USD 11.5 billion compensation, nearly four times Greenland's annual GRP. In a survey in southern Greenland 71 per cent of the population opposed the Kvanefjeld project.¹¹

Although Greenland has huge undiscovered petroleum resources, substantial exploration has been in vain. However, the resources are located in a pristine natural environment and challenged in terms of ice and storms. Even if profitable discoveries had been made, reserves in Greenland were not expected to be developed in the near future because the time lag between discoveries and production tends to be considerable in the Arctic. Instead, Greenland has joined the Beyond Oil and Gas Alliance, aligning oil and gas production with the Paris Agreement goal of well below 2°C, pursuing efforts for 1.5°C.¹²

Energy

Energy consumption relies on imported oil for 82 per cent of total energy use. The remaining energy use consists largely of hydropower. Oil is needed in the large fishing fleet, in ocean transportation, and air traffic. Greenland has no road network linking communities and relies heavily on domestic air traffic. Further, Greenland use oil for heat and electricity in communities without grid connection.

The hydropower potential is huge and so is the potential for water storage, in itself a valuable battery service. The government has offered for tender a large-scale project near Maniitsuk and the upper Nuuk fjord. However, without cabled connections to other countries Greenland must find indirect ways of exporting its surplus electricity. There is a vision to combine new power with production of ammonia from renewable energy, which is seen as a low carbon fuel for ocean transport.

The public utility company Nukissiorfiit operates 5 hydropower plants, using meltwater from the Greenland Ice, with an increasing potential as temperature rises and the Arctic is warming nearly 4 times faster than the global mean. The Government has called for bids for two large hydropower projects on the Southwest coast of Greenland, holding the right of repatriation.

The potential for wind power is also large, and investors have formalized the intention to start building Greenland's first commercial wind park. The wind park will supply power for green hydrogen and ammonia production,¹³ using a floating production and storage facility.¹⁴

Greenland has signed the Paris Agreement and is on its way towards a CO₂-free electricity, Conversion of oil fueled boilers is on-going. More than 50 small settlements have no connection to electricity grids and on-site solar cell systems with batteries are installed in 10 settlements. There is a political ambition to supply power at equal price all over Greenland. The geography of Greenland makes air and sea transport the only feasible option for travel. The large consumption of the fishing fleet and air traffic need to be solved through conversion to renewable electricity or low carbon fuels.

However, souls need more than commercial energy. At 11th of March 2025 the citizens of



Greenland. Photo: Colourbox

Greenland had elections for parliament where the large majority supported independence from Denmark although within different time horizons. Serious colonial suppression of Inuit people has taken place, among them the IUD campaign, seriously violating reproductive rights of more than 4 000 Inuit women, and the institutionalized economic and social discrimination through the "birthplace" criterion imposing different wage levels and social rights for Greenlanders and non-Greenlanders.¹⁵

Notes

- ¹ <https://www.fao.org/faolex/results/details/en/c/LEX-FA-OC199526/>
- ² https://data.worldbank.org/indicator/SP.DYN.TFRT.IN?locations=DK+-FO-GL&name_desc=false
- ³ <https://www.nationalbanken.dk/media/pngneoh5/analysis-no26-the-greenlandic-economy-final.pdf>
- ⁴ https://www.ft.dk/ripdf/samling/20231/redegoerelse/R10/20231_R10.pdf
- ⁵ <https://stat.gl/dialog/mainTheme.asp?lang=en&sc=VM&tname=t1>
- ⁶ <https://www.seafoodsource.com/news/supply-trade/fisheries-law-revision-royal-greenland-s-financials-upending-greenland-s-seafood-sector>
- ⁷ <https://www.nationalbanken.dk/media/pngneoh5/analysis-no26-the-greenlandic-economy-final.pdf>
- ⁸ <https://tourismstat.gl/wp-content/uploads/2024/05/Tourism-Statistics-Report-Greenland-2023.pdf>
- ⁹ <https://www.naa.is/news/greenland-implements-new-port-and-cruise-passenger-taxes-effective-january-1-2024/>
- ¹⁰ <https://english.stm.dk/the-prime-ministers-office/the-unity-of-the-realm/greenland/>
- ¹¹ https://isg.gl/images/pdf_downloads/Rapport-Kuannersuit-DK.pdf?fbclid=IwAR3_x7KJz8mFsnJnQQUl8hUOc6RLTvwj0USep-fEjVNIa2QjMTH1tFMSTjk
- ¹² <https://beyondoilandgasalliance.org/>
- ¹³ <https://www.highnorthnews.com/en/greenland-and-norway-wants-produce-green-ammonia-greenlandic-wind>
- ¹⁴ <https://www.h2carrier.com/post/h2carrier-receives-approval-in-principle-from-dnv>
- ¹⁵ Poppel, MK. (2024): Indigenous Citizenship: Gender and Discrimination. Ch. 25 in B. Siim and P. Stoltz (eds.): The Palgrave Handbook of Gender and Citizenship 2024, Palgrave, pp. 565-590.



Iceland

By 1 January 2024 the population counted 383 726 persons, increasing by 8 508 or 2.3 per cent from the year before. Reykjavík was the most populous municipality with 136 894 inhabitants, increasing by 1.9 per cent during 2023.¹

The total fertility rate of Icelandic women was 1.59 in 2023 and has not risen above 2.0 for over a decade.²

During 2019-2022 GRP increased by 29 per cent, which is high considering that the covid 19 pandemic reduced GDP by 3 per cent in 2020. The economy of Iceland is relatively diversified, but fisheries stand out as the backbone of the economy (Table 4.8). The commercial fishery cluster consists of marine wild fish harvesting, aquaculture and fish processing. Fisheries alone increased income by 34 per cent during 2019-2022, contributing 3.7 per cent to GRP in 2022. Aquaculture reduced income by a third of the 2019 level to 0.2 per cent of GRP in 2022. Fish processing at 2.8 per cent of GRP in 2019 raised the share further to 3.1 per cent by 2022. Altogether, the fishery cluster generated 7.0 per cent of total income in 2022 and employed 13 400 persons in 2023, about the same level as in 2022.³

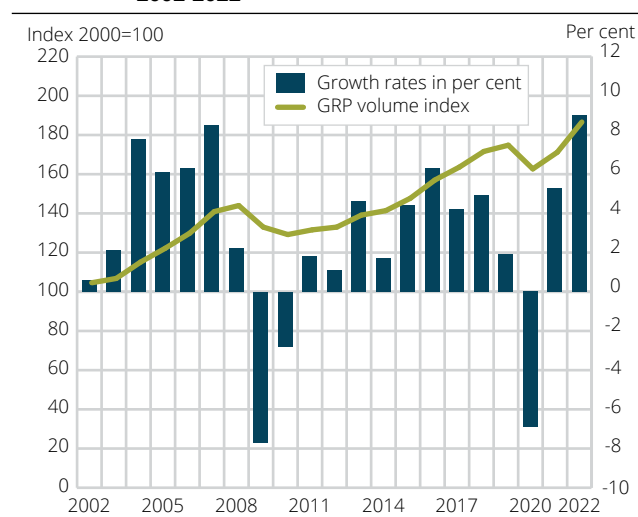
By far the highest growth was seen in Basic metal industry, increasing income in 2022 to more than 7 times the 2019 level by 2022. The extraordinary high growth could be seen in connection with a recession in the aluminum industry in 2019, a manufacturing recession in Asia in the wake of trade wars, and restrictive tariffs and sanctions.⁴ The recovery was propelled by a steep rise in metal prices due to the war in Ukraine. Besides alumi-

Table 4.8. Value added¹ by industry. Iceland. 2019 and 2022

	2019		2022	
	Mill. ISK	Per cent	Mill. ISK	Per cent
Agriculture and forestry	24 474	0.9	28 225	0.8
Fishing	95 837	3.5	128 594	3.7
Aquaculture	12 385	0.5	8 602	0.2
Mining and quarrying	3 310	0.1	3 161	0.1
Fish processing	76 967	2.8	108 489	3.1
Basic metals	13 957	0.5	104 103	3.0
Metal products	20 539	0.8	25 006	0.7
Other manufacturing	145 319	5.3	160 183	4.6
Electricity, gas, steam and air conditioning supply	94 142	3.5	147 086	4.2
Water supply, sewerage, waste	20 699	0.8	26 287	0.8
Construction	216 114	7.9	253 302	7.2
Wholesale and retail trade	241 491	8.9	310 732	8.9
Transportation and storage	171 789	6.3	196 760	5.6
Accommodation and food service activities	100 495	3.7	125 418	3.6
Information and communication	134 455	4.9	175 898	5.0
Finance and insurance	163 055	6.0	200 696	5.7
Real estate activities	322 753	11.9	364 665	10.4
Scientific, technical and administrative services	229 952	8.5	297 247	8.5
Public administration and defence	149 723	5.5	193 123	5.5
Education	166 536	6.1	204 381	5.8
Human health and social work	235 489	8.7	318 735	9.1
Arts, entertainment and other services	80 474	3.0	115 980	3.3
Total	2 719 955	100	3 496 674	100

¹ At basic prices net of taxes and subsidies.

Figure 4.28. GRP volume index and growth rate. Iceland. 2002-2022



num, Iceland also produces ferrosilicon, used for enhancing the quality of steel.

Iceland has no opportunity for transmitting electricity to other countries and export of basic metals represents a way to indirectly export a surplus of



Nesjavellir geothermal power plant in Iceland. Photo: Crestock

renewable energy. Like basic metal industry, data-centers provide power intensive services like digital processing and currency mining, enabling Iceland to export otherwise stranded renewable energy. The Information and communication industry increased income by slightly more than the economy at large to 5.0 per cent of total income in 2022.

Mining and quarrying continued to be a minor industry, with only 0.1 per cent of GRP in 2022. Raw material for basic metals is imported.

Growth in basic metal production and datacenters made Electricity, gas and steam the second fastest growing industry from 2019 to 2022, raising income by 56 per cent and its share in total income from 3.5 per cent to 4.2 per cent in 2022.

The information and communication industry including the data centers almost kept track with the growth of the general economy. Iceland's naturally cool climate reduces the need for energy-intensive cooling systems and their climate footprints as electricity is 100 per cent renewable. The use of natural cooling and renewable energy reduces both operational costs and the carbon footprint and thus reduces the need for a CO₂ tax as levied in some other countries.

Electricity use by data centers more than doubled in recent years. In the early phase, cryptocurrency dominated the business, involving moderate levels of service and income generation. New applications have emerged with an option to increase the volume of services and income, like supercomputing and above all, new areas of business in the wake of AI.

Construction is an important contributor to income generation and employment. From 2019 to 2022 the construction share in GRP fell from 7.9 per cent to 7.2 per cent. However, 2022 and 2023 saw employment reach 16 600 persons against 13 000 during 2019-2021.

Public administration kept track with the economy at large, sustaining its share of GRP at 5.5 per cent. Among public services, Health and social work increased markedly already before the pandemic broke out in 2020 and continued to grow towards 2022, raising its share of GRP from 8.7 per cent in 2019 to 9.1 percent. Activity in Education grew less than the economy, accounting for 5.8 per cent of GRP, against 6.1 in 2019.

Tourism is the largest export activity of Iceland, generating nearly one-third of total export value.

Visitors spend money on a variety of activities and their economic footprint is not directly accessible from the national account data in Table 4.8.

There are however two industries in Table 4.8 that capture a considerable share of the spending by tourists, namely Accommodation and Food services and Transportation. Both fell short of matching the growth rate of GRP during 2019-2022 burdened by a marked decline as tourism plunged in 2020. The transportation industry – in particular, the demand for air flights – suffered from the pandemic but had already seen some decline before 2019.

Among private services, Wholesale and retail trade saw strongest growth, markedly above the growth rate of the economy, due to a combination of higher prices and activation of household savings during the pandemic closedowns.

Iceland has three data cables to other countries. Farice, owned by the government, operates the two submarine cables connecting Iceland with Scotland, with a branch to the Faroe Islands, another is running between Iceland and Denmark. The third is a new high-speed undersea cable system connecting Iceland with Ireland, which started operation in 2023.⁵ Farice also offers capacity between Iceland and North America via the Greenland Connect submarine route.⁶

Figure 4.28 shows substantial real economic growth over the period 2002-2022, interrupted by serious recessions in 2009/2010 and in 2020. The first recession was a deep and lasting result of Iceland's role in the global financial bubble that broke in 2008/2009. However, real growth was turning positive already in 2011 and has since then mostly been positive and substantial, except in 2020 when the covid19-pandemic devastated tourism, and real GRP decreased almost 7 per cent. Growth took off soon after the pandemic, also supported by the beneficial price increase on fish products and basic metals, and stimulated by household spending drawing upon savings during the lockdown period. The year 2022 saw the highest real economic growth during 2000-2022 at 9 per cent.

Figure 4.29 shows marginal shift in major industrial activities during 2019-2022. Primary production based on resource extraction saw minor change, so

Figure 4.29. Value added by main industry. Iceland. Per cent of GRP. 2019 and 2022

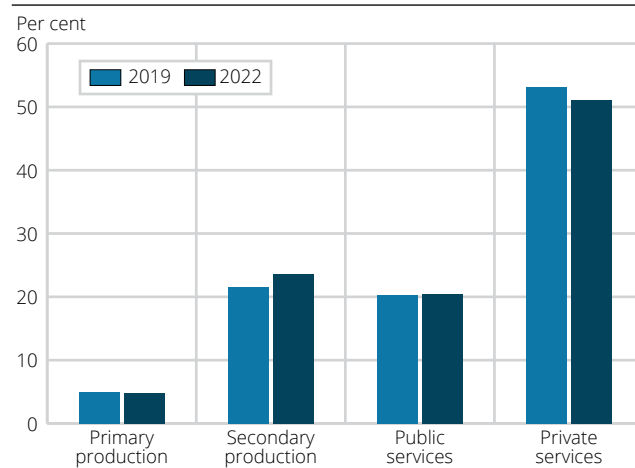
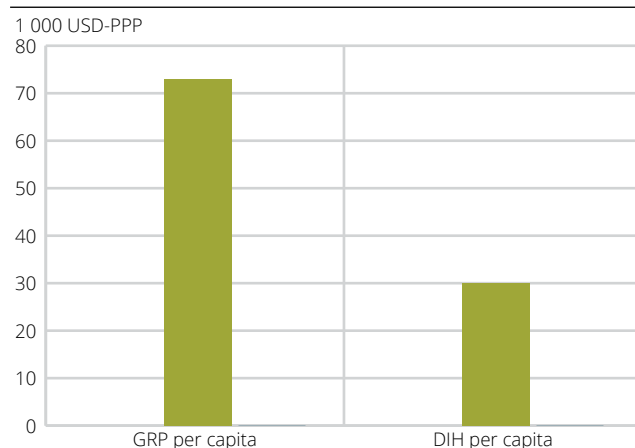


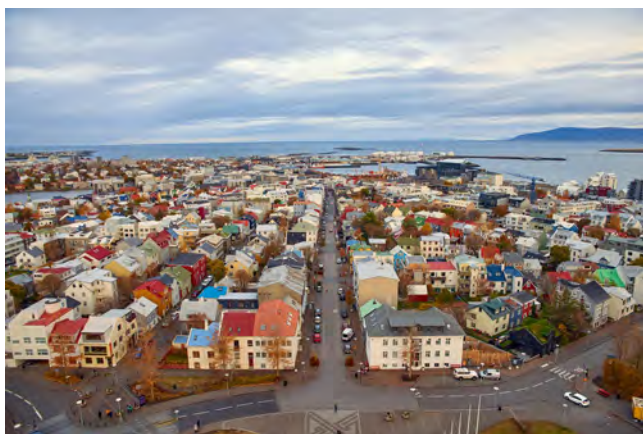
Figure 4.30. Gross regional product (GRP) per capita and Disposable income of households (DIH) per capita. Iceland. 2022. 1 000 USD-PP



with public services. There was a marked increase in secondary industries, containing construction, manufacturing and electricity production, largely driven by strong growth in production of electricity and basic metals.

Private services reduced their share in total income from 53.1 to 51.3 per cent.

Figure 4.30 compares GRP per capita with disposable income of households per capita in 2022. GRP per capita is three times higher than disposable household income per capita. Note, however, that households also may benefit from public services through free education and health services, together representing 14.9 per cent of GRP in 2022. In Iceland, adjusting disposable income of households for in-kind income is statistically feasible as



Reykjavik, Iceland. Photo: Colourbox

shown in Highlight 4.2. In 2023, the at-risk-of-poverty rate was 9.0 per cent, corresponding to about 35 000 individuals.⁷

Tourism

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. As nature is the magnet of visitors there is also a concern that loss of valuable nature through growth in energy supply to energy intensive industries is a factor which might interfere with interests of the tourists and the tourist industry.⁸

The share of tourism in GDP reached 8.8 per cent in 2023, a full recovery after the fall to 3.1 per cent in 2020.⁹

Iceland received 3 million international visitors in 2023, with 72 per cent arrivals by air and 27 per cent cruise visitors. The cruise traffic to Iceland increased by 73 per cent from 2022 to 2023, after increasing fourfold from 115 145 in 2021 to 484 941 in 2022.¹⁰

The expenditure by foreign visitors amounted to ISK 503 billion in 2023 against ISK 399 billion the year before. In 2023, tourism accounted for 40 per cent of Iceland's export revenue.

Employment in tourism suffered heavily during 2020-2021, declining from 10 to 6 per cent of total employment. In 2023, 9.7 per cent of total working hours were estimated to be directly related to final consumption by tourists. Among the 22 500 employed in tourism, the majority worked in Accommodation and food services.

During the pandemic, Iceland introduced a reduced work-hour scheme to sustain employer- employee relations and prevent high unemployment. Iceland also established a permanent Package Travel Guarantee Fund (2021) to lower the future risk in the tourism business.

Energy

In recent years Iceland again witnessed volcanic outbreaks, literally bringing heat and fire from the inner earth to the surface. A volcanic river runs below the island, and in controlled ways geothermal energy has long provided Iceland with heat. Around 30 per cent of primary energy production is geothermal, 70 per cent from hydropower.

Electricity is above all generated by hydropower (91 per cent), with the rest (9 per cent) from geothermal energy. The 100 per cent renewable electricity production of 14.7 TWh in 2023 is used in manufacturing (80 per cent), services and households (15 per cent) and datacenters (5 per cent).

Increasing costs of geothermal energy and falling costs of wind power has made it more attractive to invest in wind power. Landvirkjun, the national energy company, has been running two pilot wind turbines close to a hydropower plant since 2013 for research purposes, confirming the high efficiency of wind power in Iceland. Landvirkjun has contracted a new scaled up 28 turbine wind park with 120 MW capacity, producing 440 GWh per year. The first turbines are expected to be delivered in May 2026.

Expanding wind power production is, however, facing a challenge related to transmission, as some parts of the grid have medium voltage and some high voltage lines, limiting the options for sending electricity from suitable wind park sites to areas short of supply.

Cheap and clean energy makes Iceland an attractive location for investments in energy intensive industries. However, other domestic demand for electricity is also expected to increase and Iceland has already experienced power shortages, driven by summer droughts, with rationing in fishmeal factories, aluminum smelters, and data centers. Planning for new hydropower plants is ongoing, involving dams in glacier rivers considered by environmentalists as a huge damage to nature.¹¹

The potential for further supply of renewable energy is huge, but continues to be limited by domestic demand, lack of connections to international markets, and by environmental constraints.

Iceland has signed the Paris Agreement, and the government's target is to make Iceland carbon neutral by 2040. 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 2026¹². In 2024 there were 18 500 electric vehicles and 20 400 plug in hybrid cars in Iceland.¹³

While the road transport might be electrified within reasonable time, the largest obstacle to carbon neutrality is fossil fuel use by the large fishing fleet. Iceland plans to use carbon offsets from carbon capture, use and storage (CCUS) together with reforestation, land reclamation and restoration of wetlands. Currently, emissions of CO₂ are captured from the Hellisheidi Geothermal Plant and injected deep underground into rocks, where a mineralization process occurs, turning CO₂ into stone. A CO₂ mineral storage terminal supported by a EUR 3.9 million (600 million ISK) grant from the EU's Innovation Fund will receive CO₂ transported from industrial emitters in Northern Europe.¹⁴

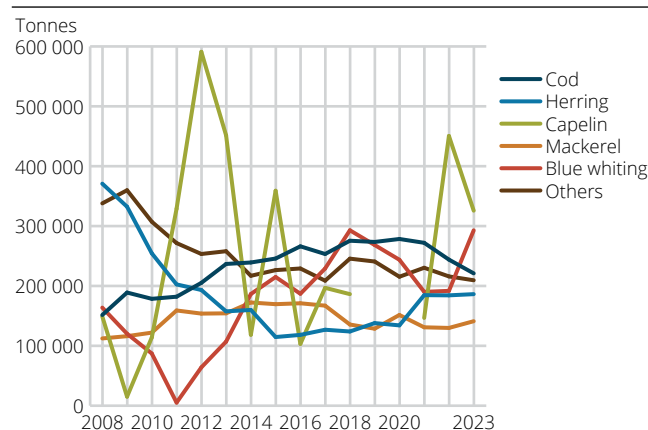
Fisheries

Figure 4.31 shows development in wild fish harvests during 2008-2023. Cod is the dominant species in terms of value, with moderately increasing landings from 2008 to 2018, before declining 2021-2023. The cod fisheries take place around Iceland, mostly at depths of 100-250 m and ocean temperatures of 4-7 °C, and is mainly harvested by bottom trawl and long line.

The Icelandic cod fishery was certified in 2010 at the FAO-based Iceland Responsible Fisheries Management Certification Program. The certification covers all sectors and all fishing gears of the Icelandic cod fishery within the 200-mile Exclusive economic zone (EEZ). A system for tracking the fish products back to its origin in a certified fishery is established, from harvests and landing to retail trade.

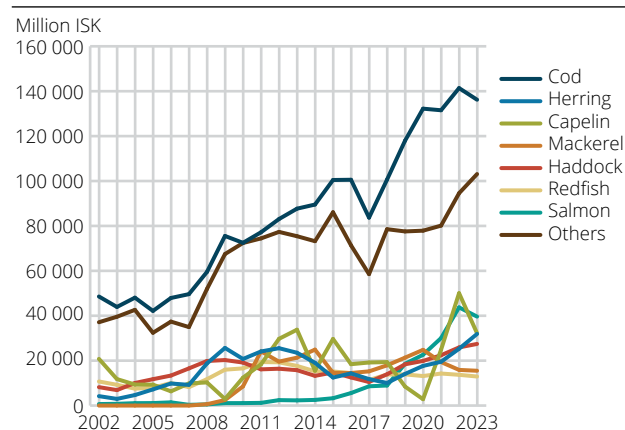
Export value of cod has more than tripled during 2002-2023 benefiting from the strong increase in

Figure 4.31. Catch by species. Iceland. 2008-2023. 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. 2002-2023. 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

cod price in recent years. Over the past decade the trend has been to increase the share of fresh and chilled products in Icelandic cod exports. Large volumes are also exported frozen or salted. The main markets for Icelandic cod are France, UK, USA and Spain.

Capelin is a short-lived species with a dynamic stock development, reflected in the volatile harvest records (Figure 4.31). After a peak harvest in 2022 and a high catch in 2023 the Marine Research Institute recommended a full stop in 2024 harvesting, as the estimated spawning stock did not meet the minimum required threshold.¹⁵ A similar moratorium was also imposed during 2018-2021.

Traditionally, capelin has been used for fish meal and fish oil production and has a lower commercial

value than cod (Figure 4.32). Over the last years, however, there has been increasing consumer demand from Asia. The export value peaked in 2022, a year with the largest catch since 2012.

Growth in farmed salmon production took off around 2014 and the export value surpassed the export value of demersal species other than cod from 2020. However, the value declined somewhat in 2023 due to stronger international competition and lower prices.

Iceland has pioneered fishery management, introducing individual transferable quotas (ITQs) for pelagic fisheries in the 1970s, and in most demersal fisheries by 1984. By 1990 the ITQ trading system covered nearly all commercial fisheries, in practice establishing a private ownership to fish resources. The fishing effort was reduced, companies and profitability increased as larger companies and vertical integration got a stronger position in fishing, processing and marketing.¹⁶

Increasing profit led the government to introduce a tax to make society at large take part in the extraordinary benefit from the exclusive right to harvest the fish resource. However, the tax was not levied on the resource rent, which is the profit beyond normal rate of return to investments. Rather, a fee on catches was levied, and differentiated across 3 vessel groups, based on size represented by cod value equivalents. A fee is also levied on volume of farmed fish production. Iceland expects ISK 15.6 billion (USD 111 million) in fees from fishing companies in 2025, up 50 per cent from 2024.¹⁷

The total fish catch of Icelandic vessels in 2024 was 994 000 tonnes, 28 per cent below total catch in 2023. The pelagic catch was 545 000 tonnes, 42 per cent less than in the previous year, mainly due to the moratorium on capelin fisheries. Demersal catch was 421 000 tonnes, 4 per cent more than in 2023. The net profit of fishing and fish processing decreased from 26 per cent to 24 per cent between 2022 and 2023.¹⁸

Notes

- ¹ <https://statice.is/publications/news-archive/inhabitants/the-population-on-1-january-2024/>
- ² <https://statice.is/publications/news-archive/inhabitants/births-2023/>
- ³ https://px.hagstofa.is/pxen/pxweb/en/Efnahagur/Efnahagur_vinnuagnogframlidni_vinnuagn/THJ11002.px/
- ⁴ <https://www.spglobal.com/marketintelligence/en/mi/research-analysis/aluminium-price-fall-to-gain-momentum-in-second-quarter-130519.html>
- ⁵ <https://www.datacenter-forum.com/datacenter-forum/cable-connection-iceland-and-ireland-commences>
- ⁶ <https://farice.is/services/>
- ⁷ <https://www.statice.is/publications/news-archive/quality-of-life/at-risk-of-poverty-rate-2023/>
- ⁸ https://www.oecd.org/en/publications/sustaining-nature-based-tourism-in-iceland_f28250d9-en.html
- ⁹ <https://www.statice.is/publications/news-archive/national-accounts/tourism-satellite-accounts-2023/#:~:text=Preliminary%20results%20of%20the%20Tourism,to%20the%20Covid%2D19%20pandemic.>
- ¹⁰ https://px.hagstofa.is/pxen/pxweb/en/Efnahagur/Efnahagur_thjodhagsreikningar_ferdathjonustureikningar_ferdathjonustureikningar/SAM08006.px
- ¹¹ <https://guidetoiceland.is/history-culture/rivers-for-sale-the-future-of-iceland-s-nature>
- ¹² https://en.wikipedia.org/wiki/Phase-out_of_fossil_fuel_vehicles#Countries_and_large_jurisdictions
- ¹³ <https://www.statice.is/stat-bank>
- ¹⁴ <https://www.carbfix.com/carbfixbuilds-aco2mineralstorage-terminal-in-iceland>
- ¹⁵ <https://www.hafogvatn.is/en/about/news-announcements/zero-catch-advice-for-capelin-remains-1>
- ¹⁶ Gunnlaugsson S.B. et al. (2018): Fishing for a fee: Resource rent taxation in Iceland's fisheries. *Ocean and Coastal Management*, 1163, 141-150. Matthíasson, T. (2003): Closing the open sea: Development of fishery management in four Icelandic fisheries. *Natural Resources Forum*, 27, 1-18.
- ¹⁷ https://www.intrafish.com/whitefish/iceland-set-for-record-annual-income-from-fishing-fees-in-2025/2-1-1752147?zeph_sso_ott=X2OSAd
- ¹⁸ <https://www.statice.is/publications/news-archive/fisheries/profitability-in-fishing-and-fish-processing-2023/>



Arctic Norway

Arctic Norway includes the counties Nordland, Troms-Finnmark,¹ and the Svalbard archipelago, with a total population of 486 000 in 2024, adding 0.1 per cent to the number of inhabitants since 2022, while the total population of Norway increased by 1.8 per cent. Gross regional product (GRP) for Arctic Norway increased by 18.6 per cent from 2019 to 2022.

Wild fisheries have been a major source of living during history but are now overtaken by a rapidly growing aquaculture industry, based on the favorable natural conditions of numerous fjords and suitable sea temperatures along the Norwegian coastal current. Fisheries saw 35 per cent income growth from 2019 to 2022 due to higher fish prices and growth in volume.² Aquaculture grew by 67 per cent, more than three times the growth of the economy at large.

Fisheries and Aquaculture contributed 3.4 and 7.4 per cent respectively to GRP in 2022, well above their 2019 shares. Fish processing also belongs to the seafood cluster and makes up the major share of the Food processing industry at 3.2 per cent of GRP in 2022, almost on a par with wild fisheries in terms of income generation. However, income in Food processing declined somewhat from 2019 to 2022, possibly reflecting more export of fresh and frozen cod directly from vessels. If including the Food processing industry, the fishery cluster contributed 14 per cent to GRP in 2022.

Petroleum extraction contributed only 0.8 per cent to Arctic Norway's GRP in 2022, up from 0.6 per cent in 2019. Only a minor income is generated within the context of the regional economy, as

Table 4.9. Value added¹ by industry. Arctic Norway. 2019 and 2022

	2019		2022	
	Mill. NOK	Per cent	Mill. NOK	Per cent
Agriculture and forestry	1 515	0.7	1 636	0.6
Fishing	6 705	2.9	9 074	3.4
Aquaculture	11 987	5.3	20 047	7.4
Oil and gas extraction including services	1 464	0.6	2 077	0.8
Food processing	8 773	3.9	8 615	3.2
Other manufacturing	8 454	3.7	16 213	6.0
Electricity, gas and steam	11 968	5.3	15 385	5.7
Water supply, waste	2 054	0.9	2 527	0.9
Construction	17 339	7.6	18 896	7.0
Wholesale and retail trade, repair of motor vehicles	17 500	7.7	18 425	6.8
Transport activities excl. ocean transport	4 788	2.1	8 375	3.1
Accommodation and food services	4 135	1.8	4 788	1.8
Information and communication	3 921	1.7	4 620	1.7
Finance and insurance	5 960	2.6	5 647	2.1
Real estate activities	4 428	1.9	5 259	1.9
Imputed rents of owner-occupied dwellings	12 503	5.5	15 707	5.8
Scientific and technical activities	6 686	2.9	7 745	2.9
Administrative and support service activities	5 443	2.4	5 428	2.0
Public administration and defence	24 991	11.0	29 853	11.1
Education	18 223	8.0	19 533	7.2
Health and social work	38 154	16.8	42 977	15.9
Arts, entertainment and other services	9 727	4.3	10 183	3.8
Total	227 710	100.0	270 024	100.0

¹ At basic prices net of taxes and subsidies.

income from offshore production outside the coast of Northern Norway, as well as from all other parts of the Norwegian continental shelf, is accounted separately from the onshore economy. There is no onshore oil and gas production in Norway.

Due to a fire at the liquefied natural gas (LNG) plant at Melkøya outside Hammerfest in 2020, production was shut down on the Snøhvit field for nearly 20 months. From May 2022, the production from Melkøya had fully recovered.³ The production capacity at Melkøya accounts for around 5 per cent of Norway's total exports of natural gas.

Within Other manufacturing, basic metal production is the dominant activity, producing advanced silicon-based materials and products. Electricity, gas and steam increased income by 28.6 per cent, supported by high prices of energy due to the war in Ukraine. However, the increase in electricity prices in Arctic Norway was constrained by limited transmission capacity to southern high-price

regions. Electricity, gas and steam contributed 5.7 per cent to GRP in 2022.

Over the years, tourism has grown into a major activity in many Arctic economies, and was hit hard by the Covid-19 pandemic. Accommodation and food processing sustained its share of GRP at 1.8 per cent from 2019 to 2022 despite a drop to 1.4 in 2021. Transportation activities rose by 75 per cent, while their share of Arctic Norway's GRP rose from 2.1 per cent to 3.1 per cent. Seafood, energy-intensive manufacturing and tourism are industries that require much transportation in Arctic Norway.⁴

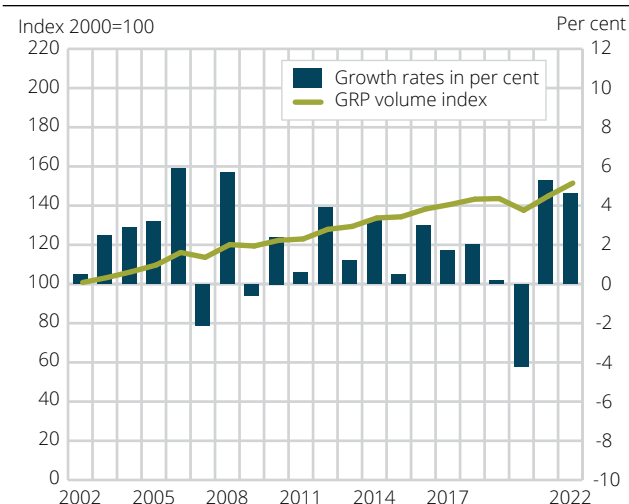
Among private services, Wholesale and retail trade is the largest industry, reducing its share in total income from 7.7 per cent in 2019 to 6.8 per cent in 2022. There was a marked decline in Finance and insurance, whereas Real estate services and Accommodation and food services kept track with the regional economy.

Among public services, Public administration and defense grew marginally faster than the average, whereas Health and social services and Education both lagged behind regional economic growth.

When adjusting economic performance for inflation we find real economic growth. Figure 4.33 shows real GRP growth rates 2002-2022 and GRP volume index, assuming fixed prices. There was generally high real economic growth towards the financial crisis 2008-2009, while the period 2010 to 2019 saw positive but varying growth rates. The pandemic peak of 2020 saw a significant decrease in GRP, followed by strong rebound in 2021 and 2022 as petroleum and mineral prices took off. The closedowns during the pandemic affected many Arctic regions heavily, and tourism suffered the most. However, by 2022, tourism had recovered well in terms of visitors and overnight stays.⁵

Figure 4.34 shows structural shifts in the economy. Primary production, containing both extractive industries and Fishing, Aquaculture and Agriculture and forestry represented 12.3 per cent of GRP in 2022, up from 10.1 per cent in 2019, largely driven by the increase in value added in Fishing and Aquaculture. Both public and private services reduced their contributions to GRP during 2019-2022.

Figure 4.33. GRP volume index and growth rate. Arctic Norway. 2002-2022



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.

Figure 4.34. Value added by main industry. Arctic Norway. Per cent of GRP. 2019 and 2022

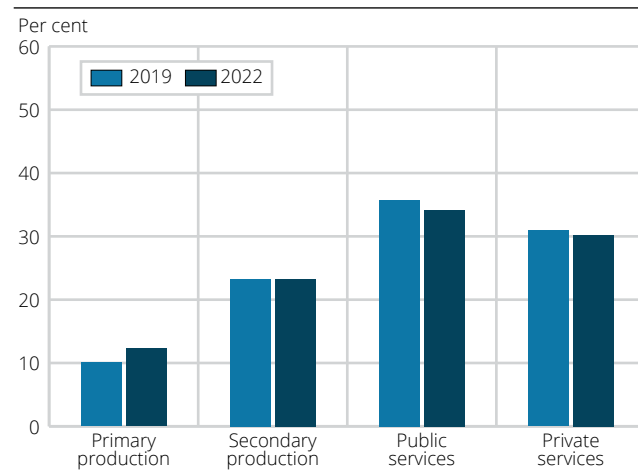
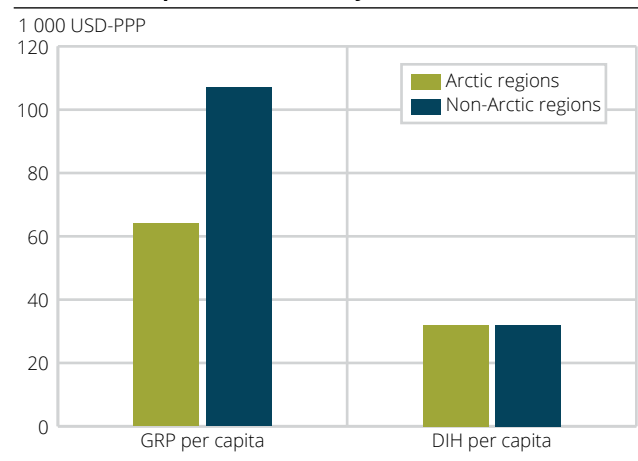


Figure 4.35. Gross regional product (GRP) per capita and Disposable income of households (DIH) per capita. Arctic Norway. 2022. 1 000 USD-PPP





Lofoten, Norway. Photo: Colourbox

Figure 4.35 compares the GRP per capita and disposable income for household (DIH) per capita in the Arctic and non-Arctic regions of Norway. GRP per capita is considerably higher in the non-Arctic regions of Norway, however, for disposable income per capita there is no gap. Note that contributions to disposable income for households from publicly financed education and health services is not included in DIH due to lack of data, except for Arctic Canada and Iceland. See Highlight 4.2 on adjusting DIH per capita for in-kind income for Canada and Iceland respectively.

Fisheries

The seafood industry with fishing, aquaculture and processing is an important contributor to employment, value added and tax income in Arctic Norway. As seen in Table 4.9, Fishing and Aquaculture generated almost 11 per cent of GRP in 2022. There are no official figures for fish processing at regional level, but the trend for Norway over two decades is a reduction in fish processing and an increase in direct export of fresh and frozen cod, the most valuable of the fish species. Within aquaculture industry, processing of salmon has increased.⁶ Due to high labor costs investment in automation of production is attractive but large investments require facilities to be operated year-round to achieve profitability, which is difficult with the seasonal catch pattern for Norwegian fisheries.

The number of farmed salmon increased by 17 per cent from 2020 to 2024. Meanwhile the industry involves increasing problems of fish health. As much as 37.7 million salmon died in hatcheries on land, whereas 62.8 million salmon or 16.7 per cent died in the sea cages, the highest death rates registered so far. The main causes are not new: damage from delousing practices, gill diseases and winter sores. In 2023, damage from jellyfish also ranked among the 10 most important health challenges.⁷

Petroleum

Norway is producing gas in the Norwegian Sea and the Barents Sea (Snøhvit) outside the Arctic region of Norway. The Johan Castberg oil field 100 km north of Snøhvit in the Barents Sea will come on stream in early 2025 and is expected to produce oil for the next 30 years. Environmental organizations argue that this activity will take Norway further away from the climate target of the Paris agreement. Development of petroleum activity in Lofoten, Vesterålen and Senja, the spawning ground of the Northeast Atlantic cod, will most likely be spared through parliamentary support. The 26th licensing round was put on hold in 2022. More recently, the Norwegian Ministry of Energy offered 53 new production licenses on the Norwegian continental shelf in the APA 2024 licensing round of which 19 are located north in the Norwegian sea, and one in the Barents Sea.⁸ There is no onshore oil and gas production in Norway.

The Norwegian government favors electrifying the LNG plant on Melkøya. Planning for significant expansion of power production and grids in Troms-Finnmark has been launched to secure power supply and grid capacity. The Sámi Parliament has sued the government over this decision as the projected wind power projects will lead to a degradation of land extensively used for reindeer herding.⁹

Wisting is another planned offshore oil field in the Barents Sea where electrification is considered a possible option for reducing field emissions. Production was planned to start in 2028, but in 2022 the license holders put the project on hold due to surging costs. Wisting oil and gas field is the northernmost petroleum field in the world, and drilling is strongly opposed by the environmental organizations. However, Equinor cooperates with other companies to revive the investment process.¹⁰



Svalbard, Norway. Photo: Colourbox

Renewable energy

Nordland has a substantial surplus of green electricity due to limited transmission capacity. In Troms-Finnmark 64 per cent of the production of electricity came from hydropower and 22 per cent from wind power in 2022.¹¹ In total, five new wind power plants started production in the period 2019 – 2022 in Troms-Finnmark.¹² Sámi reindeer herding areas are under pressure from mining, hydropower, transmission lines and cabins, however wind power is the primary concern. In August 2024 the government introduced new guidelines for planning and licensing onshore wind power. According to these guidelines, a zoning plan must be obtained before a wind power concession can be granted, providing the municipalities with decisive influence over wind power development within the municipality.¹³

The option to produce zero-emission hydrogen based on renewable electricity is attractive to regions with a surplus of renewable power. Several initiatives are under way in Nordland. Among others, Neptun Glomfjord Green Ammonia¹⁴ and Aker Horizons¹⁵ will transform green hydrogen to green ammonia as part of a complete regional value chain from renewable electricity to zero-emission fuel serving the marine sector. Other projects build electrolyzers or fuel cells, core elements in the green fuel supply chain. The Norwegian Public Roads Administration (NPRA) has signed a contract with the company Torghatten Nord to operate hydrogen ferries between Bodø and Lofoten from 2025.¹⁶

Notes

- ¹ The counties Troms and Finnmark were merged in 2020 and again split from 2024. For the period 2019-2022 covered here, data are only available for the merged county.
- ² https://www.rafisklaget.no/media/zfdduuff/240247_nr_a-rsmelding_2023_web.pdf
- ³ <https://www.tu.no/artikler/na-produserer-melkoya-anlegget-for-fullt/520418>
- ⁴ <https://www.kbnn.no/files/2022-Rapport-N%C3%A6ringslivets-behov-for-transportinfrastrukturbehov.pdf>, https://www.nfk.no/_f/p1/if9efdf81-dcf2-488a-94ee-f6fdfff86861/sjomatkartet-2021-m-aktorer.pdf
- ⁵ <https://www.nho.no/regionkontor/nho-arktis/artikkelarkiv/2023/overnattingsstatistikk-for-desember-2022/>
- ⁶ <https://nofima.brage.unit.no/nofima-xmlui/bitstream/handle/11250/3163768/Rapport%2031--%202024%20-%20Sj%C3%B8matn%C3%A6ringsens%20ringvirkninger%202023%20inkl%20vedlegg.pdf?sequence=5&isAllowed=y>
- ⁷ <https://www.vetinst.no/rapporter-og-publikasjoner/rapporter/2024/fiskehelse rapporten-2023>
- ⁸ <https://www.regjeringen.no/en/aktuelt/tfo-2024-53-nye-utvinningstillatelser/id3083489/>
- ⁹ <https://www.thebarentsobserver.com/news/sami-parliament-takes-state-of-norway-to-court/109859>
- ¹⁰ <https://e24.no/energi-og-klima/i/63nML/nytt-equinor-samarbeid-haaper-aa-modne-frem-wisting-og-bay-du-nord>
- ¹¹ <https://www.ssb.no/en/statbank/table/08308>
- ¹² <https://www.nve.no/energi/energisystem/vindkraft-paa-land/data-for-utbygde-vindkraftverk-i-norge/>
- ¹³ <https://www.northwindresearch.no/news/norwegian-government-releases-guidelines-for-planning-and-licensing-of-onshore-wind-power-projects/>
- ¹⁴ <https://greenstat.no/en/news/fid-for-neptun-glomfjord-green-ammonia-as>
- ¹⁵ <https://akerhorizons.com/what-we-do/narvik/>
- ¹⁶ <https://www.vegvesen.no/en/fag/trafikk/ferje/hydrogen-ferries-to-lofoten/>



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 2024 the population counted 6.3 million, down from 6.5 million in 2018. The economy is largely based on petroleum extraction and other mining industries, and the development during 2019-2022 strengthened the mineral basis of the economy.

The Russian Arctic is facing the most impacting changes from global warming. The shrinking sea ice brings new options for connectivity and access to resources, vitalizing trade and development in the Russian Arctic. Opening of the Northern Sea Route (NSR) along the northern coast of Siberia can replace over-land transportation by river and ocean transportation, a great benefit to the extractive industries. The NSR is estimated to reduce sailing time between Asia and Europe by two weeks compared with sailing through the Suez Canal.

Plans and projects are developed to harvest the benefits of new trade routes, with harbor facilities on the Siberian coast and reloading hubs in the ice-free ends of the NSR, moving LNG from ice-class tankers on to conventional ones.¹

The number of NSR sailings was record high at 95 in 2024, transporting 3.1 million tons by 54 cargo vessels, with 41 sailings carrying ballast only. 2024 was also a record year for transit cargo, mainly from Russia to China. China launched its 58 000 tons polar-ready cargo ship late 2024, avoiding reloads from conventional to ice-breaking vessels.²

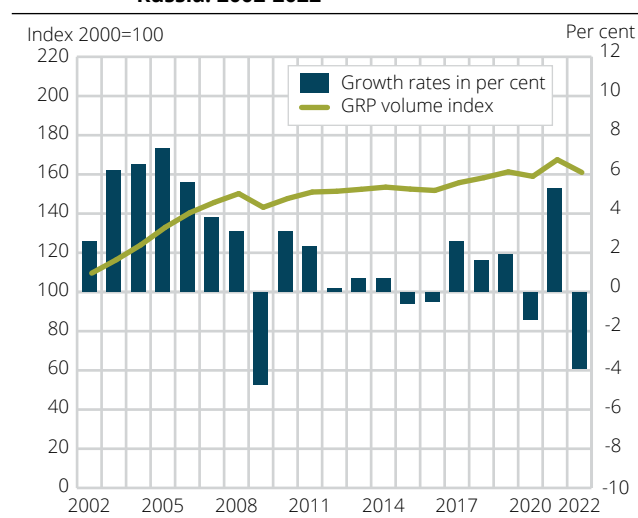
The loads towards Asia dominate and crude oil and containers make up about 20 per cent each of total cargo. The largest volume of cargo is crude oil.

Table 4.10. Value added¹ by industry. Arctic Russia. 2019 and 2022

	2019		2022	
	Mill. Rubles	Per cent	Mill. Rubles	Per cent
Agriculture, forestry, hunting, fishing and fish farming	184 053	2.1	219 250	1.6
Petroleum and other mining	4 702 242	54.6	7 957 055	59.0
Manufacturing	504 731	5.9	928 346	6.9
Production and distribution of electricity, gas and water	245 219	2.8	304 108	2.3
Construction	546 622	6.3	786 144	5.8
Wholesale and retail trade	341 161	4.0	441 094	3.3
Transportation, Information and communication	565 941	6.6	748 971	5.6
Hotel and catering activities	54 659	0.6	79 516	0.6
Financial and insurance	8 592	0.1	10 024	0.1
Real estate	316 996	3.7	486 974	3.6
Public administration and military security; social Security	371 238	4.3	532 901	4.0
Education	192 544	2.2	296 088	2.2
Health and social services	271 098	3.1	276 475	2.1
Other private services	312 297	3.6	416 817	3.1
Total	8 617 393	100	13 483 764	100

¹ At basic prices net of taxes and subsidies.

Figure 4.36. GRP volume index and growth rate. Arctic Russia. 2002-2022



Transportation between Russian ports is a minor part of cargo traffic.³

The opening of the Northern Sea Route is a large windfall gain for Arctic Russia, although the warmer climate incurs costs in terms of loss of habitat for reindeer herding, ecosystem changes and damage to buildings and infrastructure from thawing permafrost (see Chapter 10).

Table 4.10 shows the industry structure of the economy in 2019 and 2022. GRP of Arctic Russia in current rubles increased by 56 per cent during 2019-2022, partly a result of higher world prices on

metals and energy in 2022 but also subject to inflation at a rate of 13.8 per cent for Russia in 2022.

Mining, including petroleum extraction, was the main driver of the Arctic Russian economy, raising its contribution to GRP from 54.6 to 59.0 per cent. Manufacturing, mobilized for military purposes, had the fastest growth among all industries, increasing income to 84 per cent above 2019 level in 2022. Mining, including oil and gas, came second, raising income by 69 per cent.

Construction is an industry that is heavily involved in resource development and infrastructure investments. As several huge investments projects have been completed within oil and gas at the Yamal Peninsula, construction saw less than average growth.

Within private service industries, the income in Wholesale and retail trade and Transportation grew by 29 and 32 per cent respectively, both lagging somewhat behind the economy at large. Hotel and catering did somewhat better, increasing income by 45 per cent and roughly sustaining its share in GRP of 0.6 per cent. Real estate almost kept track of general economic growth whereas Financial and insurance services continue to be a marginal industry.

Among public services, Public administration and military and social security sector grew by 44 per cent, less than the economy at large. On the other hand, Education almost kept track with the general growth rate and sustained a share of the total economy of 2.2 per cent. Expenditure on Health and social services kept constant in nominal terms, reducing its share in total income from 3.1 per cent to 2.1 per cent during 2019-2022.

When adjusting for inflation we find the real annual growth rate and GRP volume index (Figure 4.36). There was strong growth until 2009 when GRP declined by 4.7 per cent in response to the financial crisis. After a rebound in 2010/2011 the economy entered a period with marginal real growth towards 2017.

In 2020, the peak year of the covid19-pandemic, there was a marked reduction in petroleum demand and declining income, followed by a rebound in 2021, whereas 2022 saw a 3.9 per cent decline in

Figure 4.37. Value added by main industry (at current prices). Arctic Russia. Per cent of GRP. 2019 and 2022

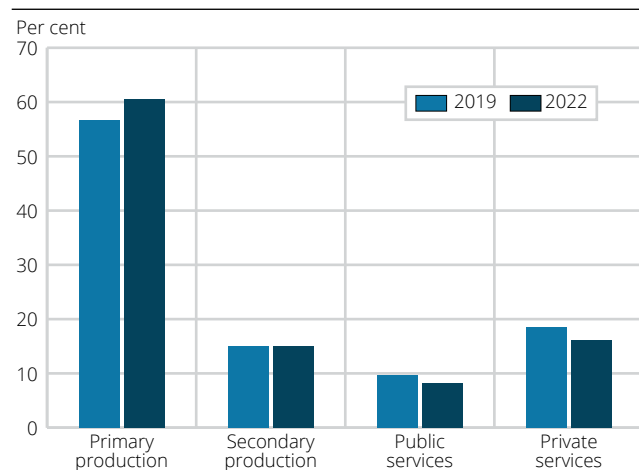
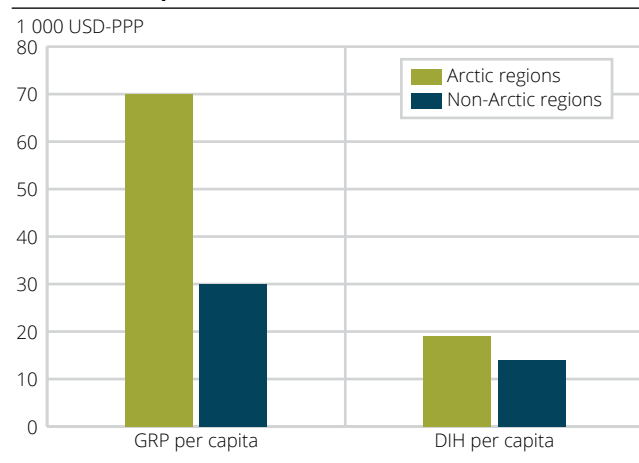


Figure 4.38. Gross regional product (GRP) per capita and Disposable income of households (DIH) per capita. Russia. 2022. 1 000 USD-PPP



total income as Russia aligned with OPEC+ capacity constraints.

Figure 4.37 illustrates the dominating role of primary or extractive industries in Arctic Russia, increasing from 56.7 per cent in 2019 to 60.6 per cent of GRP in 2022.

The largest source of income in primary industries is mineral extraction, as agriculture, forestry, hunting, fishing and fish farming only contributed 1.6 per cent to GRP in 2022.

Secondary or goods producing industries (manufacturing, utilities, and construction) maintained their share in total income at 15 per cent. Among secondary industries, utilities (production and distribution of electricity, gas and water) showed weakest growth. Public services including public administration, education and health declined, and private services even more so.



GRP per capita in Arctic Russia was double that of non-Arctic Russia (Figure 4.38). This gap is largely a result of the petroleum industry in Arctic Russia producing around 70 per cent of total Russian oil and more than 90 per cent of Russian natural gas.

Disposable income of households (DIH) indicates the economically sustainable potential for private consumption. The Russian Arctic has a 32 per cent higher disposable income per capita than in non-Arctic regions. The higher wage level in petroleum and mining can explain the higher DIH in the Arctic region.

Petroleum

The Yamal Peninsula is a power center of above all gas related, but also oil based industrial development. The first Russian Arctic offshore oil field, the Prirazlomnoye oil field started production in 2014. The Yamal LNG plant started production in 2017 intended for export to Asia and Europe. A new port facilitates the export of oil and gas as well as other minerals along the Northern Sea Route to Asia.

The Arctic LNG 2 project has been developed to scale up LNG export to western countries but is subject to sanctions and has recently been halted by the owner Novatek, leaving an uncertain future for the floating LNG-producing platforms at the Gydan Peninsula, Russia's largest production unit.⁴

The Republic of Sakha is a rapidly emerging petroleum region and close to Yamal Nenets in terms of petroleum income in 2022, and suitably located at

the East Siberia – Pacific Ocean (ESPO) oil pipeline and the Power of Siberia gas Pipeline to China.

Petroleum income fuels the Arctic and the Russian economy but incurs large costs to traditional living in the area as petroleum expansion, pollution and associated infrastructure has put a huge pressure on the sensitive ecosystems of Siberia. Indigenous Nenets Peoples have been living on the Yamal peninsula as nomadic reindeer herders, now facing interruptions of nomadic migration routes, threatening the culture and traditions for the Nenets' way of life.⁵

Regional development

The rich mineral resources of Arctic Russia are unevenly distributed across the 9 sub-regions, affecting their economic basis. Table 4.11 shows sub-regional income levels and shares in Arctic Russia's GRP in 2016, 2019 and 2022 in basic prices, thus reflecting the net results obtained by the industries.

The growth of GRP during 2019-2022 was 57 per cent. The petroleum producing regions of Yamal-Nenets, Khanty-Mansii and the republic of Sakha show different development paths. Yamal-Nenets saw income being reduced by 40 per cent from 2016 to 2019, despite rising world fuel prices, followed by less than average growth towards a share in Arctic Russian GRP at 12.8 per cent in 2022, half of the 2016 level.

In oil-producing Khanty-Mansii there was practically no income growth 2016-2019, but high oil prices raised GRP by almost 70 per cent during 2019-2022.

Table 4.11. GRP by sub-regions of Arctic Russia. 2016, 2019 and 2022

	2016		2019		2022	
	1 000 mill. Rubles	Per cent	1 000 mill. Rubles	Per cent	1 000 mill. Rubles	Per cent
Murmansk Region	467	5.6	617	7.2	1 149	8.5
Karelia	248	3.0	319	3.7	391	2.9
Arkhangelsk Region	713	8.6	890	10.3	1 188	8.8
Komi Republic	579	7.0	718	8.3	976	7.2
Yamal-Nenets Autonomous Area	2 028	24.5	1 235	14.3	1 720	12.8
Khanty-Mansii	3 130	37.8	3 159	36.7	5 350	39.7
Republic of Sakha (Yakutia)	889	10.7	1 228	14.2	2 025	15.0
Magadan Region	154	1.9	396	4.6	604	4.5
Chukotka Autonomous Area	72	0.9	57	0.7	81	0.6
Total	8 281	100.0	8 617	100.0	13 484	100.0

The development in Sakha reflects a less mature petroleum region, raising its contribution to GRP from 10.7 per cent in 2016 to 15 per cent in 2022.

Several factors may have influenced these petroleum regions differently. A 2019 tax reform gradually transformed the mineral export tax to a tax on income in oil and gas production and mining of iron, coal diamonds and gold.⁶

As a member of OPEC+ Russia contributed to oil production cuts to support the global oil price in times of shrinking demand during 2019-2022.

Other sub-regions showed more steady development. The activity and mineral income in Murmansk reflects the high minerals prices in 2022, but also a development boom related to the investments in infrastructure around Murmansk as a hot spot of transportation along the NSR.

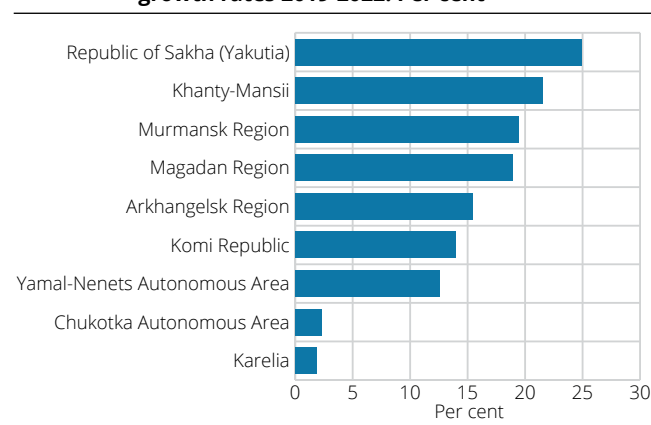
Arkhangelsk has one of the largest diamond mines of Russia and in the world. The sub-region had mineral income growth at 15 per cent annual average from 2019 to 2022. As a precious mineral, diamond production is also subject to the higher income tax rates on petroleum and precious minerals.

Figure 4.39 shows average annual income growth rates in petroleum and other mining industries by sub-regions. For the Arctic region, total value added in petroleum and other mining increased by 19 per cent per year on average during 2019-2022.

The fastest annual average growth in mineral income among sub-regions was seen in the Republic of Sakha at 25 per cent, almost doubling the income from 2019 to a level on a par with income from mineral extraction in Yamal-Nenets in 2022 (Figure 4.39).⁷ The rapid growth is facilitated by the East-Siberia – Pacific Ocean (ESPO) oil pipeline and the Power of Siberia gas pipeline, passing through the territory on the way to the Pacific Ocean. China built the Power of Siberia pipeline to import gas from Siberia, reaching a capacity of around 10 per cent of Chinese consumption.⁸

The top oil producer Khanty-Mansii saw the second fastest average growth in mineral income at 22 per cent per year, increasing income from 2.3 billion to 4.1 billion rubles in 2022.

Figure 4.39. Value added in petroleum and other mining in Arctic Russia in current Rubles. Annual average growth rates 2019-2022. Per cent



The sub-regions of Murmansk and Magadan are lagging somewhat behind the large mineral producers but came third in terms of annual growth. Murmansk oblast is one of the most developed mining regions of Russia with the Kola Peninsula's large deposits of metals and raw materials as a basis for a complex of enterprises within metallurgical and chemical industry. The third most important region for production of petroleum and other minerals is Yamal-Nenets with a more moderate income growth at 13 per cent annually.

Chukotka Autonomous Okrug with the Kupol Gold Mine, and Arkhangelsk oblast with the Lomonosov mine, among the largest diamond mines in the world, both saw low growth in mineral income at 2 per cent per year on average 2019-2022.

Notes

¹ <https://gcaptain.com/russias-yamal-Ing-gets-new-tanker-for-ship-to-ship-transfers/>

² <https://chnl.no/news/overview-of-transit-navigation-on-the-nsr-update-september-30-2024/#:~:text=The%20transit%20data%20for%20the,Ust%20Luga%20in%20August%2DSeptember.>

³ <https://chnl.no/news/overview-of-transit-navigation-on-the-nsr-update-september-30-2024/#:~:text=The%20transit%20data%20for%20the,Ust%20Luga%20in%20August%2DSeptember.>

⁴ <https://www.thebarentsobserver.com/arctic-Ing/new-production-platform-arrives-in-utrenneye-it-is-part-of-russias-big-push-into-arctic-Ing/112475>

⁵ <https://gogel.org/yamal-Ing-and-arctic-Ing-2-gas-extraction-russian-arctic#s-15239>

⁶ Outlook 2019: Russia's tax overhaul has refining in a fever | S&P Global Commodity Insights

⁷ <https://openpolar.no/Record/crioppubl:10.1088%2F1755-1315%2F459%2F5%2F052005>

⁸ <https://www.reuters.com/business/energy/china-completes-full-pipeline-power-of-siberia-gas-2024-12-02/>



Arctic Sweden

Arctic Sweden consists of the sub-regions Norrbotten and Västerbotten with a total population in 2024 of 530 000 with around 132 000 living in the largest city of Umeå. The majority live 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.

Total value added or Gross Regional Product (GRP) for Arctic Sweden increased by 29 per cent from 2019 to 2022. Mining, quarrying and manufacturing was the main contributor to GRP in 2022 with a share of 28.1 per cent.

The fastest growth appeared in Wholesale and retail trade, raising its share in GRP from 6.8 to 10.4 per cent, followed by Utilities and Mineral and quarrying and manufacturing at 56 and 45 per cent increase respectively. Construction just kept track with general economic growth of the region

Among private service industries, Wholesale and retail trade doubled income, growing three times as fast as Mining and manufacturing. Transportation struggled to sustain the nominal income level of 2019 in 2022, reducing its share in total value added from 6.1 per cent to 4.7 per cent during the period. Accommodation and food services did not enjoy a sufficient rebound to lift the post-pandemic activity above 2019 level, reducing its share in GRP from 1.7 to 1.1 per cent. Financial services roughly kept track with general economic growth, whereas Real estate services saw negligible growth and stepped down from 5.7 to 4.5 per cent of total income.

Table 4.12. Value added¹ by industry. Arctic Sweden. 2019 and 2022

	2019		2022	
	Mill. SEK	Per cent	Mill. SEK	Per cent
Agriculture and forestry	5 669	2.5	5 339	1.9
Mining and quarrying and Manufacturing	55 644	25.0	80 581	28.1
Utilities	12 457	5.6	19 435	6.8
Construction	16 365	7.3	21 164	7.4
Wholesale and retail trade	15 065	6.8	29 840	10.4
Transportation and storage	13 529	6.1	13 475	4.7
Accommodation and food services	3 732	1.7	3 199	1.1
Financial and insurance services	3 505	1.6	4 428	1.5
Real estate activities	12 682	5.7	12 777	4.5
Public administration and defence	12 505	5.6	13 682	4.8
Education	13 965	6.3	14 902	5.2
Health care and social work	25 451	11.4	29 540	10.3
Other service activities	32 204	14.5	38 477	13.4
Total	222 773	100.0	286 839	100.0

¹ At basic prices net of taxes and subsidies.

Among public services, Public administration and defense lagged markedly behind the economy at large, reducing its contribution to regional income from 5.6 to 4.8 per cent. Education shrank even more, from 6.3 to 5.2 per cent of total income, while Health care and social work fared somewhat better but came out with a lower share of regional income at 10.3 per cent in 2022 against 11.4 per cent in 2019, the year before the pandemic broke out. In total, the public sector saw its share of GRP decline from 23.3 per cent in 2019 to 20.3 per cent in 2022.

When adjusting economic performance for inflation by assuming fixed prices we find real growth or growth in the scale of production (Figure 4.42). In 2009 Arctic Sweden faced a striking negative effect of the world financial crisis 2008/2009 and a strong rebound in 2010, illustrating the high sensitivity of minerals and metal products to uncertainty – and the potential to store output and bounce back in better times. At the outbreak of the pandemic in 2020 real growth was slightly negative, whereas real income 2021 grew by 7.2 per cent along with the international post-pandemic recovery. In 2022, prices on minerals and metals were particularly high due to the war in Ukraine, and so was income in current prices, but volume growth was more moderate.

The main structure of the economy has varied over the three years as shown in Figure 4.43. Note

that Mining and quarrying, an extractive industry, is merged with manufacturing and included in secondary production together with Construction and Utilities, rather than seen as a part of primary industries as usual in national account statistics, blurring the distinction between income from extraction of natural resources and processing industry, potentially subject to different tax regimes. The reasons behind such aggregations are frequently confidentiality rules or vertical integration of activities. As a consequence, Agriculture and forestry emerge as the only primary production activity, declining from 2.5 to 1.9 per cent of GRP from 2019 to 2022. The Secondary production containing Mining and quarrying and manufacturing, Construction and Utilities, had the highest share of GRP at 42.2 per cent in 2022, up from 37.9 per cent in 2019. Both private and above all public services reduced their shares in GRP in 2022 compared with 2019.

As seen from figure 4.44, GRP per capita is somewhat higher in Arctic Sweden than in Non-Arctic Sweden as is typical in many Arctic regions where extractive industries with relatively high wage and price levels are dominating. Disposable income of households per capita is slightly higher in Non-Arctic Sweden. Note that disposable income of households in terms of publicly financed education and health services is not included due to lack of data, except for Canada and Iceland. See Highlight 4.2 adjusting DIH per capita for in-kind income for Canada and Iceland.

Mining and minerals

Arctic Sweden is a key mining region at the national and European levels, home to 9 of the 12 active mines in Sweden and contributing around 90 per cent to the iron ore supply in Europe.

The Covid-19 pandemic caused a global slowdown, halting economic activity and mobility. However, the impact on the mining and mineral industry in Sweden turned out to be relatively modest and affecting production only temporarily.¹ Many mines remained operational and productive during the pandemic, despite having less people on site. Increased steel production in China in late 2020 increased the price on iron ore, the main output from Mining in Arctic Sweden. From 2021, the activity within the mining industries was considered fully recovered.

Figure 4.40. GRP volume index and growth rate. Arctic Sweden. 2002-2022

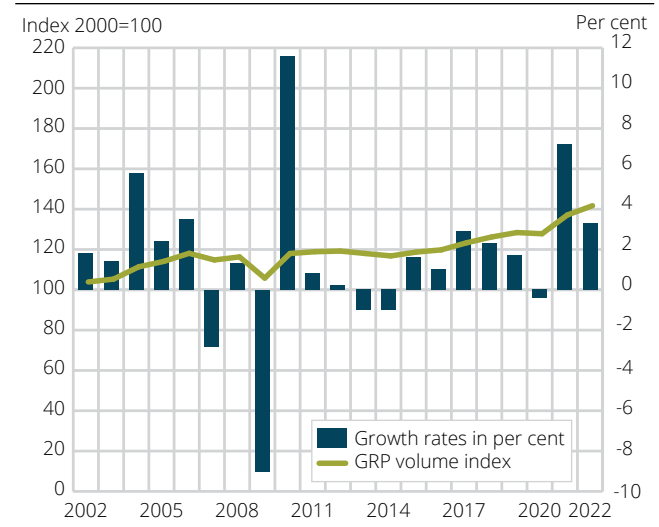
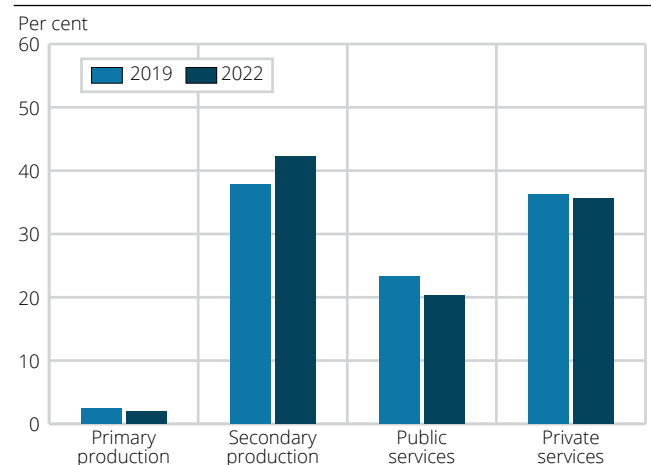
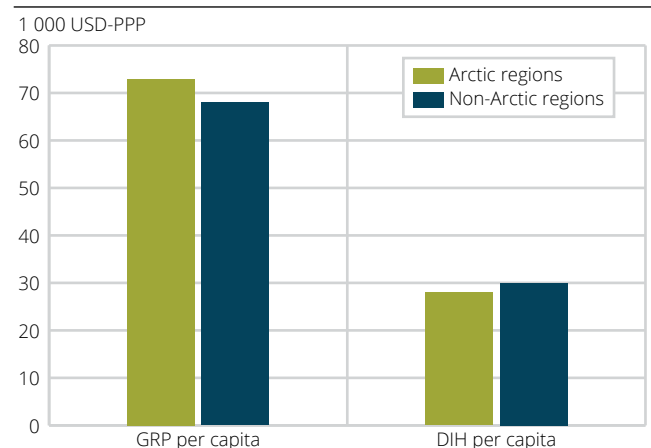


Figure 4.41. Value added by main industry¹. Arctic Sweden. Per cent of GRP. 2019 and 2022



¹ Mining and quarrying is included in secondary production, rather than primary production, due to data availability.

Figure 4.42. Gross regional product (GRP) per capita and Disposable income of households (DIH) per capita. Sweden. 2022. 1 000 USD-PPP



Europe's largest deposit of rare earth metals was discovered in Kiruna in 2023, and the huge iron ore producer LKAB wants to develop the deposit

along with establishing a circular industry park in Luleå extracting critical minerals. The production is planned to start in 2027.²

After a decade of discussion and planning and close consultations with the inhabitants, the government owned LKAB is relocating the town of Kiruna as the current mine has caused ground subsidence, thus securing population and property while opening access to valuable reserves below the original mining town.³ The relocation is compensated and started in 2014 with an expected finish in 2033.

Green industrial transition

Strong growth is expected in Arctic Sweden, driven by investments in fossil-free steel industry based on renewable energy and more efficient use of resources. The rapid industrial growth is raising demand for energy and infrastructure, challenging the regional governments due to labor shortage as the population is ageing and immigration settings constraining. Many migrants tend to stay only temporarily in Northern Sweden and eventually move south to larger cities.⁴

Within the HYBRIT project, industrial giants in Northern Sweden have joined forces to produce the world's first fossil-free value chain for iron and steel production by 2035 using renewable electricity and green hydrogen, reducing Sweden's CO₂ emissions by 10 per cent.⁵ The technology has been tested and proven successful, but not yet been used on a large scale. In 2021, the steel manufacturer SSAB produced and delivered the world's first fossil-free steel to a customer, replacing coal with hydrogen,⁶ and by 2024, after 6 years of research, fossil-free steel approaches production at industrial scale.

Europe's largest fully vertically integrated lithium-ion battery cells plant was established in Skellefteå in 2016. The government contributed SEK 88 billion to the project. By 2024 the company faced major financial problems and the daughter company Northvolt Ett Expansion, responsible for the construction work, was declared bankrupt by late 2024.⁷ As of March 2025, the parent company Northvolt has filed for bankruptcy in Sweden⁸ with 5000 workers losing their jobs.

In the period 2019–2022, more than 3 600 wind power plants were established in Västerbotten and Norrbotten with a total capacity of almost 11 GW,⁹ dominating within Sweden's national wind power capacity of 12 GW from 4 679 turbines.

The green industrial transition is increasing the pressure on the environment through wind parks and infrastructure, interfering with wilderness for hunting, fishing and tourism. Maintaining traditional Sámi reindeer herding routes is a further challenge. Plans to expand infrastructure, including winds farms and Arctic mines, need to consider the rights of the indigenous Sámi to herd reindeer in the region as well as other issues to obtain the necessary permits.



Notes

¹ Galaś, A. et al. (2021). Impact of Covid-19 on the Mining Sector and Raw Materials Security in Selected European Countries. Resources, 10(5), 39.

² <https://www.highnorthnews.com/en/europes-largest-deposit-rare-earth-metals-found-northern-sweden>

³ <https://www.smithsonianmag.com/travel/instead-being-swallowed-mine-swedish-arctic-town-moving-180955314/>

⁴ https://www.oecd.org/content/dam/oecd/en/publications/reports/2021/01/mining-regions-and-cities-case-of-vasterbotten-and-norrbotten-sweden_9b12c1b6/802087e2-en.pdf, <https://www.mfat.govt.nz/en/trade/mfat-market-reports/green-transition-in-the-north-of-sweden-december-2023#bookmark1>

⁵ <https://www.hybritdevelopment.se/wp-content/uploads/2023/03/Minimize-CO2-EN-no-bleed-for-printer.pdf>

⁶ <https://lkab.com/en/press/positive-decision-on-support-for-lkab-and-hybrit/>

⁷ <https://www.nettavisen.no/okonomi/svensk-batterifabrikk-skandale-for-northvolt-uapnede-varer-til-fem-milliarder-kroner-kan-bli-skrotet/s/5-95-2168755>

⁸ <https://northvolt.com/articles/northvolt-files-for-bankruptcy-in-sweden/>

⁹ https://pxexternal.energimyndigheten.se/pxweb/sv/Energimyndighetens_statistikdatabas/Energimyndighetens_statistikdatabas__Officiell_energistatistik__Vindkraftsstatistik/EN0105_3.px/

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 with some recognizable clusters.

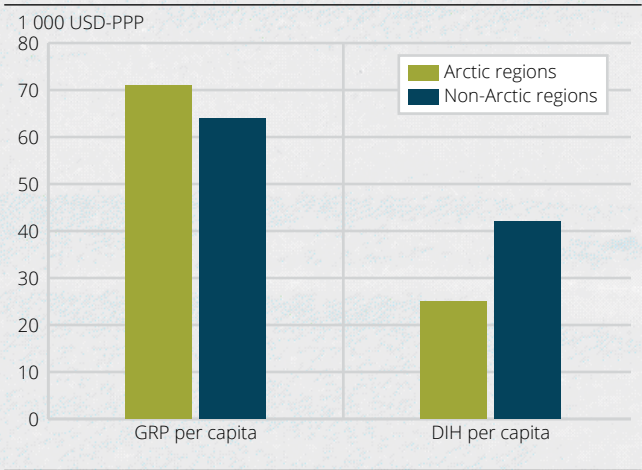
Arctic Russia, Alaska and Northern Canada are the main producers within petroleum and other mineral mining. In Arctic Russia, the primary production, consisting of mainly petroleum and mining, totally dominates the income generation as 60 per cent of GRP originate in these activities in 2022 (Table 4.10, 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 15 per cent in Arctic Russia, 9 per cent for Alaska and 11 per cent for Northern Canada. In secondary industries including manufacturing, utilities and construction, Arctic Sweden takes the lead at 42 per cent of GRP. However, this high share reflects that Mining and quarrying is not separated from manufacturing and is included in secondary production rather than primary production. In Arctic Finland, secondary production is at 30 per cent of GRP.

A major sector of Greenland’s and Faroe Islands’ economy is the fisheries industry, and in Arctic Norway aquaculture dominates the regional blue economy. With a diversified economy, Iceland also has a large tourism sector. Overall, the public sector has an important role for providing health and education services in Arctic regions.

Figure 4.43 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 4.43. Gross regional product (GRP) per capita and Disposable income of households (DIH) per capita. Total Arctic. 2022. 1 000 USD-PPP



Highlight 4.3. Regional accounts data sources**Alaska**

Bureau of Economic Analysis, United States, Regional data.
<https://www.bea.gov/itable/regional-gdp-and-personal-income>

State of Alaska: Department of Revenue Permanent Fund Dividend.
<https://pfd.alaska.gov/Division-Info/summary-of-dividend-applications-payments>.

Mineral production of Alaska. 2019-2021 data are from Table 15 in Szumigala, D.J., 2024, Alaska's mineral industry 2021: Alaska Division of Geological & Geophysical Surveys Special Report 77, 97 p. <https://doi.org/10.14509/31272>.

Canada

Statistics Canada. Table 36-10-0402-01 Gross domestic product (GDP) at basic prices, by industry, provinces and territories (x 1,000,000). <https://www150.statcan.gc.ca/t1/tbl1/en/tv.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=2023&Lang=en>

NWT Bureau of Statistics. Table 1 at <https://www.statsnwt.ca/economy/oil-gas/>

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/stat-bank>

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://pxdata.stat.fi/PxWeb/pxweb/en/StatFin/StatFin__altp/statfin_altp_pxt_12bd.px

Russia

Federal State Statistics Service of Russian Federation: <https://rosstat.gov.ru/statistics/accounts>

Highlight V. The value of having the exclusive right to exploit a natural resource

Lars Lindholt, Statistics Norway

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, regions like Northern Finland has hopes for increasing its cromite production further, being the only Arctic producer.

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 measured 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 (SEEA, 2014). However, the terminology is somewhat different. Below we go through the individual components:

Value Added

Less Product subsidies

Plus Product taxes

Less Compensation of employees (input costs for labor)

Less Other taxes on production plus other subsidies on production

Equals Gross operating surplus—for the derivation of resource rent

Less Consumption of fixed capital (depreciation) + return on produced assets

Equals Resource rent

The value added earned through domestic production activity in an industry, is defined as output minus intermediate uses. 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. In addition, we deduct compensation of employees from the value added. To get the gross operating surplus—for the derivation of resource rent, we deduct other taxes on production and add other subsidies on production. Finally, we deduct return on fixed capital (produced assets) 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 mainland 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 neglectable and disregarded.

The size of the resource rent is very dependent on world market prices of oil and gas. The oil price drop from late 2014 explains the decline in resource rents from 2010-2014

to 2015-2019, and the subsequent rapid oil and gas price increase from mid-2020 leads to the record high resource rent in the 2020-2022 period. Compensation of capital is the sum of return on produced assets and capital consumption. Note that the compensation of labour makes up a very small part of value added, and that the compensation of capital makes up a relatively large and increasing 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 reinvested 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. 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. The growth in resource rent in aquaculture the last decade is mainly due to increasing prices of salmon. In hydropower, the resource rents follow closely the electricity prices, at least after 2001. The record high resource rents in 2021 og 2022 is due to the very high electricity prices in 2021 and above all in 2022.

Reference: 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

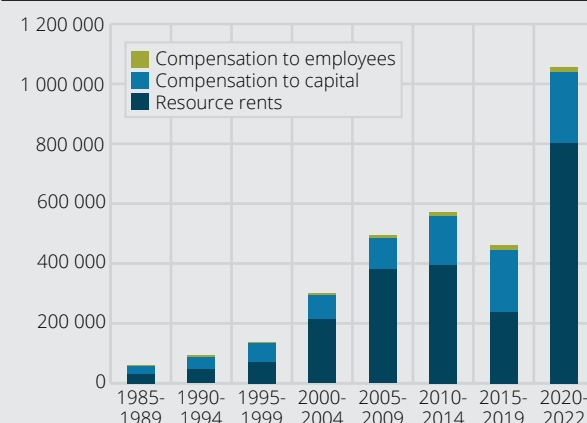
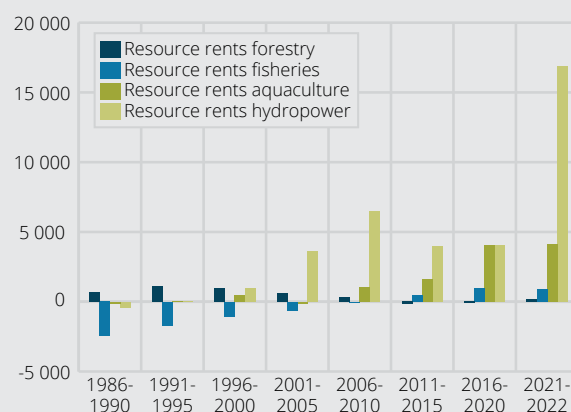


Figure 2. Five-year average resource rents from the renewable natural resources in Norway. NOK (2019-prices)/capita



Highlight VI: The blue economy of the Arctic – resource rent in fisheries in Iceland and Norway

The Arctic has been characterized as an ocean bordered by land. Along the coasts people are closely connected to the fisheries, their variability and importance to livelihood. This has been a base for daily or seasonal harvesting for own consumption and tradition, and for commercial fisheries.

The Arctic Ocean is a hot spot of favorable conditions for algae production along the ice edge, and for nutrients brought by the ocean currents from tropical waters to the North Atlantic, boosters of life from micro to macro level. The generous ocean currents belong to the Atlantic Meridional Overturning Circulation (AMOC), the conveyor belt which brings nutritious and warmer water to the Arctic regions. Economists have a reputation of trying to value everything in monetary terms, but so far nobody has assessed the value to northern communities of the conveyor belt (AMOC). These currents are pillars of our future existence. Who would dare to monetize that?

Unfortunately, climate change does not bode well for the AMOC.¹ Observations show that AMOC was at its weakest level for 1600 years – and researchers hold a tipping point as increasingly likely in a not too far future. Warming of the Arctic runs three times faster than globally. Rapidly shrinking sea ice challenges wildlife and traditional hunting and erodes coastal shorelines. Although the AMOC is the clue, it still makes sense to assess the potential and values of the ocean's productivity and sustainable harvesting of northern regions. The ocean is warming with consequences for habitat and behavior of important fish species. Capelin, an important source of food for cod and other valuable species, seems to be less plentiful than before. Schools of Atlantic mackerel, seldom seen in Icelandic waters, appeared for a while in the mid to late 2010s but have now mostly disappeared.

Commercial fishing vessels are roaming the open oceans, and vessels and fisheries run their businesses far out in the blue, with a technology that might catch “the last fish” of some species if harvesting had not been regulated. The right to harvest is getting increasingly valuable as global demand for limited marine resources is increasing. Income in fisheries have increased markedly to those with the right to harvest, as quotas have given the owners an exclusive right to harvest. The Arctic is on the supply side, and to meet the demand sustainably, the fisheries have to be constrained correspondingly.

The fisheries in Arctic waters

Table 1 indicates the importance of fisheries to the Arctic regions, focusing on their contributions to total income (value added) of the respective regional economies and income generation in various segments of the fishery cluster, consisting of fisheries, fish processing and aquaculture. The focus here is on Iceland and Norway, while sidestepping also to other Arctic regions which face many of the same challenges but might have different solutions or approaches.

Coastal Arctic regions are surrounded by a 200 mile Exclusive Economic zone (EEZ), open for a diverse fishery of Atlantic cod and other demersal species in addition to pelagic fish for consumption (herring and mackerel) and industrial use (capelin, blue whiting). Fisheries in Greenland is dominated by deep sea prawns and halibut,

Table 1. Contributions of the fishery cluster to value added (VA) at regional currencies (basic prices) and per cent. Arctic regions. 2022

Region	Cluster share of VA. Per cent	VA Fisheries	VA Processing	VA Aquaculture
Alaska	2	340 mill USD	875 mill USD	
Arctic Canada	0.3	34 mill CAD	-	
Faroe Islands	28.7	2 539 mill DKK	1 744 mill DKK	2 160 mill DKK
Greenland	18.7	3 242 mill DKK	381 mill DKK	
Iceland	7	128 594 mill ISK	108 489 mill ISK	8 602 mill ISK
Arctic Norway	14	9 074 mill NOK	8 615 mill NOK	20 047 mill NOK

Source: National accounts for Arctic regions. See tables in Chapter 4

Table 2. Number of trawlers, size of trawler fleet and average size of trawlers in gross registered tonnes (GRT). Iceland. 1999 to 2023

	Numbers	Size of trawler fleet GRT	Average trawler size GRT
1999	91	87 545	962
2005	65	80 937	1 245
2010	57	65 090	1 142
2015	47	55 476	1 180
2020	46	56 622	1 231
2023	39	52 020	1 334

Source: Statistics Iceland, Fisheries profitability studies

whereas Alaska's most important fisheries are salmon and Alaska pollock.

The large majority of catches are landed for processing in the region, however, an increasing trend is that vessels are owned by vertically integrated firms favouring processing of catch at their own facilities. The trend towards vertical integration can be seen in light of potential benefits of transfer pricing within an enterprise, as arm's length pricing within vertically integrated companies is not introduced. Hence, there is a possibility to benefit from different tax regimes for fishing and fish processing, which is increasingly the case as resource rent taxes are already introduced in several fishing regions, like Norway, Iceland and Faroe Islands.

On the other hand, the shipping industry has increased the frequency of transport between the dominant fishing regions of the Northeast Atlantic regions to UK or the continent. Hence, it is now more cost-effective to transport fish on container vessels than using the fishing vessel as a means of transportation. Avoiding import tariffs might increase the attraction of using container ships. This is the background for a trend towards a reduction in onshore fish processing of cod towards more export of fresh and frozen cod, as observed in Norway.

Fleet and invested capital in Icelandic ITQ fisheries

In Iceland, the insurance value of all vessel groups except the pelagic fleet and the trawler fleet was considerably reduced from 1990 until 2022. The value of the vessels below 200 gross registered tonnage (GRT) was reduced by 65 per cent while the value of the vessels larger than 200 GRT increased by 20 per cent from 1990 to 2022. The total value of the pelagic fleet and the trawlers was reduced by 5 per cent over the period.

Table 2 shows that number of trawlers has been reduced by as much as 57 per cent during the last 25 years, from 91 to 39, at a first glance pointing to a reduction in potential fishing capacity. However, the capacity of the whole trawler fleet measured in GRT show a markedly smaller reduction and the average GRT of trawlers has increased by 39 per cent. Trawlers are fewer and larger, clearly showing the effect of the quota system. The over-capacity is reduced, as recruitment and entry is discouraged by the cost of the quota.

Regulative regimes

Fisheries are regulated primarily for two reasons – to sustain the fish resources and increasingly to control the extraordinarily high profit, originating from the exclusive right of the quota holder to harvest limited fish resources represented by a transferable quota. There is repeatedly raised questions about the legitimacy of the management regime for the common good. In the Northwest Atlantic a rich stock of cod was seriously depleted by overfishing in 1993 and subject to a fishing moratorium. After 30 years the Canadian government lifted the fishing ban for cod off the north and east coasts of Newfoundland and Labrador, allowing commercial fishing for the first time since 1992 and set the total allowable catch at 18 000 tons.²

Considering the huge social and economic cost of this mismanagement, Arctic states introduced Exclusive Economic Zones (EEZ) of 200 miles to protect their resources and their economies, largely following up on scientific advice on the total allowable catch and the international framework for allocation among regions. Today, the Northeast Arctic cod is in a situation where the spawning stock is below a critical level and the catches are being reduced, although somewhat less than according to scientific advice.³ Total allowable catch of a species within an ocean region is based on scientific advice. Within the boundaries of the EEZs, national regulations allocate catches and there has been a marked change in fleet structure and efficiency, as observed in Iceland and Norway.

Iceland introduced partially transferable vessel quotas in 1984, while individual transferable quotas (ITQs) came in 1990. Quotas can be transferred between vessels either temporarily or permanently and a market for both options has evolved. There are separate quotas for regular (large) vessels and for hook-and-line (small) vessels. Vessel quotas can be transferred between species (except for cod and Greenland halibut). Transferring quotas from hook-and-line vessels to regular vessels is not allowed. The flexibility with respect to transfers of quotas helps in counteracting discard of fish or the misreporting of catches but might periodically increase fishing pressure on some species beyond a fixed total allowable catch (TAC). Mesh-size regulation and closure of fishing in areas rich with juvenile fish are used to discourage catch of undersized individuals. Iceland has introduced a ceiling for quota holding at 12 per cent for cod and 20 per cent for other species per fishing company in the regular quota system and 5 per cent in the hook-and-line system. Quotas are measured in cod-equivalents (CEs), reflecting the average port-side price of a species relative to average port-side price of cod for the previous fishing year.⁴

Distributional issues

The resource rent has so far seldom been a number to take right out of the statistics tables, but the essence of it is creeping into the issues of national or regional ownership to resources and the right of the general public to extraordinary high income from the use of valuable and limited resources. The management system is increasingly challenged by repeated questions of legitimacy in Iceland, Norway, and Faroe Islands, seen in light of the introduction of quotas which formally or informally serve as private ownership to resources.

In Iceland, quotas for demersal fisheries were allotted in 1983 as a part of a temporary solution to the overfishing problem. Factors influencing the distribution of quotas across boats and fisheries included previous catch and equality across vessels, adjusted for cargo capacity. The methods used to allot quotas were assumed to be temporary. A rudimentary market for temporary as well as permanent quotas soon developed. Critics pointed out the lack of social justice, as vessel owners in small communities were handed valuable quotas for free and could rent or sell the quota out of the community. The quota owners earned substantial income, and many saw that the free transfer of quotas would put concentration in the industry on a fast track.

In order to meet this criticism, an amendment to the Fishery Management Act in 1988, stated that “[T]he fish stocks around Iceland are the property of the Icelandic people”. Further, the first article of the current Act states that the fish stocks in Icelandic waters are the common property of the Icelandic people, and that allocation of ITQs to individual harvesters does not represent irrevocable property right in these TAC shares. In Iceland, in a 2012 referendum related to a proposal for constitutional reform (Stjórnarráð Islands, 2012), 83 per cent of respondents agreed that in a new constitution, natural resources should be declared public property – except where private ownership was already explicitly established.

In 2002 the Icelandic Parliament (Althing) required the vessel owner holding a quota right to pay a catch fee, making Iceland the first to tax the resource rent in wild fisheries, followed by Greenland (veiðigjald). Institutionalizing the catch fee can be seen as an effort to reducing the social tension caused by free allotment of quotas. The catch fee is levied yearly as a given amount per cod-equivalent kilogram.⁵

However, the Fishery Management Act does not require arms-length pricing of products within vertically integrated conglomerates. That opens possibilities of transfer



Atlantic cod. Photo: iStock/wrangel

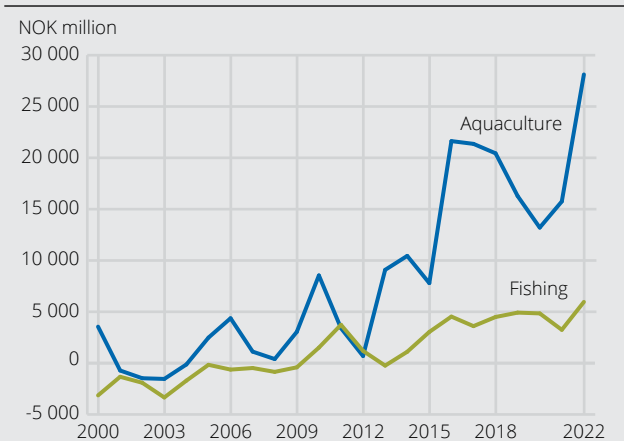
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Figure 1. Resource rent in Icelandic fisheries accruing to vessel owners (net of corporate income tax) and to the government (sum of corporate income tax and fishing fee). Per cent of Icelandic fish export revenues. 2002-2021



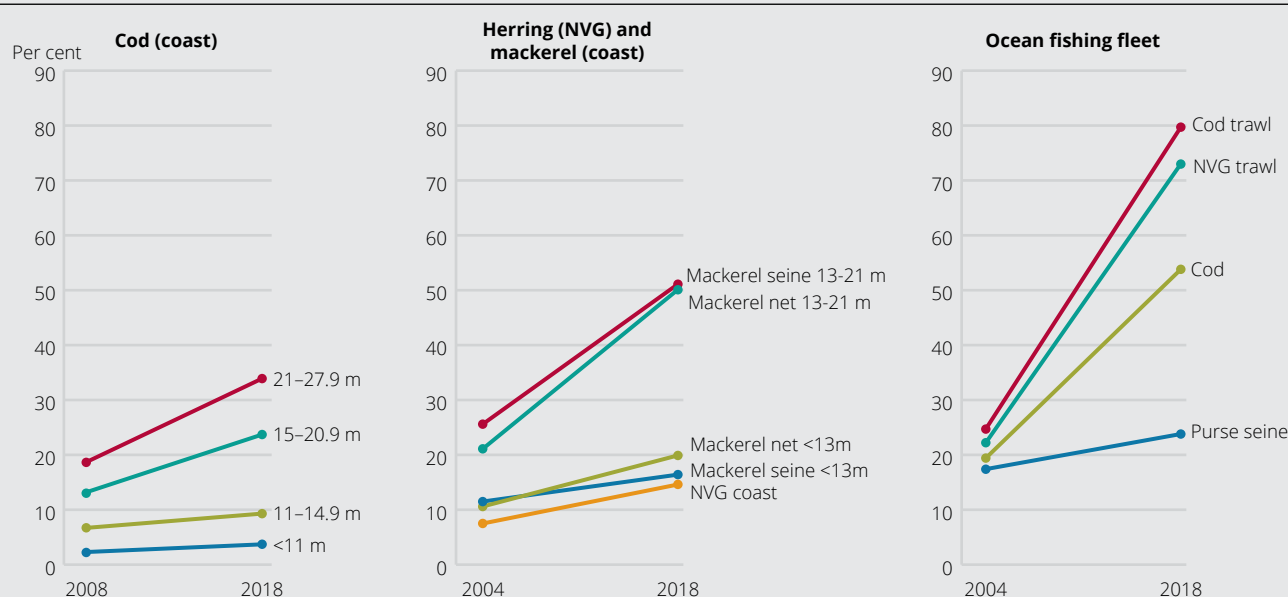
Source: Statistics Iceland and author's own calculation

Figure 2. Resource rent in Norwegian wild fisheries and aquaculture. 2000-2022. Current NOK



Source: Statistics Norway

Figure 3. Share of ownership quota for the ten largest companies in the coastal fisheries for cod, mackerel, and Norwegian spring-spawning herring (NVG). 2008 (2004) and 2018



Source: National Audit Office of Norway. <https://www.riksrevisjonen.no/undersokelse-av-kvotesystemet-i-kyst-og-havfisket/dokument-3/utdyping-av-hovedfunn/>

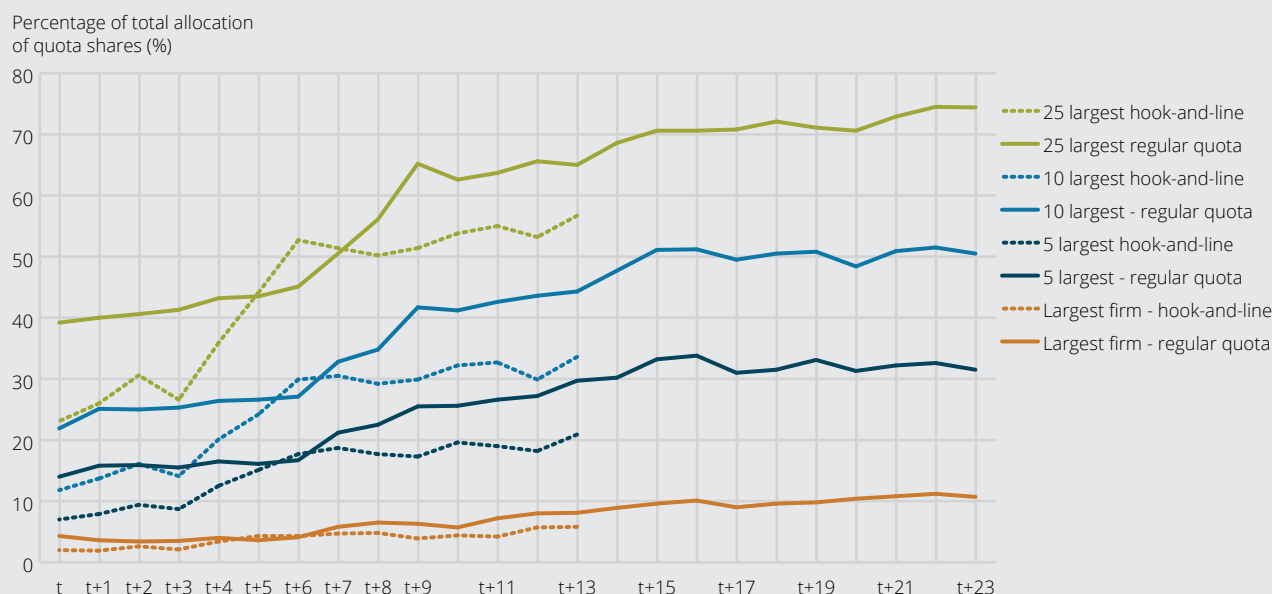
pricing, moving profits from the fishing operation to processing.⁶

The increasing efficiency lowered costs, while price hikes boosted income, both contributing to the profit markedly above the general rate of return to investments. Fishery management in various regions adopted tax or fees to secure this surplus profit for the community. Figure 1 shows the resource rent in Icelandic fisheries, as per cent of the export value of fish products, accruing to the fishing companies (net of corporate income tax) and to the government through taxes (sum of corporate income tax and the fee on the value of landed fish measured in cod price equivalents). The extremely high values in 2008 stem from the turbulence during the financial crisis and the following monetary policy with extreme nominal variations in several economic indicators.

The high revenues in aquaculture have brought attention to the fact that a surplus above normal return to investment (resource rent) originates in the use of limited and natural resources belonging to the whole population. In the Faroe Islands, a progressive tax on resource rent was introduced in 2023. The tax rates were scaled from 2.5 per cent to a maximum of 20 percent, depending on the gap between the actual and normal rate of return to investments. In 2025 the tax was revised, by lowering the maximum tax rate from 20 to 7.5 per cent, while introducing an additional corporate tax of 12 per cent for salmon farming at sea. Iceland also has an aquaculture industry where a fish fee is levied on farmed fish to capture some of the resource rent associated with use of the marine environment.

In Norway, the Law on management of wild marine resources states that marine resources belong to the public. Resource rents are increasing in Norwegian fisheries and especially in aquaculture (Figure 2). However, there is no tax on resource rent in Norwegian wild fisher-

Figure 4. Actual concentration of quotas by firms Iceland 1990-2013 (regular quotas) and 2000-2013 (hook-and-line quotas)



Source: Agnarsson, Matthiasson & Giri (2016) (see note 7)

ies. In 2024 a resource rent tax was introduced in aquaculture, not as a tax on slaughtered fish, but as a tax on income, with a tax-free amount per company. The idea behind was to let the tax payments decline when income declined. However, this tax opened for a splitting of companies and outsourcing of tasks to daughter companies, thus reducing the tax base through vertical disintegration, as the industry also pointed out beforehand.

Concentration of quotas in fisheries

In Norway, the share of the ownership quotas for the ten largest companies has increased much more for the ocean fishing fleet than for the coastal fishing fleet (Figure 3).

In Iceland, after nearly two decades of quota trading, a study mapped the actual development of concentration of quotas by firms and by geography during 2000- 2023.⁷ 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 4 shows that the 25 largest 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 largest 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 largest 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.

Environmental and social concerns

Damage to the seabed from bottom trawl has long been a concern. In a report to The International Council for the Exploration of the Sea (ICES) the Marine and Freshwater Research Institute of Iceland points to damage from use of bottom trawl targeting demersal species, shrimp and shellfish. Introduction of non-fishing areas is among various efforts to reduce the damage. The United Nations warn of ecological risks of deep-sea mining.⁸ Aquaculture is increasingly a challenge to animal welfare and impacts on the marine environment.⁹

Notes

¹ Strehl, A.-M., K.Våge, L. H. Smedsrud, T. Barreyre, 2024. A 70-year perspective on water-mass transformation in the Greenland Sea: From thermobaric to thermal convection. *Progress in Oceanography*, 227, 103304

² <https://www.globalseafood.org/advocate/canada-lifts-30-year-cod-fishing-ban-off-newfoundland-and-labrador-to-mixed-reactions/>

³ <https://www.fiskeribladet.no/forskning/torskebestanden-er-i-darligere-foratning-enn-forskerne-trodde-hvorfor-er-de-usikre-pa/2-1-1472884>

⁴ Agnarsson, S and Matthiasson T: Property Rights in Icelandic Fisheries, ch. 22 in *Handbook of Marine Fisheries Conservation and Management* (Oxford University Press, USA). Edited by R. Quentin Grafton, Ray Hilborn, Dale Squires, Maree Tait and Meryl Williams, 2010

⁵ Matthiasson, Thorolfur. (2008). Rent Collection, Rent Distribution, and Cost Recovery: An Analysis of Iceland's ITQ Catch Fee Experiment. *Marine Resource Economics*. 23. 10.1086/mre.23.1.42629604.

⁶ Flaaten, O., Heen, K., & Matthiasson, T. (2017). Profit and Resource Rent in Fisheries. *Marine Resource Economics*, 32, 311 – 328

⁷ Agnarsson, S., Matthiasson, T., & Giri, F. (2016). Consolidation and distribution of quota holdings in the Icelandic fisheries. *Marine Policy*, 72, 263-270.

⁸ https://www.oceancare.org/en/stories_and_news/un-body-issues-warning-on-ecological-risks-of-deep-sea-mining/

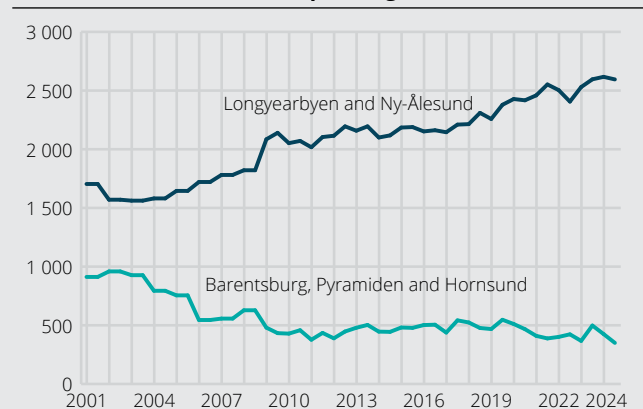
⁹ <https://www.vetinst.no/rapporter-og-publikasjoner/rapporter/2025/fiske-helserapporten-2024>

Highlight VII: Svalbard – coal, tourism and research



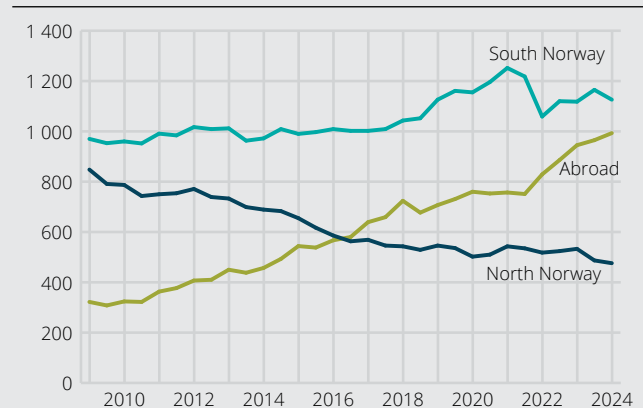
Svalbard is an archipelago in the Arctic Ocean, lying between 74 and 81 degrees North. It is in its entirety part of the Kingdom of Norway, as the Svalbard treaty of 1920 grants Norway the full and absolute sovereignty of Svalbard. Citizens of countries that have signed the treaty have equal rights to uphold commercial activity there, and the archipelago is visa-free.

Figure 1. Number of people living in different settlements of Spitsbergen. 2001-2024



Source: Statistics Norway

Figure 2. Number of people living in Longyearbyen and Ny-Ålesund, sorted by their country of registered residence, or part of country. 2009-2024



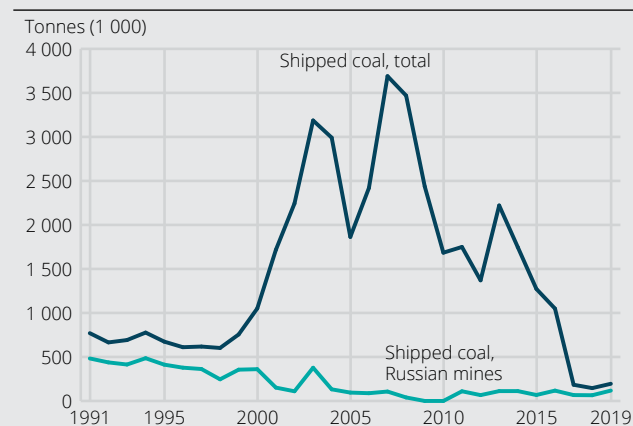
Source: Statistics Norway

The area of Svalbard is approximately 16 per cent of the total area of Norway, and 62.1 per cent of it is covered by snow and ice. The largest island is Spitsbergen, where all permanent settlements and human activity are located.

Longyearbyen is the Norwegian administration center 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 Kulkompani, to a more diverse society. The other settlements are Barentsburg, Sveagruva, Ny-Ålesund, Hornsund and the two meteorological stations on Hopen and Bjørnøya.

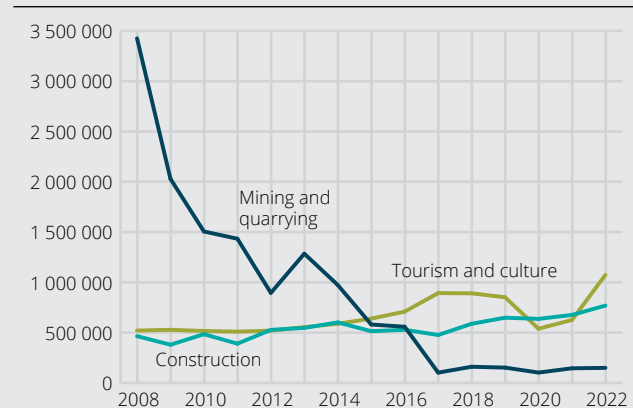
68.9 per cent of the land area of Svalbard, including freshwaters, is protected, and the protected areas include national parks, nature reserves, and a geotope (geological protection areas)¹. This is to conserve the archipelago's unique nature, landscape and cultural heritage.

Figure 3. Coal shipped from Svalbard. Thousand tonnes. 1991-2019



Source: Statistics Norway

Figure 4. Turnover in selected industries in Svalbard. 2008-2022



Source: Statistics Norway



Svalbard. Photo: Colourbox

For a small community, there is a decent amount of good and up-to-date statistics about Svalbard. In general, data availability and quality for Longyearbyen is better than for the rest of Svalbard. The data material for Barentsburg is limited. Apart from population statistics, there are few figures for Hornsund and Ny-Ålesund.

Population

There are no Indigenous peoples on Svalbard. The archipelago was discovered in 1596 by a Dutch expedition led by Willem Barentsz, while they were looking for a northern sea route from Europe to Eastern Asia.

The population on Svalbard consists mainly of people moving there to work.² There are about 2 900 people settled on Svalbard in 2024 and the population is mainly concentrated in two settlements: Longyearbyen and Barentsburg.

The increase in population since 2016 is due to more people of working age living in Longyearbyen.

Svalbard used to be inhabited to a large degree by men from Northern Norway, many of them working in the coal industry. As this industry has become less important, the Norwegian share has fallen.

The share of the population in Longyearbyen and Ny-Ålesund with Norwegian citizenship fell from 85 per cent in 2009 to 62 per cent in 2024. As of now, citizens from more than 50 nationalities are living there.

The average length of stay for Norwegian citizens was 7.4 years in 2022, while the median length of stay was 3.6

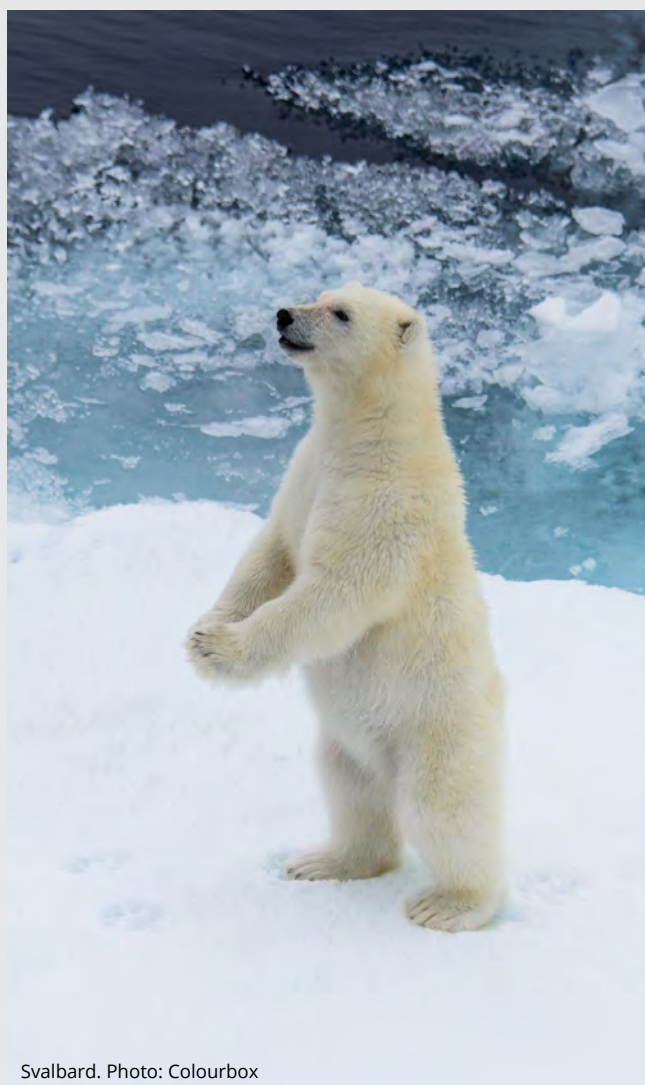
years. Especially the latter has fallen in recent years. The proportion of women in Longyearbyen and Ny-Ålesund has increased for years, and in the second half of 2023 it was 47 per cent, the highest ever.

Economic conditions

The tax system on Svalbard is different from mainland Norway, as the Svalbard treaty limits the right to taxation to that of providing services on Svalbard. Therefore, Svalbard has a lower income tax than mainland Norway, and there is no value added tax. The public sector – including state-owned companies such as Store Norske – is still an important employer on Svalbard. Approximately 50 per cent of those employed work in the private sector, compared to 65 per cent on the mainland. The mining operation at Store Norske has a much less dominant role in business life in Longyearbyen than before.



Svalbard. Photo: Colourbox



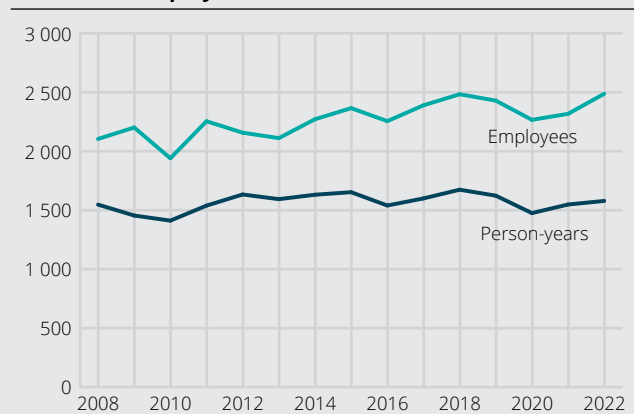
The proportion of employees in mining operations fell from 19.5 per cent in 2008 to 3.2 per cent in 2022. This amounts to a reduction of 330 employees. The total number of employees on Svalbard has nevertheless increased during the period. Accommodation and catering employed the most people in 2022.

The industry of transport and storage has increased its sales (turnover) the most, by 380 per cent since 2015. The proportion of turnover on Svalbard that comes from sales to local people or businesses has been increasing for a long time but fell back in 2022. Employment on Svalbard has increased more than hours worked, as the proportion of people working part-time has increased.

Living conditions

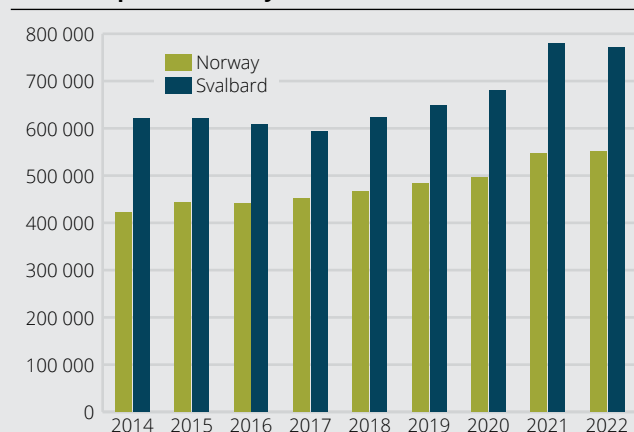
Those who live in Longyearbyen have on average relatively good health and finances. Sick leave is much lower than on the mainland, although there has been an increase after the pandemic. There has been an improvement in equality between women's and men's

Figure 5. Number of person-years and number of employees. Svalbard 2008-2022



Source: Statistics Norway

Figure 6. Average gross income per capita. NOK, current prices. Norway and Svalbard. 2014-2022



Source: Statistics Norway

economic situation. The number of dwellings per inhabitant changed little from 2015 to 2022. There is relatively little crime in Longyearbyen. The pupils at the schools are doing just as well as elsewhere in Norway, in terms of satisfaction and grades achieved.

As the median residence time for Norwegian citizens has fallen, the share of children has also been falling. Currently, there are 74 children in kindergarten in Longyearbyen, down from an average of 120 in the period 2004-2014.

Statistics Norway has not carried out a survey on level of living for Svalbard since 2009. Based on previous surveys and selected categories for level of living, living conditions in Longyearbyen overall seem to be somewhat above average for Norwegian local communities, although there is of course great variation between groups. However, one cannot conclude too firmly about this, because the data material is limited.



Tourism

Data from the Norwegian Coastal Administration shows that Longyearbyen was the fifth largest cruise destination in Norway in 2022. Cruise tourism comprises overseas cruise tourism with large ships and expedition voyages where tourists arrive in Longyearbyen and embark for voyages. In 2022 about 19 500 cruise ship passengers arrived on a total of 17 ships. The number of cruise ship passengers was lower than before the pandemic. In the years from 2015 to 2019 the number of cruise ship passengers was between 37 000 and 50 000. The number of expedition tourists in 2022 was about 24 100, much higher than before the covid pandemic. A report from Epinion in 2019 showed that expedition cruise tourists in 2018 spent more than five times as much money in the local economy than cruise ship passengers.³

Figure 7 shows the number of passengers arriving in Longyearbyen by ship and by cruise ship. In 2022 almost 85 000 passengers arrived by air and almost 19 500 passengers arrived by cruise ship.

Tourism was considerably reduced in Svalbard during the covid pandemic. The number of passengers in 2020 was reduced by 63 per cent from the year before. No overseas cruise passengers arrived in Svalbard in 2020 and 2021. Despite recovery the following years, the number of air passengers was almost 8 per cent lower in 2022 than in 2019. The overseas cruise tourism was also at a lower level than before the pandemic.

Notes

¹ Nature conservation areas | Governor of Svalbard

² Svalbard: Population, economy and living conditions – SSB

³ Epinion Cruise Study Svalbard PowerPoint Presentation

Figure 7. Air and cruise passengers. Svalbard. 2010-2022



Source: Statistics Norway, Longyearbyen harbor





Local marketplace, Nuuk, Greenland. Photo: Tom Nicolaysen

5. The effects on Arctic petroleum extraction of achieving a 1.5°C scenario

Lars Lindholt and Solveig Glomsrød

Introduction

This study looks at the potential effects on the oil and gas extraction in the Arctic if the world manages to limit global temperature change to below 1.5°C compared to pre-industrial levels, ultimately reducing global CO₂ emissions to or potentially below net zero around 2050. The Intergovernmental Panel on Climate Change (IPCC) report indicates that from a physical science perspective, limiting human-induced global warming to a specific level requires reaching at least net zero CO₂ emissions, also requires strong reductions in other greenhouse gas emissions.¹ Net-zero energy systems, where CO₂ emissions are balanced by removals like carbon capture and storage (CCS) or carbon sequestration in the biosphere, are likely to be central to bring overall emissions to zero.²

The Paris Agreement from 2015 is an international treaty on climate change that was strengthened at the Glasgow meeting in 2021 to limit global warming to below 1.5°C. A strand of studies has been published using integrated models that analyse how the 1.5°C target can be reached, e.g. the IPCC-scenarios presented in Masson-Delmotte et al.³

In 2021, the International Energy Agency (IEA) released a report describing a roadmap for the global energy sector to achieve net zero emissions by 2050 (NZE), which is necessary for a 1.5°C world.⁴ This net zero emissions scenario is the most cited and well-known NZE pathway for energy sectors, referred to in this chapter as NZE IEA. NZE IEA depicts a pathway of both demand for fossil fuels (coal, oil and gas) and total CO₂ emissions from the



Melkøya, Finnmark. Photo: Colourbox



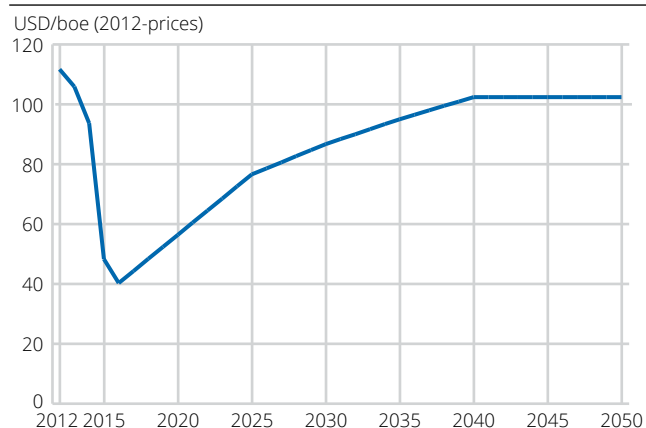
Part of the Labrador Iron Mine facilities in Schefferville, at the beginning of open pit operations in Schefferville. Photo Gérard Duhaime, 2011.

combustion of fossil fuels. Lindholt and Wei⁵ create a similar pathway to 2050 using a general equilibrium model GRACE as well as a model of the global energy markets FRISBEE. In the present study we apply the latter model.

We ask how the NZE IEA pathway may affect petroleum production in the Arctic regions, using a version of the FRISBEE model where also the Arctic regions relevant for petroleum activity are specified (Alaska, Northern Canada, Greenland, Northern Norway, and Northern Russia). FRISBEE is a comprehensive and transparent global oil and gas model 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 new reserves, which can be new fields or improved 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 model feature for this study is that due to generally long lead times, it takes time before investments in new fields reserves lead to production. Likewise, there will also be a time lag between a decline in oil and gas investment and reduced production. However, additional investments in im-

proved oil and gas recovery from existing fields will have a more rapid effect on supply. These features of the model will be central when we implement climate policies that reduce and limit investments. We emphasize that due to uncertainty in many estimates, the focus of this analyse is not on forecasting the future level of extraction in the reference scenario itself, but the relative effects of stringent climate policies on oil and gas production in Arctic regions. This logic also applies to geopolitical issues bringing uncertainty into the study, for instance to what extent there might be long-lasting effects of disturbances in the oil and gas markets through enhanced supply of renewable energy.

In 2021 Russian oil production was 14 per cent of the world's total supply. In addition, Russia has the world's largest gas reserves and is the world's largest gas exporter.⁶ A major part of the gas production and a large part of the oil production in Russia is situated in the country's vast Arctic region. Hence, a reduction in Russian oil and gas extraction will certainly have effects on activity in Arctic Russia with possible repercussions to other Arctic regions. However, how this might unfold in our reference scenario is very uncertain. In general, our reference scenarios are clearly influenced by many uncertain estimates and assumptions. For example, to what extent should we assume reductions in future oil and gas extraction in Greenland since the government of Greenland introduced a law of zero exploration licenses in 2021? And further, should we close the Arctic Ocean in Alaska for invest-

Figure 5.1. Oil price assumption. 2012-USD/boe

Source: IEA 2019 Stated Policy Scenario

ments, now that the present (2023) administration has announced to block any future offshore leasing in that area? Our answer to all this uncertainty is to stick with our consistent reference scenarios, and rather focus on the relative effects of implementing a global net zero emission scenario. Hence, when modelling reference scenarios we continue to assume that petroleum companies have full access to the reserves, disregarding environmental or political barriers. The production and investment decision in the model will solely be based on profitability. Below we will discuss to what extent this is realistic with regards to each Arctic region.

The oil price follows an exogenous trajectory in FRISBEE. Firstly, we develop the reference scenario based on the Stated Policy Scenario (STEPS) of IEA.⁷ In this IEA scenario the real oil price is expected to be 77 USD per barrel in 2025 before rising to around 102 USD in 2040, all prices in 2012-USD⁸ (Figure 5.1). As we study the effects until 2050, we prolong the real oil price trajectory by keeping the real 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 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 has been 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, being sea transport for LNG or pipeline for gas. In the FRISBEE model, investors respond

with adaptive price expectations, assuming that 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 in the reference scenario, as the endogenous market price for gas is increasing.

We start by constructing a reference scenario for petroleum production in the Arctic regions. Assumptions on population development, GDP growth rates and CO₂ prices in each region are taken from STEPS in IEA⁹ and included in the reference scenario in FRISBEE.

When establishing the NZE scenario in FRISBEE we incorporate fixed paths for core policy variables applying the following strategy: Introduce the CO₂ taxes by year and region calculated from the NZE IEA scenario. Further, introduce the NZE given regional use of non-fossils (renewables and nuclear) in the power sector, which will lead to less use of gas (and coal) and increased use of non-fossils in the power production. In addition, we increase the annual energy efficiency improvement in use of fossil fuels, which entails lower demand for a fuel for given income and prices. We also run the model simulations with a halt in new investments in oil and gas reserves as from 2021, which are key milestones in the NZE IEA.¹⁰

Arctic oil supply

Figure 5.2 compares the simulated future production of oil in the Arctic in the NZE IEA with the reference scenario. The reference scenario will lead to a relative constant total Arctic oil production up until the mid-2040s, before it increases from around 460 Mtoe to almost 510 Mtoe in 2050. We emphasise that behind this development, many fields are exhausted, while new fields are being developed. The reason for the surge towards the end of the projection period is rapidly rising supply above all from Greenland and to some extent from Alaska.

As from 2021 we introduce measures to mimic the NZE scenario in FRISBEE, including a halt in new investments in oil reserves from 2021. The latter measure means that future production must come from already developed proven reserves leading to a decline in production over the forecasting period.

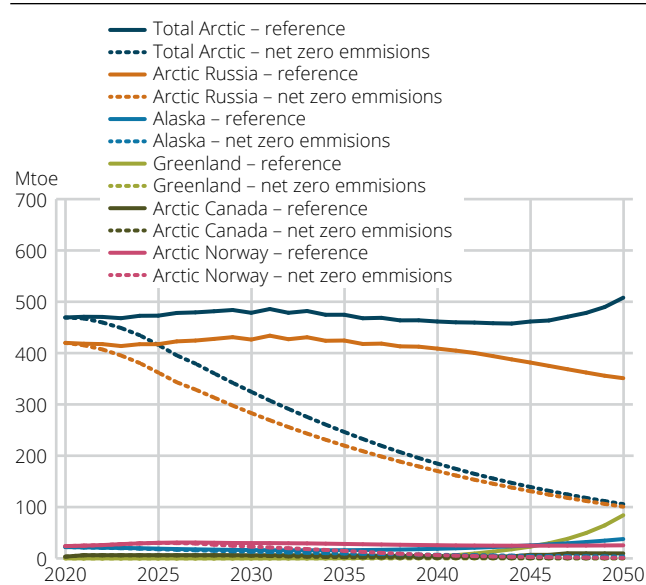
Figure 5.2. Arctic oil production. Reference scenario and net zero emission scenario. Mtoe

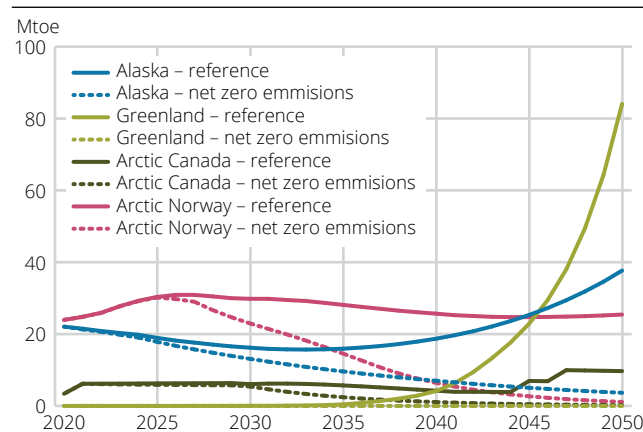
Figure 5.2 shows that total Arctic oil production declines by almost 80 per cent from the reference scenario in 2050 to a level slightly above 100 Mtoe.

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-2030s, before it enters a declining path towards 20 per cent below today's level by 2050. Around three-quarters of the present Arctic Russian oil production takes place onshore in Khanty-Mansi, Yamal-Nenets 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.

There are plans to develop the Vostok Oil project in the Taimyr Peninsula by the Russian state company Rosneft, potentially reaching a production level of 100 Mtoe per year in 2030. The oil will be pipelined several hundred kilometres north to a new terminal on the coast of the Kara Sea. There are also plans for developing other fields. Russia currently redirects its export from Europe and other Western countries to Non-OECD Asia due to sanctions, but it is highly uncertain how smooth the opening of new logistics chains will go, in particular transport along the Northern Sea Route, requiring large

Figure 5.3. Regional distribution of West Arctic oil production. Reference scenario and net zero emission scenario. Mtoe

investments.¹¹ This could mean that our reference scenario overestimates Russian oil supply in an early phase. From 2030 an increasing part of the production must nevertheless come from undiscovered fields, involving considerable investments and development costs. Prior to 2030 almost all production comes from already discovered reserves, both developed and undeveloped.

Figure 5.2 shows that oil production in Arctic Russia declines markedly when investments is stopped as from 2021. Production declines as there are no new investment projects coming on stream and production must come from an ever-diminishing resource base of already developed fields. Accumulated supply during 2021- 2050 in Arctic Russia and the Arctic as a whole declines by 43 and 45 per cent, respectively (Table 5.1). However, Arctic Russia's production in 2050 is still over one quarter of the present level. This means that Arctic Russia has enough profitable proven and developed oil reserves to sustain a production level of 100 Mtoe in 2050, whereas other Arctic regions are marginalized in the NZE IEA scenario.

Figure 5.3 highlights the impact of a net zero emission scenario in other and less dominating petroleum regions in the Arctic.

Alaska

Alaska's oil production is mainly taking place on the North Slope, where the Central North Slope and adjacent waters of the Beaufort Sea has been the dominant producing region. Alaskan oil production has been declining since the giant field of Prudhoe Bay peaked in 1988 and continues to decline up until the mid-2030s in our reference scenario. How-

Table 5.1. Reduction in accumulated oil production 2021–2050. Net zero emission scenario relative to reference scenario. Per cent

Total Arctic	Green-land	Arctic Russia	Arctic Canada	Arctic Norway	Alaska
45	100	43	52	47	49

ever, new resources at relatively low cost are available and over time, investment in these reserves steadily increases supply towards 2050 to almost 16 Mtoe above the level in 2020. However, substantial future increase in Alaskan oil production probably requires that onshore areas including the area of the Arctic National Wildlife Refuge (ANWR)¹² and the National Petroleum Reserve Alaska (NPRa) both under federal management are accessible. It is possible that a large part of the Alaskan undiscovered oil might be 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, where previous activity was cancelled due to protests from Indigenous Peoples. In March 2023 the Biden administration approved the controversial Willow project in the NPRa, whereas the President announced that his administration will block any future offshore leasing in the Arctic Ocean and plans to block 13 million acres of the NPRa from future leasing.¹³

Introducing measures to align with the NZE scenario leads to a declining production profile over the whole projection period. Alaskan oil production in 2050 is 90 per cent below the production level in the reference scenario. Aggregated supply over the whole period declines by 49 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 the 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 was due in 2021 and the ban was extended to the end of 2022. Canada is mulling a review of its current moratorium on Arctic drilling.¹⁴ 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 the mid-



Photo Mary Stapleton

2040s, followed by a relatively strong increase up to almost 10 Mtoe by 2050, a level which will require infrastructure investments as e.g. pipelines.

Introducing a stop to new investments in line with the NZE scenario results in declining production up to 2050, when production practically reaches zero. Accumulated supply decreases by 52 per cent over the period. The reason for the relatively large decline is that future oil production is relatively more dependent on future investments in terms of exploration and field development compared with Arctic Russia, endowed with a considerable amount of already proven reserves.

Northern Norway

Arctic Norway includes the Norwegian Sea, where production started on the Draugen-field in 1993, and the Barents Sea. We keep the areas of Lofoten, Vesterålen and Senja closed for petroleum activity as is the present policy to conserve important spawning and fishing grounds. Currently there is only one producing oil field in the Barents Sea, where the Goliat field was developed in 2016. Another Barents Sea field, Johan Castberg, is expected to start oil production early 2025.

In 2022 the Equinor company with the Norwegian government as the major shareholder postponed plans for the Wisting field to 2026 due to an uncertain market situation. In 2024, the Norwegian Offshore Directorate announced that it has approved drilling at two blocks located in the central parts of the Barents Sea.¹⁵ The blocks are located in the Wisting field, situated even farther north in the Barents Sea, and considered by many a climate and environmental risk in a particular vulnerable area.¹⁶

In the reference scenario, oil production increases over the next few years, before it declines as from late 2020s and ends up around the present production level in 2050. Behind such a development lies increasing supply from the Norwegian Sea up to mid-2020s, followed by a relatively steep decline. This decline is almost counterweighted by increasing production in the Barents Sea over the next 30 years, as relatively large amounts of new reserves are coming into production (Figure 5.3).

Introducing stringent climate measures leads to a rapidly decline in supply which ends up at 1 Mtoe in 2050, 95 per cent below the level in the reference scenario. Accumulated production decreases by 47 per cent over the period.

Greenland

Greenland has almost one-sixth of the undiscovered oil in the Arctic, but no reserves have been proven as profitable and recoverable. In addition, Greenland has possibly the longest lead times and highest costs among the Arctic regions. Greenland has only four active exploration and production licences left - three onshore in Jameson Land on the east coast and one offshore in southwest Greenland. Those licences expire in 2027 and 2028.¹⁷ In our simulations production for total Greenland starts as late as from around 2035 and reaches over 80 Mtoe by 2050. Such an increase in production is dependent on increased future exploration leading to discoveries and development of new reserves.

On 16 July 2021 the government of Greenland announced it would suspend its strategy for oil exploration and stop granting exploration licences¹⁸, having assessed that the environmental consequences of oil exploration and extraction are too great. Alongside environmental concerns, the government said its decision was underpinned by economic analysis showing any development would either deliver low profits or make a loss. To stop investment as from 2021 means that there will be no oil production in Greenland over our projection period. This is in line with the policy of the NZE IEA scenario.

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 various scenarios.

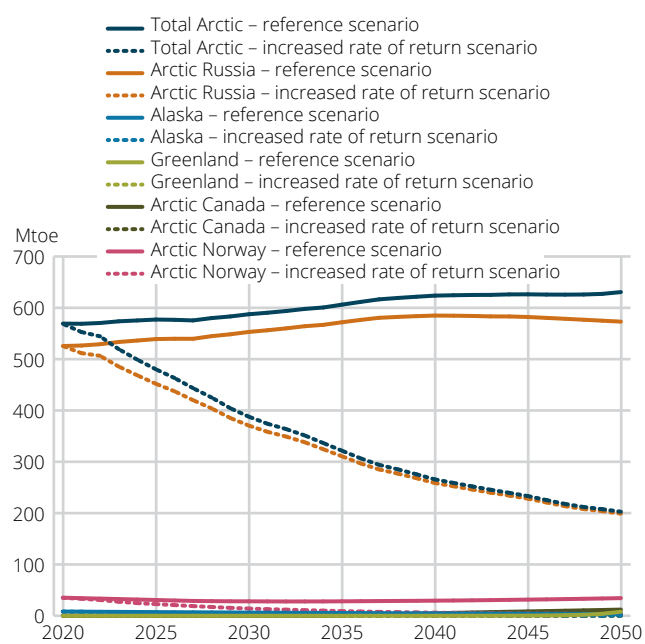
Figure 5.4 shows total Arctic gas production in the reference scenario. Gas supply increases slightly up until around 2040 when it reaches a plateau. Arctic gas production in 2050 ends at 10 per cent above the 2020 level. In our reference scenario the average gas price across Arctic regions is 74 per cent higher in 2050 than in 2020, not far from the increase in oil price of 82 per cent over the same period.

We introduce lower gas demand through CO₂ taxes and a halt in new investment as from 2021 corresponding to the NZE scenario. Like for oil, this means that future production of gas must come from already developed proven reserves leading to declining gas production over the whole forecasting period. Figure 5.4 shows that total Arctic gas production declines by almost 68 per cent from the reference scenario in 2050, compared to a decrease of 80 per cent for oil. This means that a larger share of the developed proven gas reserves remains profitable to extract under climate policy compared to oil. This holds even if the gas price is depressed before it settles at a more or less constant level in the climate policy scenario, compared with the fixed, generally increasing exogenous producer price of oil.

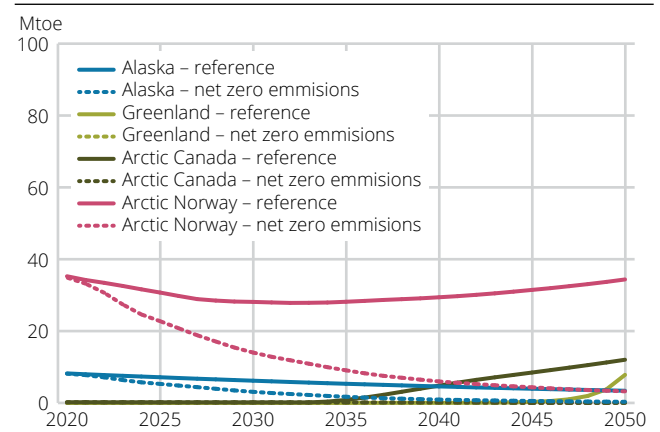
Arctic Russia

Arctic Russia is a giant gas producer in Arctic and global context, with over 90 per cent of the total Arctic production and 85 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. In the reference scenario Arctic Russian supply increases somewhat until 2040, then declines marginally to the end of our projection period when gas production still is around 9 per cent above the present level. The reference scenario for Arctic Russia is to a relatively large extent based on production from already discovered reserves, both developed and undeveloped, compared to the other Arctic regions.

Generally, fields are emptied over time and to prevent production from declining, new fields must be discovered and developed to sustain an increasing, or even constant, production profile. Some of the 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

Figure 5.4. Arctic gas production. Reference scenario and net zero emission scenario. Mtoe

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 various Yamal Peninsula projects, where almost all Arctic Russian gas production takes place. Offshore production is generally costlier and more demanding than onshore extraction and is also dependent on different technological expertise and experience. Today, western companies are not allowed to deliver such technologies due to sanctions. The supergiant Bovanenkov onshore gas field, larger than the giant offshore Stockman gas field put on hold, began production in 2012. Bovanenkov is producing 15-20 per cent of total Russian gas in 2021. Another giant field, the Kruzenshternskoye field, will probably start production in the mid-2020s and will be connected to the Bovanenkov field via pipelines.¹⁹ It is not obvious how future European gas import will develop to 2050 and affect Russian gas export and production. However, it seems unlikely that this export will increase within the given time frame. Two gas pipelines -North Stream 1 and 2- from Russia to Germany were destroyed in 2022. In addition, as from 2023 the EU has cut almost all petroleum imports from Russia. Further, we can expect gas demand from Asia to continue to increase. A new pipeline from East Arctic Russia is currently delivering increasing amounts of gas to China. In addition, possibly starting in 2024, there are plans for building a new

Figure 5.5. Regional distribution of West Arctic gas production. Reference scenario and net zero emission scenario. Mtoe

gas pipeline from Yamal through Mongolia and to China. This could mean that in some years, probably in 2030 at the earliest,²⁰ it might be possible to transport gas from Yamal in Western Siberia to China and other Asian markets.

Also, the Yamal LNG plant started production in 2017 for export to Asia along the Northern Sea Route and to Europe. Planned investments in additional LNG capacity through the Arctic LNG 2 plant has been postponed, as western gas companies halt all investments in Russia, possibly indicating that Russia is dependent on Western technology to follow up its major Arctic LNG projects.²¹ Alternatively, Russia is currently constructing Arctic LNG 2 in joint collaboration with China.²² Note that in our model gas will be traded if profitable, using the lowest cost transportation method, gas via pipelines, or LNG transport at sea. Hence, the reference scenario in our study reflects a situation in the long term without sanctions or other potential constraints. However, lower gas production in Arctic Russia as from 2023 might occur due to a halt in EU imports even if export to Asia might increase somewhat. This would mean that we may overestimate Russian supply in the reference scenario at least up to 2030, when the new eastern pipeline at the earliest might come into operation.

Introducing climate policies, including a halt in new investments, to align with the net zero emission scenario entails that declining Russian gas production and supply ends up 65 per cent below the level in the reference scenario in 2050. Accumulated production decreases by 42 per cent over the period (Table 5.2). The reason for the relatively small decline is that a relatively large part of future Arctic



Pipelines in Alaska. Photo: Colorbox

Table 5.2. Decline in accumulated gas production 2021-2050. Net zero emission scenario relative to reference scenario. Per cent

Total Arctic	Green-land	Arctic Russia	Arctic Canada	Arctic Norway	Alaska
44	100	42	96	61	54

Russian production is based on already developed proven reserves, so stopping investments does not affect future extraction that much compared to other regions.

Figure 5.5 highlights the projected future reference supply of gas from other Arctic regions than Russia.

Alaska

The reference scenario sees a steady decline in Alaskan supply of gas of almost 60 per cent over the projection period. The reason is that many fields become unprofitable even if Alaska probably has as much as one-fifth of undiscovered gas in the Arctic, including Alaskan shale gas. To prevent the decline in gas supply it seems paramount to build infrastructure to bring gas from Prudhoe Bay to the market. After more than a decade of planning and negotiations the government on January 10th 2025 signed a deal with the Glenfarne Group to build a natural gas pipeline for the proposed USD 44 billion Alaska LNG project, taking natural gas 800 miles from the North Slope to a new liquefaction plant at Nikiski in the south, North America's longest serving LNG export location.

After decades of opposition to drilling in the ANWR oil and gas leases were auctioned in January 2021. However, interests were low, above all towards gas,²³ possibly reflecting a more risk averse attitude

towards large gas projects with a long-term horizon and uncertain profitability. The January 2025 oil and gas lease sale also drew no bids from oil companies.

Introducing measures to reach a net zero emission scenario leads to an even faster decline in gas production over the whole projection period. Alaskan production almost comes to a halt at the end of the period, when production is 91 per cent lower than in the reference scenario.

Aggregated supply until 2050

declines by 49 per cent (Table 5.2). This study tracks gas extraction to be marketed as an energy carrier. However, the majority of gas extraction is injected into oil reservoirs to increase pressure and improve oil production, which declines as fields are emptied.

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. As undiscovered gas reserves gradually are found and developed in the reference scenario, supply starts to increase around the mid-2030s, reaching 12 Mtoe in 2050. 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 opposed by Indigenous People was meant to transport gas from the Northwest Territories and south to Alberta oil sands areas and further. With increasing need for gas in Europe, the possibilities of exporting LNG seem however somewhat more realistic.

In line with the NZE scenario, with lower gas demand and a halt in new investments as from 2021 production will stay at the present level of 0.1-0.2 Mtoe over the whole period. Table 5.2 shows that aggregated supply over the whole period declines by 96 per cent as almost all future extraction would require new investments.

Northern Norway

Today Arctic Norway produces gas in the Norwegian Sea and the Barents Sea (the Snøhvit field). In the reference scenario production declines by around 20 per cent up to around 2030. From then on production increases as new fields are developed and ends up at the present level. Behind such a development lies increasing supply from both the Norwegian Sea and the Barents Sea. A new pipeline 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. Increased future production in the Barents Sea is dependent on pipelines and/or increased LNG capacity beyond what is already available at Melkøya near Hammerfest, supplied with gas from the Snøhvit field.

Introducing stringent climate measures in the NZE scenario leads to a rapid decline in supply which ends up at only 9 per cent of the present level, at around 3 Mtoe in 2050. Accumulated production decreases by 61 per cent over the period as a relatively small part of this production is based on already developed proven reserves.

Greenland

In Greenland gas has been indicated by seismic surveys, but no findings have proven viable. Even after decades of exploration for hydrocarbons, many parts of the Greenland continental shelf area are relatively unexplored. There is still some exploration activity for gas (and oil), and two new licenses for exploration and extraction of gas (and oil) were granted in 2019.²⁴ There are now four licences that will expire in 2027 and 2028. 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. Supply reaches almost 8 Mtoe in 2050, a level higher than that of Alaska. 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 as well as increasing exploration.

With no new investment as from 2021 there will be no gas production in Greenland up to 2050. This is in line with the law of 24 June 2021²⁵ introduced by the government of Greenland, allowing no new exploration licenses from 2021.

Summary

IEA presents the most cited and well-known net zero emission pathway for energy sectors. This scenario is aligned with the criteria of the Paris Agreement when it comes to limiting global warming to 1.5°C. The scenario depicts a pathway of both demand for fossil fuels and total CO₂ emissions from fossil fuels. We have modelled a similar pathway to 2050 using a partial equilibrium model FRISBEE of the global energy markets. This study looks at how the net zero emission scenario might affect the oil and gas supply in Arctic regions until 2050.

Introducing a net zero emission scenario including a halt in new oil and gas investments as from 2021 leads to a reduction in accumulated Arctic oil and gas production of 45 and 44 per cent respectively up to 2050. One might ask: Why is the relative change in oil and gas so similar? On the one hand, a larger amount of the developed proven gas reserves remains profitable to extract under climate policy compared to oil. This should result in a lower decline in accumulated gas production. On the other hand, the global measures on the demand side have a stronger effect on gas demand than on oil consumption. Firstly, the introduction of CO₂ taxes has a stronger effect on gas, even though it contains less carbon than oil. The reason is that oil basically represents more expensive energy than gas. A price premium in relation to the CO₂ content therefore gives a relatively smaller burden to the end-user price for oil than for gas. Secondly, phasing in large amounts of non-fossil energy in the electricity sector in line with the NZE scenario will affect gas much more than oil as oil is hardly used in electricity production. The two latter effects mean a larger decline in gas consumption and production, so gas and oil end up with a very similar relative decline in accumulated production when stringent climate policy measures are introduced.

The relative decline in oil and gas supply varies between the regions but is lowest in Arctic Russia and highest in Greenland, where there will be no petroleum production if the world is to follow a net zero emission scenario. In this scenario, Russian production in 2050 constitute 95 per cent and 98 per cent of total Arctic supply of oil and gas, respectively. The reason is that this region contains relatively large amounts of already developed proven petroleum reserves that can sustain some production until 2050.

Highlight 5.1. The FRISBEE model of global petroleum markets

The FRISBEE model is a recursive, dynamic partial equilibrium model for fossil fuels (oil, gas and coal), renewables and electricity in 18 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.¹ We have perfect competition on the gas and coal markets (endogenous prices). Regarding oil and gas, the model distinguishes between fields in production, fields not developed and undiscovered fields. Both production and investment decision are modelled explicitly and are based on profitability. We distinguish between capital and other production costs. We also implement bilateral gas trade between regions. Coal supply is based on more simple cost functions. Non-fossils (renewables and nuclear) are introduced in exogenous amounts.

¹ IEA-International Energy Agency (2019): World energy outlook, OECD/IEA, Paris.

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. 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 developing new fields 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 relatively 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 USGS² as well as Norwegian Petroleum Directorate³.

² 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>.

³ Norwegian Petroleum Directorate (2021): Resource report 2020, Stavanger.



Photo: Colorbox

Notes

- ¹ Masson-Delmotte, V., Pörtner, H.O., Roberts, D., Skea, J., Shukla, P.R., Pirani, A., Moufouma-Okia, W., Péan, C., Pidcock, R., Connors, S., Matthews, J.B.R., Chen, Y., Zhou, X., Gomis, M. I., Lonnoy, E., Maycock, T., Tignor, M. and T. Waterfield (2018): Global warming of 1.5°C. An IPCC Special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty, <https://www.ipcc.ch/sr15/>
- ² See, e.g., Energy and Climate Change (2021): Special issue on Net-Zero Energy Systems, Energy and Climate Change (2), 100066.
- ³ Masson-Delmotte, et al. 2018, op. cit.
- ⁴ IEA-International Energy Agency (2021), Net zero by 2050: A Roadmap for the global energy sector, International Energy Agency, OECD/IEA, Paris.
- ⁵ Lindholt, L. and T. Wei (2023): The effects on energy markets of achieving a 1.5 °C scenario, International Journal of Environmental Research and Public Health 20, <https://doi.org/10.3390/ijerph20054341>.
- ⁶ IEA (2022): IEA-International Energy Agency (2022): Energy Fact Sheet: Why does Russian oil and gas matter?, <https://www.iea.org/articles/energy-fact-sheet-why-does-russian-oil-and-gas-matter>.
- ⁷ IEA-International Energy Agency (2019): World energy outlook, OECD/IEA, Paris.
- ⁸ An oil price in 2023 of 70 USD per barrel in 2012-prices corresponds to around 90 USD in 2023-prices. This might deviate from the present price level, but the study focuses on long-term prices and not short-term fluctuations.
- ⁹ IEA, 2019, op. cit.
- ¹⁰ We assume an exogenous pathway of carbon capture, utilization, and storage (CCS), following IEA (2021). This allows for more production of and emissions from fossil fuels equivalent to the exogenous amount of CO₂ removals, at the same level as in the net zero emission scenario in IEA (2021).
- ¹¹ The Barents Observer (2023): New huge oil terminal on Arctic coast will promote national sovereignty, says Russian government, 1. January.
- ¹² EIA (2018), Development of Alaska´s ANWR would increase U.S. crude oil production after 2030, Today in energy, June 14, also finds increased oil production from ANWR in Alaska from the beginning of the 2030s if the reserves in the region are developed.
- ¹³ <https://www.doi.gov/pressreleases/interior-department-substantially-reduces-scope-willow-project>.
- ¹⁴ Canada Energy Regulator (2023): Provincial and Territorial Energy Profiles – Northwest Territories.
- ¹⁵ <https://www.sodir.no/en/whats-new/news/drilling-permits/2024/drilling-permission-for-well-73248-4/>
- ¹⁶ <https://www.thebarentsobserver.com/industry-and-energy/norwegian-oilmen-prepare-for-far-northern-drilling-at-disputed-wisting-field/141060>
- ¹⁷ Reuters (2021): Greenland ends unsuccessful 50-year bid to produce oil, 16. July. <https://www.reuters.com/business/energy/greenland-puts-an-end-unsuccessful-oil-adventure-2021-07-16/>.
- ¹⁸ Reuters, 2021, op. cit.
- ¹⁹ The Moscow Times (2020): Gazprom fixes eyes on new gas field, January 29.
- ²⁰ Reuter (2023): Explainer: Does China need more Russian gas via the Power-of-Siberia 2 pipeline?, 22. March.
- ²¹ High North News (2023): Transport of LNG modules to Russia continues, calling effectiveness of EU sanctions into question, 11. September.
- ²² The Barents Observer (2023): Arctic shipping and energy on Putin's agenda with Xi Jinping, 21. March.
- ²³ The Economist 9th January 2021.
- ²⁴ The Law Reviews (2023): The oil and gas law review: Greenland, 1. November.
- ²⁵ The Law Reviews, 2023, op. cit.

Highlight VIII: 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 in an often harsh Arctic environment. 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 important minerals. Some limited information on reserves will be included in the comments to extraction of the specific mineral. For information on the application of the different minerals, we have leaned heavily on the websites of Mbendi² and ScienceViews.³ Other sources have information on world production decomposed on a country level.⁴

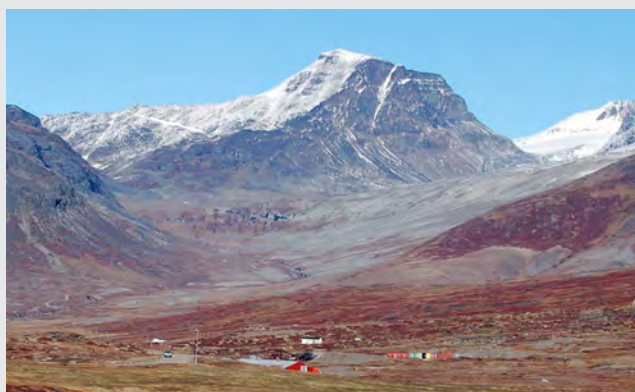
Mineral fuels

Coal is the world's most abundant and widely distributed fossil fuel. Coal is still the primary energy source for several countries worldwide, and is used primarily for electricity generation and steel production. Coal is a less abundant fossil fuel in the Arctic than oil and gas. However, Arctic coal production increases by 339 per cent from 2002 to 2018 (Table 1), leading to a doubling in the share of the world's coal extraction that takes place in the Arctic from 2 to 4.6 per cent (Figure 1). Coal production takes place above all in Arctic Russia, but there is also some minor production in Alaska and Norway (Svalbard).

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 in power production and may in addition play a role in production of low carbon energy through hydrogen production with carbon capture and storage (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



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, 2015 and 2018

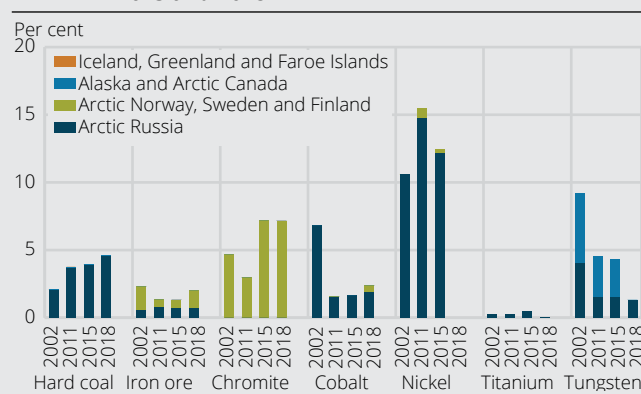


Table 1. Change in volume of coal and iron and ferro-alloy mineral extraction in the Arctic from 2002 to 2018. Per cent

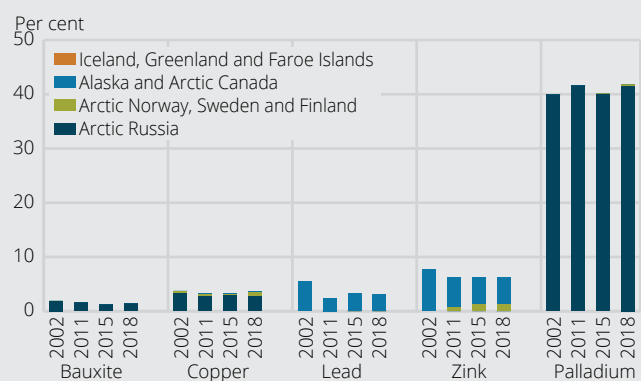
Coal	Iron ore	Chromite	Cobalt	Nickel	Titanium	Tungsten
339	255	300	17	139	-94	-83

uses as in pipes, fittings and engine blocks, its main use is in the production of steel. The Arctic share of global iron ore extraction declines from 2.3 per cent to 1.3 per cent from 2002 to 2015, before it increases to 2.0 per cent in 2018 (Figure 1). There is an increase in the production volume of 255 per cent over the period. In 2018 iron ore extraction takes place in Arctic Russia, in Kiruna and Kaunisvaara in Sweden and to a minor extent in 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. Further, there are no economical substitutes for chromite ore in the production of ferro-chromium. Northern Finland is the only Arctic producer. Production is 300 per cent higher in 2018 than 2002, leading to an increase in the Arctic share of 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 turbine engines. Further, cobalt based alloys are used in highly durable steels. Cobalt oxide is also an important additive in paint, glass and ceramics. Even if production is 17 per cent higher in 2018 than in 2002, the share of global cobalt production declines from 6.8 to around 2.4 per cent. The lion's share of production takes place in Arctic Russia. There is also some production in Arctic Finland in 2018.

Nickel is used in the manufacture of stainless steel, steel alloys and super alloys, all of them having a major role 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. Almost all Arctic extraction of nickel takes place in Arctic Russia and total Arctic

Figure 2. Arctic share of global non-ferrous mineral extraction. Per cent. 2002, 2011, 2015 and 2018**Table 2. Change in volume of non-ferrous mineral extraction in the Arctic from 2002 to 2018. Per cent**

Bauxite	Copper	Lead	Zink	Palladium
81	39	-14	10	15

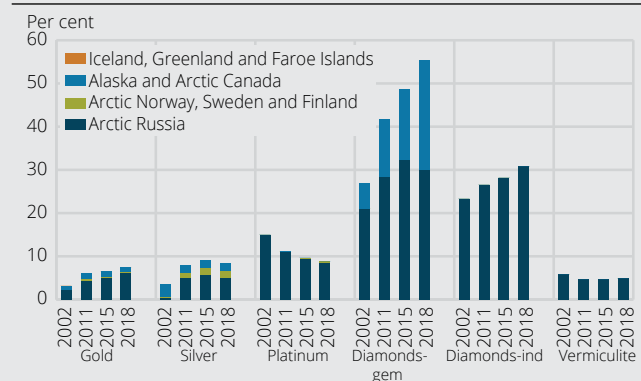
extraction increases by 139 per cent from 2002 to 2018 (Figure 1). Arctic production amounts to 10.6 per cent of the world's production in 2002 and 12 per cent in 2018. There is also some minor extraction in Arctic Finland.

Titanium is a lightweight mineral, non-corrosive, able to withstand extreme temperature 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 from 2002 to 2015, leading to an increase in the Arctic share of global titanium from 0.3 to 0.5 per cent. However, the share falls to 0.01 per cent in 2018 due to a steep decline in extraction after 2015.

Tungsten is produced both in Arctic Canada and Arctic Russia, and the Arctic share of worldwide production declines from over 9 to 1.3 per cent as extraction declines from 2002 to 2018 by 83 per cent due to the closure of mines. In 2018 there is no production in Arctic Canada. 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. It is also used 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. Applications of aluminium include electrical equipment as well as cars, ships and aircrafts. It 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 1.4 per cent even if the production volume increases by 81 per cent (see Table 2). When it comes to production of aluminium, we find the Arctic share to be around 3.6

Figure 3. Arctic share of precious metal ores and industrial mineral extraction. Per cent. 2002, 2011, 2015 and 2018**Table 3. Change in the volume of precious metal ores and industrial mineral extraction in the Arctic from 2002 to 2018. Per cent**

Gold	Silver	Platinum	Diamonds-gem	Diamonds-ind	Vermiculite
219	234	-16	112	25	-5

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. 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 17 million tons in 2018.⁶

Copper has its end uses in construction and in the electrical and electronic industries. The Arctic produces around 3.7 per cent of total copper production in 2002, above all in Russia. An increase in Arctic production of 39 per cent towards 2018 leads to a more or less constant share of global extraction over the period. In 2018 there is also some copper production in Arctic Sweden and to a lesser extent in Arctic Canada 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 and



Greenland Minerals and Energy's administration building in Narsaq. Photo: Mads Fægteborg

Highlight VIII: cont.

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 resulting in a quite large “secondary” production amounting to about 50 per cent of current global lead supply. Production in Northern Canada was around 1 per cent of world production during the period 2000-2002, but as was the case with zinc, most of 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 some extent in Arctic Canada and to a minor degree in the Russian Arctic. However, the Arctic volume of production declines by 14 per cent and the share of global extraction is halved from 2002 to 2018. There is no production in Arctic Russia and Northern Canada in 2018.

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 Arctic Sweden and declines by

more than 1 percentage point from 7.8 per cent of the world production over the period, even if the volume increases by 10 per cent. In 2018 production in Arctic Canada has come to an end, as was the case with lead production.

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. Further, palladium is 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 over the 2002-2018 period as extraction increases by 15 per cent. Data suggest that Arctic Russia has around 10 per cent of global reserves in 2002⁷.

Precious metal ores

Gold has historically been used for jewelry and as a base for global monetary reserves. However, gold's role as a monetary reserve has been changing over the past decades, with several banks selling their reserves. This is seen as a move to disconnect gold from currencies. However, most countries hold gold as official reserves and large stocks of gold and jewelry are still held by



True North Gems Greenland Ruby Mine Site, Greenland. Photo: Hunter T. Snyder

banks and individual investors worldwide. 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 in 2002, the Arctic share is 3.2 per cent, primarily 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 219 per cent (see Table 3), the share of worldwide extraction increases to 7.4 per cent in 2018. The tiny amount of gold production in Greenland has ceased in 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 234 per cent the share increases to over 8 per cent in 2015. Production over the 2002-2018 period above all increases in Arctic Russia and to some extent Northern Sweden, while declining somewhat in Alaska. The small silver production in Arctic Canada stays more or less constant over the period, while the tiny production in Arctic Finland has ceased in 2015.

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 sixth over the period leading to a share of almost 9 per cent of global extraction in 2018. Alaska has stopped its small platinum production in 2015, while Arctic Finland still has a small production in 2018.

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 are only produced in Arctic Russia and make up around 23 per cent of global production by weight in 2002 and 31 per cent in 2018, as extraction increases by one quarter. 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 112 per cent from 2002 to 2018. This leads to a large upturn in the share of global extraction from 26.8 per cent in 2002 to 55.3 per cent in 2015. Hence, more than 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. Production declines by almost 5 per cent and the share of worldwide extraction declines by one percentage point to 2018.

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 after 2002 is USGS (2023): 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 up to 2018, 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): The mineral industry of Russia, USGS (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 (2016): Alaska's mineral industry 2015, Special report 71, Alaska Department of Natural Resources (2019): Alaska's mineral industry 2018, Special report 74, 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, Government of Canada (2023): Annual statistics of mineral production, <https://mmsd.nrcan-rncan.gc.ca/prod-prod/ann-ann-eng.aspx?FileT=2015&Lang=en>, Mining Journal (2016): Various issues of supplements to Mining Journal, CICERO (2014): Socio-economic drivers of change in the Arctic, AMAP (2014): AMAP technical report no. 9, Wilson, E. and F. Stammler (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 (2023): <https://mbendi.co.za/investments-in-mining/>

³ ScienceViews (2023): <https://scienceviews.com/geology/minerals.html>

⁴ British Geological Survey (2014): World mineral production 2008-2012, British Geological Survey (2019): World mineral production 2013-2017, British Geological Survey (2021): World mineral production 2015-2019, Reichl, C., Schatz, M. and G. Zsak (2018): World mining data, Vol. 33 Minerals production, Reichl, C., and M. Schatz (2021): World mining data, Vol. 36 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 (2018): 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

6. Arctic economies from a gender perspective

*Anna Karlsdóttir, MarieKathrine Poppel, Marya Rozanova-Smith,
Andrey N. Petrov, Hanne Marit Dalen*

Arctic economies from a gender perspective: Persistent, recent, and emerging trends¹

*Marya Rozanova-Smith, George Washington University,
and Andrey N. Petrov, University of Northern Iowa*

In recent decades, the Arctic has undergone significant economic changes driven by the development of a more diversified economy and the rise of emerging “other economies”.² Many Arctic communities, particularly Indigenous ones, exhibit a mixed economy where subsistence activities are closely integrated with other sectors.³ Despite these changes, the Arctic economy continues to be predominantly supported by three main pillars—resource, subsistence, and public sectors.⁴ Although recent reports on Arctic economic development emphasize the importance of gender issues, discussions addressing the role of women in Arctic economies remain limited.⁵

Women have historically been underrepresented in higher-paying industries and leadership roles in key sectors of natural resource extraction, transportation, construction, and fisheries, which typically offer higher wages.⁶ Women have been disproportionately employed in less-paid, female-dominated sectors of healthcare, childcare, education, social services and NGOs, and the expanding tourism industry.

Persistent trends

Across most Arctic regions, women earn, on average, approximately 20 per cent less than men (Figure 6.1), although this gap is gradually narrowing in some regions. Persistent occupational clusters remain, driven largely by the overrepresentation of women in lower-paying sectors and part-time positions. These disparities contribute to gender gaps in income levels, wealth, and entrepreneurial opportunities for women.⁷

While women are playing an increasingly prominent role in business and administrative leader-

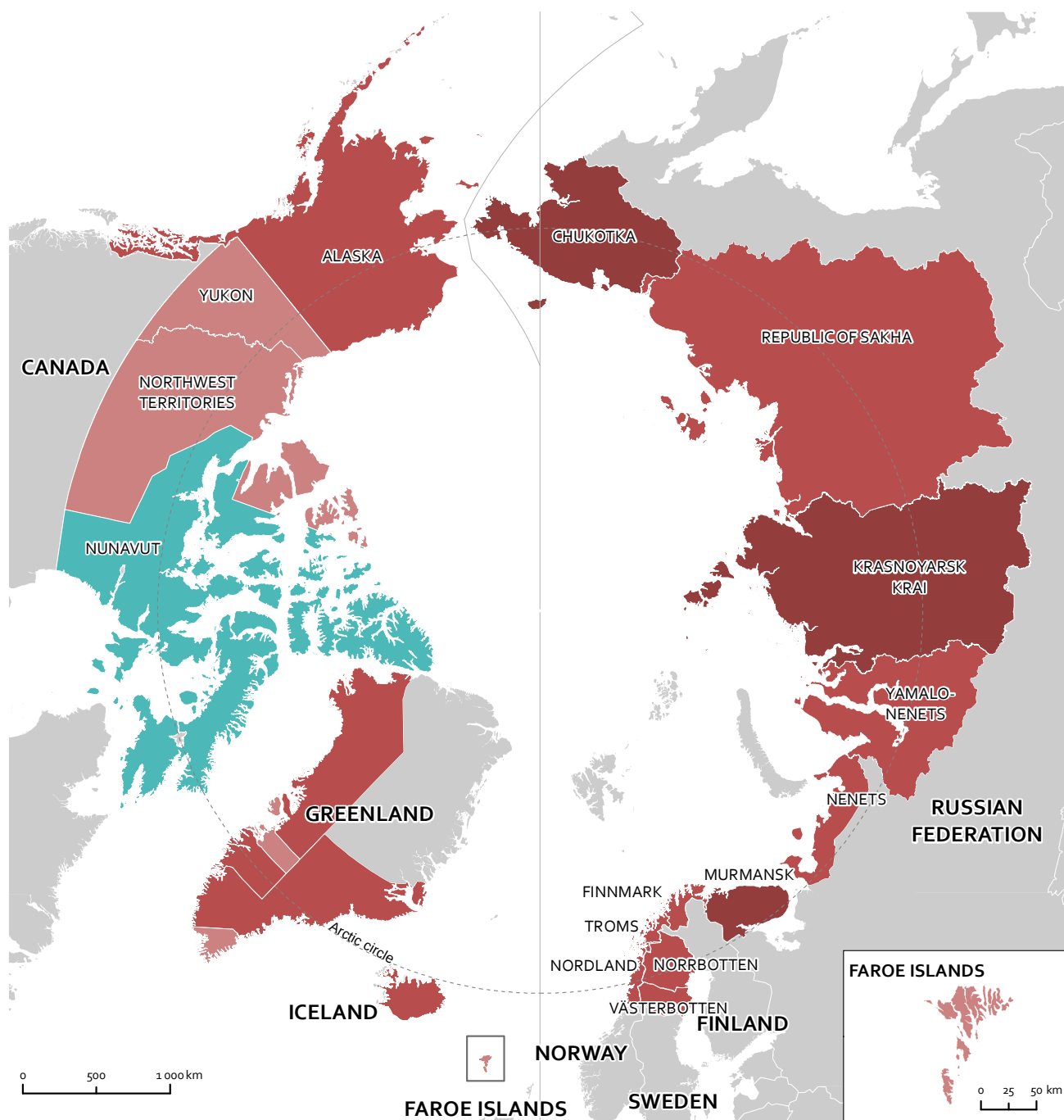
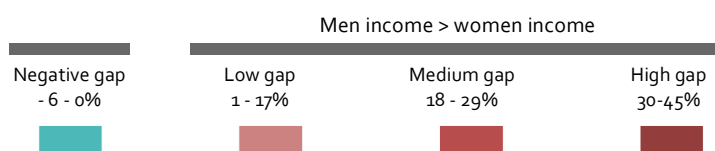
ship, enhanced by the Nordic countries introducing gender quotas, and rising levels of human capital, their presence in leadership positions remains limited. This is further compounded by occupational biases and restrictions, for instance, in Russia, certain positions are deemed “dangerous for female health”, limiting access to employment opportunities.

Indigenous Peoples in the Arctic engage in subsistence-related economic activities or in wage-based occupations, or both.⁸ Indigenous women play a significant role in the public sector, NGOs, tribal corporations, often balancing these roles with subsistence practices while seizing emerging economic opportunities in areas such as the Indigenous cultural economy and tourism.

Recent trends

The Arctic is experiencing a growing ‘reverse’ education gap, with men, on average, achieving lower levels of educational attainment than women.⁹ However, disparities exist in fields of specialization, with women remaining underrepresented in science, technology, engineering, and mathematics (STEM) disciplines. Despite high rates of tertiary education among women, they often are concentrated in predominantly female-dominated and lower-paid fields.

Women are gradually demonstrating high labor force participation and steadily advancing presence and leadership in traditionally male-dominated occupations. Women’s representation is notably increasing in elected municipal, regional, and national political offices, tribal corporation leadership, the blue economy, construction, and other sectors, and at the same time, contributing to labor deficit in traditionally female domains.¹⁰ This shift often introduces new challenges for women, including the risk of gender-based harassment in male-dominated sectors as well as health risks for women in Arctic regions where industries have weaker health and safety regulations.¹¹

Figure 6.1. Gender Earnings Gap in the Arctic. Per cent**Gender Earning Gaps (%)****Regions included:**

US - Alaska; CA - Yukon, Northwest Territories, Nunavut; GL - Kommune Qeqertalik, Avannaata Kommunia, Qeqqata Kommunia, Kommune Sermersooq, Kommune Kujalleq; IS; FO; NO - Nordland, Troms, Finnmark; SE - Norrbotten, Västerbotten; FI - Lappi, Kainuu, North Ostrobothnia; RU - Murmansk, Nenets, Yamalo-Nenets, Krasnoyarsk Krai, Republic of Sakha, Chukotka.

Based on data published by the National Statistical Offices. Year: 2018; Greenland – 2019; Canada – 2015.

Data collected by A. Petrov, M. Rozanova-Smith, T. Heleniak, and J. Ramage.

Map design: Nordregio (Justine Ramage). Source: GEAll Report (Rozanova, Petrov, and Korkina Williams, 2021). Reprinted by permission from GEAll.

Emerging trends

Out-migration of women, coupled with aging of the Arctic population, has a pronounced impact, particularly in smaller towns and rural areas.¹² In some regions, social services are becoming increasingly reliant on international labor through guest worker programs, highlighting a broader trend of international labor substitution in Arctic regions.

Many immigrant women in the Arctic face the issue of “brain waste”, as many are highly educated and skilled.¹³ Without degree recognition, credential equivalency, and targeted policies to support their integration into local labor markets, these women encounter significant barriers to employment that matches their qualifications. As a result, their education and skills remain underutilized.

Nordic countries have mandated greater representation of women on corporate boards and implemented gender-equal parental leave policies. The Canadian government has embraced and actively promoted a culture of diversity and inclusivity. In other Arctic states there are growing barriers to gender equality, including the absence of federal paid parental leave in the United States and the rollback of Diversity, Equity, and Inclusion (DEI) initiatives in Alaska, expected to disproportionately affect women of color and Indigenous women. Russia’s increasing emphasis on traditional gender roles in public policy and economy, coupled with the absence of a DEI framework and restrictions on occupations for women in some industries with elevated risks, is likely to have long-term adverse effects on equal opportunities and economic participation in various sectors of the Arctic economies.

Economic impacts of the COVID-19 pandemic on women: Overall setback in gender equality

The COVID-19 pandemic profoundly disrupted Arctic regional economies and labor markets.¹⁴ Significant increase in household and caregiving responsibilities and the widespread closure of schools and childcare services restricted women’s ability to participate in the labor market. During the pandemic, many employed women with children were compelled to part-time work or to leave the workforce. Female front-line workers in health-care, education (kindergarten through secondary school), and retail trade endured disproportionate exposure to the virus, severe mental health pressures, and insufficient financial support.

Indigenous women in urban areas, outside their traditional communities or kinship safety networks, faced barriers to relief programs and limited tribal financial support and support from Indigenous governments. Immigrant women employed in low-wage or informal jobs were particularly vulnerable to job and housing insecurity, social isolation, and discrimination in an increasingly shrunk labor market during the pandemic. Immigrant women often were the first to lose their jobs.

Women, especially those in lower-wage positions were disproportionately affected by financial instability. Additionally, most cultural activities were suspended, including cultural centers and community events, mainly affecting women employed in this traditionally female-dominated sector. Immigrant women and Indigenous women residing in urban areas, in particular, in regions with stringent travel restrictions, were more heavily impacted.

Overall, the pandemic significantly set back gender equality in the economic sphere, leading to widening pay gaps and diminishing economic security for women. Women working in female-dominated sectors – health-care, education, social work and childcare – faced burnout and heightened exposure to health risks due to their roles on the pandemic’s frontlines.¹⁵ Lingered burnout is likely to affect economic productivity, as many women face challenges in returning to work or maintaining full time positions.¹⁶ Indigenous families living in overcrowded homes in rural Alaska or Canada experienced heightened challenges working from home. Limited access to affordable and reliable Internet exacerbated these difficulties, highlighting how remote work remained an inequitable solution for women in Arctic rural communities.

In rural communities, COVID-19 restrictions on social distance limited opportunities for collective berry picking, crafting and cooking, preventing Indigenous women in quarantine to participate in subsistence and other culturally significant activities.¹⁷

During the COVID-19 pandemic, government support prioritized larger-scale sectors of the economy, such as infrastructure, energy, mining, transportation, logistics, and construction, which are predominantly male-dominated. In contrast, small business owners, many of whom were women,



Missing And Murdered Indigenous Women And Girls Monument

Dedicated to victims, survivors, and affected families of violence against Indigenous women and girls, this space serves as a tribute for remembrance, reflection, and intergenerational healing.

The Red Parka symbolizes Northern culture, honouring the Missing and Murdered Indigenous Women and Girls. The Dene Drum represents the Dene. Feathers formed into an infinity symbol represent the Metis.

The Qulliq, an oil lamp, symbolizes the Inuvialuit and Inuit people, also serving a functional purpose. The infinity is adorned with hearts symbolizing the Native Women's Association of the Northwest Territories efforts for awareness on Missing and Murdered Indigenous Women and Girls.

The Legislative Assembly unveiled the Missing and Murdered Indigenous Women and Girls monument in front of the Legislative Assembly building on October 4, 2023. Thoughtfully designed by Inuvialuit artist Myrna Pokiak, the monument serves as a sacred place for families to sit with their loved ones, honour those who have fallen, and recognize the injustices experienced by Indigenous women, girls, and 2-spirited people. It is a place to share in the healing journey and will remain a permanent fixture that will raise awareness of this ongoing national tragedy.

Source: Northwest Territories Legislative Assembly, Yellowknife.

Photo: Devlin Fernandes

often were under-supported. This lack of targeted assistance disproportionately impacted female entrepreneurs.

Women in many Arctic regions experience ongoing and possibly long-lasting economic impacts of the pandemic. As economic recovery is taking place, labor market re-entry has proven more challenging for women, as a still-recovering childcare system complicates their return to the labor market. Many immigrant women in the tourism sector are also facing housing shortages in areas of tourist attraction, e.g., in Iceland.

Conclusion

Sustainable and thriving Arctic communities are those where all genders have equal access to economic assets and means of economic success. Several positive trends are contributing to women's empowerment and evolving roles in Arctic economies. These include higher tertiary education attainment, growing presence in higher-paid and traditionally male-dominated sectors, and increased representation in leadership positions. However, significant challenges remain, such as the out-migration of educated women from smaller Arctic communities to larger cities within and beyond

the region. This trend has led to labor shortages in female-dominated sectors, a critical issue for many Arctic regions.

Long-standing gender inequalities have been further exacerbated by the emergence of new challenges associated with the COVID-19 pandemic and the ongoing recovery process. Future research on the complex post-COVID Arctic economic landscapes necessitates a comprehensive, nuanced approach that incorporates diverse perspectives, with particular attention to gendered perspectives.

Gender distribution in the Nordic primary industry with a focus on the Blue Economy

Anna Karlsdóttir and Hanne Marit Dalen

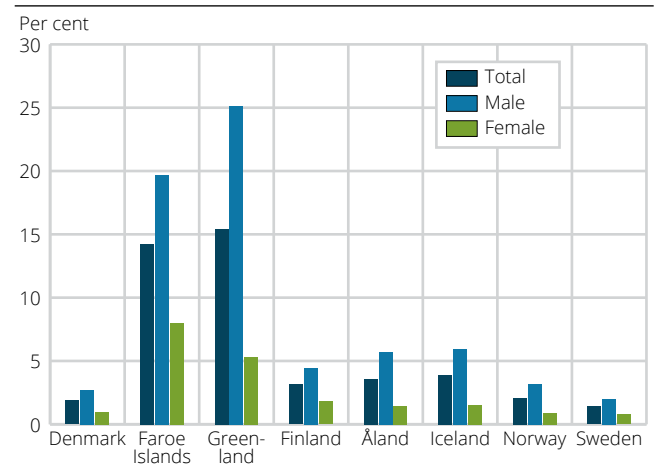
The primary industry, comprising agriculture, forestry and fisheries, plays an important role in the Nordic countries. The share of the workforce employed in the primary industry varies across countries, with Greenland having about 15 per cent, but most countries in the region have between 1.5 and 4 per cent of the employed workforce in this industry (Figure 6.2). However, in all countries the share of the male workforce employed in the primary industry is much larger than the share of employed women in the industry. Despite the larger share of males working in the primary industry, all Nordic countries have a significant share of women in the industry (Figure 6.3).

Women's role in the Blue Economy

A recent report by Karlsdóttir and Guðmundsdóttir examines gender and equality issues within the blue economy in the Nordic countries.¹⁸ The blue economy refers to economic activities related to the sea, lakes, and coastal areas, including fisheries, aquaculture, shipping, and other marine industries. The report maps the current gender distribution and disparities in different sectors of the Nordic blue economy, discusses challenges women face, and actions taken and needed to contribute to increased gender equality in the Nordic blue economy.

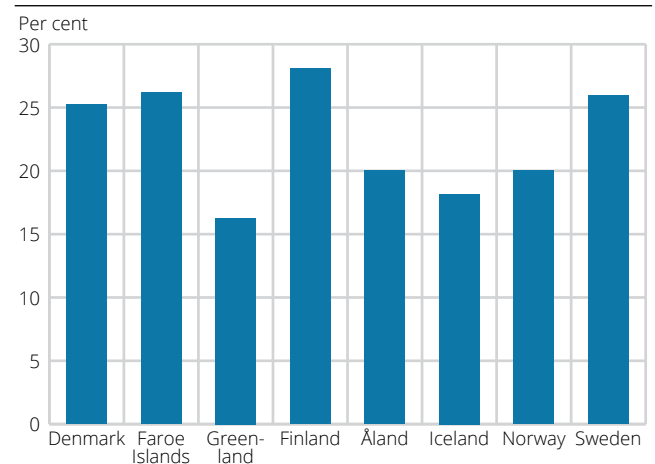
As figures 6.2 and 6.3 combined agriculture and forestry employment statistics with fishing, the data can be skewed towards employment in the former two sectors in Finland, Sweden and Denmark. As a result, it does not clearly represent employment in the blue economy. Generally, in

Figure 6.2 Employed persons in agriculture, forestry and fishing in Nordic countries relative to employed persons between 15 and 64, by gender. 2022. Per cent



Source: Nordic Statistics database (table WORK02 and LABO01). Data for Faroe Islands are based on Nordic Statistics table WORK02 and Statistics Faroe Islands, Statbank AM03030.

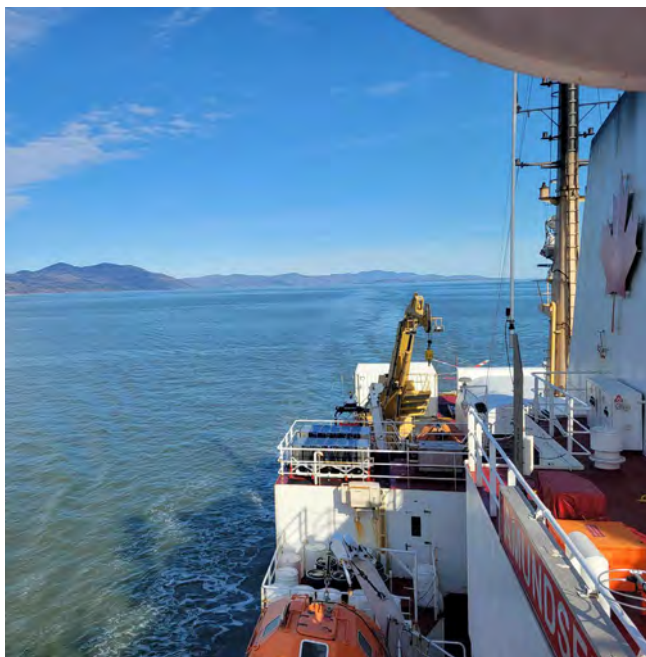
Figure 6.3 Share of women in employed persons in agriculture, forestry and fishing in Nordic countries. 2022. Per cent



Source: Nordic Statistics database (table LABO01). Data for Faroe Islands are based on Nordic Statistics table WORK02 and Statistics Faroe Islands, Statbank AM03030.

the Nordic countries, the blue economy becomes increasingly important in coastal areas the further north the area is situated.

National data do not necessarily reflect well the regional importance of aquaculture. For example, in Norway the importance of aquaculture in the counties of Finnmark, Troms, and Nordland, followed by Vestland and Trøndelag are much more pronounced in the economy than in more south-bound counties. The same goes for Iceland where Westfjords and Eastfjords are the main regions with aquaculture. Many jobs in aquaculture require tertiary educational specialization or at least vocational education. STEM (science, technology, engineering and mathematics) and biology disci-



View from Canadian Coast Guard Amundsen.
Photo: Nadine Boucher

plines are prominent and often linked to biotech and the marine industry but in recent reports on green jobs, gender and STEM, both blue economy and biomass related jobs in the marine industry are missing in the accounts.¹⁹

Historically the Nordic blue economy, including fisheries, aquaculture, and related maritime activities, has been male dominated. The share of women in fisheries and aquaculture varied between 4 and 20 per cent in the Nordic countries in 2020, with Finland and Faroe Islands having the largest share of women in the sector. The concept of blue economy includes more than the traditional maritime sector as it includes also innovative practices and sustainable use of biological resources. The report by Karlsdóttir and Guðmundsdóttir reveals that women are underrepresented in all types of roles within the sector and highlights a gender-blind approach in literature on the blue bioeconomy and the need to include gender perspectives.

The role of women is, and have been historically, important for all stages and processes in the fisheries and aquaculture sectors. However, when analysing the value chain in fisheries and aquaculture, the formal role of women, in terms of employment, leadership and ownership, is found to be limited.

²⁰ In the past, women were the “ground crew” of fisheries and maritime activities. The development of the blue economy, especially related to the development of activities related to the sea, the coast

and coastal communities is highly relevant for all inhabitants in coastal areas and affects the lives of both men and women.

In aquaculture, women are somewhat better represented, especially in processing and administrative roles. Nonetheless, there are still gender imbalances, especially in technical and leadership roles. The blue economy value chain is, in general, largely dominated by men, with few women holding executive or decision-making positions. Women are also underrepresented in technical and field-based roles. These positions include roles such as fishers and maritime engineers. These patterns are persistent across the Nordic countries, although slight variations are found.

At the educational level there are evidence of an increase in the number of women pursuing relevant educations for the blue economy. However, this seems to have yet to significantly translate into the labour market.

Challenges and barriers

Women in the Nordic blue economy face challenges for their participation and advancement in the sector related to e.g. cultural norms, workplace conditions, and more systemic barriers such as a lack of availability to relevant networks. Stereotypes and cultural norms can discourage women from pursuing careers in the maritime sector, including fisheries. The maritime sector is male-dominated and the culture is in large parts of the industry often seen as traditionally masculine. These stereotypes are reinforced by societal expectations and the portrayal of maritime work as physically demanding and unsuitable for women.

Efforts to promote women's participation

Several organizations and networks work to promote women's participation in the Nordic blue economy. These initiatives aim to support women through mentorship programs, networking opportunities, and awareness campaigns. There are also examples of more stringent policies such as recruitment quotas. Examples of women in the sector holding leadership roles and being innovators, show the positive impact of gender equality initiatives and the potential for women to thrive in the sector. Efforts to further improve gender equality in the blue economy are found both on a national and local level. These efforts focus on policy re-



Lauvøya, Nordland. Photo: Tom Nicolaysen

forms, education and training, and the establishment of support networks for women. Improved availability of data and gender-disaggregated statistics related to the blue economy is needed to develop effective measures and guiding policies aimed at improving gender balance.

Access to childbirth health care – gender, future generations and politically derived inequalities in remote regions of the North

Anna Karlsdóttir, University of Iceland

Lack of access to healthcare services for people living in the Circumpolar North may have important consequences for their health and well-being.²¹ Routine evacuation of pregnant Indigenous women from remote regions to urban centres for childbirth has been a strategy for addressing maternal health disparities in Canada. Maternal evacuation continues in many places despite mounting evidence of its negative impacts on Indigenous women and families.²² All the family is affected by a child birth especially when pregnant women are forced to travel away.²³

Health care services for childbirth varies across regional and national boundaries.²⁴ From 1960's to recently the medical model of care during childbirth was implemented in many countries of

the North. The Nordic countries and Canada are in focus here. The medical model came to overshadow the midwifery model that focuses on and supports the normalcy in childbirth and has a woman centered approach.²⁵

Women living in remote areas may be in a vulnerable situation when giving birth as they may have to travel far to receive healthcare.²⁶ However, centralisation of childbirth may challenge the way remote communities normally manage major social events such as childbirth, thus reducing the family involvement. The social aspect of pregnancy and childbirth is of pivotal importance for remote communities as being born where the family lives is essential to the survival of remote communities.²⁷ An example is a remote area in Nunavik in Northern Canada, where the community decided to support women to give birth in their own community.²⁸

It is a policy concern that many remote regions in Arctic sparsely populated areas suffer from ageing and outmigration of youth. Declining reproduction levels may reduce the future potential of thriving communities. Sustainability of communities requires that childbirths are allowed where people live and that the support of midwife services is safeguarded.

Highlight 6.1. Female rate in Arctic regions

The Pan-Arctic Report on Gender Equality in the Arctic gives an overview of gender-related issues in the Arctic, including law and governance, security, gender and environment, migration and mobility, Indigeneity, gender, violence, and reconciliation, and empowerment and fate control.¹

In this edition of the ECONOR report, Chapter 2 presents data for the female rate, the proportion of women in the total population. The female rate is an important socio-economic indicator as it indicates economic and social stability and growth potential.

In regions in Arctic Russia, the female rate in general is higher than 50 per cent, while in the Arctic North America and Nordic Arctic regions, the female rate is generally less than 50 per cent. The lowest female rate is found in Greenland.

In Arctic communities, women have an important role in the traditional nature-based economy which is mostly invisible in statistics. An aim of the ECONOR reports is to express a double perspective on livelihoods, recognizing the importance of traditional nature-based economic activities and the importance of paid work for securing a living.

Recognizing the importance of the traditional economic activities for economic well-being raises conceptual and statistical challenges similar to recognizing the importance of household care work, as drawn attention to in Marilyn Waring's book *If Women Counted*.²

¹ Gender Equality in the Arctic

² Waring, M. (1988): *If Women Counted*. Macmillan, London.

Nunavut and Nunavik

Inuit midwives or traditional birth attendants have disappeared from Nunavut communities. Currently nurses are the primary health care providers in aboriginal communities across Canada. Prior to the 1960s and 1970s childbirth took place in large family groups.²⁹ Since the 1960s, Indigenous women living in remote regions in Canada have been transferred to urban hospitals for childbirth. In the following decades, evidence emerged linking maternal evacuation with negative impacts on Indigenous women, their families, and communities.³⁰ The practice of evacuation before childbirth had marginalized community involvement in health care while leaving the community unfit for childbirth. A return of birth to the communities would require a rethinking of relationships between the communities, levels of government, health providers, and community control.³¹

The Inuulitsivik midwifery program, for returning childbirth to remote communities of Nunavik has

emerged as a model of community-based education of midwives, integrating traditional and modern approaches. The midwifery service is linked to community development, cultural revival, and healing from the impacts of colonization. Despite acknowledgement of their success in developing and sustaining remote maternity care, the Nunavik midwives have only recently gained formal recognition under the Quebec Midwifery Act.³²

Ittoqqortoormiit in Eastern Greenland

Eastern Greenland with its 2 600 km long coast and a population of 3 500 is one of the most remote areas in the world. With around 340 inhabitants Ittoqqortoormiit is the northernmost town on the east coast. Giving birth locally has become more difficult as a result of regional reforms and political priorities. In 2017 East Greenland was included in the municipality of Sermersooq, together with the capital Nuuk, situated 1 500 km away from Ittoqqortoormiit.³³ Since 2012 women need to travel to Nuuk to give birth but the travel takes at least two days and passes through Iceland. The town had a nurse but no doctor and till 2007 it also had a birth helper who worked with the midwife in Tasiilaq, 840 kms southwards.³⁴ Since 2008, midwives from Nuuk occasionally visited the town to provide ante-natal care services but this is no longer available, due to the transport connections. In most emergency cases women in birth end up in Iceland, being brought by helicopter to the only direct airline connection.

Uummannaq in Western Greenland

In 2022 the nationwide perinatal guidelines were introduced in Greenland.³⁵ From then on, pregnant women had to give birth in hospitals and health centers with surgical preparedness.³⁶ A midwife from Nuuk (interview August, 2022) told that the local hospital in Uummannaq has not been allowed to help mothers give birth since 2014. Pregnant women from the town need to travel to Ilulissat, the population centre in Avannaat municipality, in their 36th week of pregnancy and stay in the patient home until they give birth. The only transport is helicopter. This proves to be a difficult experience for many women. They are lonely and fathers are not allowed to accompany them.

Rural Iceland and Northern Sweden

Pregnant women in Rural Iceland and North of Sweden have experienced the effects of an effort



Greenland. Photo:Colorbox

to effectivize the health care system and the impacts of budget cutbacks. In Iceland it has spurred a debate in communities where the birth clinics have been closed down, in Egilsstaðir in 2003, in Sauðárkrúkur in 2009 and in Westman islands in 2016.

In Northern Sweden women have launched a campaign “the road is no birth clinic” (Vägen är inget BB). For women from Kåtaviken, Borgarfjäll and Åsele the car transport takes between two and six hours to the closest hospital with birth care services in Umeå. Also women in rural areas in Norrbotten have to travel long hours to reach the closest hospital to give birth, a dangerous journey when weather in the winter makes roads less safe.

Finnmark, Northern Norway

In Finnmark, Norway, there are large distances between communities and hospitals. Three generations of women, who shared traumatic experiences during childbirth, have started a blog “Kvinner i Nord” (Women in the North), to fight for better childbirth services. In the winter, aviation and road connections can be dangerous, and in the summer five of six maternity wards in the North of Norway close down due to summer vacation.³⁷ A recent

proposal on future structure of hospitals which could have meant an improvement in birth care services in the town Alta was turned down.³⁸

Indigenous Citizenship: Gender and Discrimination³⁹

MarieKathrine Poppel, Ilisimatusarfik, University of Greenland

In 2022, it was documented that the Danish healthcare authorities carried out a family planning program in Greenland from 1965 until the mid-1970s, the ‘IUD campaign’, where Danish doctors in Greenland implanted contraceptive intra-uterine devices (IUDs) on almost half of the 9 000 girls and women of childbearing age in Greenland, including girls down to the age of 12, as reported by the UN Special Rapporteur on the rights of Indigenous Peoples.⁴⁰ The IUD campaign was only aimed at Greenland Inuit women living in Greenland, based on a perception that prescribing the birth-control pill to Greenlandic women was too uncertain to ensure the Danish government’s policy to reduce the birthrate in Greenland.

The IUD campaign have had severe consequences for many of the more than 4 000 girls and women



Kamikker (seal skin boots) displayed in a hotel in Tasiilaq, East Greenland. Greenland. Photo: MarieKathrine Poppel

who were exposed to it. Apart from the physical and mental harm, including traumas, basic rights of children for the girls that became victims of the campaign, women's reproductive and other rights, the campaign also implied unequal treatment, discrimination, and prejudices towards Greenlandic Inuit women that, despite formally having Danish citizens' rights, were treated differently from female Danish citizens born in Denmark.

Implanting an IUD without consent constitutes a serious violation of reproductive rights, the right to self-determination, and can be seen as a degrading and inhumane treatment. While the UN Convention on Elimination of All Forms of Discrimination against Women (CEDAW), from 1997, was not in effect at the time, it is obvious that the campaign violated both the Universal Declaration of Human Rights (UDHR 1948) and the European Convention of Human Rights (ECHR 1953).

Discrimination also occurred in economic rights, in the 1960s and 1970s, with salary differences between Danish citizens born and raised in Denmark and Greenland Inuit born and raised in Greenland. The discrimination was institutionalized through the 'birthplace criterion' of 'belonging to Greenland' and 'not-belonging to Greenland'. In the 1960s, the Danish government planned substantial economic development for Greenland, and there was a focus on how to attract workers with the necessary skills. A key issue was whether workers 'belonging to Greenland' (typically Greenland Inuit) and workers 'not belonging to Greenland' (typically Danes) should have the same wages and work conditions, or if people 'not belonging to Greenland' should have better wages and work conditions.⁴¹

The birthplace criterion was unfair, discriminatory and, as it was based on where people were born, also by many considered racist. The discrimination and unequal treatment affected males in the labour force most directly, but also had consequences for women. At the individual level it contributed to a feeling of powerlessness and marginalization linked to ethnicity, origin and language.

The birthplace criterion made it easier to recruit foreign labour and thus added to the potential social and ethnic imbalance in the labour market. When Danish norms became the norms in administration and other sectors of the Greenland society, it led to actual and perceived Danish dominance in relation to Greenlandic administrative employees and might have limited the willingness of Greenlandic employees to (further) educate themselves and seek promotion. Danish technicians and construction workers achieved similar dominance within the building and construction sector, probably a contributing factor to the difficulties in attracting Greenlandic labour to this sector.⁴² This meant that income inequalities related to (although not justified by) ethnic belonging continue to exist, as the non-Greenlandic part of the workforce generally has a higher education level.

The birthplace criterion exemplifies how discrimination of the Indigenous peoples of Greenland was practiced, despite the Greenlanders being Danish citizens and formally on equal terms with other Danish citizens. The birthplace criterion was a key issue in debates for almost three decades and became one of the main issues and drivers in the struggle for a more independent Greenland in the 1970s.

Also Greenland Inuit children living with their parents in Denmark were forcefully removed from their parents, showing the discrimination through Indigeneity, citizenship, and belonging, in the sense that ‘the intersecting oppressions are mutually constituted by each other’.⁴³

Discrimination and racism against Greenlanders in Denmark are serious problems. The Danish government has as of 2025 granted DKK 35 mill. over four years and proposed 12 specific new measures to counteract discrimination.⁴⁴ At the same time, the Danish and Greenlandic governments have agreed that evaluation of Greenlandic parents living in Denmark, in the context of child protection cases, shall be culturally sensitive and not subject to psychological tests.⁴⁵

Gender-based power structures in contemporary Greenland

MarieKathrine Poppel, Ilisimatusarfik, University of Greenland

Demographic changes

In the 1950s and 60s, Greenland underwent a modernization, where the overall goals of Greenland policy were to make Greenlanders equal members of Danish society and bring the standard of living in Greenland on a par with the rest of Denmark. The Danish state made large investments in housing, infrastructure, fishing industry, and expansion of health services. Many seasonal workers from Denmark were brought to Greenland for building and construction work because the Greenlanders lacked education and experience, and because the involvement, including education, of local labor was not prioritized.

Population data for Greenland have been recorded from 1781.⁴⁶ Until 1960, there was a surplus of women, due to excess mortality among men, especially because many men perished at sea. There has been a declining share of women since 1960, primarily due to an influx of workers from Denmark. The population born outside Greenland consists of 2/3 men and 1/3 women.⁴⁷

Employment

Hunting was the main activity in the 19th century, and at the beginning of the 20th century many still subsisted on traditional hunting, while in that period, primarily in South Greenland, there was a



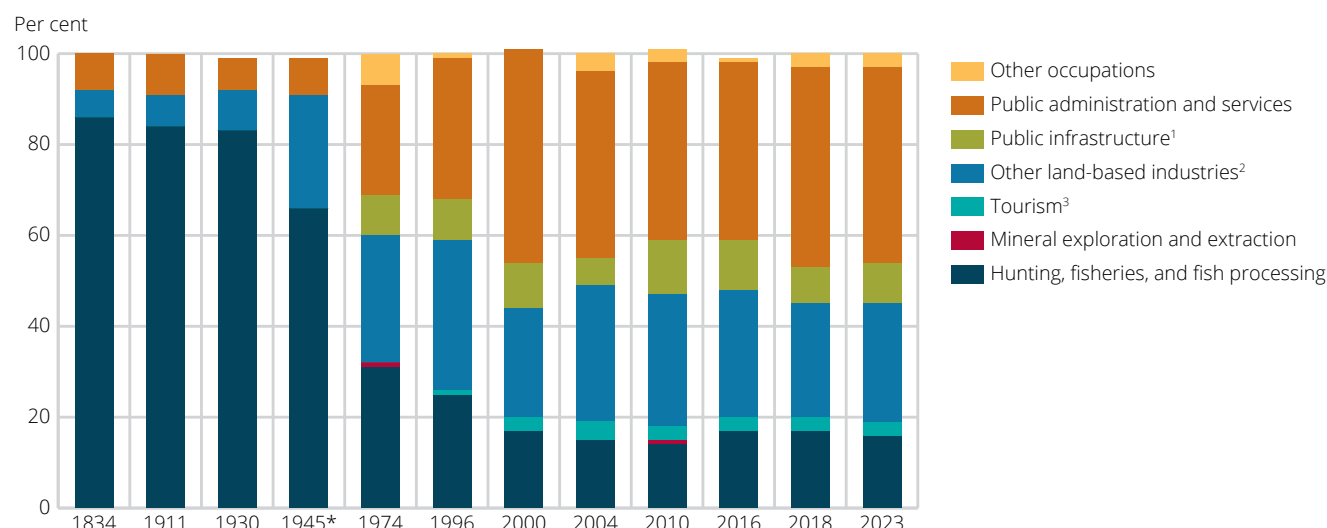
Students in national costumes celebrating graduation in Nuuk, Greenland. Photo: MarieKathrine Poppel.

shift from hunting to fishing. Before 1930, more than 80 per cent of Greenland residents were engaged in hunting and fishing.

Figure 6.4 illustrates the major changes that have taken place in the Greenlandic industrial structure since 1930 with profound impacts for women's employment opportunities. In 1945, 66 per cent of the labor force was engaged in hunting and fishing. This share was just under 31 per cent in 1974, and in 2000 and 2018, respectively, 17 and 18 per cent of the labor force were employed in hunting and fishing. Employment in public administration and services has had an opposite trend, with 8 per cent employed in this sector in 1945, 24 per cent in 1974 and 48 per cent in 2018. Public services, including education, health and social work, are care functions typically occupied by women. The share of the labor force employed in other land-based occupations - including crafts and trade - has been around 25-30 per cent in the period 1945-2018.

Education

Both during the home rule period (1979-2009) and after the introduction of self-government in 2009, an increased level of education has been

Figure 6.4. Main occupation for residents, by sector. Greenland 1834-2018, selected years

¹ Figures include public energy and water supply and public and private transportation.

² Figures include construction, trade, and financial and other business services.

³ Figures include hotels and restaurants.

Sources: Greenland Home Rule 1942 (*Sammendrag af statistiske oplysninger om Grønland*); Danielsen et al. 1998; M. Poppel 2007; Statistics Greenland 2003, 2005, 2011; Statistics Greenland Data bank 2010, 2016, ARXBFB7 and ARXBFB8 (2018), ARXBFB07 (2023).

part of the political basis for the Naalakkersuisut (Government of Greenland). The main reasons for this priority have been to become less dependent on labor from Denmark, to be able to take over responsibilities from the Danish state, and become as self-sufficient as possible with local Greenlandic labor.

Since the end of the 1980s there has been an overall increase in the level of education. Since the early 1990s more women than men have completed higher education.⁴⁸ In 2018, about the same share of women and men completed youth education (high school and vocational school), whereas the share who completed higher education was almost 15 per cent for women and less than 10 per cent for men.⁴⁹

Are women taking over power and labour from men?

The development of gender relations in the rapid societal development since World War II to the present, is characterized by significant changes, with qualifications obtained through education and an increasing share of women breadwinners due to the increased labour market participation by women.⁵⁰ Since 1979, when women first were elected to the Greenland Parliament, the share of women elected to the the Parliament has increased to around 40 per cent in 2018.⁵¹

However, gender power has not been redistributed according to the changing roles. Jobs occupied by women are still to a large degree within the sphere of reproduction, with low status and relatively low paid. A larger share of women in the labour force and with higher education has not yet resulted in a significantly more equal income distribution between the genders, also because there is still an unequal distribution of (highly salaried) management positions. Patriarchal structures are still dominant in Greenlandic society, where the elite mainly consists of Greenlandic men rooted in both Greenlandic and Danish culture.

Yet at the same time a relatively large share of men are unemployed and without education. A consequence of changing gender roles and relations in families, households, and the labour market is a deprivation among those of the male population who have not benefited from the societal changes. As the size of the gender gap in Greenland varies between regions and communities, a further consequence might be an out-migration of younger men from communities with fewer young women, eventually leading to a depopulation of some settlements and towns.

Notes for Rozanova-Smith and Petrov: Arctic economies from a gender perspective

- ¹ This research was funded by NSF (Project “Understanding the Gendered Impacts of COVID-19 in the Arctic” (COVID-GEA), award number PLR 2137410; Project “Measuring Urban Sustainability in Transition” (MUST), award number PLR 2127364; Project “Socio-Ecological Systems Transformation in River basins of the sub-Arctic under climate change” (SESTRA), award number 2318381, 2318382).
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Skardalen, Troms. Photo: Tom Nicolaysen

7. Indigenous economies in the Arctic: Promoting traditional and emerging economies in an evolving Arctic

Indigenous Peoples organizations that are Permanent Participants to Arctic Council, Bridget Larocque, Eleonora Alariesto, Viola Ukkola, Polina Syadeyskaya, Andrey N. Petrov, Ksenija Hanaček, EntrepNorth and National Indigenous Economic Development Board

This chapter aims to strengthen the involvement in ECONOR of the Indigenous Peoples' organizations that are Permanent Participants of the Arctic Council. For this purpose, the Nordic Council of Ministers funded a workshop in Yellowknife in 2024, to discuss and begin developing a new contribution to the ECONOR report. This chapter is based on the discussions at the Yellowknife workshop and other relevant material, including the Environmental Justice Atlas.

A key theme of this chapter is the importance of the relation with the land for Indigenous Peoples. There is a need to meet in Sharing Circles, with Indigenous Peoples and researchers and other participants, working in respect for the protocols of Sharing Circles, and that the recording of the stories remains in the ownership of the Indigenous Peoples. In Sharing Circles, stories can be shared by Indigenous Peoples, describing in their own words how wealth and economic aspects of well-being are understood from Indigenous perspectives on the relation with the land. There is a need

to listen to the voices of the numerous Indigenous Peoples, both those whose organizations are represented in the Arctic Council and other Indigenous Peoples in the Arctic. Creating a space for this cooperation is an aim of future ECONOR projects.

Beyond traditional nature-based livelihoods, this chapter has focus on Indigenous employment opportunities and participation in education and training, within Indigenous-led economic development corporations. The role and increasing prominence of Indigenous-led corporations, in different Arctic regions, and their contribution to the economy and well-being, is a key theme that remains to be further explored in future ECONOR projects.

Climate change impacts on the land of Indigenous Peoples

In the Arctic, climate change is progressing much faster than in other regions of the world, as reported by the Intergovernmental Panel on Climate Change (IPCC), the Arctic Monitoring and Assessment Programme (AMAP), and research organiza-



■ Sámi reindeer herding in Finland. Photo: Viola Ukkola



Fires in Northwest Territories. Photo: NWT Fire.

tions. The consequences of climate change in the Arctic are profound for the land of Indigenous Peoples. Sea ice is melting, the tundra is transforming, and forests face a higher risk of fires. Policies aimed at climate change mitigation and the energy transition also significantly impact Indigenous lands, as described in the Sámi Council climate report (p. 63).¹

*“The Arctic has already been identified as a region with ‘huge potential for renewables’ and development of clean energy in EU’s updated Arctic policy. [...] The Saami Council issued a statement noting the great concern for EU’s support for further resource extraction in the European Arctic.² [...] Developments taking place in Sápmi aimed to secure what governments refer to as a ‘green transition’ include measures such as increased mining for raw materials, increase in energy production through wind power plants and hydropower and increases in bioenergy from forestry - with impacts on Sámi culture and livelihoods”.*³

The situation in Sápmi reflects the broader Arctic context. Climate change impacts vary across Arctic

regions, but the energy transition and expansion of extractive industries have significant, often irreversible effects, threatening the culture and nature-based livelihoods of Indigenous Peoples.⁴ In the face of the climate and nature crisis, and with global economic interests in Arctic resources, decisions are often made hastily.⁵ The pressure for energy transition and demand for Arctic resources challenge the resilience of social-ecological systems.⁶ While impact assessment procedures are designed to inform decision-makers, they often fail to consider the relationship of Indigenous Peoples to their land. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) calls for impact assessment approaches that include Indigenous Knowledge.⁷

Consequences of forest fires

With warming climate, forests are more exposed to fires. The recent forest fires on the land of the Indigenous Peoples in the Northwest Territories and other areas in Canada had devastating consequences and profound impacts on the land and the way of life of Indigenous Peoples. It is

Highlight 7.1. 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

Highlight 7.2. Concepts and language reflecting Indigenous values

The economy needs to be understood from an Indigenous perspective, and the choice of words and concepts needs to reflect Indigenous values.

The term “subsistence” may not be appropriate to reflect traditional nature-based livelihoods.

In Canada, the Inuit do not use the term “subsistence”. Indigenous Peoples emphasize a subsistence way of life, a traditional way of life.

The words “wild”, “wilderness”, “wildland”, and “environment” carry a colonial history. Stewardship, rather than land management, describes better the relation of Indigenous Peoples with the land.

“Blue economy” is a term with focus on the income of industrial fisheries, aquaculture, and subsea mining, while transition to the “blue economy” can be disruptive to Indigenous livelihoods.

“Resource extraction”, for what, for whom? The concept of the land needs to be understood for its own value, not as a resource extraction unit. “Value of the land”.

The so-called “green” shift is a grey shift, in terms of its destruction of land.

Words should create a safe space. Our words should not be stolen or misrepresented.

We often hear “local” communities and “local” knowledge and “northerners”. These words make the Indigenous Peoples invisible.

“Circular” economy is a buzz-word. Indigenous Peoples’ use of land was always circular, giving back, not taking more than needed.

“Poverty”. What does poverty mean? The why, who and when? Poverty is not a monetary question.

The conceptualization of “sustaining” economies need to be understood in terms of traditional practices. The global sustainable development goals (SDGs) were made without the voices of the Indigenous Peoples of the Arctic.

crucial to highlight how the land was used and its importance to our culture and livelihoods to understand the economic and well-being consequences for Indigenous communities. Indigenous perspectives need to be included when economic consequences of these fires are evaluated. It is essential to recognize the enormous loss and damage to the land and the impact on traditional activities such as hunting, harvesting, sharing, and knowledge transfer. These activities are often not accounted

for in economic measurements and do not qualify for public support while at the same time, insurance compensations are unclear.

The last major fires revealed a lack of cooperation and responsibility where Indigenous practices were not acknowledged in the emergency response. Media coverage focused on business impacts, neglecting the effects on humans, animals, and the land. This disaster is not just about businesses; it is about our lives, our land, and our sacred animals. Forest fires worsen the loss of land due to economic developments and serve as an urgent reminder of the importance of the relation with the land. Communities were also severely harmed by COVID-19 lockdowns and the 2016 Fort McMurray fire and oil sands pollution.⁸

Fire is a natural part of Arctic ecosystems, however, as the Arctic warms, the fire season is longer with more frequent and intense fires. The Arctic Council is addressing the changing face of fire and working with Arctic communities to respond. The Arctic FIRE project, led by Gwich’in Council International, applying Indigenous Knowledge and local knowledge, aims to improve the understanding of fire ecology, impacts in Arctic States and to communities represented by the Permanent Participants, and to reduce the threat of catastrophic fires.

It is not enough to talk about management regimes without talking about Indigenous stewardship of the land that has been successful in the North for time immemorial.⁹ Gwich’in burn grass during early spring, when the meadows have thawed but there is still snow around the timber line. This was traditionally important because it increased the biodiversity of plant species in that area, fertilized the soil so that plants were more nutritious and increased the land’s carrying capacity of animals. There would be an increase in rabbits, and moose would have two or three calves instead of just one. It is also a carbon-neutral practice to burn the land during spring, due to the low amount of vegetation. It is important to understand that if that same fire was lit just a month later, it could be destructive to the rich structures of plants and interfere with migrating animals. It is important to document and transfer knowledge to understand how Indigenous Peoples have worked with fire in the past to better manage what we have going forward.



Dettah Ice road, Yellowknife, Northwest territories. Photo: Hanne Marit Dalen

The relationship of Indigenous Peoples with the land

The relationship of Indigenous Peoples with the land is deeply rooted and extends far beyond economic or territorial aspects. This connection forms the foundation of our identity, culture, and way of life. The land provides food and materials, and it sustains knowledge and language. Indigenous Peoples have a spiritual bond with the land, expressed through respect, gratitude, and protection. The land is also the foundation for social relations and economic survival of Indigenous communities. Before colonization, the relation with the land was essential for all aspects of life for Indigenous Peoples. This relation remains fundamental today for our identity, way of life, well-being, and the survival and health of Indigenous communities. Recognition and respect for the connection with the land are essential to preserving the culture and well-being of Indigenous Peoples and separation from our homelands is perceived as a form of homelessness.

For Indigenous Peoples, the relation with the land is not about ownership but stewardship, responsibility, and protection. We have a duty to care for the land, waters, sea, and the creatures that inhabit them. Indigenous Knowledge, languages, and cultural practices, passed down through generations, are intertwined with the land and shared through storytelling. If this connection is severed, the well-being of Indigenous Peoples is at risk. A study of Indigenous communities that experienced land loss due to industrial resource development found predominantly negative mental health impacts.¹⁰ These impacts stemmed from colonial

relations that threatened Indigenous Peoples' connection with the land, our identities, languages, and ways of life.

This relationship is also the basis for self-determination.¹¹ Article 25 of the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) recognizes this connection: *"Indigenous Peoples have the right to maintain and strengthen their distinctive spiritual relationship with their traditionally owned or otherwise occupied and used lands, territories, waters and coastal seas and other resources and to uphold their responsibilities to future generations in this regard."*¹²

To understand the impact of economic development on Indigenous lands, it is essential to critically address historical accounts of legislation, resource extraction, and land governance. The context of power and industrial developments must be expressed through ground-truthing. Storytelling serves as a tool for ground-truthing, teaching, and communication, expressing resilience, adaptation, and transformation. It helps in remembering and re-visioning place – land and home – and fosters a new understanding of the economy. Reciprocal



Intergenerational knowledge transfer while processing vadzaih. Photo: Malinda Bruce



Sámi reindeer herding in Finland. Photo: Viola Ukkola

relationships between humans, animals, and the land need to be conveyed through direct experience and storytelling.

For Indigenous Peoples, land is not just a physical space but a living entity in a reciprocal relationship. The land is an extension of themselves, expressing creation stories. Ancestors shaped the landscape and brought it to life. Every part of the landscape – rock, tree, river, or hill – holds spiritual significance and is part of a larger whole imbued with the spirit of the ancestors. Certain areas are considered sacred and are vital for the survival of Indigenous cultures. Access to the land and participation in land use decision-making to protect spirituality, cultural practices, and traditions is a key concern. The voices of Indigenous Peoples are often unheard when economic developments with significant impacts on communities take place. Indigenous Peoples have lived experiences and knowledge based on our worldviews, traditional economies, and experiences with political interferences. It is crucial to incorporate Indigenous perspectives into remembering, planning, strategizing, and new visioning.

Balancing Indigenous science with Western science is necessary to mitigate the destruction of human well-being, land, and animal life. The Indigenous worldview is different where Indigenous Peoples share knowledge between generations.¹³ The memory of the state is shorter than that of Indigenous Peoples, who have lived and harvested in the Arctic since time immemorial. Justice is a key issue and the fight for rights to lands and waters continues.

Land encroachment and legislation pose barriers to the traditional way of life and policy regulations limit the flexibility needed for Indigenous communities.

In a study of ocean harvesting, Indigenous researchers highlight the use of Indigenous Knowledge to enable Indigenous Peoples to actively participate in our future, further our rights to self-determination, and tell our own stories.¹⁴ Coastal communities and Indigenous fisheries must be considered when evaluating the blue economy of industrial fisheries, aquaculture, mariculture, offshore oil and gas, offshore wind, subsea mining, and tourism. The transition to the blue economy can disrupt Indigenous livelihoods and food security.¹⁵ Indigenous Knowledge and perspectives need to be combined with science for knowledge co-production.¹⁶ The walking interview is an important method for knowledge sharing.¹⁷

Arctic Food Systems and Land Loss

The Arctic food systems are integral to the traditional way of life for Indigenous Peoples, as illustrated by the stories of salmon in Alaska, caribou in Canada, and reindeer in Sápmi. Climate change significantly impacts these food systems. The Saami Council climate report highlights the relation with nature as the foundation of their economy (p. 73)¹⁸: *"In the Sámi cosmology, humans are seen as part of nature, not above other forms of life, where maintaining harmony within the ecosystem is the core value. Guiding principles are modesty – taking only what is needed – and respect, towards other beings both as individuals and as populations. [...] 'The salmon you catch should last from the time the river freezes until it opens again', according to a Sámi saying in the Deatnu area. If you still have salmon from last summer when the new fishing season begins, your luck will not be with you—you've either taken too many fish or shared too little".*¹⁹

The Convention on Biological Diversity (CBD), Article 8(j), calls for the application of traditional knowledge of Indigenous Peoples to achieve sustainable use and conservation of biodiversity. This principle is also reflected in the Ottawa Indigenous Knowledge principles. Sámi scholar Ellen Inga Turi explored the governance of Sámi reindeer pastoralism in Norway and found a lack of recognition of Indigenous Knowledge and lack of incorporation of CBD principles in protecting reindeer pastoralism.²⁰

Highlight 7.3. Alaskan Inuit Food Security Conceptual Framework¹

Text quoted from the report: Inuit Circumpolar Council-Alaska 2015. *Alaskan Inuit Food Security Conceptual Framework: How to Assess the Arctic From an Inuit Perspective: Summary Report and Recommendations Report*. Anchorage, AK, p. 12-13:

“The development of a conceptual framework provides a platform for understanding the pieces that make up the Arctic ecosystem and the interconnections between the many pieces that make up food security. The framework provides direction for what information is needed and how to interpret that information in order to assess food security.

The conceptual framework is provided through an image of a drum and explains that food security is characterized by environmental health; environmental health is achieved with the stability of six dimensions: 1) Availability, 2) Inuit Culture, 3) Decision-Making Power and Management, 4) Health and Wellness, 5) Stability and 6) Accessibility. Three tools support the stability of the six dimensions: policy, knowledge sources² and co-management. All of this is held together by the spirit of everything³ (Cillam Cua, Eslam Yuga, Iñua and Ellam Yua). The drum is held up by food sovereignty – a requirement for food security.

The six dimensions of food security are defined as follows:

Inuit Culture – Food is the cornerstone of our culture and self- and shared identity. Harvesting of traditional foods is how cultural values, skills and spirituality are learned – this is how all learn to be within their environments and to be part of the ecosystem. The relationship between Inuit and all else that makes up the Arctic environment aids in the maintenance of cultural and environmental integrity.

Availability – The ability of the Arctic ecosystem to maintain a high variety of life (biodiversity), allowing adequate transfer of nutrients and energy. It is the knowledge of seasons and how to collect, process, store and consume traditional foods, allowing for Inuit to eat what has been gathered from the previous season and harvest a variety of medicines.

Accessibility – The ability to live of the land, ocean and air and to obtain sufficient access to a diverse source of healthy food, water, animals, plants, fish, ice, etc. The ability to maintain Inuit traditional economic practices, such as trading, sharing and providing foods and medicines. It is the ability to access and maintain an economic system based on cash in connection to an Inuit traditional economic system. It is the ability to obtain skills, tools and technologies needed to collect, process and store traditional foods.

Health and Wellness – Physical health of all life within the Arctic and of the land, water and air; adequate passage and absorption of nutrients throughout the Arctic ecosystem; mental health related to community and household relations and self- and cultural identity;

environmental integrity and productivity to withstand pollution, habitat destruction and other disturbances.

Stability – The ability of the puzzle pieces (systems) to adjust to each other as shifts within the ecosystem occur. The ability to maintain sustainability through the management of human actions that support and ensure younger generations will have sufficient healthy food to harvest and that all pieces of the puzzle maintain connected. Stability is obtained through a level of Alaskan Inuit mental security and is in reference to the legal protections for the environment against harm caused by pollutants. Mental security is also in reference to legal protection against forced assimilation, which allows for the maintenance of a level of cultural confidence and hope.

Decision-Making Power and Management – The Alaskan Inuit ability to use and value IK to manage daily activities; to build and rely on self-governance across space and time; for Alaskan Inuit to use their knowledge system in synergy with other knowledge systems, such as Western science, to equitably manage human activities within the Arctic environment and to better understand changes occurring; to apply holistic knowledge to understanding the Arctic environment through IK philosophies and methodologies; to manage activities within the Arctic in a way that ensures younger generations will have healthy and nutritious foods to harvest; for Alaskan Inuit to have control over their own fate and to use their cultural value system.

Food Sovereignty – The right of Alaskan Inuit to define their own hunting, gathering, fishing, land and water policies; the right to define what is sustainable, socially, economically and culturally appropriate for the distribution of food and to maintain ecological health; the right to obtain and maintain practices that ensure access to tools needed to obtain, process, store and consume traditional foods. Within the Alaskan Inuit Food Security Conceptual Framework, food sovereignty is a necessity to supporting and maintaining the six dimensions of food security.⁴

Notes

¹ <https://iccalaska.org/wp-icc/wp-content/uploads/2016/03/Food-Security-Summary-and-Recommendations-Report.pdf>

² Both IK and science are needed.

³ The spirit of all spoken in all four of our languages. Cillam Cua is from the Cup'ik language, Eslam Yuga is from the St. Lawrence Island Yupik language, Iñua is from the Iñupiaq language and Ellam Yua is from the Yup'ik language.

⁴ The food sovereignty definition presented here accounts for all points identified by Alaskan Inuit and has been adapted from the definition written by Hamm and Bellows in First Nations Development Institute's Food Sovereignty Assessment Tool, 2004 and in addition to the definition provided in the Declaration of Nyéléni (2007).

Highlight 7.4. The Case of Proposed Wind Power Development at the Sacred Mountain Rásttigáisá*Eleonora Alariesto, University of Lapland*

Wind industry development has become a controversial topic in Nordic countries. Many of the projects are geographically located in areas, which are crucial pastures for reindeer herding in Norway, Sweden and Finland. Land-use conflicts between wind industry, other infrastructure and building developments, and reindeer herders have been taken to court to be resolved¹

The Norwegian Supreme Court ruled in 2021 that the Fosen wind power development violated Sámi People's rights, according to the Article 27 of the International Covenant on Civil and Political Rights.² However, the government did not implement the Supreme Court decision, thus leading to continued violation of Sámi human rights. A characteristic feature of the Fosen court cases is what Sámi scholar Eva Maria Fjellheim described as "strategic ignorance", namely that the wind power interests and the government failed to acknowledge the Sámi land rights and traditional Sámi knowledge. The government's lack of implementing the Supreme Court decision reflects the policy priority to developing carbon neutral energy, ignoring ecological and cultural protection.³

In the area near the sacred mountain Rásttigáisá, located in Norwegian side of Northern Sápmi and close to the borders of Finland and Sweden, the Finnish energy company St1 together with the Norwegian based energy company Grenselandet AS are planning to build a wind industry site named Dávvi. In September 2024 the project has not gained a Social License to Operate (SLO) from different stakeholders and rightsholders. The Ministry of Environment and the Regional Office of the Finnish Ministry of Environment (SYKE) have collected statements from stakeholders and rightsholders in regard to the Dávvi project. As Rásttigáisá is a Sámi Cultural Environment, these statements can function as a way of making visible the pure status of the sacred area, which Dávvi as a form of colonial contamination violates. In 2024 the Norwegian Water Resources and Energy Directorate (NVE) decided to postpone the approval of the Dávvi wind power site.⁴ Yet it is important to continue to explore the mechanisms for decision-making on energy development on Sámi land.

My research on the Rásttigáisá case builds on the anthropological theory of contamination.⁵ The project develops the theory beyond its original focus on separate categories, an approach that does not work well in a relational Sámi environment, where the physical, social and cultural dimensions weave together, and a deeper and more holistic approach is in place. A decolonial method is carried out, highlighting the voices of the marginalized Sámi people by placing the collected statements on the relational landscape in the center of the research.

Within the Sámi Cultural Environment, the question of meahcci – the North Sámi word for the land, where the traditional Sámi nature-based activities take place – also becomes relevant. In Sámi holistic and relational

thought, places and activities are tightly connected in environments, where the Sámi carry out nature-based activities with skills and knowledge transferred from previous generations. And so, meahcci is not a specific location, but becomes one in relation to the activity⁶ In luomemeahcci, cloudberry meahcci, the Sámi carry the social wisdom inherited from one's own community including knowledge on where to find berries and where it is permitted to pick the berries according to customary laws. Meahcci also carries an understanding of home, belonging and safety, and thus the endangerment and destruction of meahcci can rupture the individual and collective sense of safety.⁷

The conflicts of wind power development are questioning Indigenous self-determination. In my research, I explore to which extent the paternalistic practices of the state, patronizing discourse and states governmental policies in the land-use conflicts today are related to historical continuities in the impression of the Sámi people as inferior people.⁸ The governments' overruling of Sámi rights to land has deep historical roots in land colonialism and assimilation. From this perspective the so-called "green" transition in many ways has been perceived as renewing colonial structures, and thus, strengthening the Indigenous experience of injustice in land-use conflicts.⁹

Wind industry demands large land areas in producing energy, accelerates mining of minerals, and causes environmental, psycho-social and cultural damage to Indigenous communities. The ongoing conflict is not only between different forms of land-use, but also between different worldviews, between sacredness, sustainable ways of life, and capitalistic forces extracting sacred land. Court rooms as frames of the conflicts are seen as stages of asymmetrical power relations leaving a marginal space for Indigenous self-determination and justice.¹⁰

¹ Hernes, H., Broderstad, E. G., & Tennberg, M. (2022). *Indigenous rights and governance theory: An introduction*. <https://doi.org/10.4324/9781003131274-1>; Cambou, D. (2020). Uncovering Injustices in the Green Transition: Sámi Rights in the Development of Wind Energy in Sweden. *Arctic Review on Law and Politics*, 11, 310-333.

² Cambou, D., Sandström, P., Skarin, A., & Borg, E. (2022). *Reindeer husbandry vs. wind energy: Analysis of the Pauträsk and Norrbäck court decisions in Sweden*. <https://doi.org/10.4324/9781003131274-3>

³ International Covenant on Civil and Political Rights | OHCHR

⁴ Fjellheim, E. M. (2023). Wind Energy on Trial in Saepmie: Epistemic Controversies and Strategic Ignorance in Norway's Green Energy Transition. *Arctic Review on Law and Politics*, 14, 140-168

⁵ Oversikt over prosjekter - NVE.

⁶ Douglas, M. (2002). *Purity and danger*. Routledge.

⁷ Joks, S., Østmo, L., & Law, J. (2020). Verbing meahcci: Living Sámi lands. *The Sociological review* (Keele), 68(2), 305-321.

⁸ Joks, S. (2022). Frustrated Caretakers: Sámi egg gatherers cloudberry pickers. In S. Valkonen, Á. Aikio, S. Alakorva & S. Magga (Eds.), *The Sámi World*. Routledge.

⁹ Lawrence, R. (2014). Internal Colonisation and Indigenous Resource Sovereignty: Wind Power Developments on Traditional Saami Lands. *Environment and planning. D, Society & space*, 32(6), 1036-1053.

¹⁰ Fjellheim, E. M. (2023), op. cit.

¹¹ Fjellheim, E. M. (2023), op. cit.



Sámi reindeer herding in Finland. Photo: Viola Ukkola

The lack of recognition of Sámi land use is expressed in the report of the Truth and Reconciliation Commission to the Norwegian parliament in 2023. The dispute surrounding the Fosen wind power plant, for which the Supreme Court in Norway ruled the original license invalid because it violated Article 27 of the UN Covenant on Civil and Political Rights, exemplifies land use conflicts where Sámi rights are violated. The Fosen wind power case illustrates how Indigenous Peoples can contest dominant knowledge through the legal system, however, the Norwegian state's reluctance to respect the Supreme Court verdict reveals asymmetric power relations.

In Canada, many national parks and other protected areas were established with the aim of preserving "wilderness" without people.²¹ National parks not only removed Indigenous Peoples from our lands, as stewards and rightsholders, resulting in the loss of livelihoods and spiritual sites, but also perpetuated the idea of "wilderness" as devoid of human life and influence.²²

The Pathway to Canada Target 1, an initiative to meet obligations under the CBD, contributed to the establishment of Indigenous Protected and Conserved Areas (IPCAs).²³ This strategy holds the potential to be more holistic and inclusive of Indigenous Peoples. Conserving lands and waters in partnership with Indigenous Peoples is the best way to protect land and decolonize environmental policy, consistent with obligations to respect and uphold the rights of Indigenous Peoples who call this region home.²⁴

Parks Canada's Indigenous Stewardship Policy,²⁵ co-developed with the Indigenous Stewardship Circle,²⁶ represents a renewal of how national parks can better support Indigenous Stewardship. The Policy builds on the work of Indigenous peoples to advocate for their rights and responsibilities to steward the lands, waters and ice of their traditional territories, treaty lands and ancestral homelands.

Highlight 7.5. Viability of reindeer herding in Finland – a case study

Viola Ukkola, University of Lapland and Sámi reindeer herder

In Finland in 2023 reindeer herding was a livelihood for 4 279 people in the Reindeer Herding Area, in Lapland and the northernmost parts of Pohjois-Pohjanmaa and Kainuu. The Reindeer Herding Area is divided into three legislative areas: the Sámi homeland area, the area specially intended for reindeer herding, and the southern reindeer herding area.¹ The situation of reindeer herding in Finland diverges from that of Norway and Sweden as, in Finland, reindeer herding is not only practiced by Sámi people but is also an important livelihood for other people.

There is a substantial subsidy and compensations system for reindeer herding in Finland.² Subsidies do not usually contribute more than 12-20 per cent to the total income of herders, significantly less than in agriculture, at approximately 30 per cent.³

Costs and income in reindeer herding

Previous research has illustrated costs and income structure at an example reindeer farm in Sattasniemi cooperative, Northern Finland.⁴ Supplementary feeding is now a widespread practice in the whole reindeer herding area.⁵ Supplementary feeding and vehicle costs (maintenance and fuel) dominate the costs. The main income in reindeer herding is from sales of meat. The sales value depends on calf production and on whether the meat is sold before or after being processed. Herders can sell the meat to larger businesses, but the income is smaller than when processing the meat themselves and selling the products directly to the customers.⁶

The most important subsidy is the animal-specific subsidy when the number of alive reindeer at the end of the herding year is at least 80. Compensations depend on losses to predators and traffic accidents, which have large yearly and local variations. In addition to income from meat-production, subsidies and compensations, reindeer herders can earn income from work in the cooperative. Herders sell other products alongside meat, such as antlers and hides.

Yearly statistics for reindeer herding is provided by LUKE, the Natural Resources Institute Finland.⁷ According to their calculations herding has been economically unprofitable during the whole 20-year period covered by LUKE. However, in the yearly economic viability calculation,



Sámi reindeer herding in Finland. Photo: Viola Ukkola

LUKE includes a required reference salary (derived from the agricultural sector), which does not depict the reality, as herders do not obtain a salary that matches the required reference salary. Reindeer herding can achieve the covering of its own costs, but not necessarily the required reference salary. Still, often reindeer herders need to find additional income, from another entrepreneurial activity or salary job, to allow reindeer herding to remain as the main livelihood.⁸

Reindeer herding beyond numbers

Climate change and mineral extraction have forced changes upon traditional reindeer herding.⁹ Reindeer herding is, however, still a significant livelihood and an important basis for Sámi culture, but also an important traditional livelihood for non-Sámi communities. Reindeer herders do not describe reindeer herding as an entrepreneurial activity, but as a way of living that cannot be translated into money, as it is embedded in identity, tradition and social and cultural values.¹⁰

Viability of reindeer herding can be seen to go beyond numbers as a multifaceted culture, preserving traditional knowledge and identity in the social landscape and within herding communities. When viability of reindeer herding is examined, looking at more than income and cost structure can be more meaningful. The factors of viability in the livelihood approach by De Haan, including labor, natural capital, physical capital, financial capital and social capital, represents a holistic approach suitable to explore the viability of reindeer herding.¹¹ Viability of reindeer herding consists of cultural practices, identity, well-being, social-environment and economic factors.

¹ Paliskunnat. Poronhoitajat. <https://paliskunnat.fi/py/materiaalit/tilastot/poronhoitajat/> Poronhoitolaki 1990/848, 25.

² Saarni, K., & Nieminen, M. (2011). Tukipolitiikan vaikutukset Suomen poronhoitoon. Riista- ja kalatalous. Tutkimuksia ja selvityksiä. https://jukuri.luke.fi/bitstream/handle/10024/530739/rkts2011_10.pdf?sequence=1.

³ Ylikoski, P. (2014). Porotalouden tuen sähköistäminen. Esiselvitys hakuprosessin vaatimusmäärittelyyn. Opinnäytetyö. Seinäjoen ammattikorkeakoulu. https://www.theseus.fi/bitstream/handle/10024/85019/Opinnaytetyo_lopullinen.pdf?sessionid=06985522A5C9DB46D0F41C252C166570?sequence=1. Maa- ja metsätalousministeriö. (2024). Tukien osuus maatalouden kokonaistuotosta noin kolmanneksen. <https://mmm.fi/maataloustukien-merkitys1> at 23/2/2024. Kotala, K. (2021, March 18). Porotalouden kannattavuus nousut. YLE.

⁴ Ukkola, V. (2024). *Validity of Economic Viability as a Description of Reindeer Herding: A Case Example from Sattasniemi, Northern Finland*. Bachelor of northern studies. UiT The Arctic University of Norway. Data are being revised.

⁵ LUKE. (2024). Porotalouden kannattavuus parani koko poronhoitoalueella.

⁶ Saarni et al., 2008, op. cit.

⁷ LUKE (2024), op. cit.

⁸ Kietäväinen, A., & Vatanen, E., & Ronkainen, S. (2013). Porotalouden taloudelliset ja työllistävät vaikutukset sekä muut arvot: kohti kokonaisarvoa? Lapin yliopiston yhteiskuntatieteellisiä julkaisuja B. Tutkimusraportteja ja selvityksiä 63. Lapin Yliopisto.

⁹ Sarkki, S., Komu, T., Heikkinen, H., Gracia, N.A., Lépy, É., Herva, V.P. (2016). Applying synthetic approach to the resilience of Finnish reindeer herding as a changing livelihood. *Ecology and Society* 21(4):14. Rasmus, E., Wallen, H., Turunen, M., Landauer, M., Tahkola, J., Jokinen, M., & Laaksonen, S. (2021). Land-use and climate related drivers of change in the reindeer management system in Finland: Geography of perceptions. *Applied Geography*, 134, 102501.

¹⁰ Kietäväinen et al., 2013, op. cit.

¹¹ De Haan, Leo J. (2012). The livelihood approach: a critical exploration. *Erdkunde*, 66(4), 345–357.

Highlight 7.6. Nenets Reindeer Herding: An Example of the Yerv Cooperative

Polina Syadeyskaya, University of Victoria, Canada

Reindeer herding in Nenets Autonomous Okrug faces an uncertain future: there are not enough shepherds to herd reindeer, not enough women to maintain family life in the tundra, being a reindeer herder is considered non-prestigious and unpromising, and there is a loss of Indigenous Nenets knowledge.¹ I examined the experiences of Yerv Private Agricultural Production Cooperative, an organization that unites several Nenets reindeer herding families, who are legally established as family peasant farms under Russian law.

I chose Yerv to study because this research concerns me directly as a member of the Nenets community. I was born in the region and grew up in the Village of Krasnoe, Nenets Autonomous Okrug with my extended family. My Nenets grandfather, who raised me, was born and raised in the Bolshezemelskaya tundra and is a co-founder of Yerv. Yerv was created in 1992 after the collapse of the Soviet Union in 1991, one of the first and unique in Nenets Autonomous Okrug, it switched from industrial to family nomadic reindeer herding, as practiced before the Soviet collectivization and industrialization of reindeer herding.

With the support of the WAGE Circumpolar Partnership based at Laval University, I conducted fieldwork in the Nenets Autonomous Okrug in the summers of 2023 and 2024. In this study, I used the following methods: content analysis of newspaper articles, archives, and other documents gathered from literature review and recommended by community members; analysis of data collected with Indigenous methods of research such as nature walk in tundra, talking circle, storytelling, observation; in-person interviews, informal in-person and online conversations and observations using qualitative content analysis; secondary data analysis such as organizational structure, profits, reports, and publicly available court cases. Limitations of my research were that there was no access to non-public administrative and financial documentation of Yerv.

Under traditional Nenets family nomadism, families migrate together and nomadic reindeer herding is their way of life, while under industrial nomadism imposed by the Soviet regime, women and children were moved to villages, and men became hired nomadic workers on collective farms, when reindeer husbandry was viewed as an industry by the government.

Yerv's main activity is reindeer herding plus some engagement in fishing. Yerv has an affiliated company for processing venison – Yerv Limited Liability Company (Yerv LLC). In Yerv, de facto reindeer are privately owned by its reindeer herding families, de jure reindeer belong to Yerv, and land lease rights belong to peasant family farms (reindeer herding families) who are legally members of Yerv and not to Yerv as a cooperative. Yerv's reindeer herders receive payments for supplying

reindeer meat, its by-products or fish, Yerv LLC freezes or processes reindeer meat, its by-products and fish and sells them through its stores in Naryan-Mar. Sometimes Yerv LLC brings its products in a cold-food specialty food truck to the Krasnoe village.

Reindeer herders also sell reindeer meat directly to people, but most of it they sell to Yerv LLC. In 2023, Yerv LLC bought venison from Yerv's reindeer herders at the rate of 170 rubles per kg. So, in 2023, with the state subsidy of 150 rubles, Yerv reindeer herders got 320 rubles per kg of venison. The hides are most often destroyed. Bone antlers (that fall off of reindeer in the spring) are sold to private traders in Naryan-Mar, and they take them out of the region and re-sell them.

In Yerv, reindeer herders migrate with their families, including children which is family nomadism that was practiced by the Nenets people before the USSR. The system of boarding schools continues, and nomadic children are taken to boarding schools from the age of 7 and return to their families in the tundra during school summer breaks and some children visit their families in the tundra by snowmobiles during school winter breaks when the reindeer herding camps are near the village of Krasnoe. This state educational system interrupts the transferring of Indigenous knowledge to the youth. Nenets have their land-based ways of knowing and being, some of the forms of transferring Nenets knowledge are: verbally through singing, storytelling, and other types of narrative folklore; non-verbally through watching, doing, repeating, playing; verbal and non-verbal communication between a reindeer and a human; written forms which appeared less than a century ago.² Nenets knowledge is also transferred by leaving some things unspoken. Silence, in combination with spoken words, endows unspoken words with powerful messages about the past.³ Yerv is contributing to maintaining the Nenets family nomadic reindeer husbandry and transfer of Nenets Indigenous knowledge to the youth.

The reindeer herders in Yerv maintain a sense of ownership and responsibility for their reindeer and livelihood. Families migrate together, and children visit their parents or relatives in the tundra during school breaks, which, although limited in time, allows them to pass on some Indigenous knowledge to the younger generation. Yerv is an effective organizational form for reindeer herding in Russia in current realities and plays a role in maintaining the Nenets nomadic reindeer herding.⁴

² Vylka Ravna, Zoia. 2019. The Inter-Generational Transmission of Indigenous Knowledge by Nenets Women: Viewed in the context of the State Educational System of Russia. PhD diss., the Arctic University of Norway.

³ Laptander, Roza. 2020. When we got reindeer, we moved to live to the tundra: The Spoken and Silenced History of the Yamal Nenets. PhD diss., University of Lapland.

⁴ Syadeyskaya, Polina. 2024. "Indigenous Economic Institutions Building: A Case Study of the Yerv Reindeer Herding Cooperative". Master's thesis, University of Northern Iowa.

¹ Khanzerova, Irina. 2014. The wrong reindeer herder. Naryana Vynder, December 23. <http://nvinder.ru/article/vypusk-no-140-20199-ot-23-dekabrya-2014-g/5983-olenevod-da-ne-tot>.



Early August evening in one of the Yerv cooperative's brigades. Photo: Polina Syadeyskaya

Strengthening Indigenous perspectives in ECONOR

Key messages from the workshop in Yellowknife

The dramatic climate change impacts throughout the Arctic regions will continue to alter the way of life for Indigenous Peoples and our relationship with the land. This relation – belonging to the land – is central to the economies of Indigenous Peoples. Cooperation with Indigenous Peoples' organizations that are Permanent Participants to the Arctic Council can support ECONOR in realizing its ambition to better reflect the relation between people, economies, the economic contributions of Indigenous Peoples, and the impacts of economic development on our livelihoods. Including Indigenous Knowledge will enhance the learning and knowledge transfer components of the report.

Although Indigenous Peoples participate in international forums, significant improvements for the many Indigenous Peoples and our communities in the Arctic remains to be seen. The Arctic's future under climate change, the distribution of profits, and the persistent disparities faced by Indigenous Peoples are pressing concerns. Despite the wealth generated from the rich deposits of natural resources, Indigenous communities continue to live in inequity. From an Indigenous perspective, it is

crucial to respect and enable the flourishing of our way of life, where access to hunting, fishing, and herding in our land and waters is a prerequisite to live decent lives. Therefore, a significant aim for Indigenous involvement is to achieve respect for our relation with the land. We focus on what the ECONOR as an inclusive project can do for Indigenous communities. In this respect, the report represents a means to express our way of life and amplify our voices in decisions about the Arctic's future. By reflecting Indigenous realities in policy-relevant reports, our experiences can be shared and voices heard as an equal part of the much needed and shared knowledge base about the Arctic.

Efforts are under way to complement the different perspectives of governments and Indigenous Peoples. Indigenous stories and the values of our work need to be told, reflecting our diverse roles within communities, to draw better and more complete pictures of the society and economy. It is essential to convey the stories behind graphs and numbers, bridging the gap between community language and economic language to illustrate the diverse values and to inform processes of decolonization. Comparing different regions and measuring community well-being requires a holistic view of Indigenous communities' way of life. Indigenous

values emphasize the strength found in community partnerships, staying present during uncertain times, and finding resilience in hardship. Economics of well-being must be relevant to community members, with frameworks developed collaboratively. Indigenous Peoples are taking on leadership roles, addressing infrastructure challenges such as unreliable internet, and public health and societal challenges such as discrimination, lack of formal recognition for volunteer work, loss of skills between generations, and the need for integrating economic and Indigenous practices. Opportunities include entrepreneurship, support programs, recruitment strategies, and conservation efforts.

The Indigenous Peoples Economics Account (IPEA) (Highlight 8.4) developed by Statistics Canada needs to be followed by analysis and explanations to accurately reflect Indigenous Peoples' lives. Statistical challenges such as data gaps and incomplete administrative data must be addressed, and new data sources, including Indigenous Knowledge, need to be explored. Then a more complete statistical portrait can be drawn to better describe the realities and values of Indigenous communities. The risk of not embarking on this collaborative effort is that decision-makers are kept unaware of the impacts of their decisions with consequences of homelessness, trauma, family disconnection, and housing crises, calling for policy efforts like land-based healing programs. Visionary thinking is needed to address concrete and present challenges of food security, climate risks, and the costs of hunting and other traditional activities in inflationary times.

Indigenous statistics and “good numbers”

For Indigenous Peoples, statistics is needed for evaluating to what extent governments are following up Indigenous rights of international law implemented in national legislation. Indigenous institutions need statistics to document living conditions and how rights are supported through institutional and societal conditions. Statistics is not value-free knowledge, and the categories of statistics are shaped by society.²⁷

Following the adoption of the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) in 2007, it has been emphasized in the international statistical and research community that concerted effort is needed to improve statis-

Highlight 7.7. A fairytale “The goat kid that could count to ten”

This popular fairytale from Norway, written by the author Alf Prøysen, is often brought forward as a warning of excessive use of measurement and statistics in situations when inappropriate.

“Once upon a time there was a little goat kid who had learned to count to ten. When he came to a water puddle, he stood for a long time and looked at his mirror image in the water, and now you will hear how it went: - One, said the goat kid. A calf walking nearby and eating grass heard this.

What are you doing? Said the calf. - I count myself, said the goat kid. Shall I count you too? - If it doesn't hurt, said the calf. - I guess it doesn't, just stand still and I'll count you. - No, I don't dare, maybe my mother won't even allow it, said the calf and pulled away. But the kid goat followed and said: - I am one, and you are two, 1 - 2. - Mother! The calf bleated and began to cry, and then the mother came to the calf, and she was the bell cow of the farm. - What are you raving about? said the bell cow. - The goat kid counts me! roared the calf. - What is that? said the bell cow - I count, said the goat kid. I have learned to count to ten, I just do like this: I am one and the calf is two and the cow is three, 1 - 2 - 3. - Oh, now he counted you too! roared the calf. And when the bell cow realized that, she became terribly angry. - I'll teach you how to make fun! Come my calf, and we'll take him.”

tics on and for Indigenous peoples.²⁸ In line with UNDRIP, Articles 3 and 4 on self-determination and autonomy, Indigenous Peoples need to have an active role in identifying gaps in knowledge and informing policy.²⁹ Yet there has been no international statistical effort to respond to the calls for improved Indigenous statistics.³⁰

In 2009, the “State of the World’s Indigenous Peoples” reported available data on extreme disadvantage of a range of Indigenous Peoples. A second edition was published in 2015.³¹ Even countries with well-developed national statistics have only partly developed statistics on Indigenous populations.³² Although statistics on the situation of Indigenous Peoples are not readily available, since few countries disaggregate data by ethnicity, it is possible to find a picture of Indigenous Peoples' social and economic conditions through selected national and regional data.³³

Indigenous statistics comprise data, information and knowledge that describe or can impact on the Indigenous Peoples, collectively or individually. This comprises data on demographic, social, legal,



Sámi reindeer herding in Finland. Photo: Viola Ukkola

health and educational related conditions, data on land use and natural resources, and data from the indigenous Peoples' culture, traditional knowledge, archival material, and oral traditions.

The book *Indigenous Statistics* explores qualitative and quantitative aspects of Indigenous statistics and suggests the concept of "good numbers", denoted *Nayri kati*, in the Tasmanian language Palawa, to characterize data and statistics that are culturally meaningful for Indigenous Peoples and can contribute to make visible the conditions for social and economic development aligned with the Indigenous culture.³⁴

Making visible, or remaining invisible, is a key issue. Counting is important, and what is not counted, does not count. Equally important is that what is counted, is correct and relevant and used in a sound and fair way. Historical, social, and political conditions influence on what and who are counted and not.³⁵

Indigenous data sovereignty denotes an approach for ethical guidelines related to collection, analysis and use of data, ensuring that Indigenous people have an autonomous right to determine which data shall be collected, how data are collected, who

shall have access to data, and what they can be used for.³⁶ An international framework for Indigenous data sovereignty, *Collective benefit, Authority to control, Responsibility, Ethics (CARE)* gives guidelines for culturally sensitive use of data.³⁷

Interpretation of statistics needs to be placed in a holistic approach that highlights the strengths and resilience of the way of life of Indigenous Peoples.³⁸ Comparative statistics often points to lower socio-economic and health related conditions and higher prevalence of violence and lower educational attainments.³⁹ "Good numbers" need to be grounded in the cultural context of Indigenous people and the history of assimilation and colonialization.

For example, Sámi people in Norway is more exposed to discrimination than the majority population. Yet there is no overview of where and how discrimination takes place. The European Commission against Racism and Intolerance (ECRI) recommends establishing a system to register and monitor discrimination.⁴⁰ Sámi use of nature has large importance for Sámi culture, language, knowledge and way of life. Nature-based activities are important sources for income and self-sufficiency in Sámi traditional areas. In the mapping of land use, where and when and by whom, it is important to integrate traditional Sámi knowledge into statistical indicators.

"Good numbers" require that Indigenous Peoples have trust that concepts, data, and communication of statistics are culturally meaningful, and that the research is placed in a recognizable and useful context.⁴¹ Guidelines to deal with ethical challenges, reflect on the perspectives of Indigenous statistics, Indigenous Data sovereignty, and the principles of "good numbers", are worked out in many countries. It is crucial that these experiences are brought into the future development of Indigenous statistics.

Reindeer herding in the Nenets Autonomous Okrug, Russia: Current State and Trends

Polina Syadeyskaya, University of Victoria, Canada, and Andrey N. Petrov, University of Northern Iowa

The main traditional occupations of the Nenets have long been reindeer herding, hunting, and fishing, and the whole life of the people is connected with reindeer.⁴² Preserving the nomadic Nenets

Figure 7.1. Indigenous Peoples of the Russian North, Siberia and Far East. Compiled and drawn by W. Dallmann

way of life is key to maintaining reindeer herding. Nenets reindeer herding has survived multiple transformations, including collectivization in the 1930s and collapse of the Soviet system in the 1990s. The contemporary reindeer herding practices in Nenets Autonomous Okrug stem from a complex interplay of strong Indigenous traditions, Soviet legacies and market forces. From the economic perspective, the reindeer herding sector is represented by various institutional forms, organizational types and supply-chain arrangements.⁴³ After the decline of the 1990s, the Okrug maintains steady reindeer population and was able to gradually develop its infrastructure to increase local reindeer meat processing. Still the issues of profitability, dependency on state subsidies, and labor force shortage persist.

According to the Report on the State of Reindeer Herding in the Nenets Autonomous Okrug by

the regional Department of Natural Resources, Environment and Agro-Industrial Complex⁴⁴, as of January 1, 2024, 31 organizations were engaged in reindeer husbandry in the region, including 11 agricultural production cooperatives, one joint stock company, 11 family (clan) collectives of the Indigenous Peoples of the North (obschinas), and eight peasant family farms. About 700 residents of the Okrug were officially employed by these nomadic reindeer herding enterprises, most of whom were Nenets, officially recognized in Russia as an Indigenous Small-Numbered People of the North.

The area of reindeer pastures in the region is about 13.2 million hectares, or 74.5 per cent of the land area of the Okrug. The herd size has not changed significantly over the last few years (Table 7.1). The region still has the second largest reindeer population in Russia, second only to the Yamalo-Nenets Autonomous Okrug. As of January 1, 2024,

Table 7.1. Total number of domestic reindeer and reindeer herding personnel in Nenets Autonomous Okrug

Date	01.01.2019	01.01.2020	01.01.2021	01.01.2022	01.01.2023	01.01.2024
Total number of reindeer	179 200	175 700	168 200	174 400	175 500	184 600
Workers employed in reindeer herding ¹	860	860	830	700	700	700

Source: Reports 2019-2024; ¹ official employment only

Table 7.2. Dynamics of key financial indicators in reindeer herding, Nenets Autonomous Okrug

Indicators ¹	2019	2020	2021	2022	2023
Production costs (per cent to previous year)	87.9	106.5	103.7	140.0	69.3
State subsidy (per cent to previous year)	87.8	69.9	144.8	139.1	87.10
Revenues (per cent to previous year)	118.5	96.2	105.8	122.3	87.5
Profit/Loss (per cent to previous year)	93.1	58.5	239.3	122.6	170.9
Percentage of state subsidy in production costs, Per cent	57.8	36.0	50.2	53.4	62.6

¹ Not inflation adjusted.

Source: Reports 2019-2024

there were 184 600 reindeer in the Okrug, including 158 400 reindeer, or 85.8 per cent, owned by agricultural organizations, and 26 200 reindeer, or 14.2 per cent in personal ownership. Compared to 2022, the total number of reindeer increased by 9 100 reindeer or 5.2 per cent, including personal ownership growth by 3 000 reindeer. The increase in the number of reindeer reported on January 1, 2024, was mostly due to the late dates of the slaughtering in several reindeer herding organizations (January-March 2024) mainly due to warm weather conditions. At the same time, the number of people employed in reindeer herding, i.e. predominantly Indigenous herders, has been declining, indicating a concerning trend that may result in the eventual loss of tradition and local economy.

After harvesting, the main part of venison is sent for further industrial processing to the local enterprises. The total volume of reindeer herding products sold in 2023-2024 amounted to 1 436 tons, including 1 207 tons to organizations carrying out (industrial) processing in the Nenets Autonomous Okrug (including Myasoprodukty Joint Stock Company with 832 tons), 214 tons for other sales (population, trade organizations, etc.) and 15 tons own processing by reindeer herding organizations and individual reindeer herders. Myasoprodukty Joint Stock Company, the largest purchaser of reindeer meat, is a monopolist determining the terms of product supply and price level.⁴⁵ The situation could be more favorable for reindeer herders if they participated in managing the enterprise as shareholders, but this is not the case.

In October 2023, the Governor of the Nenets Autonomous Okrug instructed Myasoprodukty Joint Stock Company to increase the purchase price for the first category of reindeer meat from 200 to 250 rubles per kilogram.⁴⁶ The state subsidy is 150 rubles per kilogram of venison sold to organizations processing venison in the Nenets Autonomous Okrug or to any other consumers,

and processed by themselves. The condition to qualify for this subsidy is that if the reindeer herders sell their venison to other consumers, the price should not exceed 250 rubles per kilogram. So, the Myasoprodukty's venison purchase price of 250 rubles and state subsidy of 150 rubles allows reindeer herders to receive up to 400 rubles per kilogram of reindeer products sold for processing. One can find reindeer meat products by Myasoprodukty at the Russian Ozon online marketplace.⁴⁷ At the St. Petersburg International Economic Forum (SPIEF) in 2024, an agreement was signed to create a production facility for deep processing of secondary products of reindeer herding into collagen, for the international market, with investments amounting to about one billion rubles.⁴⁸

State support for the reindeer husbandry is carried out within the framework of the state program of the Nenets Autonomous Okrug. The main measures of state support for reindeer husbandry are subsidies for: 1) costs of production and realization of agricultural products; 2) preservation of reindeer herds and breeding stock of farm animals; 3) creation, reconstruction, and (or) modernization of agro-industrial facilities; 4) partial reimbursement of transportation costs for the delivery of venison meat and by-products for further (industrial) processing from slaughtering sites in Naryan-Mar.

In general, reindeer herding incurs high production costs and receives limited revenues, and to a considerable extent, depends on state subsidies (Table 7.2). Although cash profits have increased, the dependency on subsidies has not diminished in the last decade making government programs a critical source of support for Nenets reindeer herding enterprises. The total amount of measures aimed at the development of reindeer husbandry in the Nenets Autonomous District in 2023 amounted to about 361.2 million rubles.⁴⁹



Laksefjordvidda, Finnmark. Photo: Marit Holm Pettersen

Global Atlas of Environmental Justice: Reporting extractivism, environmental distribution conflicts, and resistances across the Arctic

Ksenija Hanaček, University of Helsinki and Autonomous University of Barcelona⁵⁰

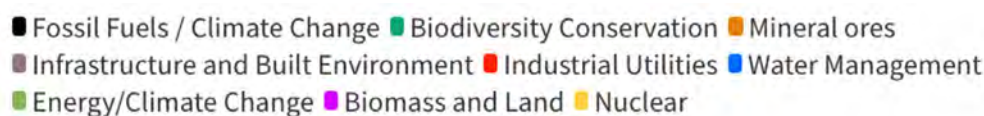
Data sources and method: EJAtlas

The Global Atlas of Environmental Justice (EJAtlas.org) is a research project and an online database, that documents environmental conflicts globally (ejatlas.org).⁵¹ Cases are documented by academics, activists, and civil society with experience in different geographical regions and types of conflicts. These include cases in Latin America, Europe, Asia, and the Arctic with impacts on Indigenous Peoples, Roma people, women, peasants, or fisher people. The database uses secondary material, like case studies, reports, or published literature as sources, registering qualitative description of the cases and standardized quantifiable variables, such as conflict type, commodities, social, environmental and health impacts, mobilizing actors, forms of mobilization, and conflict outcomes.⁵² After a case has been reported and introduced in the database, it undergoes a revision and sources checking by an editor. Once approved, cases are published on the website in an open source. EJAtlas offers valuable space for voices that often have not been heard in environmental and social justice questions.

Limitations of the database include uneven geographical cover of cases, due to lack of newspaper coverage and collaborators. The database does not offer ethnographic and storytelling depth, but is a valuable tool for obtaining global and regional analyses of extractivism, socio-environmental impacts, and resource conflicts.⁵³ The emphasis is on peoples' everyday resistances and efforts to stop damaging projects, as transformations towards sustainability.⁵⁴

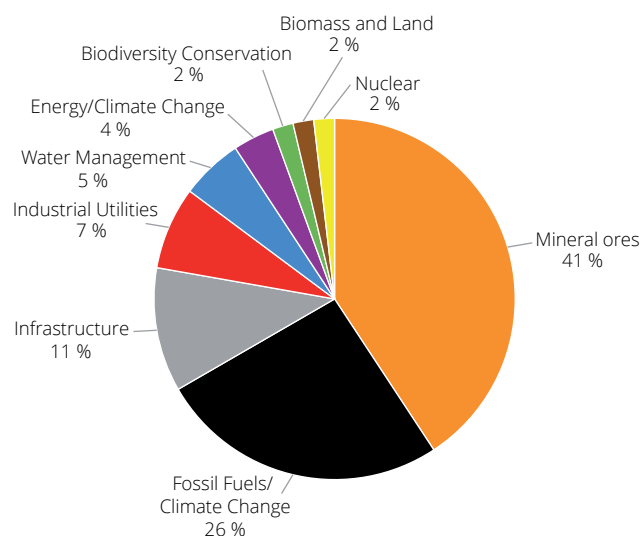
Environmental distribution conflicts and extractivism in the Arctic

Environmental distribution conflicts refer to situations in which people protest, report, and defend their livelihoods, territories, land, waters, health, relation with nature, knowledge and existence against damaging extractive projects.⁵⁵ Extractivism, both historically and presently, has sustained economic development, however, often at the expense of Indigenous Peoples, local communities, women, working class, and the racially discriminated.⁵⁶ As such, extractivism perpetuates colonial relations, violence, and destruction of human and other-than-human life.⁵⁷ Still, resistances emerge in places where extractive projects materialize, as forces of sustainability, environmental governance, and social justice.⁵⁸

Figure 7.2. Map of conflict type across the Arctic. 2022

Note: N= 54. Variables are mutually exclusive.

Source: EJAtlas. Compiled from publications by Hanaček et al., 2022; Hanaček et al., 2024 under Creative Commons Licence (open source)

Figure 7.3. Conflict type across the Arctic. 2022

Note: N= 54. Variables are mutually exclusive.

Source: EJAtlas. Compiled from publications by Hanaček et al., 2022; Hanaček et al., 2024 under Creative Commons Licence (open source)

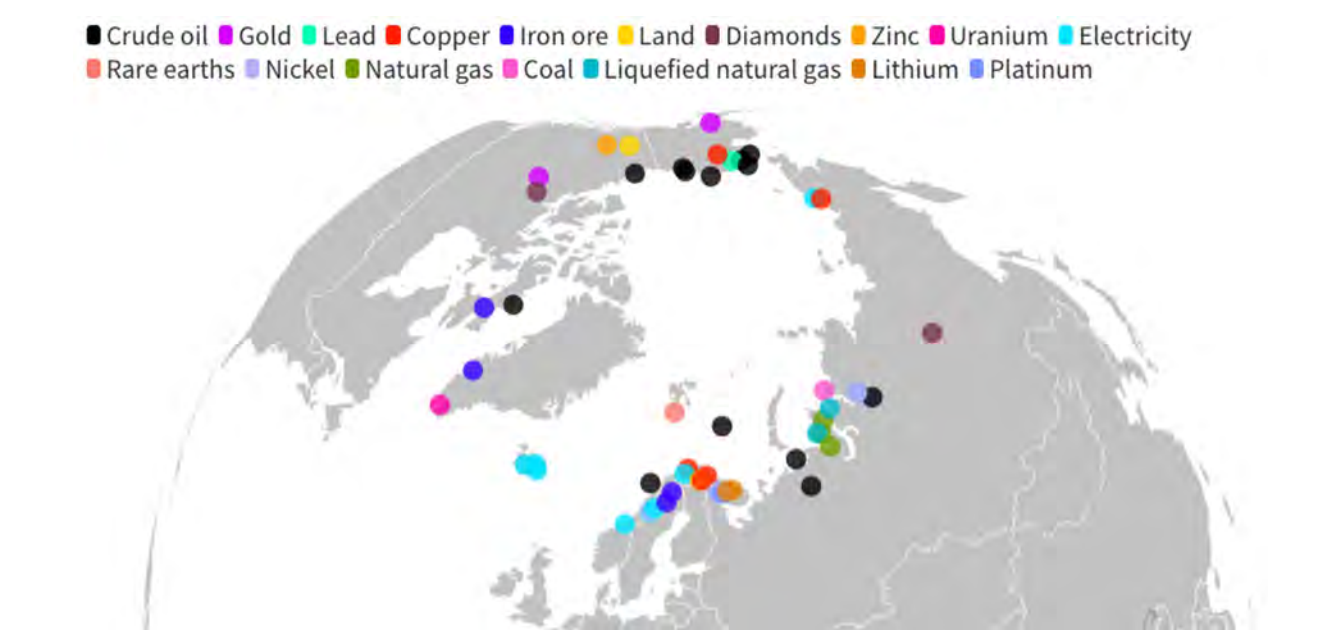
In the North American Arctic, environmental distribution conflicts and land dispossession have included fur trade across the region, following the gold rush in Yukon, military boom in Alaska, the Prudhoe Bay oil field exploitation, infrastructure such as pipelines built in 1970s, and the US oil-revenue boom in the 1980s.⁵⁹ In the Nordic region, examples include Swedish mining activities in the Sápmi region, Finnish forestry, and Norwegian oil and gas economy. Denmark exploited Ivigtut cryolite deposit in Greenland already in 1845. In

the Russian Arctic, industrialization and mining in Sápmi (Kola peninsula) now continue into the gas and oil economy across Yamal, Gydan, and Taymyr peninsula and Chukchi region.⁶⁰

To date, Norway is the only Arctic state that has ratified the International Labor Organization Convention No. 169 on the Rights of Indigenous and Tribal Peoples (ILO 169). The ratification in 1990 followed a period of improving Sámi rights after the Alta movement «La elva leve!» [Let the river live!] by Sámi people against a hydropower project on their lands.

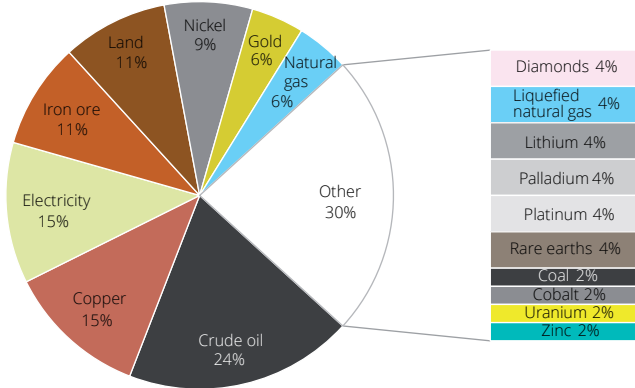
Recently, Indigenous and non-Indigenous scholars and activist have increasingly reported that colonial aspects of climate change impacts in the Arctic continue with massive expansion of the extractive, industrial, and shipping sectors, including those emerging from «green» sustainable.⁶¹ There is mounting evidence indicating how social, economic, and environmental impacts from “green transition” in the Arctic remain the same.⁶² The Fosen Vind project in Norway and the triangle of lithium extraction in Kola peninsula are examples of what Sámi people have called, green (neo)colonialism that serve the nation state economies and privileged groups of the society, at the expense of the traditional land use of the Sámi, while not necessarily reaching a real change to the climate crisis.⁶³

Figure 7.4. Map of commodities extraction across the Arctic. 2022



Note: N= 54. Variables are not mutually exclusive.
Source: EJAtlas.Compiled from publications by Hanaček et al., 2022; Hanaček et al., 2024 under Creative Commons Licence.

Figure 7.5. Commodities extraction across the Arctic. 2022



Note:N= 54. Variables are not mutually exclusive.
Source: EJAtlas.Compiled from publications by Hanaček et al., 2022; Hanaček et al., 2024 under Creative Commons Licence.

Environmental conflict type and commodities across the Arctic

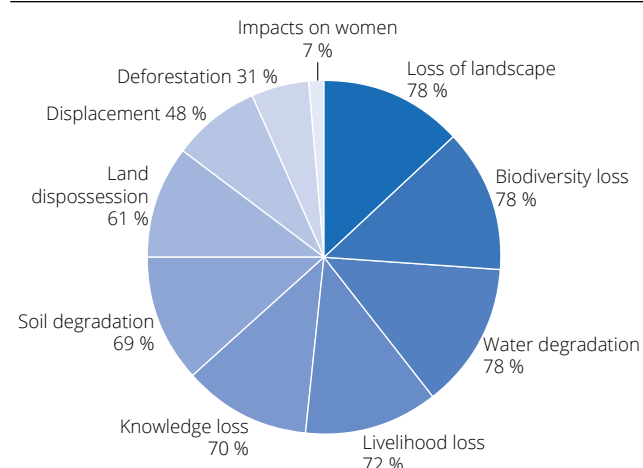
The EJAtlas reports 54 conflict cases in the Arctic (Figure 7.2). The most frequent conflict types are mineral ore extraction (41 per cent), fossil fuels and climate justice (26 per cent), infrastructure developments (11 per cent), and industrial utilities (7 per cent) (Figure 7.3).

The most frequent types of commodities extraction that encounter resistances from Indigenous Peoples and local communities are crude oil (24 per cent), copper and electricity (15 per cent), iron

ore (11 per cent), land (11 per cent), nickel, gold, diamonds (4 per cent), natural and liquified gas (6 per cent and 4 per cent respectively) (Figure 7.5). The results reveal that many environmental conflicts are related to the energy transition that require minerals like lithium palladium, platinum, and rare earth minerals (4 per cent).

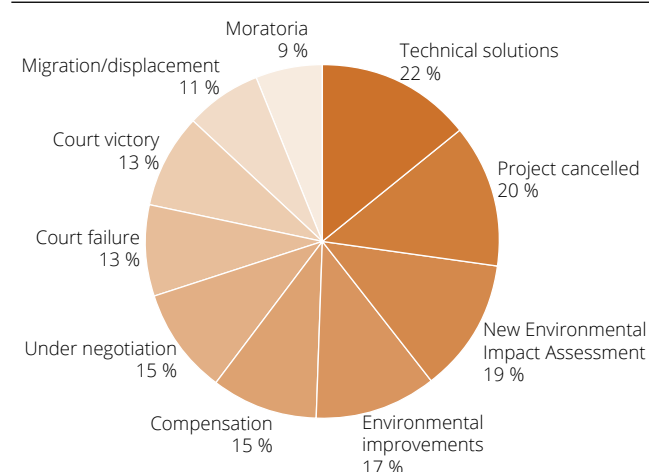
Reported impacts from communities in the Arctic include loss of landscape, biodiversity loss, and water degradation (78 per cent), livelihood loss (72 per cent), knowledge loss (70 per cent), soil degradation (69 per cent) and deforestation (31 per cent) (Figure 7.6). Land dispossession and displacement of Indigenous Peoples and local communities indicate 61 per cent and 48 per cent, respectively. Impacts particularly affecting women include additional labour-burdens because of a conflictive project, or health and body conditions, such as more severe impacts of contamination on women’s bodies and health during pregnancy, as well as murder, sexual and other forms of gendered violence towards women around workers camps.⁶⁴

Social groups mobilizing against extractive projects, violence, and colonial continuation vis-à-vis extractivism in the Arctic are Indigenous Peoples (69 per cent), local environmental justice organizations (EJOs) (52 per cent), neighbours and citizens (46 per

Figure 7.6. Reported socio-environmental impacts across the Arctic. 2022

Note: N= 54. Variables are not mutually exclusive.

Source: EJAtlas. Compiled from publications by Hanaček et al., 2022; Hanaček et al., 2024 under Creative Commons Licence

Figure 7.7. Conflict outcomes across the Arctic. 2022

Note: N= 54. Variables are not mutually exclusive

Source: EJAtlas. Compiled from publications by Hanaček et al., 2022; Hanaček et al., 2024 under Creative Commons Licence

In 15 per cent of the cases, there is an economic appeal to the environment to defend against socio-environmental destruction, such as for reindeer husbandry, and development of an alternative proposal to a project implementation. These include communities' and Indigenous own knowledge and participative research.

As an outcome of peoples' claims for social and environmental equity and justice, government and companies often propose technical solutions to improve environment (22 per cent and 11 per cent), without considering social questions (Figure 7.7). However, many projects given the communities efforts can be ultimately cancelled (20 per cent), which is high for the Arctic context in comparison with the global trend of 11 per cent.⁶⁵ 15 per cent of the cases are under negotiation status, while court cases with victory for people's claims and failure are evenly distributed across the Arctic cases (13 per cent). Cases resulting in migration and displacement of local communities is 11 per cent. Moratoria delay of a specific current or future project (e.g., seabed mining or nuclear) resulted in 9 per cent of the cases.

National Indigenous Economic Development Board

National Indigenous Economic Development Board

The National Indigenous Economic Development Board in Canada is a Ministerial (Indigenous Services Canada) appointed board established in 1990. Board members are First Nations, Inuit, and Métis business and community leaders. Their mandate is to provide the federal government with advice on the development and implementation of policies and programs that support the Indigenous Peoples in Canada.⁶⁶ Through its recommendations, the Board makes the case for better access to financing, public procurement opportunities, and policies that support Indigenous businesses to thrive – creating pathways for increased economic participation and reconciliation. As part of its work, the Board platforms and amplifies the success stories of First Nations, Inuit, and Métis businesses across communities. Sharing stories about thriving Indigenous businesses, is not only a way to communicate the diverse skills, innovative approaches, and cultural values of Indigenous entrepreneurs, but also represents a meaningful way to showcase the economic contributions Indigenous Peoples are

cent), international EJOs, scientific community (35 per cent), local government (22 per cent), as well as fisher people, pastoralists and racially discriminated social groups, often Indigenous (17 to 20 per cent).

The most common forms of mobilizations are development of a network with collective action (65 per cent), media-based activism (50 per cent), lawsuits (43 per cent) and official complaint letters (41 per cent). Street protest and creation of alternative knowledge (37 per cent) e.g., project impacts by activists, communities, or scientists, to challenge information produced by the state or companies.



Street view from the community of Kuujuaq, Nunavik, Canada. Photo: Nadine Boucher

making across the country, to inspire investment and to further economic development opportunities.

In its 2024 Indigenous Economic Progress Report (IEPR), the Board updated key economic indicators for Indigenous populations in Canada using census data.⁶⁷ From 2012 to 2020, all economic indicators showed a growing Indigenous economy. The only exception was in 2020, due to the COVID-19 pandemic. The COVID-19 pandemic significantly disrupted economic outcomes for Indigenous Peoples, who experienced higher rates of job losses than non-Indigenous individuals, particularly in sectors like hospitality, retail, and other activities within tourism. Income reductions deepened economic disparities, especially for Indigenous-owned small businesses, which faced limited access to capital and digital infrastructure. These challenges were especially pronounced in remote Northern communities, where digital access remains a critical barrier to adapting to market changes.

Community well-being

While First Nations saw long-term improvements in Community Well-Being (CWB) scores, Inuit communities experienced short-term declines, increasing disparities. Innovative Northern solutions, like Clyde River, Nunavut's full-time hunter programs, significantly enhance food security with minimal

cost, highlighting the importance of culturally aligned approaches.

Education is key to closing economic gaps and remains a significant barrier. High school completion rates improved overall, though gaps remain for Inuit youth. Métis youth show near parity in employment outcomes, but systemic barriers like incarceration persist. Indigenous youth, a growing demographic, are vital to addressing Canada's labor shortages.

Based on internal and external research, along with findings from a Roundtable event held in Whitehorse, Yukon in June 2018 to discuss food systems with Northerners, the Board released the *Northern Sustainable Food Systems Recommendations Report*, which makes a suite of recommendations to address gaps within sustainable food systems in North.⁶⁸

Infrastructure and governance

Northern communities face critical infrastructure gaps in broadband, housing, and clean water. Investments in health and energy infrastructure, along with Indigenous-led management, are crucial for long-term sustainability. Protecting access to traditional lands remains central to economic development, as neglected land agreements limit autonomy.



Tundra near Ungava Bay, Nunavik, Canada.
Photo: Nadine Boucher

Beyond the Indigenous Economic Progress Report, the Board participates in activities that integrate Indigenous perspectives into Arctic and global sustainable development initiatives and ensuring that the needs and strengths of Northern Indigenous communities are central to national economic development strategies:

The National Indigenous Economic Development Board (NIEDB) played a pivotal role in advancing the National Indigenous Economic Strategy (NIES), a comprehensive framework designed to enhance economic opportunities and self-determination for Indigenous Peoples across Canada. Developed in collaboration with Indigenous organizations, governments, and private sector partners, the NIEDB emphasized critical areas such as infrastructure, education, connectivity, and sustainable resource development, addressing the challenges faced by Northern and remote Indigenous communities. By integrating international best practices and fostering global collaboration, the Board ensured the strategy was aligned with broader Indigenous economic initiatives while remaining tailored to local needs. This work not only empowered Northern Indigenous communities but also connected them to global networks, fostering resilience, innovation, and economic sovereignty.

Highlight 7.8. Det'on Cho Management LP – an Indigenous-led corporation in the Canadian North

Det'on Cho Management LP is an investment company dedicated to strengthening the economic self-sufficiency of the Yellowknives Dene First Nation by pursuing economic opportunities in the Northwest Territories.¹ The company was established in 1988 and has a portfolio of 20 companies, including seven wholly-owned subsidiaries and 13 joint venture partnerships.

Annual gross revenue is more than CAD 59 million. The company employs over 300 people within its seven wholly-owned subsidiaries. Det'on Cho Management LP is 100 per cent owned by the Yellowknives Dene First Nation. The shares are held in trust by the Chiefs and Council who govern the membership. The company is governed by a seven-member Board of Directors and managed by a team led by a President/CEO. With no land-claim or self-government settlement to finance its businesses, Det'on Cho started with a modest seed grant.

In 2024 Det'on Cho was named the Aboriginal Economic Development Corporation of the Year by the Canadian Council for Aboriginal Business, recognizing the corporation's "profound work and ability to increase the prosperity and sustainable economic development of entire communities."²

¹ <https://www.detoncho.com/>

² <https://www.detoncho.com/recent-news.html>

Det'on Cho Companies

The companies with 100 per cent Det'on Cho ownership provide a range of services, from camp management at NWT diamond mines and boarding for medical travel guests, to drilling services and heavy equipment operation. One company pairs the traditional knowledge of the Yellowknives Dene First Nation with scientific approaches and technical tools to manage projects in and around Chief Drygeese Territory. Other companies manage buildings and assets, supply food to restaurants, catering, and remote mining and exploration camps, provide logistics, freight, and air cargo services, and serve Yellowknife and surroundings with waste collection and management. Det'on Cho partnering with Landtran Systems Inc. is Canada's leading northern transportation company, offering year-round transportation to the Northwest Territories.

Det'on Cho Joint Venture Companies

The joint venture companies operate in a range of industries, from provision of health care personnel, medical equipment, supplies and emergency vehicles, to diamond appraisals. Other companies provide mine site services, drilling services and mining developments and civil infrastructures. Yet other companies provide aviation in the traditional territory of the Yellowknives Dene, with movement of passengers and freight to remote destinations, including aviation to gravel and ice airfields, and provide survey, mapping, and remote sensing services in the traditional Akaitcho Territory of the Northwest Territories.

Highlight 7.9. EntrepreNorth – an Indigenous-lead corporation in the Canadian North

EntrepreNorth is a project initiative that offers programs to empower Indigenous and community-based entrepreneurs to build sustainable businesses and livelihoods across Northern Canada.¹ EntrepreNorth is a movement of Northern Indigenous entrepreneurs who are innovating solutions to strengthen economic resilience and community wellbeing for generations to come.

The purpose of EntrepreNorth is to advance thought leadership on business education and financial practices that honours Indigenous knowledge systems, creates social change, and generates new economic pathways. The mission of EntrepreNorth is “Empowering Indigenous entrepreneurs to build sustainable businesses and livelihoods across Northern Canada.”

The Guiding Values of EntrepreNorth are: strive for excellence while uplifting each other with dignity, kindness and respect; honour the lived experiences, gifts and teachings that we all carry into our work; center personal wellbeing and acknowledge the courage it takes to walk in power; focus our energy on solutions that hold purpose and meaning for communities; teach business practices that demonstrate care for the land, water, and animals; embrace ideas that promote greater self-determination and economic justice; and amplify narratives that inspire new ways of doing business where we all grow and benefit.

Over the last five years, EntrepreNorth has empowered over 200 Indigenous entrepreneurs across Canada’s North through business education and mentorship. We have seen these entrepreneurs experience personal and business transformations through the programming that we offer. We have seen the exponential impact that those entrepreneurs have brought back to their communities through the creation of local and meaningful employment, building sustainable pathways for breaking through poverty, knowledge sharing and mentorship for youth, the revitalization of traditional cultures, and through improvements in health and wellbeing.

EntrepreNorth is a project on shared platform of MakeWay, a national charity that builds partnerships and solutions to help nature and communities thrive together.² The platform is focused on empowering Indigenous entrepreneurs to build sustainable businesses and livelihoods across the North, supporting Northern Indigenous entrepreneurs to be catalysts of prosperity and drivers of social change within their own communities. A shared platform provides operational supports, governance, and charitable expertise for changemakers, enabling more time and money to go towards achieving greater impact.

EntrepreNorth delivers Indigenized business curriculum using the *The Multi-Directional Business Compass*. The offerings also include business ideation workshops for aspiring entrepreneurs, industry networking



EntrepreNorth Entrepreneur Growth Program’s Indigenous Language Innovation Cohort. Photo: EntrepreNorth

opportunities, and multimedia storytelling. EntrepreNorth is offering free Business Ideation Workshops in partnership with Indigenous governments, organizations, and communities across the North. The workshops are for youth between 18 to 35 years of age who have a business idea that they want to develop.

Entrepreneur Growth Program

The flagship program of EntrepreNorth is the Entrepreneur Growth Program that offers Indigenous and community-based entrepreneurs in Nunavut, Northwest Territories and Yukon the opportunity to gain the knowledge, skills and support to help take their businesses to the next level and create a positive community impact at the same time.³ The program offers practical business education that is rooted in Indigenous ways of knowing and being. EntrepreNorth uses *The Multi-Directional Business Compass* which offers a multi-dimensional perspective on value creation, business development and systems thinking. The program covers business leadership, marketing, operations, finance, and community impact. Program delivery occurs both in-person at cohort gatherings and online through distant applied sprints.

Northern Impact Fund

There are people out there who are creating change. By investing in them, we can start the chain reaction that is needed to change course and create a world that we all want to live in - now and for generations to come. To do this, we need to reimagine how capital is offered to Indigenous entrepreneurs in ways that align with Indigenous worldview, values, and ways of life. Join us in reimagining how to invest in Indigenous entrepreneurs. We envision a growing movement of Northern Indigenous entrepreneurs working together and alongside their communities to create transformative change for their people and the planet.

¹ <https://www.entreprenorth.ca/>

² <https://makeway.org/>

³ Entrepreneur Growth Program - EntrepreNorth

Highlight 7.10. Tłıchǫ Investment Corporation – an Indigenous-led corporation in the Canadian North

The Tłıchǫ Investment Corporation has a goal of enhancing the economic self-reliance and prosperity for Tłıchǫ citizens by creating sustainable economic development.¹ The Tłıchǫ Investment Corporation supports the North, by investing in the North.

Employment of Tłıchǫ Community Builders comprises about 65 per cent Tłıchǫ employees, about 17 per cent Northern Non-Indigenous, about 9 per cent Southern Non-Indigenous, about 6 per cent Northern Indigenous, and about 4 per cent Southern Indigenous employees.²

Tłıchǫ land claim and self-governance agreement

The Tłıchǫ Agreement from 2005 is the first combined land claim and self-government agreement in the Northwest Territories.³ The agreement provides rights to lands, resources and self-government. The agreement included the creation of the Tłıchǫ Government, ownership of 39 000 km² of land between Great Slave Lake and Great Bear Lake including surface and subsurface rights, the ability to define its membership known as Tłıchǫ citizens, and the jurisdiction over lands and resources in the Tłıchǫ traditional territory.

Tłıchǫ companies

Tłıchǫ Investment Corporation and its group of companies carry out projects in a range of industries. The Civil, Equipment and Environmental division of the Tłıchǫ In-

vestment Corporation is comprised of Tłıchǫ Engineering & Environmental Services Ltd. (TEES) and Tłıchǫ Equipment Ltd. (TEL).

TEES provides management and services for civil construction, contaminated site remediation, remote site logistics, and winter road construction in the Northwest Territories. TEES annually constructs 420 kilometers of winter road to the communities of Whati, Gamètì, and Wekwetì. TEL is responsible for the management of light vehicles and heavy civil equipment and provides mechanical services. TEL provides the surface mining fleet to KeTe Whii Procon and Dominion Diamond for the Misery Underground project, equipment support to infrastructure projects, and home heating fuel delivery to the community of Behchokò.

The Tłıchǫ Investment Corporation's construction unit provides services throughout the Tłıchǫ region. Their expertise includes wood-frame buildings, concrete foundations and structures, and steel structures for industrial, institutional, commercial, recreational and multi-family residential construction. Projects are delivered in remote locations with unique logistical challenges.

The tourism business operates through a new and emerging division in the Tłıchǫ Investment Corporation. This venture offers a new economic diversity and is focused on tourism and adventure experiences in the Northwest Territories, while also increasing the employment opportunities available to Tłıchǫ citizens.

¹ Homepage | Tlıcho Investment Corp

² Newsletters & Reports | Tlıcho Investment Corp

³ www.tlıcho.ca.

Notes for Indigenous Peoples organizations that are Permanent Participants to Arctic Council

¹ <https://www.saamicouncil.net/documentarchive/sami-climate-report>

² Saami Council. EU Has Launched Its New Arctic Strategy. October 15, 2021.

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⁶ Berkes, F. 2023. *Advanced Introduction to Resilience*.

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⁸ Forest Fires and Indigenous Communities (ictinc.ca)

⁹ Wildland Fire | Arctic Council

¹⁰ Ninomiya, MEM, Nicole Burns, Nathaniel J Pollock, Nadia T G Green, Jessica Martin, Janice Linton, Jenny R Rand, Laura Jane Brubacher, Arn Keeling, Alex Latta, Indigenous communities and the mental health impacts of land dispossession related to industrial resource development: a systematic review, *The Lancet Planetary Health*, 7, 6, 2023, e501-e517.

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¹⁸ <https://www.saamicouncil.net/documentarchive/sami-climate-report>

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Torngat Mountains, Nunavik, Canada. Photo: Nadine Boucher

8. Interdependency of traditional and market economies in the Arctic

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Indigenous subsistence economies

Birger Poppel, Ilisimatusarfik, University of Greenland

A number of reports have documented Arctic Indigenous Peoples' livelihoods and living conditions, e.g. Arctic Human Development Report, Survey of Living Conditions in the Arctic (SLICA), The Economy of the North (ECONOR), Arctic Social Indicators, Arctic Climate Impact Assessment (ACIA), and Snow, Water, Ice and Permafrost in the Arctic (SWIPA).¹ Despite all differences, the Indigenous Peoples of the Arctic have survived in an often-harsh environment, cold climate and changing socio-economic conditions by adapting to the market economy while being rooted in a subsistence-based economy. Thus, a variety of 'mixed subsistence-cash economies' have developed, where hunting, fishing, herding, and gathering for the household and sharing is combined with direct sales and wage-earning.

Subsistence includes social, cultural and spiritual dimensions. 'Traditional harvest activities' and 'activities related to food security' are terms that particularly Indigenous Peoples' organisations use more frequently, whereas 'subsistence' is still a key concept in social science.

'Subsistence' and Indigenous rights in an international perspective

The report of the 11th session of United Nations Permanent Forum for Indigenous Issues (UNPFII) in May 2012 stated that: *"The Permanent Forum notes that indigenous peoples' right to food and food sovereignty is inextricably linked with the collective recognition of rights to land and territories and resources, culture, values and social organization. Subsistence activities such as hunting, fishing, traditional herding, shifting cultivation and gathering are essential not only to the right to food, but to nurturing their cultures, languages, social life and identity"*.² The quotation encompasses both key elements of

'subsistence' and the link between the right to food and the rights to land and culture.

The significance of 'subsistence' beyond surviving, was emphasized by the Inuit Circumpolar Conference in 1992: *"Subsistence means much more than mere survival or minimum living standards. It is a way of life that requires special skills, knowledge and resourcefulness. It enriches and sustains Inuit communities in a manner that promotes cohesiveness, pride and sharing. It also provides an essential link to, and communication with, the natural world of which Inuit are an integral part"*.³

Addressing the Inuit Circumpolar Conference in 1998, Finn Lynge highlighted an issue that *"is essential in securing a place for hunting cultures in the world of tomorrow. And that is the issue of economic quantification of subsistence values [...]. For governments' economic planners, what cannot be counted in money doesn't exist"*.⁴ More than 20 years later, documentation of subsistence harvest based on detailed and reliable data, published regularly, only exists for Alaska.⁵

The ILO convention 169 on Indigenous and Tribal Peoples (Articles 14 and 23) highlights the importance of rights to the land traditionally occupied by Indigenous Peoples for subsistence and traditional activities, and maintenance of cultures, economic self-reliance and development.⁶ The United Nations Declaration on the Rights of Indigenous Peoples (Articles 20 and 26) 'confirms the right of indigenous peoples to self-determination and recognizes subsistence rights and rights to lands, territories and resources'.⁷

Regulatory regimes

Regulatory and management regimes that impact Arctic Indigenous Peoples' traditional harvest activities include the International Whaling Commission (IWC) and the Convention on International Trade



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).

in Endangered Species of Wild Flora and Fauna (CITES). Commercial whaling was stopped by the International Whaling Commission, but since 1985 aboriginal whaling catch quotas have been set by the IWC.⁸ Several species listed by CITES are of significance to Arctic subsistence economies, including the polar bear, with severe economic impact for Canadian hunters. Greenlandic hunters and artisans are impacted through the listing of several species, including whales and birds.⁹ Wildlife regulations, as well as environmental campaigns, have had severe impacts on Indigenous harvesters and on Indigenous Peoples' subsistence economies.¹⁰

A unique management agreement is the Moratorium to commercial fishing in the Arctic Ocean signed in 2018 by nine countries and the European Union to protect the Central Arctic Ocean from commercial fishing in a 16 year period. The agreement aligned with advice from Arctic scientists and the Inuit Circumpolar Council and will be followed up by research in the Central Arctic Ocean marine ecosystem.¹¹

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 rural 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. Sharing with family and community is

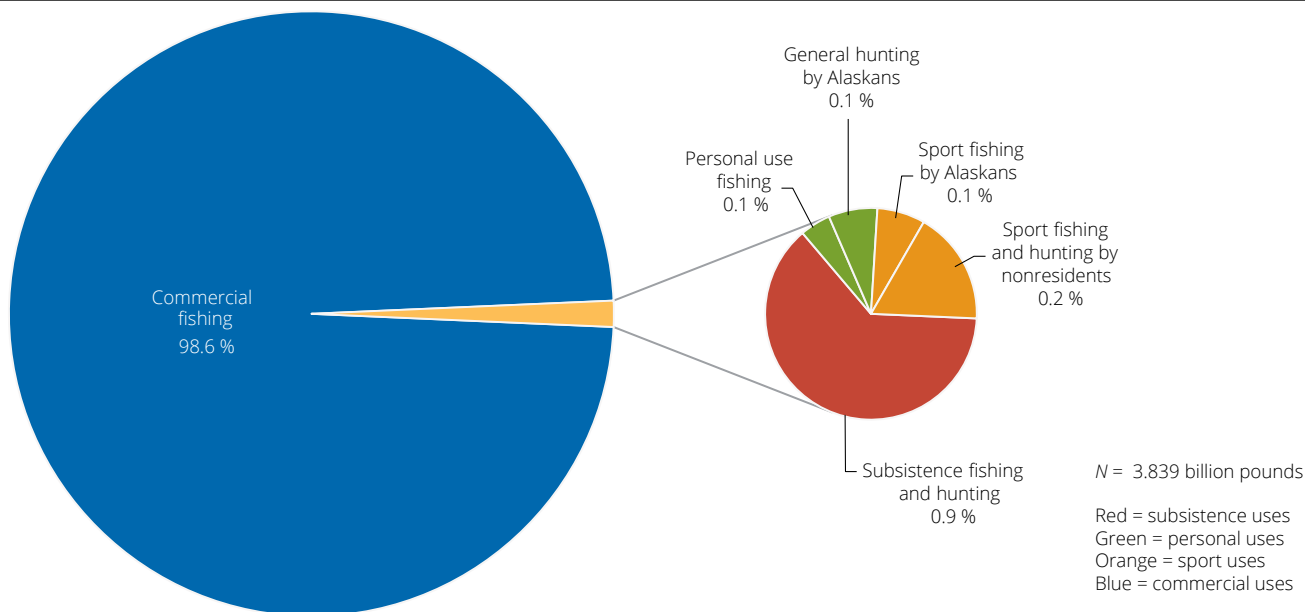
an important and traditional component of the subsistence economy. Harvesting wild resources in Alaska occurs under several regulatory regimes. Most fish harvested by rod and reel are subject to sport fishing regulations, whereas the use of set nets to harvest salmon for home use is considered subsistence. 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." Different seasons, gear allowances, and bag limits for harvest add to the complexity of regulations.

Customary and traditional harvesting wild resources meets the needs for nutrition and embodies spiritual ties with the land and animals, fish, and birds. The best evidence-based information in management requires both Indigenous Knowledge and science, with Indigenous Peoples taking part in the decision-making process and in the analysis of information.

Commercial harvests of salmon, herring, pollack, and other fish are important for rural communities. The commercial seafood industry of Alaska, contributing 60 per cent of the total US seafood harvest, directly employed 48 000 people in Alaska on average in 2021 and 2022, with an economic output of USD 6 billion and USD 2.3 billion in labor income.¹² Commercial and subsistence fisheries are inter-related as fishing equipment is often used for subsistence fishing outside commercial fishing periods.¹³ Households with commercial fishing permits often have a high production of subsistence foods. A household's wild food harvest increases by 125.8 per cent if the household is also involved in commercial fishing.¹⁴ Subsistence harvests in Alaska are still relatively high compared to other Arctic areas.¹⁵ However, commercial fish harvests account for 98.6 per cent of all wild resource harvests in Alaska in terms of volume, and subsistence users harvest 0.9 per cent of wild resources while sport activities account for 0.5 per cent (Figure 8.1).¹⁶

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 is largely set aside for public use. Twenty-eight per cent of Alaska is designated state land. In addition, Alaska

Figure 8.1. 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 16.

Natives received 44 million acres, considered private and managed by Alaska Native corporations created as part of Alaska Native Claims Settlement Act (ANCSA). Federal and state regulations differ as to harvest limits and seasons.

Alaska manages wild resources for residents and visitors, through general hunts and sport fishing. For conservation, a fishery or hunt may be restricted to Alaska residents only (Tier I). If the harvestable surplus cannot sustain all Alaska residents, a Tier II regulation is established where Alaska residents must apply to participate by demonstrating a long term and continued dependence on the resource.

Federal law gives rural communities preference to subsistence unlike the State of Alaska which allows all residents to participate. In 1980, Title VIII of the Alaska National Interest Lands Conservation Act (ANILCA) enacted 10 National Parks and Preserves on existing federal lands, with priority to rural communities that border or are located within these lands. The two competing laws, Alaska Subsistence Law and ANILCA, are commonly referred to as the “subsistence dilemma.” Federal lands often follow state seasons and harvest limits to make it less confusing for local users. However, on federal ANILCA lands and waters, subsistence hunts or fisheries are often restricted to local residents, often leading to confusion as crossing from federal land to state land could mean moving from an area

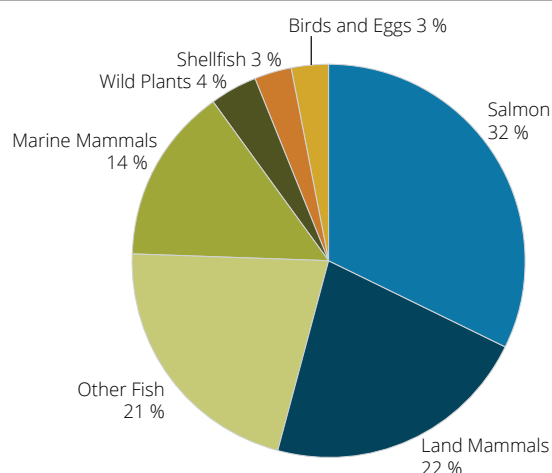
where hunting is open to where it is closed.¹⁷ The State of Alaska has tried to amend this impasse; however, resolution would require a change in the Alaska constitution.

Variety of Subsistence Economies throughout Alaska

Surveys completed over the past 40 years have found that the subsistence economy varies by region and across neighboring communities, as ecosystems and natural resources are diverse, stretching from Alaska’s northern coastal plane, through the interior with its boreal forests, to Southwest Alaska with tundra and multitude of river systems, the rainy windswept islands of the Aleutians, to the temperate rain forests of Southeast Alaska.

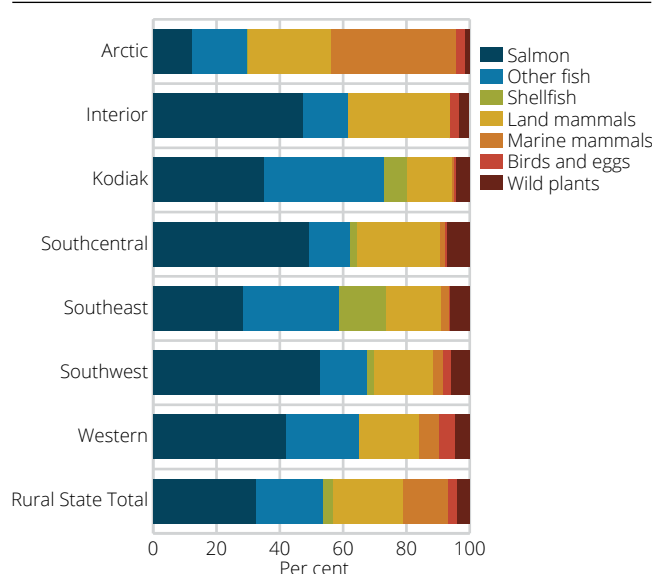


Cleaning sockeye salmon on the shores of Sixmile Lake, Bristol Bay, Alaska. Photo: Davin Holen.

Figure 8.2. 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 16.

The composition of wild food harvest in Alaska aligns with this variety of ecosystems (Figure 8.2). Salmon (32 per cent) and large land mammals (22 per cent) such as moose, caribou, bears, and deer make up the highest share of harvest measured in terms of edible weight. Also important are other finfish (21 per cent), especially in coastal communities where halibut and cod are available and in communities in the interior 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.

Figure 8.3. Composition of the harvest of wild resources in Alaska, by region. Per cent based on pounds edible weight. 2017

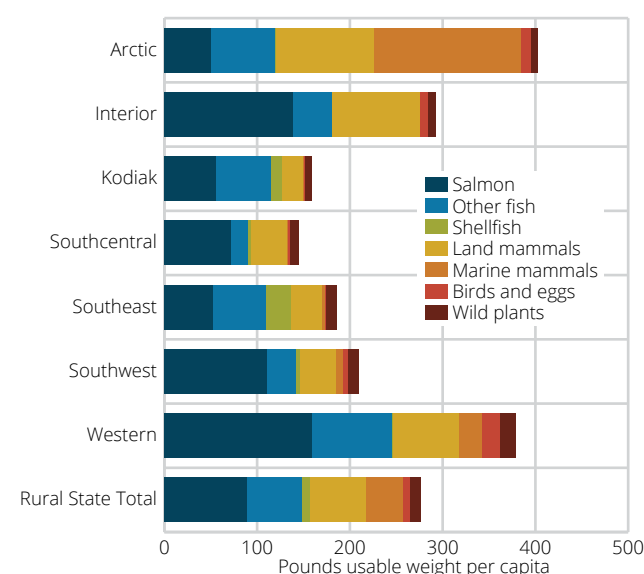
Source: Division of Subsistence, Alaska Department of Fish and Game, and Fall (2018), see note 16.

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 3 per cent, and shellfish such as clams, crab, and other marine invertebrates comprise 3 per cent.¹⁸

Figure 8.3 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, large land mammals such as moose and caribou comprise a larger share of the harvest than in other areas. Arctic and Western Alaska have the highest per capita harvest in terms of edible weight (Figure 8.4).

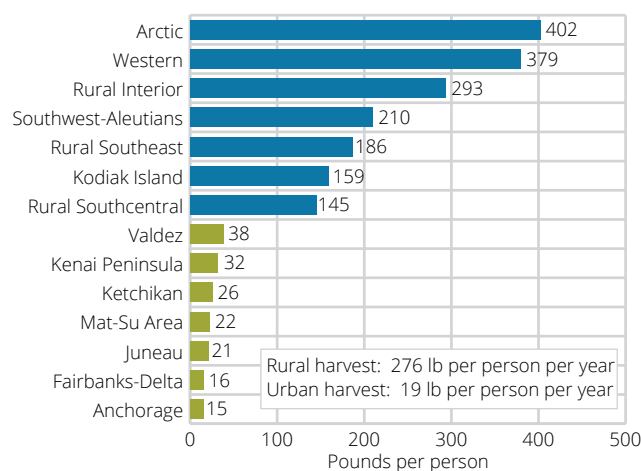
Harvests are higher in rural communities than in urban areas (Figure 8.5). Within Southcentral Alaska, there are large differences in household harvest, with Anchorage the lowest harvest at 15 pounds per person, followed by the Mat-Su Area (22 pounds per person), and the Kenai Peninsula (32 pounds per person), as compared to rural Southcentral Alaska (145 pounds per person). Fairbanks follows a similar pattern for Interior Alaska and Juneau and Ketchikan for Southeast Alaska.

Participation in subsistence is highest in Western Alaska where 70 per cent of households are ac-

Figure 8.4. 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 16.

Figure 8.5. Harvest of wild resources by region. Alaska.
Pounds usable weight per person per year. 2017



Source: Division of Subsistence, Alaska Department of Fish and Game, and Fall (2018), see note 16.

tive in harvesting game species and 83 per cent of households participate in fishing activities. In rural Alaska 60 per cent of households hunt and 83 per cent harvest fish.¹⁹ The number of households using wild resources is higher than of those harvesting 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.²⁰ These households tend to have higher incomes and spend more money on subsistence related 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 arrive by air in winter. In the summer, cost of transportation is lower as coastal communities receive barges with fuel and supplies, with smaller barges transporting supplies up major rivers, and residents must order a year's worth of groceries and other supplies.

Energy costs are a main concern. 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.²¹ There is a trend towards using wood in efficient home stoves and in large scale biomass boilers in public buildings, especially in interior Alaska and Southeast Alaska, with boreal forests



Cargo container ship, Alaska. Photo: Colourbox

and rainforests. Typically, residents will use several barrels of heating oil throughout a cold winter.

Many homes receive electricity from diesel powered generators and pay some of the highest electricity and fuel costs in Alaska. In the Yukon-Kuskokwim region, home to 56 communities, there is a shift to wind energy to bring down the cost of electricity and ensure greater energy security. As part of the Yukon-Kuskokwim (Y-K) Comprehensive Economic Development Strategy, in 2018, the Native Village of Napaimute presented a wind turbine project that resulted in a 50 per cent reduction in their use of diesel, a net reduction of around 55 000 gallons a year. In Kwethluk, also in the Y-K Delta, four wind turbines are being installed that are projected to last 20-25 years. The turbines are expected to replace 50 000 gallons of diesel fuel, or half their load annually.²² The savings will shrink household energy costs by 30-50 per cent. The community also received funding to install a 675 kWh lithium-ion battery to capture excess energy



Post Typhoon Merbok, Chevak, Alaska. Photo: Davin Holen

Highlight 8.1. 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 ground-work 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. 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.



Damaged wind turbines, Chevak, Alaska. Photo: Davin Holen

communities. For example, Pillar Mountain in Kodiak supplies 18 per cent of the power to Kodiak City, with a wind plant of six 1.5 MW turbines.²⁴ Along with two hydroelectric dams, over 98 per cent of the energy needs of Kodiak City residents are met by renewable energy.²⁵ In Igiugig, at the outflow of Iliamna Lake, the largest lake in Alaska, a hydrokinetic energy project has been successfully deployed through a collaboration with Ocean Renewable Power Company. The project has offset one-third of the community's use of diesel, and a second unit is in the works for installation as well as wind turbines to further reduce diesel reliance.²⁶

Lowering energy costs in rural Alaska is critical to the resilience of communities as subsistence maintains the ability to continue living in areas where jobs are harder to come by and costs of living are high. In a study of salmon harvest, respondents in three rural coastal communities stated that they rely on salmon for subsistence needs, cultural continuity, and economic wellbeing.²⁷ A 2017 summary of wild food production estimated the cost of replacing the harvested wild food of rural communities at 454 million USD, valued at USD 10 a pound (Table 8.1). 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 varies from 159 pounds edible weight per capita on Kodiak Island to 400 pounds per capita in the high Arctic (Table 8.1).²⁸

A study of 13 rural communities in coastal Alaska examined the reasons residents continue to live in their communities.²⁹ These include a sense of home or place, the subsistence lifestyle, family, culture, and a sense of freedom. Being able to fish,

from the wind turbines to reduce their dependence on diesel further. The Alaska Village Electric Cooperative in Western Alaska has installed wind-diesel hybrid systems in 12 of 58 communities.²³

There is great potential for renewable energy in Alaska to enhance energy security for rural

Table 8.1. 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 16.

hunt, and gather on one's ancestral waters and lands embodies many of these responses; people desire to be with and participate alongside family in harvesting activities in a landscape where there is a deep-felt sense of connection. Although many residents did not express this sentiment of freedom directly in the surveys, freedom, or living in a place that allows one to direct their own destiny for themselves and their family, came out in many of the more in-depth interviews.



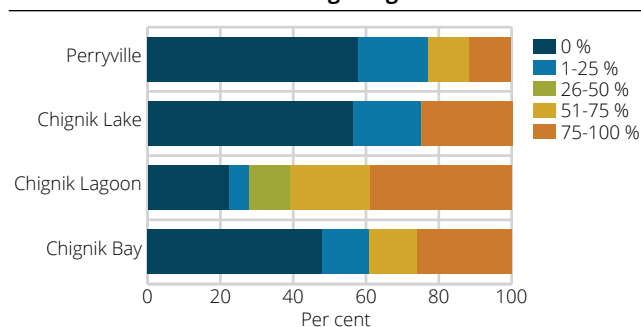
Sockeye salmon drying on the shores of Lake Clark, Bristol Bay, Alaska. Photo: Michelle Ravenmoon, National Park Service.

The Intersection of Commercial and Subsistence Fishing in Alaska

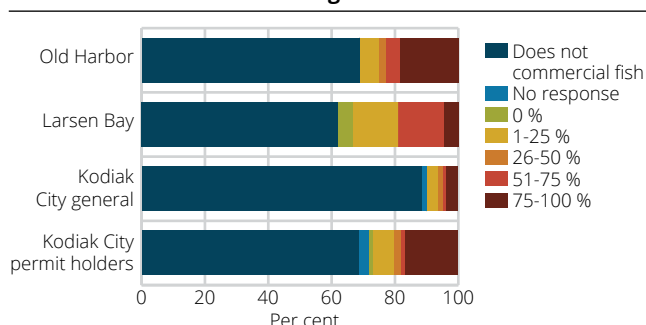
Davin Holen, University of Alaska Fairbanks

Commercial fishing is a way of life, often passed down from one generation to the next, a vital component of a mixed economy in communities. In Chignik Lagoon and Haines, commercial fishing provides a significant portion of a household's income. But commercial fishing also provides means for residents to direct their own work and allows them to remain in their communities off the abundance of locally available resources. Commercial fishing provides rural coastal residents in Alaska with a sense of freedom and self-determination. Both subsistence and commercial fishing shape the perceptions of youth in coastal fisheries, as well as other vocations that enable youth to remain in their communities.³⁰

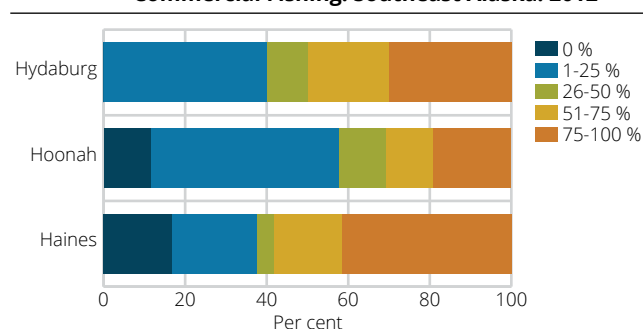
Commercial and subsistence fishing are intertwined in a mixed economy that embodies subsistence, culture, and economics. A study by Holen³¹ was conducted in 13 Gulf of Alaska communities including Chignik Bay, Chignik Lake, Chignik Lagoon, and Perryville.³² Over 40 per cent of households in all four communities reported income from com-

Figure 8.6. Percentage of household income from Commercial Fishing. Chignik area. 2011

Source: ADF&G Division of subsistence household surveys

Figure 8.7. Percentage of household income from Commercial Fishing. Kodiak. 2012

Source: ADF&G Division of Subsistence household surveys, 2013

Figure 8.8. Percentage of household income from Commercial Fishing. Southeast Alaska. 2012

Source: ADF&G Division of subsistence household surveys, 2013

mercial fishing and in Chignik Lagoon, 39 per cent of households reported that 75 to 100 per cent of their income came from commercial fishing, with around 25 per cent of Chignik Bay and Chignik Lake households, and 12 per cent of Perryville residents reporting the same (Figure 8.6). Significantly, Chignik Lagoon residents had 61 per cent or more of their income from fishing.

Three communities were surveyed in Kodiak, comparing participation, harvest and use among subsistence salmon permit holders in Kodiak City, the general population, and two smaller remote communities, on Kodiak Island, Larsen Bay with a thriving sport fishing industry as well as resident commercial fishers, and Old Harbor which has a strong commercial fishing industry.³³ In Old Harbor and Kodiak City a little under 20 per cent of households reported that 75 to 100 per cent of their income comes from commercial fishing (Figure 8.7). Not all Kodiak City residents who hold permits fish their permits every year. In 2013 for example, there were 317 permit holders with only 221 in use.

In Southeast Alaska, the study included surveys conducted in 2013 in Angoon, Haines, Hoonah, Hydaburg, and Whale Pass representing a broad diversity of communities across the region.³⁴ Haines had the highest share of income from commercial fishing, with 59 per cent reporting that 50 per cent or more of their income comes from commercial fishing, while 50 per cent of Hydaburg commercial fishers reported the same. Hoonah also showed a high share of income from commercial fishing (Figure 8.8). Southeast Alaska is unique in that it has troll fisheries, i. e. hook and line fisheries with small often family-run boats, which provide a modest income for a much lower overhead cost than the drift gill net or seine fisheries, which require limited entry permits and large boats. Several young people reported that they enter the commercial fishery by obtaining troll permits. If a fisher does well in the troll fishing, they could use the proceeds and experience to move into the more lucrative gill net or seine fisheries.

Residents of these rural coastal communities have a strong connection to fisheries, accounted for in their decision-making process of whether to continue living in their rural communities. The intersection of commercial and subsistence fishing, especially for salmon, supports cultural continuity. Residents noted how important it is to pass on knowledge about fishing activities to their children as an important part of their culture. Preparing gear, setting out gear, waiting, and processing, involve families working together to continue a way of life and develop a unique set of values surrounding the practice of fishing.³⁵



Kodiak harbo. Photo: Davin Holen.

Although local economies in Kodiak Island are becoming less connected to commercial fishing, subsistence practices still embody the close connections to salmon and marine resources.³⁶ A commonality found in fishery dependent communities is that fishing is for many a way of life linking commercial and subsistence practices to family, traditions, and a sense of place.

Food and the environment in Alaska

Sean Kelly, University of Alaska Fairbanks

Climate change in Arctic regions is amplified. The rate of warming across the Arctic from 1979-2021 is up to four times higher than global averages.³⁷ The regional variation in climate trends across Alaska is significant, with more severe change in the Arctic North Slope region than in the more temperate Southeast Alaska region.³⁸ Increasing temperatures have resulted in a range of impacts from permafrost degradation in several regions, including the Interior, Arctic North Slope and western regions to increasing stream temperatures impacting sensitive salmon spawning habitat in Southeast Alaska.

Climate-induced ecological change has placed stress on plant and animal species across Alaska, many of which hold significant cultural and commercial importance. Declines in Chinook salmon populations are linked to marine heat waves and high river temperatures during spawning. In 2021, declines in Chinook and chum salmon resulted in complete closures of subsistence fishing for salmon on the Yukon River.³⁹ Closures contributed to significant stress and anxiety for communities along the Yukon River who depend on salmon not only for its considerable nutritional value but also for its profound cultural value.⁴⁰

According to the National Oceanic and Atmospheric Administration's (NOAA) latest Arctic Report Card (2024), a 65 per cent decline in Arctic migratory tundra caribou populations over the past two to three decades has been linked to warmer temperatures and associated variability in winter snow and ice conditions. Indigenous elders have noted that previously large caribou populations have been in decline and are at some of their lowest populations.⁴¹ In Southeast Alaska, snowfall that has historically provided insulation for yellow cedar is falling more frequently as rain, causing higher

mortality for yellow cedar, a culturally and commercially important species.⁴²

Moreover, rapid winter warming in the interior of Alaska has resulted in unpredictability in winter ice, creating safety concerns for rural residents who depend on adequate ice thickness for wild food access.⁴³ A 2021 review of wild food harvester needs found that harvesters are adopting new modes of travel, substituting certain wild foods for others, and identifying new hunting areas to adapt to variation in species distribution and abundance.⁴⁴

The typhoon Merbok struck 1 300 miles of coastline along Alaska's western coast on September 17, 2022, during the fall subsistence hunting, fishing, and gathering season, damaging vessels and gear to such a degree that state and federal disasters were declared and Federal Emergency Management Agency funds mobilized.⁴⁵ The scale of impact to traditional subsistence activities and efforts to mitigate and respond to environmental threats illustrates the unique and vital relationship many Alaskans have with their environment.

While Alaska has had a long history of small-scale agriculture, productivity is generally hampered by several limiting factors, including a short growing season. However, climate records and forecasts indicate an actual and projected lengthening of the growing season in some of Alaska's agricultural communities, such as Fairbanks and Palmer. An increase in agricultural productivity is particularly compelling because of a growing emphasis on statewide food security amid supply chain disruptions, such as those that took place at the outset of the COVID-19 pandemic. To meet such challenges, the Scenarios Network for Arctic and Alaska Planning (SNAP) created an agriculture-themed climate forecast tool called "Alaska Garden Helper".⁴⁶

"Subsistence is our Agriculture"⁴⁷

Growing recognition of the agricultural opportunity associated with climate change, referred to as 'northern agricultural frontiers', has been met with wariness from some audiences.⁴⁸ The Nenana Totchaket Agricultural Project, an effort by the State of Alaska to offer land for purchase, calling for buyers to put this land under cultivation. Initially, the project faced concern from Nenana residents and Tribal members that it would disrupt subsistence practices.⁴⁹ Greater access to land that



Dillingham harbor. Photo: Davin Holen.

historically supported a subsistence way of life has in some notable cases resulted in a decrease in subsistence activities.⁵⁰ Concerns around agricultural development in Alaska point to an underlying tension around historical agricultural practices and suggest that agricultural activities are better thought of as complementary to traditional subsistence activities rather than a substitute.

Regional and community level climate adaptation planning

The impacts of climate change have prompted greater investment in climate adaptation. In 2023, the Bureau of Indian Affairs' Tribal Climate Resilience (TCR) program awarded USD 42.4 million to federally recognized Tribes in Alaska, a significant increase from the roughly USD 6 million awarded in 2020.⁵¹ In 2024, NOAA awarded USD 75 million to the Alaska Native Tribal Health Consortium for climate adaptation to Alaska Native communities, the largest federal funding to address climate resilience for Alaska Native communities in state history.⁵²

Many early climate adaptation plans in Alaska were driven by a concern over environmental threats to critical infrastructure, from erosion, permafrost degradation, and flooding to communities. For instance, the community of Shaktoolik, in the Bering Strait region, has been monitoring and mitigating the threat of coastal erosion and flooding since 2010. A statewide threat assessment was drafted for the Denali Commission in 2019, identifying a high level of threat for at least 29 communities from erosion, flooding, and thawing permafrost.⁵³

In rural and isolated communities, infrastructure includes power plants, water and sanitation, and

Highlight 8.2. The value of sharing and climate adaptation in mixed subsistence economies: A case study of Dillingham, Alaska

Ayşe Akyildiz, *The Pennsylvania State University*, and Davin Holen, *University of Alaska Fairbanks*

Over the past decades, the harvest of wild resources has slightly declined across Alaska.¹ Rural and predominantly Indigenous communities are impacted by climate change, with thawing permafrost, coastal land loss and inundation, disappearance of lakes, extreme storms, and declining sea ice.

The decline of salmon is of concern, especially in southern coastal communities in Alaska, which have long relied on salmon for sustained continuity of culture.² Elders who have spent their lifetime on the land and waters, describe the impacts on salmon habitat as glaciers recede and lake and stream temperatures increase.³

In the Bristol Bay community of Dillingham, changes in the food sources may pose a threat to food security. Participants in a 2022 Dillingham Wild Food Harvest Assessment conducted by the Division of Subsistence, Alaska Department of Fish and Game (ADF&G), and the Bristol Bay Native Association expressed concerns about the altered timing and availability of wild foods.⁴ The 2022 survey followed up a 2011 survey on changes in harvest and climate adaptation strategies.⁵

One of the respondents highlighted that, “Back in the day, berries used to get ripe all at once, now it varies. King salmon have been on the decline, [and we] have had to supplement with other wild foods. Seasons [and] temperatures have been so variable in recent years. It’s unpredictable. This affects when salmon come; you just never know.”

Another respondent emphasized, “...The winter moose hunt is extremely important for families to secure winter meat when freezers get low.” This aligns with the survey findings, with 33 per cent of the households indicating a need for more moose. Further, the changes in the timing of wild resources may lead to increased conflict between residents and visitors, as hunting and fishing seasons shift due to climate change.

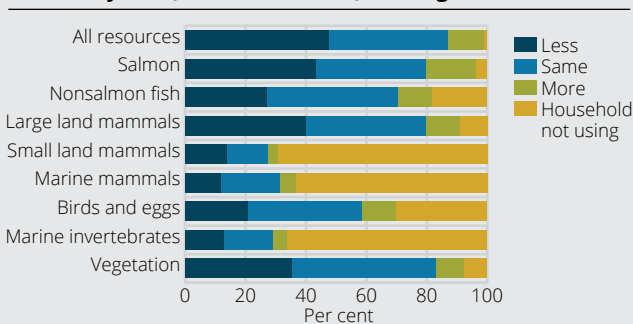
In Dillingham, harvests slightly declined from 2010 to 2021, from a per capita harvest of 212 pounds of edible

weight to 199 pounds. Nearly half of the respondents reported less use of wild foods than in previous years (Figure 1). This was especially notable for salmon, large land mammals, and vegetation. The most notable reason for the decreased use of salmon was less availability of resources. For large land mammals, the most notable reasons for less use were unsuccessful hunts, and less sharing, which may be attributed to the timing of the survey during the COVID pandemic as many rural communities in Alaska maintained strict social distancing.⁶ For resources used more in 2021, salmon saw the highest share of increased use. The culture of food sharing in rural Alaskan communities remains vital. In 2021, over 90 per cent of Dillingham respondents reported receiving wild foods from another household.⁷

The 2022 survey included questions on gardening and found that gardening households were a mix of first-generation and multi-generational Dillingham participants, including Alaska Native residents. Gardening households had higher household incomes; USD 110 607 compared to USD 58 586 for non-gardening households. Gardening households also had a higher per capita harvest of wild foods than non-gardening households; 245 pounds edible weight compared to 175 pounds. Gardening households harvested a greater diversity of wild resources; 13 types of wild foods compared to non-gardeners at 8 types.

Sharing was more common among gardeners. For example, 83 per cent of gardeners gave salmon to other households, compared to 65 per cent of non-gardeners, and 58 per cent gave large land mammals to others, compared to 46 per cent of non-gardeners. However, gardeners considered themselves to be food insecure. Overall, 68 per cent of non-gardening households felt they were food secure, whereas only 56 per cent of gardening households perceived themselves as food secure.⁸ Sharing foods, shifting to communal hunting strategies such as marine mammal harvesting, and gardening are part of the adaptive strategies of rural communities like Dillingham to ensure the continuity of culture in a changing climate and environment.

Figure 1. Changes in household food compared to recent years (less, same, more)¹. Dillingham, 2021



¹ Valid responses do not include households that did not provide any response.

Source: ADF&G Division of Subsistence household surveys, 2022

¹ Fall, J.A., *Subsistence in Alaska: A 2017 Update*. 2018.

² Holen, D., *Subsistence and commercial fisheries through the lenses of culture and economy in three coastal Alaskan communities*, in *Anthropology*. 2017, University of Alaska Fairbanks: Fairbanks.

³ Fall, J.A., et al., *The Kvichak watershed subsistence salmon fishery: An ethnographic study*. Technical Paper No. 352. 2010, Anchorage: Division of Subsistence, Alaska Department of Fish and Game.

⁴ Jones, B., C. Larson, and R. Tomlin, *The Harvest and Use of Wild Resources in Dillingham, Alaska, 2021*. 2024, Anchorage.

⁵ Evans, S., et al., *Harvests and uses of wild resources in Dillingham, Alaska, 2010*. 2013: Anchorage.

⁶ Holen, D., E.L. Howe, and G. Chi, *Fishing in the time of COVID: Assessing risk in the Bristol Bay commercial salmon fishery and the societal benefits of social science research*. *Arctic Yearbook*, 2023(Special Issue): p. 4.

⁷ Holen, D., E.L. Howe, and G. Chi, *op.cit.*

⁸ Mucioki, M., et al., *Gardening practices in Alaska build on traditional food system foundations*. *Agriculture and Human Values*, 2024.

Highlight 8.3. Remembering Jim Magdanz: A Summary of The Persistence of Subsistence in Alaska*Joseph Little, Northern Arizona University and Joshua Greenburg, University of Alaska-Fairbanks (Retired)*

Jim Magdanz (1951-2024) made seminal contributions to the study of subsistence in Alaska. Here his co-authors summarize and expand the article *The Persistence of Subsistence: Wild Food Harvests in Rural Alaska*. The findings underscore the critical role the subsistence harvest of wild food plays in supporting the continued health and well-being of rural Alaskan communities.

Climate change, industrial development, and globalization add to concerns about the viability of traditional economies. Yet traditional Arctic economies have been adapting to rapid change. BurnSilver et al. noted that “elements of mixed economies observed three decades ago – simultaneous household engagements in subsistence, markets, and traditional social relationships – have proven remarkably persistent”.

The analysis draws on data from the Alaska Department of Fish and Game Division of Subsistence household subsistence survey. From 1983 to 2013 the Division of Subsistence surveyed over 18 000 households across 200 communities in Alaska. The extent and time frame provide an opportunity to assess how harvests have changed over time and were influenced by economic development and road access.

Three approaches were used to examine subsistence harvest in Alaska. The first identifies how harvests are related to economic factors such as household income and community characteristics including community size and proportion of Indigenous population. The second approach examines the relationship between road access and harvest per capita. Finally, we revisit the seminal work of Wolf and Walker, re-evaluating their model with an updated set of subsistence survey data.

In a testament to the strength of the original analysis many key relationships identified by Wolf and Walker are again evident. When compared to community surveys between 1983 and 1989, mean harvests per person for the period 2010 to 2023 are estimated to be between 27 and 31 per cent lower. Mean harvest per person is inversely related to road or ferry access. Communities on the road system are estimated to have mean harvests per person between 31 and 47 per cent lower than off-road communities.

The analyses of subsistence harvest in Alaska suggest a diverse and persistent social-ecological system, where the most immediate challenge may not be declines in subsistence harvests but declines in real personal incomes, exacerbated by increased cost of living. To meet challenges of industrial development, commercial fisheries, infrastructure, or Arctic governance, observing socio-economic conditions in the Arctic has never been more important. This requires persistent and consistent measures, in cooperation with or entirely by local community observers over long periods. Supporting existing observation systems and exploring available datasets would seem to be a productive approach.

¹ Magdanz, J., Greenberg, J., Little, J.M., & Koster, D.S. (2016). *The Persistence of Subsistence: Wild Food Harvests in Rural Alaska, 1983-2013*. *Econometric Modeling: Microeconomic Models of the Environment* eJournal.

² Deman, M. 1982. *Contemporary Rural Alaska and the Role of the Village Corporations*. In *Alaska's Rural Development*, Cornwall, P. G. and McBeath, G. A. (eds.). Boulder, Colorado: Westview Press.

³ Krupnik, I., and Jolly, D. 2002. *The Earth Is Faster Now: Indigenous Observations of Arctic Environmental Change*. *Frontiers in Polar Social Science*. Fairbanks, Alaska: Arctic Research Consortium of the United States.

⁴ BurnSilver, S., Magdanz, J., Stotts, R., Berman, M., and Kofinas, G. 2016. *Are Mixed Economies Persistent or Transitional? Evidence Using Social Networks from Arctic Alaska*. *American Anthropologist* 118 (1):121–129.

⁵ Wolfe, R. J., and Walker, R. J. 1987. *Subsistence Economies in Alaska: Productivity, Geography, and Development Impacts*. *Arctic anthropology* 24 (2):56-81.

local airports, but might also include traditional ice cellars and fish camps, critical for sustaining a subsistence way of life.⁵⁴ A 2017 climate adaptation assessment for the Native Village of Georgetown identified the threat of increasing wildfires to fish camps and homes.⁵⁵

Centering food and food culture in climate adaptation planning

Traditional food systems are critically connected to the health and well-being of Indigenous communities. In four regional climate adaptation plans reviewed in a 2024 assessment, subsistence was the leading priority.⁵⁶ A 2023 resilience plan for the Chilkat Indian Village of Klukwan in Southeast Alaska focused on monitoring ecosystems that sup-

port culturally important plants and animals and prioritizing food security and food sovereignty.⁵⁷

In 2019, the Hoonah Indian Association in Southeast Alaska completed a community food assessment.⁵⁸ Projects included investing in a commercial greenhouse and developing educational programs for planting Tlingit and Haida heritage potato cultivars.⁵⁹ The Kodiak Area Native Association (KANA) drafted a regional climate adaptation plan in 2023 and found community support for food security and sovereignty projects.⁶⁰ In response, KANA initiated a regional food vulnerability assessment for the Kodiak Archipelago.⁶¹ The ability of Alaskans to mitigate the challenges to food security and food sovereignty posed by climate change hinges on ap-



Hot House at Meyer Farm, Bethel. Photo: Davin Holen.

appropriate, responsive, and equitable planning and management.

Survey of Living Conditions in the Arctic (SLiCA)

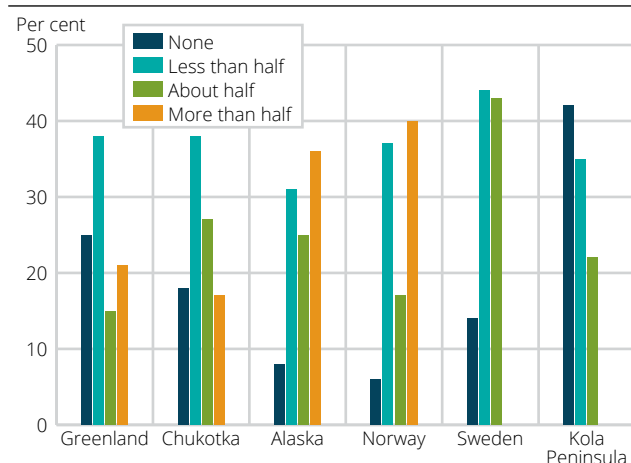
Birger Poppel, Ilisimatusarfik, University of Greenland

As an attempt to fill the documentation-gap of the significance of subsistence hunting and fishing to the Indigenous Peoples of the Arctic, the Survey of Living Conditions in the Arctic, SLiCA asked respondents about participation in subsistence activities, households' consumption of traditional food, and to which degree the households' diets consisted of meat and fish harvested by household members.⁶²

SLiCA was conducted among and in partnership with the Inuit, Sámi and the Indigenous Peoples of Chukotka and the Kola Peninsula between 2001 and 2008.⁶³ The results substantiate that catch from subsistence activities are still important for the households' diet. More than one out of three households in Greenland, more than four out of ten Indigenous households in Chukotka and the Swedish part of Sápmi and more than half of Alaskan (Inupiat) and Norwegian Sámi households report that about half or more than half of what the household consumed in a year was harvested by members of the household (figure 8.9).

Subsistence activities were defined in SLiCA as "harvesting natural, renewable resources to provide food for one's own household, for gifts for others or to exchange outside the market economy". SLiCA was designed to include key aspects related to subsistence activities beyond the economic aspects, including nutritional, social, socio-cultural, and identity aspects. Furthermore, SLiCA also confirmed the significance of mixed subsistence and cash activities.

Figure 8.9. Share of meat and fish consumption harvested by households. Regional surveys 2001-2006



Note: Data for Canada not available

Source: https://iseralaska.org/static/living_conditions/ Results Report/ Tables – Ties to Nature: Table 26

Beyond the economic and nutritional value to the Indigenous households, the sharing of traditional food, is still part of social relationships among indigenous peoples in the Arctic (Figure 8.10). Sharing with other households is common and reported by more than half of the households in most regions (apart from Chukotka and the Kola Peninsula). Sharing traditional food is often mentioned as an indication of cultural continuity among Indigenous Peoples and as an important sign of identity, kinship and traditional Indigenous values.

Canada subsistence activities

Harvesting wildlife resources including subsistence hunting for Indigenous peoples in the Canadian Arctic are regulated by provisions of the land claims agreements.⁶⁴ Although long-term monitoring data for wildlife co-management are often unavailable, some regional and territorial surveys include information of harvest activities, including Nunavut Wildlife Management Board Wildlife Surveys, NWT Labour Force Surveys, NWT Hunter Surveys, and Statistics Canada's Aboriginal Peoples Surveys.

The Northwest Territories Labour Force Surveys, conducted by the territorial government's Bureau of Statistics from 1998 to 2018, asked respondents whether they had hunted or fished during the past year. The proportion of the NWT residents 15 years and above hunting or fishing varied during the 20 years and after a peak in 2013 decreased to roughly one in three for NWT. There are variations between NWT communities with the lowest

Highlight 8.4. Alaska Native Corporations: Innovation and Adaptation in the Arctic

Thomas F. Thornton, University of Alaska

The Alaska Native Claims Settlement Act (ANCSA) was transformative in creating the Alaska Native Corporations (ANCs). These institutions have helped not only to diversify and stabilize Alaska's historically boom-and-bust development, but also to Indigenize it, providing jobs and benefits to Alaska Native regions.

Twelve regional corporations and 174 village corporations are active as of 2024. These for-profit entities have launched or partnered in thousands of businesses and programs since the mid-1970s, providing employment, resource development, and services to communities and regions and dividends to their shareholders. Many ANCs support non-profit heritage conservation organizations, cultural events, scholarships, and other community investments, alongside economic development.

A provision of ANCSA, known as 7(i), regulates revenue sharing among the regional corporations, such that top earning companies must redistribute some of their profits to those with lower earnings. This sharing also gives corporations a sense of collective mission and interdependence.

The largest company in the state, Arctic Slope Regional Corporation (ASRC), which encompasses Alaska's North Slope, totaled USD 5.5 billion in gross revenues and paid USD 115 per share dividends to some 14 000 mainly Inupiaq shareholders in 2023. ASRC employs

more than 16 000 across the country and routinely ranks in the Forbes top 200 companies.

At the southern end of Alaska, the Sealaska Corporation serves 26 000 mainly Tlingit, Haida, and Tsimshian shareholders. Sealaska has shifted from industrial timber production to businesses such as carbon forestry, environmental remediation, and geosciences and sustainable seafood. Sealaska has about 1 400 employees and gross revenues over USD 500 million. The corporation supports the Sealaska Heritage Institute (SHI), promoting Southeast Native culture. It has made Juneau and Southeast Alaska a center of Northwest Coast Art and elevated Southeast Alaska Indigenous arts as a viable sector for sustainable economic development.

The first half century of ANCs has been a major success in many ways, although not without company failures and calls to better align corporate culture and investments with Alaska Native values and priorities for sustaining their heritage and economic livelihoods.

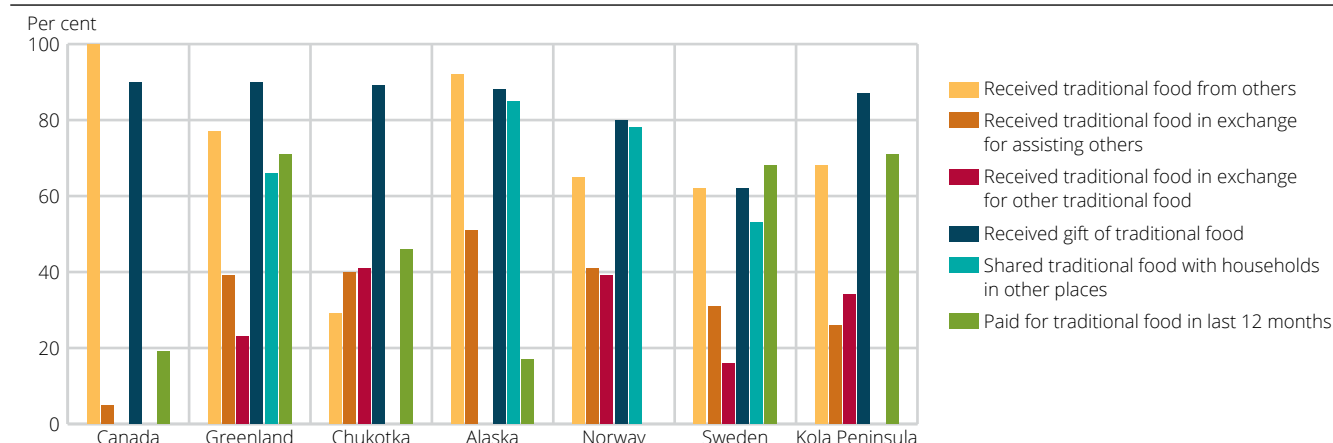
Sources

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Alaska Business Magazine. The Big 12 Corporations. Website, accessed February 15, 2025: <https://www.akbizmag.com/magazine/the-big-twelve-alaska-native-regional-corporations/>



Sealaska Heritage Institute building based on traditional Tlingit, Haida, and Tsimshian design, fronted by the arts campus plaza. To the left lie arts classrooms and display areas, to the right Sealaska Corporation headquarters. Totems and other art surround the plaza, a hub for cultural events, including Native dance groups (pictured here), Indigenous games, ceremonial gatherings, and art markets. The plaza draws tourists and other visitors to Juneau, traditionally a Tlingit settlement. Photo: T. Thornton.

Figure 8.10. Share of households receiving traditional food from others. Regional surveys 2001-2006

Note: data missing for two questions in Canada, for one question in Chukotka and one question in Kola Peninsula

Source: [https://iseralaska.org/static/living_conditions/SLiCA Results Report/Tables – Ties to Nature: Table 29.](https://iseralaska.org/static/living_conditions/SLiCA%20Results%20Report/Tables%20-%20Ties%20to%20Nature%20Table%2029)

participation rate in the Yellowknife Area. In the other NWT communities generally between four and five out of ten adults hunted or fished in 2018.⁶⁵

A measure of self-sufficiency is that 75 per cent or more of the meat and fish eaten was also obtained by the household. This ‘self-sufficiency indicator’ reveals a marked decline from 1998 to 2018 as only two thirds of NWT residents, of which more than 50 per cent are Indigenous, were as self-sufficient in 2018 as they were in 1998. Whereas the Dehcho region has experienced an increase in self-sufficiency, the opposite development has been the reality in most other NWT communities.⁶⁶

Aboriginal Peoples Surveys (APS) have been conducted by Statistics Canada roughly every five years since 2001 and the sixth and most recent in 2022 focusing on children and families. The APS results reflect the trends in participation in harvest activities among Inuit from Inuit Nunangat (Inuvialuit, Nunavut, Nunavik, and Nunatsiavut). As documented in the APS 2017, two out of three Inuit in Inuit Nunangat had hunted, fished or trapped in 2017, and almost half had gathered wild plants or berries. Data shows a decline in harvesting in Inuit Nunangat. Detailed analyses find that the only age group where harvest participation declined was working-age adults, and potential reasons for a decline including climate change and a resulting decrease in sea ice thickness and increasing costs of living and harvesting, time constraints, and generational changes in knowledge and hunting skills.⁶⁷

Another finding also documented in e.g., SLiCA is that the employed Inuit more often participated in harvest activities than the non-employed. The answers highlight some of the obstacles for Arctic Indigenous Peoples to pursuing harvest, as cash is needed to participate in traditional activities and if individuals are not participating in the wage economy, they lack the cash to be able to buy the equipment needed, and if individuals are fully engaged in the wage economy, they might lack the time to participate in harvest activities.

The analysis of the APS data further highlights the economic importance to communities referring to an estimate value of harvesting and gathering activities of over CAD 10 million in the Qikiqtaaluk region of Nunavut alone.⁶⁸

The 2019 Canada’s Arctic and Northern Policy Framework emphasized the importance of the mixed economies: “The Arctic and North has what is described as a mixed economy: some people depend on traditional economies of hunting, fishing, and gathering, others depend on a wage economy, and some depend on both”.⁶⁹ The Arctic and Northern Policy Framework document highlights key challenges to the Indigenous Peoples in the Arctic including rising rates of food insecurity, a result of “high cost of living and changes in the availability and accessibility of traditional foods”, as many northern Indigenous peoples continue to rely substantially on the land and wildlife for their traditional economy and food security.

Highlight 8.5. Canadian Northern Economic Development Agency (CanNor)

Canada's territories, Nunavut, the Northwest Territories, and Yukon, account for nearly 40 per cent of the country's land area and have a coastline twice as long as the Atlantic and Pacific coasts combined. Northerners number about 114 000, with many living in the territorial capitals of Iqaluit, Yellowknife and Whitehorse. Indigenous peoples make up 86 per cent of the population of Nunavut, 51 per cent in the Northwest Territories and 23 per cent in Yukon.

From diamond mines and oil and gas reserves to tourism and rich cultures that attract visitors from around the globe, the North has a great potential for economic growth, investment, and job creation. Canada's natural resources, including marine resources such as fisheries, are a cornerstone of economic activity and a key to building Indigenous and northern communities.

The Canadian Northern Economic Development Agency (CanNor) was established to support economic development and the social and economic pillar of the Northern Strategy. CanNor works with Northerners and Indigenous Peoples, communities, businesses, organizations, and governments to build diversified economies, sustainability and economic prosperity across the territories.¹

CanNor supports community-based efforts for development and diversification in key economic sectors such as mining, tourism, fisheries, renewable energy and cultural and traditional sectors. CanNor works with community partners to identify areas for investment, capacity and skills development, and making investments to improve local infrastructure.

Resource development

Resource extraction projects include diamonds, gold, base metals and silver, tungsten, uranium, rare earth element, iron ore, zinc, and copper. The mining sector is a cornerstone of the northern economy.

CanNor supports responsible and sustainable resource development that balances economic, environmental, and social considerations and integrates the use of Indigenous knowledge into decision-making processes.

Skills development

A skilled northern workforce is key to economic development and building prosperous northern communities. CanNor plays a lead role, in collaboration with partners and stakeholders to ensure that Northerners have the skills and training to take part in the new economy.

Pan-Territorial Growth Strategy

CanNor collaborated with territorial and Indigenous governments, industry, Indigenous communities and organizations, and academia to develop a Pan-Territorial Growth Strategy.² The partners highlighted a number of challenges in the territories that hamper development, including a significant infrastructure deficit, a higher cost of doing business related to remote locations, harsh environment, and sparse population distribution. The views, summarized in a "What we heard" report, will help guide CanNor's strategic approach towards future investments and activities in the territories.

¹ <https://www.cannor.gc.ca/eng/1351104567432/1351104589057>

² <https://www.cannor.gc.ca/eng/1562247400962/1562247424633>



The home of a hunter's family in Innarsuit a settlement in West Greenland. Photo: Kåre Hendriksen

Greenland subsistence activities

Several community analyses document the multi-faceted importance, economically, socially, and culturally of subsistence activities. A socio-economic analysis of Greenland hunters was conducted 2003-2005 focussing on catches by species, expenses to and yield from traditional activities. The study estimated that the value of the subsistence economy was 182 million DKK as an annual average 1993-2002. The estimated value of the professional hunters' subsistence activities was 130 million DKK which meant a contribution to each hunters' household worth 42 000 DKK.⁷⁰

Statistics on hunting (e.g., marine mammals and sea birds) and licensed hunters is compiled by Greenland Fisheries and License Control and the Department for Fisheries, Hunting and Agriculture. In the ten-year period from 2004 to 2013 total yield of hunting declined for whales, walrus, seals, polar bears and sea birds, however with an increase in the catch of small whales and seals at the end of the period.⁷¹ The decrease in harvest was accompanied by a decrease in the number of professional hunters, under the hunting regulations aiming to protect vulnerable species.

Recent indications of the importance of subsistence activities can be learned from a regional update of the Survey of Living Conditions in the Arctic in the northernmost part of Greenland.⁷² The results indicate that as the Upernavik district benefitted from an abundance of Greenland

Highlight 8.6. The Indigenous Peoples Economic Account (IPEA)

Jeremy Bridger, Statistics Canada

The Indigenous Peoples Economic Account (IPEA) of the Canadian System of National Accounts provides a comprehensive picture of the participation of Indigenous Peoples in the Canadian economy.¹ According to the 2021 Census, the Indigenous population was over 60 000, or 52 per cent of the total population, in northern Canada.

Indigenous Peoples, their communities, cultures and languages have existed since time immemorial in the land now known as Canada. The term Indigenous Peoples refers to First Nations people, Métis and Inuit, recognized in the Constitution Act. Their diversity is reflected in over 70 Indigenous languages reported in the 2021 Census, over 600 First Nations across the country, the plurality representing Métis nationhood, and four regions and 50 communities of Inuit Nunangat that Inuit call home.²

Purpose of IPEA

The IPEA helps recognize and address data gaps in statistics pertaining to Indigenous Peoples. To develop meaningful and efficient policy initiatives, accurate information is required. By providing reliable macroeconomic estimates, the IPEA gives a better picture of the economic reality of the Indigenous Peoples and helps in understanding the economic importance of their contributions.

For instance, Indigenous Peoples may be more likely to live in remote areas, which might influence accessibility and types of jobs and increase the cost of living. In the IPEA it is possible to identify industries where young Indigenous Peoples work and compare average wages between genders. When interpreting the results of the IPEA, users should always consider the broader regional, historical, and economic context of Indigenous Peoples.

Data sources and methodology

IPEA estimates are based on the Human Resource Module, with Census and National Household Survey data that include an Indigenous identity self-identification variable.³ These data are used to distribute hours worked, salaries, wages, and jobs from the Canadian Productivity Accounts that provide industry totals.⁴

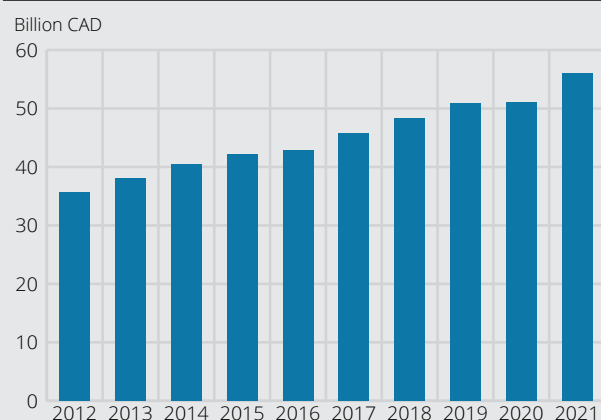
To derive Indigenous output, the ratio of Gross Domestic Income (GDI) attributable to Indigenous Peoples over total GDI is applied to total output. Similarly for jobs, the ratio of jobs held by Indigenous Peoples over all jobs is applied to total jobs.

The estimate for labour income attributable to Indigenous Peoples is compared with the total population in Canada, to derive a ratio to be applied to compensation of employees. For Indigenous entrepreneurial income, the Canadian Employer-Employee Dynamics Database is used for identifying Indigenous-owned businesses (more than 50 per cent of owners are Indigenous).⁵ The profits of Indigenous-owned businesses are divided by the profits of all businesses in Canada, to derive a ratio to be applied to entrepreneurial income.

Indigenous Gross domestic income (GDI)

Gross Domestic Income (GDI) earned by Indigenous peoples (Indigenous GDI) was estimated at CAD 56.1 billion in 2021, an increase of 10 per cent from 2020 (Figure 1). This represented 2.4 per cent of total Canadian GDI generated

Figure 1. Indigenous gross domestic income, Canada. Billion CAD. 2012-2021



Source: Statistics Canada. Table 36-10-0695-01.
<https://www150.statcan.gc.ca/t1/tbl/en/tv.action?pid=3610069501>

in 2021. Over the past decade, Indigenous GDI increased by 57.6 per cent, outpacing growth in the total economy (37.6 per cent).

A closer look at Indigenous GDI by sector shows that growth in 2021 was widespread, with the largest increases in public administration, construction, and educational services.

Jobs rebound following the COVID-19 pandemic

About 848 000 jobs in Canada were held by Indigenous peoples in 2021, an increase of 8 per cent from 2020. This followed a decrease from 2019 to 2020 (-8.2 per cent), which coincided with the onset of the pandemic. About 4 per cent of jobs in Canada were held by Indigenous people in 2021, with the highest proportions in public administration, health care and social assistance, and retail trade.

Nunavut saw Indigenous GDI increase by 9.4 per cent in 2021 to reach CAD 1.2 billion. This represented 25.9 per cent of the territory's total GDI, the highest proportion of all provinces and territories. Jobs held by Indigenous peoples increased 9.1 per cent in 2021, reaching 14 270.

In the Northwest Territories Indigenous GDI grew 12.4 per cent in 2021 to reach CAD 1.0 billion, more than one-fifth of total GDI for the territory. About one-quarter of Indigenous GDI in the territory was earned in the public administration sector.

In the Yukon Indigenous GDI increased 10.5 per cent in 2021. Indigenous GDI in the territory represented 13.8 per cent of total GDI for the territory in 2021.

Between 2012 and 2021, the number of jobs held by Indigenous peoples with a university degree grew 29.8 per cent in Yukon, 28.2 per cent in the Northwest Territories, and 30.4 per cent in Nunavut.⁶

¹ <https://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=5412>

² <https://www150.statcan.gc.ca/n1/daily-quotidien/220921/dq220921a-eng.htm>

³ <https://www150.statcan.gc.ca/n1/pub/13-604-m/13-604-m2022001-eng.htm>

⁴ <https://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=5412>

⁵ <https://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=5228>

⁶ <https://www150.statcan.gc.ca/n1/daily-quotidien/240402/dq240402a-eng.htm>

halibut, over the period from 2004-2006 to 2017, there seems to be a larger share of household's consumption of Greenland food and a larger share of the diet provided by a member of the household. At the same time there is little change in the preferred combination of productive activities i.e. being a hunter/fisher or in wage employment, or a combination.⁷³

Resilience of nomadic reindeer herding in peatlands in the circumpolar north⁷⁴

Svein Disch Mathiesen⁷⁵, Inger Marie G. Eira⁷⁶, Kathrine I. Johnsen⁷⁷, Anders Oskal⁷⁸, Merritt Turetsky⁷⁹ and Marina Tonkopeeva⁸⁰

Reindeer husbandry comprises the primary economy for over 24 Indigenous peoples in the circumpolar north. Reindeer herding culture and civilization are unique in the Arctic; today, however, they no longer form the foundation for economies of the Indigenous peoples in some circumpolar regions. Modern reindeer husbandry is experiencing challenges such as climate change, loss of pastures, and loss of languages and cultures.⁸¹

In Norway, there are two types of reindeer husbandry: nomadic Sámi reindeer herding with long migration routes between seasonal grazing grounds and more stationary reindeer herding with short migrations. Although nomadic reindeer herding dominates in the north, the management model for Sámi reindeer herding and its legal framework has been developed and 'modernized' with a knowledge base from stationary reindeer herding, especially from the southern Sámi areas. The modernization processes have eroded reindeer herding knowledge and limited the reindeer herding Sámi rights to self-organize. People's ability to self-organize is the basis for increased resilience to climate change and nature loss.⁸²

Sámi reindeer husbandry faces numerous land-use changes, of which the cumulative effects severely affect their ability to maintain traditional herding practices: damming of lakes for hydropower production, mineral exploration, development of recreational cabin areas, and wind power plants. Land use conflicts are exacerbated under climate policies encouraging 'green' energy production in reindeer herding areas. The combination of land degradation and climate change impacts challenges the adaptive capacity of reindeer herders and the

resilience of reindeer husbandry. Land use change, infrastructure development, fragmentation, and climate change are also major human-induced impact factors on biodiversity.⁸³ Recent analysis for Sámi reindeer herding land in Finnmark indicates that about 50 per cent of the biodiversity within the reindeer calving grounds was lost by 2011.⁸⁴ The quality of the calving grounds is essential for the well-being of the herds.

Another grazing area essential for reindeer husbandry is peatlands. Peatland cover and distributions vary widely across the Arctic, and bogs or fens – the two main types of peatlands – can be a dominant land cover in some regions. On average, peatlands hold 137 5000 tons of carbon per km², making them the most carbon-dense of any terrestrial ecosystem in the world because of their thick accumulations of peat.⁸⁵ Peat is defined as a substrate composed mainly of plant remains (vascular plants and mosses) that are only partly decomposed due to cold temperatures, anoxic water-saturated conditions, and recalcitrant biomass such as moss litter that resists microbial breakdown.⁸⁶ Ecosystems with more than 40 cm of accumulated peat are defined as peatlands. The legacy of peat accumulation itself has made peatlands historically resilient to disturbances such as wildfire. However, with ongoing climate change, disturbance regimes are accelerating and overwhelming the resilience mechanisms of peatlands. Abrupt permafrost thaw that can trigger subsidence, sinkholes, and erosion in peatlands will probably occur in <20 per cent of the permafrost zone in the north but could affect half of permafrost carbon. Emissions across 2.5 million km² of abrupt thaw could provide a similar climate feedback as gradual thaw emission from the entire 18 million km² permafrost region.⁸⁷

Drought (another effect of climate change) combined with land-use changes lowers the water table in peatlands and increases the frequency and extent of peat fires, which causes further carbon emissions to the atmosphere and can impact the ability of peatlands to accumulate new peat.⁸⁸ Peatlands in pristine condition lock in carbon and are therefore one of the greatest allies in the fight against climate change, and also provide valuable habitat for reindeer. On the other hand, degraded peatlands are strong net emitters of greenhouse gasses and their potential for land conservation and stewardship is eroded. Conserving and restor-



Photo: Nenets family in a nomadic reindeer herders' camp, Cooperative 'Voskhod', village Oma, Nenets Autonomous Okrug. Photo: Yasavey

ing peatlands is an effective way to improve reindeer habitat, protect biodiversity, reduce global carbon emissions, and revive and conserve this globally significant carbon sink.⁸⁹

In Sámi reindeer herders' specialized vocabulary peat is called *dâr'fe*. Historically, peat was used as building material to make *dâr'fe* *guahti*, a traditional summer house for Sámi reindeer herders.⁹⁰ In the circumpolar north, peatlands continue to play an essential role in indigenous reindeer husbandry. Peatlands provide nutritious grazing resources when there is little vegetation elsewhere and access to water in dry periods or cold temperatures.⁹¹ Therefore, in a warmer climate, the importance of the peatlands will increase. Extensive grazing and trampling, however, can degrade the peatlands. An approach to avoid this is to avoid stationary reindeer husbandry and facilitate the continuation of nomadic reindeer husbandry where the herd moves between seasonal pastures. Preventing land degradation from land use change will further conserve the peatlands and enable nomadic reindeer husbandry.

Maps are essential in land use decisions, but conventional mapping struggles to capture the complexity of reindeer husbandry. This often results in oversimplified representations lacking local and socio-ecological context. While Geographic Information Systems (GIS) efficiently handle large datasets, they are less effective at incorporating data without precise coordinates or representing Indigenous Knowledge, such as the relational and temporal insights of Sámi reindeer herders.⁹² There

is a need to use innovative methods to document reindeer herders' knowledge about peatlands and other habitats in light of land use change and climate change. There is also a need to get a better understanding of the current state of the peatlands in the reindeer herding regions. Engaging reindeer herding youth directly in herding practices and providing enhanced education is a key factor in the future sustainability of reindeer husbandry, its cultural foundations, as well as the protection of the peatland.⁹³ The resilience of reindeer husbandry can be enhanced through reindeer herders' possibility to self-organize, using both traditional and scientific knowledge in their adaptation, spreading risk by maintaining diversity in their social organization and economy, and good understanding of the biological diversity, peatlands and other habitats on which their practices depend. As such, the reindeer husbandry communities of the circumpolar north can continue to be guided by the three cultural constructs of controlling their own destiny, maintaining their cultural identity, and being able to live close to and rely on nature for their livelihood and well-being.

Sámi reindeer pastoralism in Norway: The role of traditional knowledge for economy and governance

Ellen Inga Turi, Anders Oskal, Svein Disch Mathiesen and Iulie Aslaksen⁹⁴

Reindeer pastoralism is an Indigenous livelihood of key importance for more than 20 Indigenous Peoples in Arctic and Sub-Arctic areas in Norway, Sweden, Finland, Russia, Mongolia, China, Alaska, Canada, and Greenland. In total, the livelihood involves about 100 000 people and about 2.5 million reindeer (*Rangifer tarandus*) grazing on natural pastures from the North Sea to the Pacific Ocean.

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. This has enabled the use of Arctic mountains and tundra areas for food production since time immemorial.⁹⁵

In Norway, reindeer pastoralism is predominantly a Sámi livelihood. The traditional social and economic organization of Sámi reindeer pastoralism is based on herding partnerships, referred to as a *siida*, often defined as an organization of house-



Reindeer herding, Finnmark. Photo: Tom Nicolaysen

holds, usually families and relatives, cooperating on the work of the nomadic reindeer herding⁹⁶. Activities related to herding, migrating across seasonal pastures, and preparing meat and other products, contribute to sustain and transfer the traditional knowledge the livelihood is based on. The traditional organization is similar across reindeer herding regions in the circumpolar Arctic.

Loss and fragmentation of pastures and migration routes, due to development of infrastructure associated with hydropower, mining, recreational cabin areas, forestry, and recently wind power, have severe consequences for reindeer husbandry.⁹⁷ Reports from 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 change mitigation and biodiversity.⁹⁸ The traditional knowledge of reindeer herding is of key importance for adapting to climate change.⁹⁹ Traditional knowledge is defined by the Ottawa Indigenous Knowledge Principles of the Arctic Council.¹⁰⁰

The biodiversity of Arctic regions is the basis for food systems and food security. While food governance is defined as the institutional framework for managing food systems, Arctic food sovereignty is defined by Indigenous scholars 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 the rights of Sámi as Indigenous Peoples are implemented in legislation in Norway, a challenge remains to integrate the use of traditional knowledge in governance of reindeer husbandry. There is a need to integrate traditional knowledge into institutional mechanisms for governance to achieve ecological, economic, and cultural sustainability of reindeer herding. The issue of sustainability involves dealing with the competing objectives of reducing the size of herds and increasing profit in reindeer husbandry.¹⁰¹

A key issue is the possibility for reindeer herders to decide on the composition and size of the herd.

Figure 8.11. Circumpolar reindeer pastoralism

Source: International Centre for Reindeer Husbandry (ICR)

On average, in 2023, herds consisted of 78 per cent female reindeer, 16 per cent calves, and only 6 per cent male reindeer¹⁰². In the 1960s reindeer herds in Finnmark typically comprised up to 50 per cent adult male reindeer. Their strength enabled them to break through crusted snow, providing access to the pastures for female reindeer and calves.

Structural changes of reindeer herds, in Russia from the 1930s and in Norway from the 1960s, led to the practice of targeting calves for slaughter and maintaining low shares of male reindeer.¹⁰³ While previously reindeer calves were hardly slaughtered, today subsidies provide economic incentives to slaughter calves.

These structural changes of Sámi reindeer husbandry may have made the pastoral economy

more vulnerable in times of climate change and increased risk of ice-covered pastures. A consequence is increased need for feeding of reindeer in winter, contributing to erosion of herders' economy. Use of pellets, hay and silage in reindeer herding has increased throughout Fennoscandia.¹⁰⁴

The economy of Sámi reindeer husbandry in Norway

The Norwegian Agricultural Agency compiles annual reports of the economy in reindeer husbandry.¹⁰⁵ The value of meat production was about 33 per cent of total income of reindeer husbandry in 2022 (Table 8.2). Compensations for loss of reindeer, to predators and traffic accidents and loss of area, was about 22 per cent of total income in 2022, hereof 20 per cent for loss to predators and traffic accidents and 2 per cent for loss of area.

Table 8.2. Composition of total income in reindeer husbandry in Norway. 2018 and 2022. 1 000 NOK and per cent

	2018		2022	
	1 000 NOK	Per cent	1 000 NOK	Per cent
Production based income	190 543		228 815	
Meat and by-products total	122 767	31.7	167 089	33.1
Meat production slaughter house	108 742	28.1	148 465	29.4
Meat production private	14 025	3.6	18 730	3.7
Bonus	3 988	1.0	3 925	0.8
Changes in the value of the herd	12 879	3.3	-1 453	-0.3
Incomes from related activities	13 776	3.6	13 223	2.6
Other production-based incomes	37 132	9.6	46 031	9.1
Subsidies	92 461	23.9	167 299	33.2
Compensations	104 006	26.9	108 172	21.5
Total incomes	387 010	100.0	504 287	100.0

Source: Norwegian Agriculture Agency (2023), Table 4.7.1. Shares of market and private sale estimated from Table 4.1.1.

Table 8.3. Incomes from related activities in reindeer husbandry in Norway. 2018 and 2022. 1 000 NOK

Reindeer herding region	2018	2022
Øst-Finnmark	3 630	3 696
Vest-Finnmark	3 608	3 368
Troms	4 411	2 818
Nordland	566	613
Nord-Trøndelag	99	176
Sør-Trøndelag/Hedmark	1 462	2 552
Total	13 776	13 223

Source: Norwegian Agriculture Agency (2023), Table 4.1.12.

Table 8.4. Siida share costs in reindeer husbandry in Norway. 2018 and 2022. 1 000 NOK

Type of cost	2018	2022
Freight and transportation	693	1 763
Intermediate goods	22 848	30 558
Travels	2 698	22 843
Equipment	28 762	36 582
Vehicles and machinery	31 767	17 742
Buildings and infrastructure	6 064	6 448
Depreciation	34 440	43 638
Electricity, energy	8 373	12 761
Administration, rent, insurance, sales and marketing	14 349	0
Aquisition of services	11 453	0
Miscellaneous	14 477	0
Total	175 924	172 336

Source: Norwegian Agriculture Agency (2023), Table 4.4.2.

Subsidies to reindeer husbandry were about 33 per cent of total income in 2022. 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.

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 8.3 shows that incomes from activities related to reindeer husbandry decreased slightly from 2018 to 2022, however, they vary over time, and from 2022, these incomes are estimated and no longer available from self-reporting.¹⁰⁶

Vehicles, machinery and equipment are large items of the total cost, in addition to depreciation (Table 8.4).

Income from work outside reindeer herding is of large importance for the economy of the reindeer herding family (Tables 8.5 and 8.6). Among siida share leaders, 89 per cent of women and 75 per cent of men have income from employment or self-employment outside reindeer herding (Table 8.5). Of these, 74 per cent of female siida share leaders and 32 per cent of male siida share leaders had income above 200 000 NOK.

In particular, the economic contribution from female spouses is important, as 94 per cent of female spouses and 80 per cent male spouses have income from outside reindeer herding, and a large share have relatively high incomes (Table 8.6).

With regard to ownership of reindeer, in 2022, 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.¹⁰⁷

Of the 23 956 lost reindeer in 2022, 95 per cent were lost to predators and 5 per cent to traffic accidents (Table 8.7).

Many tourists seek knowledge about authentic and traditional ways of living in the Arctic, and a growing interest in Indigenous food culture has resulted in more Sámi products and tourism companies¹⁰⁸. This increase is not reflected in income from activities related to reindeer herding (Table 8.2). Sámi family produced reindeer meat is tender, but such meat is rarely available for tourists and other consumers.

Table 8.5. Share of female and male siida share leaders with wage or self-employment income outside reindeer herding, 2022. Per cent

Reindeer herding area	Women	Men	Income < 200 000		Income > 200 000	
			Women	Men	Women	Men
Øst-Finnmark	92	71	17	71	83	29
Vest-Finnmark	90	81	27	65	73	35
Troms	82	72	0	61	100	39
Nordland	75	65	50	75	50	25
Nord-Trøndelag	89	73	50	77	50	23
Sør-Trøndelag/Hedmark	100	71	60	76	40	24
Total	89	75	26	68	74	32

Source: Norwegian Agriculture Agency (2023), Table 7.1.4.

Table 8.6. Share of female and male spouses with wage or self-employment income outside reindeer herding, 2022. Per cent

Reindeer herding region	Women	Men	Income < 200 000		Income > 200 000	
			Women	Men	Women	Men
Øst-Finnmark	100	91	11	40	89	60
Vest-Finnmark	96	75	12	67	88	33
Troms	86	67	25	0	75	100
Nordland	100	100	20	50	80	50
Nord-Trøndelag	67	33	13	0	88	100
Sør-Trøndelag/Hedmark	93	100	0	100	100	0
Total	94	80	13	45	88	55

Source: Norwegian Agriculture Agency (2023), Table 7.1.5.

Table 8.7. Number of compensated reindeer in reindeer husbandry in Norway, by cause of loss to predators and traffic accidents, 2018 and 2022

Cause of loss	2018	2022
Lynx	5 786	6 740
Volverine	6 716	6 801
Bear	228	345
Wolf	3	127
Eagle	7 426	8 127
Unspecified predator	1 083	698
Train	683	465
Road traffic	638	653
Total	22 563	23 956

Source: Norwegian Agriculture Agency (2023), Table 4.3.3.

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. 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.

Traditional knowledge and Convention on Biological Diversity (CBD)

The Convention on Biological Diversity (CBD), Article 8 (j), calls for applying traditional knowledge of Indigenous Peoples to achieve sustainable use and conservation of biodiversity.¹⁰⁹ The Norwegian Government’s Arctic Strategy recently raised the challenge of land encroachment and need for dialogue with Sámi interests. The Nature Diversity Act §8 stipulates that authorities shall emphasize knowledge based on 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.

Competing land use and climate change are threats to the pasture land of Sámi reindeer herding. Reindeer pastures are exposed to the development of infrastructure, hydropower, mineral exploration, recreational cabin areas, and wind power. Land use conflicts are exacerbated under climate policy with wind power plants in reindeer herding areas. Projected developments and climate change impacts challenge the adaptive capacity of reindeer herders and the resilience of reindeer herding.

Analysis of biodiversity loss by the GLOBIO3 model is suggested as tool for decision support, in consultation with Sámi reindeer owners, taking into account traditional knowledge of reindeer herding¹¹⁰. GLOBIO3 analysis for Sámi reindeer herding land in Finnmark indicates that in 2011, compared to an intact situation, about 50 per cent of the biodiversity of reindeer calving grounds has been lost, and it is expected to be reduced with another 10 per cent in the scenario for 2030.

Reindeer owners in Finnmark told that they expect biodiversity loss will have implications for the quality and extent of suitable grazing areas. Especially the quality of the calving grounds is essential for reindeer herding. An important lesson from dialogue with reindeer owners is that even highly impacted areas should not be considered as lost, and thus be opened to further development, as they are still important for seasonal reindeer migration and grazing at certain times of the year.

Subsistence and mixed economies in a changing Arctic

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In social sciences, the concept subsistence has been discussed to understand the process of transition from a society based on harvesting and sharing to the cash economy of the globalized world of the market economy. Today the two sectors often exist together, interdependent and mutually supportive in one socio-economic system.

Natcher claims that the focus on the economic aspects of subsistence, is often in place of a more holistic view including cultural aspects.¹¹¹ Langdon argues that the “separate domains of economic value and cultural value” shall “be identified and joined not merged or conflated into a unitary value” and that “...the behaviours and views of those who participate in the subsistence-based lifestyles must provide the basic parameters for comprehending the way in which they live”.¹¹²

Mineral exploitation due to easier access to resources and increasing world market demands have significantly increased. Attitudes towards resource extraction among the Indigenous peoples of the Arctic differ across and within regions, depending on whether Indigenous Peoples’ organizations are involved, whether there is a local benefit, and whether the resource extraction has consequences for the land and the potential for traditional hunting, fishing, gathering, and reindeer herding activities.

Based on data from more than 18 000 households in 179 Alaskan communities in the period from 1983 to 2013, Magdanz et al. studied factors that might influence subsistence harvest and concluded that “(s)ome factors were “slow” or unchanging variables – geographic location, ethnicity, mean income. Other factors were “fast” variables subject to abrupt change – subsistence priority laws, natural resource abundance, and road access – and had government dimensions”.¹¹³ Based on studies in two Inupiat communities, Kaktovik and Wainwright in North Slope Borough Alaska, BurnSilver et al. concluded that “*elements of mixed economies observed three decades ago – simultaneous household engagements in subsistence, markets, and traditional social relationships – have been remarkably consis-*

*tent” and that “(t)he vitality of mixed economies in the Arctic depends – as Alaska policy states – on continued access to bountiful lands, rivers, and seas.”*¹¹⁴

In a study from 2022, BurnSilver, Coleman and Magdanz focused on social resilience in the two coastal Inupiaq communities, Wainwright and Kaktovik and the Gwich’in Dene community, Venetie. One of the main conclusions is: “*Our results strongly support the connection between equality, social resilience, and social institutions expressed as wild food flows and ties that connect Inupiaq and Gwich’in to each other, to the animals they depend on, and to the places where they live. [...] Community networks of sharing cooperation, and trust continue to emerge as foundational in the broader effort to navigate change.*”¹¹⁵

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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

9. Tourism in the Arctic

Derek J. Clark, Mikko Moilanen and Stein Østbye¹

Introduction

Travelers are drawn to the Arctic by a vision of adventures involving natural phenomena such as the midnight sun and aurora borealis. Skiing, mountain walking, dog mushing and berry picking can be enjoyed while taking in the natural surroundings. Other attractions are based on the cultural heritage of the Indigenous Peoples. Rapid expansion by airlines, cruise lines and package tour providers has made the Arctic areas increasingly accessible.²

The World Tourism Organization (UN Tourism) defines tourism as “a social, cultural and economic phenomenon which entails the movement of people to countries or places outside their usual environment for personal or business/professional purposes”.³ International standards for the measurement of tourist activity are found in International Recommendations for Tourism Statistics, 2008 and Tourism Satellite Account, 2008.⁴ The satellite accounts are based on National Accounts and provide economic data on tourism.

Tourism brings both benefits and drawbacks. A common denominator in the tourism strategies of countries in the Arctic region is an emphasis on sustainable development of the industry.

UN Tourism is responsible for the promotion of responsible, sustainable and universally accessible tourism. The UN tourism agency has developed and adopted the Statistical Framework for Measuring the Sustainability of Tourism (2024).⁵ Here sustainable tourism “takes full account of its current and future economic, social and environmental impacts whilst addressing the needs of visitors, the industry, the environment and host communities” (page 6).⁶ In addition to traditional economic indicators such as visitor flows and employment, environmental impacts include water and energy use, solid waste production, emissions and ecosystem effects. Social impacts relate to both sides of the market; visitor satisfaction and engagement on the demand side, and host community participation and perceptions on the supply side. When this framework of sustainability is operationalized, researchers will have tools for evaluating both

Table 9.1. Industries providing services to tourists

Accommodation for visitors
Food- and beverage-serving activities
Railway passenger transport
Road passenger transport
Water passenger transport
Air passenger transport
Transport equipment rental
Travel agencies and other reservation services activities
Cultural activities
Sports and recreational activities
Retail trade of country-specific tourism characteristic goods
Other country-specific tourism characteristic activities

positive and negative side-effects from tourism, hopefully at the regional level.

This chapter looks at recent trends in tourism in the Arctic region, considering a time period including the Covid-19 pandemic of 2020-21, when the tourist industry practically collapsed due to lock down and travel restrictions. ECONOR IV documented how the urge to explore new places and natural phenomena had driven a rapid expansion in the number of tourists to the Arctic regions. This was effectively stopped by the global Covid-19 pandemic 2020-2021. Infrastructure that had been built up to serve tourists was suddenly idle, raising concerns about the ability of the industry to survive and demonstrating that rapid growth does not necessarily build a solid platform for the future, especially in an industry characterized by many small independent businesses. We present statistics on pre- and post-pandemic tourist streams to Arctic destinations in relation to number of overnight stays, visitors' country of residence and ensuing environmental impact.

One important finding is that the demand for trips to the Arctic from the Chinese market has not yet recovered. According to The Economist, outbound tourism from China will not return to pre-pandemic levels until 2025. In 2023, the number of Chinese cross-border trips to destinations other than Hong Kong, Macau and Taiwan was only 36 per cent



Polar fox. Photo: Colorbox.

of the 2019 level.⁷ Regaining this market may be important for future growth. However, our findings reveal a growing share of short-haul visitors to Arctic destinations; this has implications for the environmental footprint from traveling to the Arctic.

We investigate change in pre- and post-pandemic travel from countries of origin to the Arctic regions where data are available. Furthermore, we look at the shares of domestic and foreign overnight stays in commercial establishments to gauge the dependency on various foreign markets. Sanctions imposed on Russia due to the war in Ukraine have also significantly impacted some Arctic regions that previously relied on Russian tourists. Finland, Norway, and Iceland have experienced a noticeable decline in tourist numbers from Russia.

An interesting development in many countries, including the Arctic region, is the growth of accommodation offered by online collaborative platforms such as Airbnb. This adds to the capacity of the commercial suppliers of tourist overnight stays (such as hotels, camping sites and youth hostels). On the one hand, this represents a drain on the commercial establishments by reducing demand but may on the other hand attract tourists that otherwise would have stayed away.

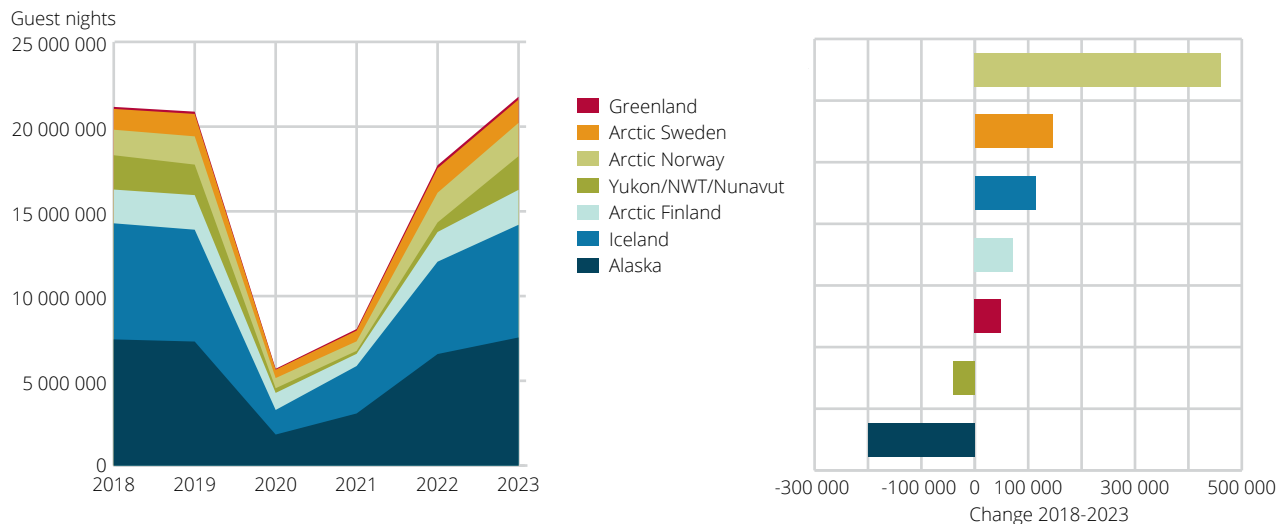
The tourist industry comprises many products and activities that depend on the number of visitors to a destination as outlined in Table 9.1.⁸

Visitors can participate in these services whether they stay at commercial or collaborative accommodation. This is especially important in regions that experience limited hotel capacity in the main tourist season.

Tourism strategies in the Arctic

Tourism is a vital economic driver of regional Gross Domestic Product (GDP) in several regions and economic growth has to be balanced against other concerns. The seasonal nature of tourism can lead to excessive tourism in the peak season, putting a strain on local resources, with ensuing fluctuating employment opportunity and environmental damage. The commercialization of local cultures may lead to cultural erosion, impacting the traditional way of life. Tourism strategies encourage sustainable practices and responsible travel, in close dialogue with local communities and stakeholders.

Arctic states have strategies for tourism at both the national and regional levels.⁹ Norbotten, an Arctic region of Sweden, has a particularly detailed plan – The Strategic Road Map for Sweden's Arctic

Figure 9.1. Number of guest nights and change in the Arctic. 2018-2023¹

¹ Due to lack of statistics, an estimate of number of overnight stays for Alaska is obtained by multiplying the number of air and highway and ferry visitors by five, and for Northern Canada, the number of US and overseas multi-day visitors is multiplied by five. This is a common procedure, applied in the previous ECONOR report. For other regions, the estimate is based on guest nights in commercial accommodation companies.

Sources: Statistics Norway, Statistics Greenland, Statistics Canada, Statistics Iceland, Statistics Finland, The Swedish Agency for Economic and Regional Growth, Alaska Tourism Industry Research, McKinsey Group.

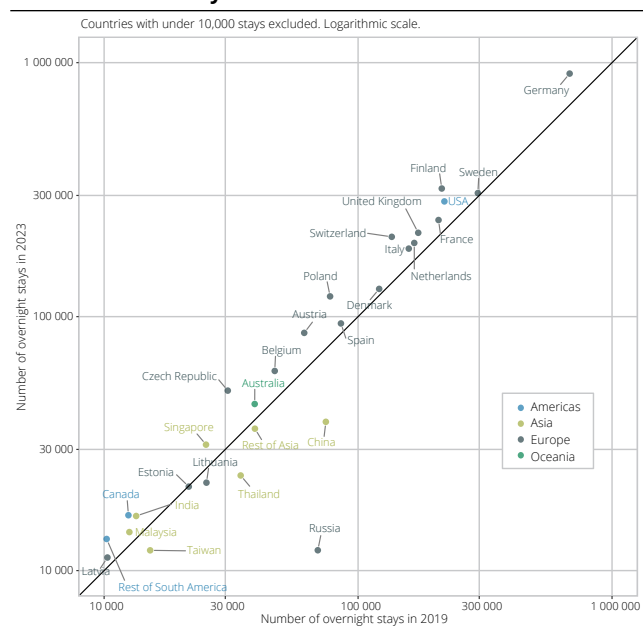
Destinations Towards 2030¹⁰ that covers common denominators in the strategy of most Arctic countries:¹¹

- **Respecting Local Culture and Community:** Emphasizing the importance of maintaining and respecting local traditions, including the rights and culture of Indigenous Peoples.
- **Balancing Development:** Ensuring that tourism development is sustainable and benefits local communities year-round. Addressing potential conflicts between tourism, local industries, and environmental conservation.
- **Innovating and Planning:** Fostering innovation in tourism services and infrastructure, including digital solutions and circular economy principles.
- **Attracting Responsible Tourists:** Targeting responsible travelers who value sustainability and make conscious choices. Using big data and Artificial Intelligence (AI) for targeted marketing and creating meaningful interactions rather than mere marketing campaigns.

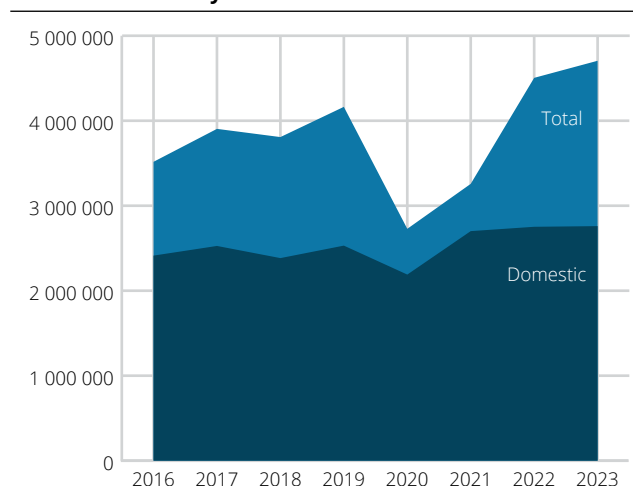
A common feature of the strategies is the desire for growth, but not necessarily the boom that has characterized tourism flows in the Arctic previously. The chairman of Air Greenland, states: "We have to develop organically, we have to develop sustainably, so the people in Greenland can be part of this growth. We don't want to grow rapidly."¹²

In Tromsø, the largest town in Arctic Norway, an extended airport was opened in September 2024 including a new terminal for direct foreign flights. The winter season is projected to attract around 450 000 foreign guests, already stretching the capacity of the extended airport and Avinor (the state-owned operator of airports in Norway), is concerned that Tromsø is too small a destination with too little infrastructure to welcome so many guests. The network-based organization Norwegian Tourism Partners spanning the Arctic region in Norway notes that Tromsø is often the port of entry, and that much effort is designated to spread tourist traffic to generate positive development around the region.¹³

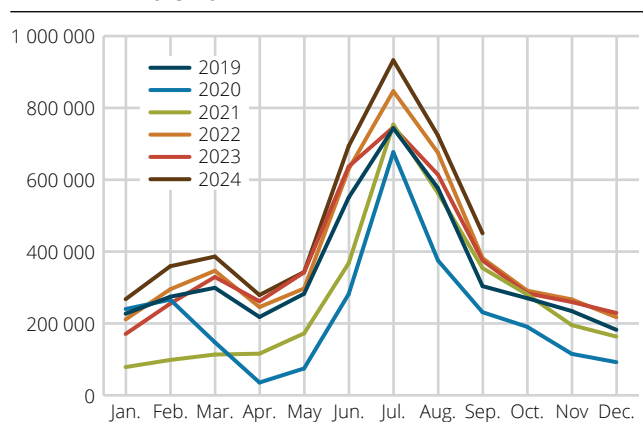
Cooperation is often called upon in tourism strategies as a way to realize the full potential in the industry but can be challenging to implement.¹⁴ The EU is currently funding a project spanning 108 companies in Arctic regions of Norway, Sweden and Finland called "Arctic Europe Tourism Cluster"¹⁵ with the purpose "to build a more resilient and regenerative tourism, to meet rapid changes and future expectations for the benefit of tourism industry, local societies, and visitors in Arctic Europe." The target markets include Alaska (USA), but are mostly in Europe, emphasizing short-haul travel. The cluster seems to tie in with Finland's Strategy for the Arctic Region (2021)¹⁶ to raise the duration of stays and spending by tourists through high-quality and well-packaged products and environmentally sustainable services.¹⁷

Figure 9.2. Number of overnight stays by visitors in Arctic Norway. 2019 and 2023

Source: Statistics Norway, Table 14162

Figure 9.3. Domestic and foreign overnight stays in Arctic Norway. 2016-2023

Source: Statistics Norway, Table 14162

Figure 9.4. Seasonality in overnight stays in Arctic Norway, 2019-2024

Source: Statistics Norway, Table 14162



Arctic Norway

Arctic Norway consists of three counties on the mainland, Nordland, Troms and Finnmark, and the Svalbard islands.¹⁸ Figure 9.2 compares the number of overnight stays in the region in 2019 and 2023.¹⁹

Tourists from countries above the diagonal in Figure 9.2 have more overnight stays in 2023 than in 2019, a year chosen for comparison since 2019 represents normality before the Covid-19 pandemic. Arctic Norway has recovered well in terms of overnight stays after the pandemic. Visitors from almost all European countries, Australia, USA and Canada have more stays in 2023 compared with in 2019. There is a small increase in visitors from India, Malaysia and Singapore, and a relatively large fall in visitors from Thailand and China.

Figure 9.3 shows the development of domestic and foreign overnight stays from 2016 to 2023. Domestic stays have been stable over this period, whereas there was slow growth in foreign stays until 2019, and more rapid growth after 2021. In 2016 the share of foreign overnight stays was 31 per cent, rising to 41 per cent in 2023.

The seasonal pattern in overnight stays in Arctic Norway is clearly captured in Figure 9.4. A clear peak is seen for the summer months, and the number of winter tourists has also recovered since the Covid-19 pandemic. The seasonal pattern is not the same everywhere. Hotels in Tromsø, the largest town in Arctic Norway, welcome many more guests in the winter months than the rest of the year, driven by Northern Lights tourism. In February 2024, over 90 per cent of all hotel rooms were occupied, in contrast to May 2024 where under half of hotel capacity was used.²⁰

Arctic Finland

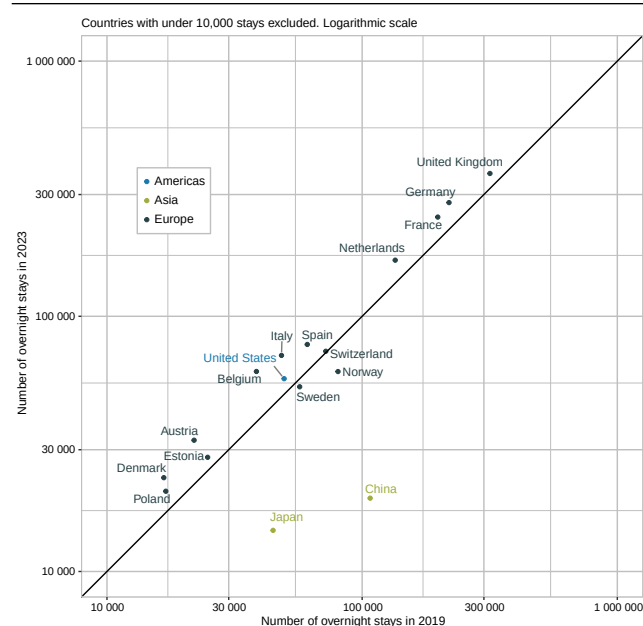
Arctic Finland consists of Lapland, Kainuu and North Ostrobothnia, comprising 44 per cent of the land mass of Finland. The composition and number of foreign overnight stays has recovered after the Covid-19 pandemic (Figure 9.5). Of European countries, only tourists from neighboring Norway and Sweden have less overnight stays in 2023 than in 2019. Travelers from the large markets in Asia have also been slow to rediscover Arctic Finland, but these countries are the exceptions to the general picture of recovery shown in Figure 9.5. The vertical distance between the diagonal and point shows that some European countries - such as Belgium, Italy and Austria – have had a large post-covid increase in overnight stays.

Figure 9.6 demonstrates the importance of the domestic market for overnight stays in Arctic Finland. The growth in domestic and foreign stays was similar up until 2019, and the number of domestic stays reached its peak in 2021, the second year of the pandemic. After this, there has been strong growth in the number of foreign overnight stays, whilst those attributable to Finns have fallen. However, the total number of stays in Arctic Finland is very similar to the share of foreign stays in 2019 and 2023, comprising about 1/3 of the total in both years.

The seasonal pattern of overnight stays in Arctic Finland is clearly bi-modal, having both summer and winter peaks (Figure 9.7). Tourists flow to this area mostly in the winter, but also in early spring and summer seasons. It is a more popular destination in the autumn than in late spring. The pattern of stays is quite similar in the post-covid years 2022 and 2023.

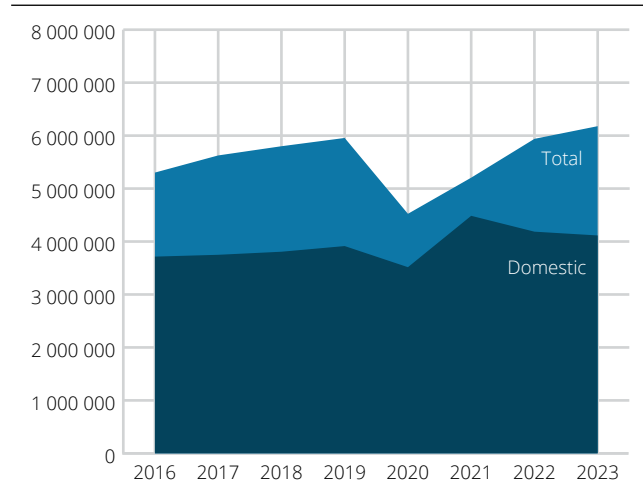
Arctic Finland has specialized in mass tourism at compact resorts such as the village of Levi in North Lapland, catering for 750 000 visitors per year, mostly in the skiing season.²¹ The months leading up to Christmas are popular; this is especially due to the Santa Claus Village in Rovaniemi, which is actually a cluster of over 50 cooperating companies.²² Accessibility of these attractions has improved during the winter season, especially due to increased air traffic. In the winter season 2023/2024, almost 900 000 passengers passed through Rovaniemi, Ivalo, Kittilä (near Levi), and Kuusamo airports.²³ During this season Rovaniemi airport could boast 20 international direct routes.²⁴

Figure 9.5. Number of overnight stays by visitors in Arctic Finland. 2019 and 2023



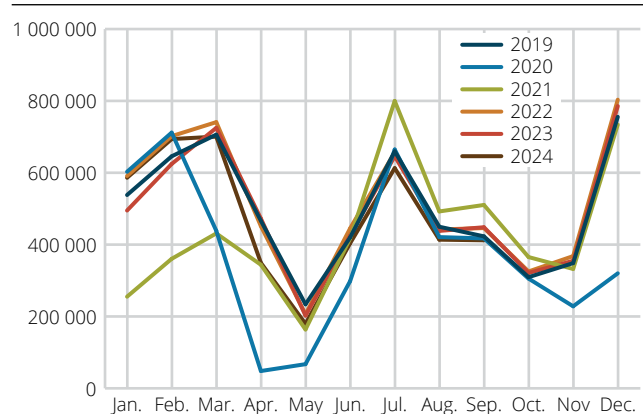
Source: Statistics Finland, Table 11iz

Figure 9.6. Domestic and foreign overnight stays in Arctic Finland. 2016-2023

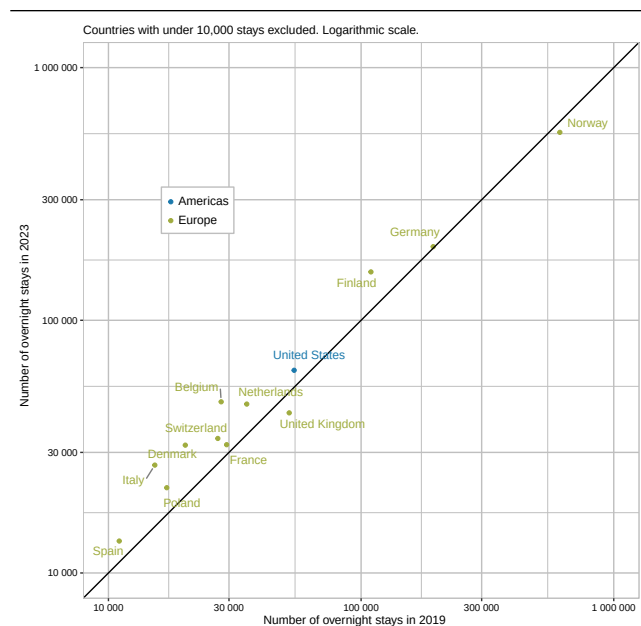


Source: Statistics Finland, Table 11iz

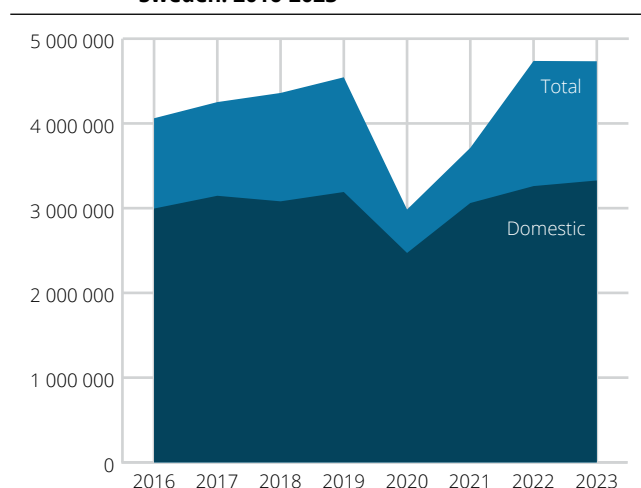
Figure 9.7. Seasonality in overnight stays in Arctic Finland, 2019-2024



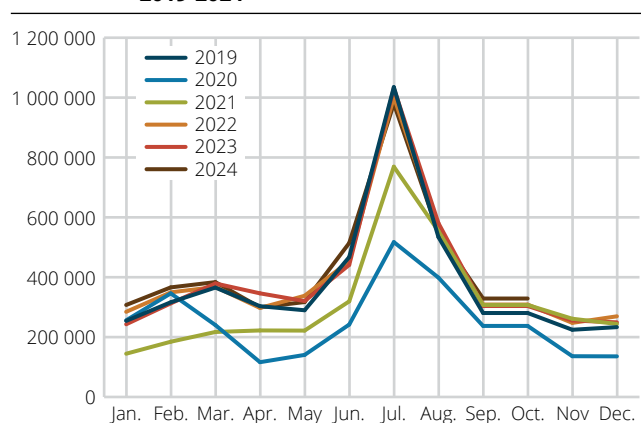
Source: Statistics Finland, Table statfin_matk_pxt_11ix

Figure 9.8. Number of overnight stays by visitors in Arctic Sweden. 2019 and 2023

Source: The Swedish Agency for Economic and Regional Growth

Figure 9.9. Domestic and foreign overnight stays in Arctic Sweden. 2016-2023

Source: The Swedish Agency for Economic and Regional Growth

Figure 9.10. Seasonality in overnight stays in Arctic Sweden. 2019-2024

Source: The Swedish Agency for Economic and Regional Growth

Arctic Sweden

Arctic Sweden comprises the counties of Västerbotten and Norrbotten. The region is heavily reliant on domestic tourism as indicated by Figure 9.9. Most foreign visitors come from European countries, and nearly all of these have more overnight stays in 2023 compared with 2019 as shown in Figure 9.8. Among the exceptions are visitors from Norway and Germany, also the largest visitor groups in Arctic Sweden. There has been considerable growth in the stays of tourists from neighboring Denmark and Finland, as well as from Belgium and Italy in the period 2019-2023.

Figure 9.9 shows the reliance of Arctic Sweden on domestic tourism, accounting for around 70 per cent of overnight stays in 2019 and 2023. Although there was strong growth in foreign stays immediately after the pandemic, this growth flattened out in 2022 and 2023.

Heavy reliance on the domestic market gives the expected seasonal pattern for overnight stays, concentrated around the summer when most Swedes take vacation. Figure 9.10 shows an almost identical seasonal pattern for 2019, 2022 and 2023, indicating little change before and after the pandemic.

Iceland

Iceland is accessible by air or by sea. Figure 9.11 shows the composition and number of arriving passengers in the years since 2016. Most tourists reach the destination by air, with a steady increase in air traffic until 2018. The reduction of air passengers in 2019 is largely attributable to the bankruptcy of the Icelandic low-cost air carrier WOW air. Passenger numbers were, of course, seriously affected by the Covid pandemic, with both modes of transport slow to recover. Whilst the number of passengers accessing Iceland by air still has not reached the peak year of 2018, the number of cruise ship passengers was large in 2023 where 38 per cent of passengers arrived by cruise ship. In 2019, the corresponding share was 28 per cent. According to Iceland Tourism Research Institute, the recent increase in arrivals is largely accounted for by cruise ships on roundtrips in the Arctic region, which have increased in both number of voyages and size of vessel.²⁵ In June 2021, the low-cost airline PLAY was founded and has expanded to cover 40 destinations with 10 aircraft in 2024.

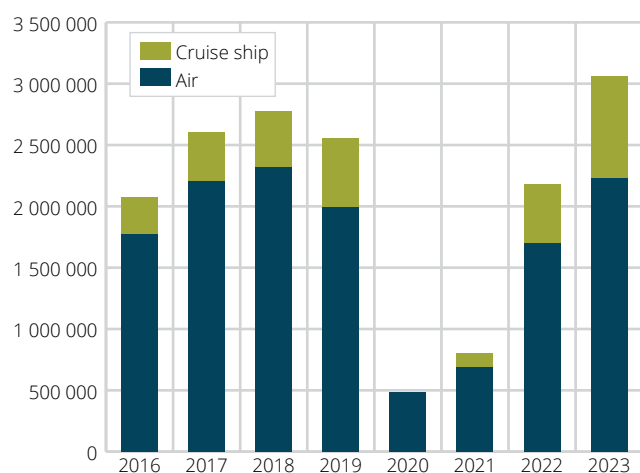
This improved accessibility may be expected to contribute to growth in the number of air passengers.²⁶

Figure 9.12 shows that Iceland attracts travelers from many countries. Most overnight stays are recorded for large markets in central Europe, with levels having recovered after the pandemic. Italy and the Netherlands are responsible for more stays in 2023 compared to the pre-covid period. Japan and China, are large markets that lie well below the 2019 number of stays in Iceland. The Scandinavian countries have also been slow to come back to Iceland.

The heavy reliance on foreign tourism in Iceland is shown in Figure 9.13. Domestic overnight stays appear to have stabilized for now at a higher level compared to the pre-covid trend. Stays by foreign visitors increased sharply from 2022 to 2023. However, the proportion of foreign stays has fallen between 2019 and 2023, as 87 per cent of nights were attributable to foreigners in 2019, compared to 80 per cent in 2023.

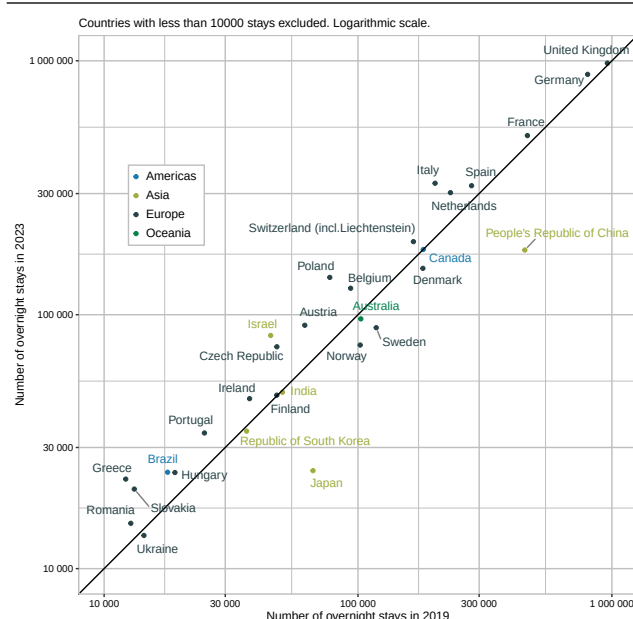
The main tourist season is summer, although there is also a fairly strong season in the early spring, as can be seen from Figure 9.14. The seasonal pattern after the covid pandemic (2022 and 2023) is quite similar.

Figure 9.11. Number of passengers by air and cruise ship to Iceland. 2016-2023



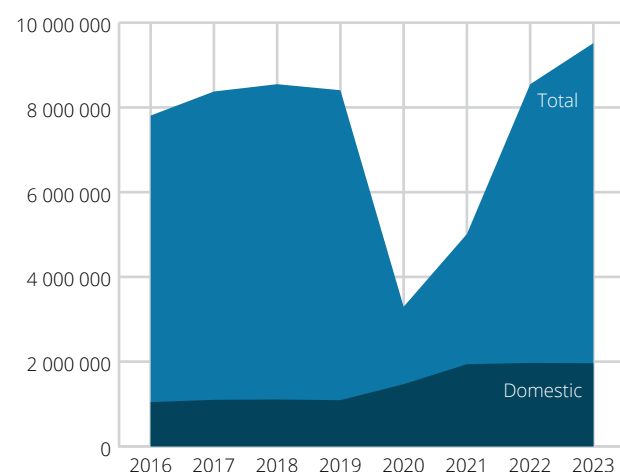
Source: Statistics Iceland, Table SAM08006

Figure 9.12. Number of overnight stays by visitors in Iceland. 2019 and 2023



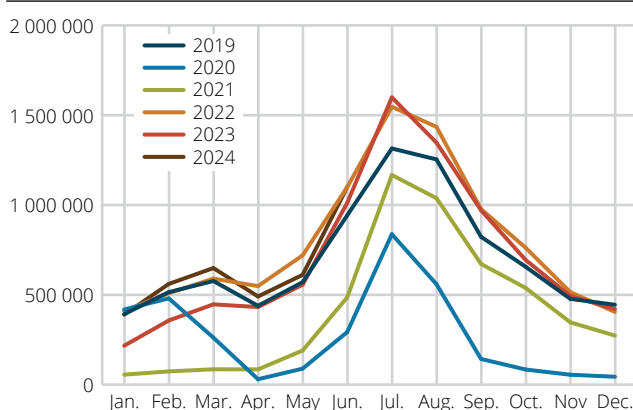
Source: Statistics Iceland, Table SAM01601

Figure 9.13. Domestic and foreign overnight stays in Iceland. 2016-2023



Source: Statistics Iceland, Table SAM01601

Figure 9.14. Seasonality in overnight stays in Iceland. 2019-2024



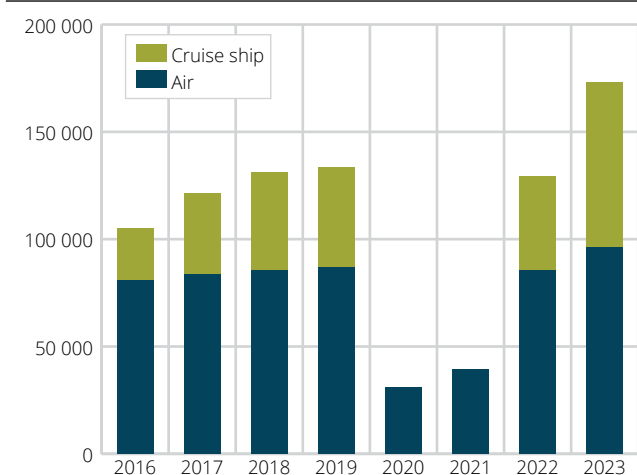
Source: Statistics Iceland, Table SAM01601

Greenland

Like Iceland, travelers access Greenland by sea or by air. Figure 9.15 shows the development in used transport mode since 2016. The increase in passenger numbers up to 2019 was clearly driven by cruise tourism. In 2023 the total number of arrivals on cruise ships increased by 64 per cent compared to the pre-pandemic peak in 2019. The corresponding increase for air travel was 10 per cent, largely attributable to poor infrastructure conducive to increasing passenger flows from air traffic. Realizing this, the airport in Nuuk - the capital of Greenland - has been the subject of massive renovation, including a new terminal and a longer runway capable of receiving aircraft directly from international destinations. Nuuk airport is scheduled to open in late 2024, and two new airports in the South of Greenland will open in 2026.²⁷ This will make Greenland more accessible by air, providing opportunities to grow the tourism industry in the future.

Visitors from Denmark are responsible for most overnight stays in Greenland, with a 37 per cent increase in 2023 compared to the pre-covid era. Figure 9.16 shows also that nationals from quite few countries stay in Greenland. With the exception of France, stays from all countries have increased post-pandemic, with the demand for overnight stays having a particularly large jump for Great Britain and the USA. Since the number of overnight visitors is closely connected to the number of air passengers arriving in Greenland, there is potential for growing the number of stays when the airport infrastructure improves, making a larger volume of passengers and more destinations possible.

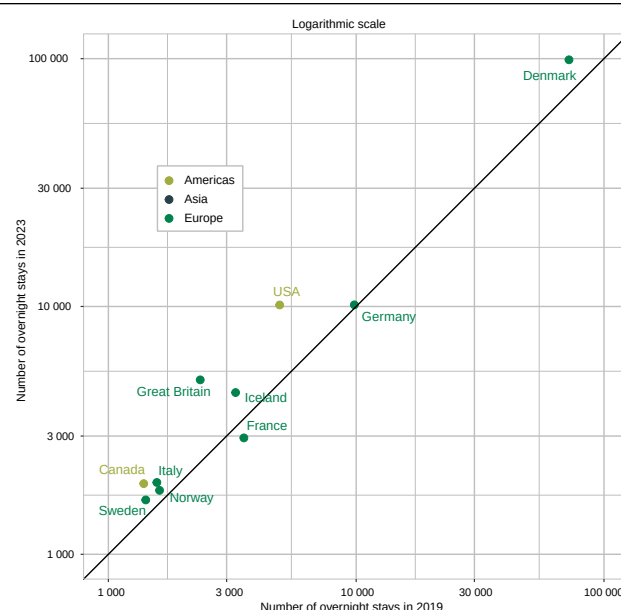
Figure 9.15. Number of passengers by air and cruise ship to Greenland. 2016-2023



¹ Missing values for cruise in 2020 and 2021.

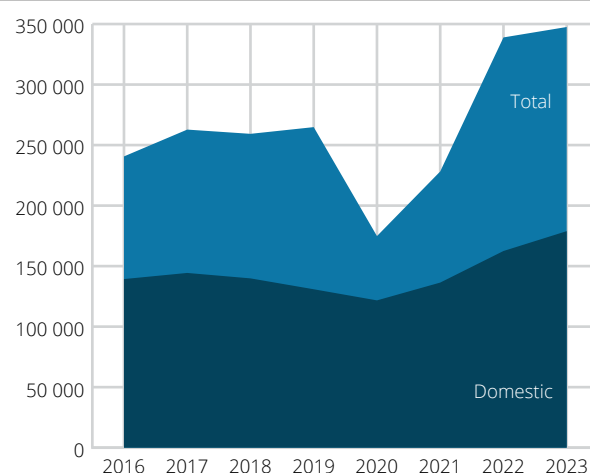
Source: Statistics Greenland, Table TUXKRP

Figure 9.16. Number of overnight stays by visitors in Greenland. 2019 and 2023



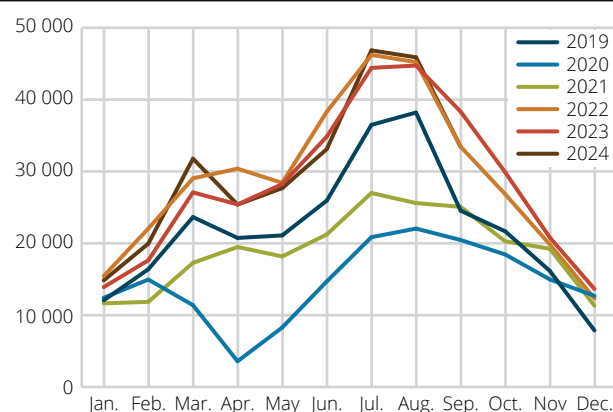
Source: Statistics Greenland, Table TUXHOT

Figure 9.17. Domestic and foreign overnight stays in Greenland. 2016-2023



Source: Statistics Greenland, Table TUXHOT

Figure 9.18. Seasonality in overnight stays in Greenland. 2019-2024



Source: Statistics Greenland, Table TUXHOT

The pattern of domestic and foreign tourism in Greenland is shown in Figure 9.17. Before the pandemic, the number of overnight stays by Greenlanders was in decline, with a strong recovery from 2021. There was a more rapid increase in foreign stays in 2021 and 2022, flattening out in 2023. The shares of overnight stays were spread equally between domestic and foreign travelers in both 2019 and 2023.

The seasonal pattern of overnight stays is stable in non-pandemic years (Figure 9.18). The post-pandemic years exhibit the same seasonal shape as 2019, shifted upwards due to more overnight stays. Summer is the most popular season, and the spring months also give a local peak.

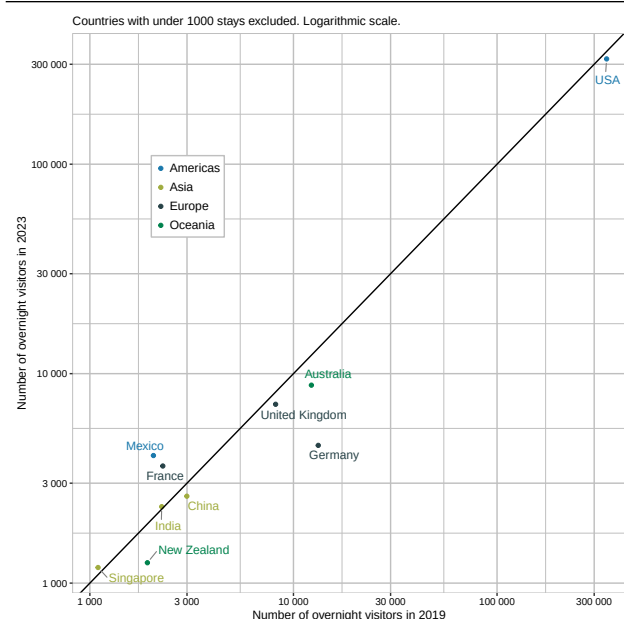
Arctic Canada

Detailed statistics are not readily available for the actual number of overnight stays in this region. To compare the development of international tourist flows pre- and post-covid, it is possible to look at the number of international visitors to Arctic Canada.²⁸ This is shown in Figure 9.19 for the largest foreign markets. Visitors from the US comprise the largest group, with little change in the number of visitors in 2019 and 2023. There were many visitors from Australia, United Kingdom and Germany in 2019, and none of these markets have fully recovered after the Covid-19 pandemic; the fall in travelers from Germany is particularly large. More visitors have been recorded in 2023 from some countries - such as France and Mexico - although these account for relatively few travelers in total.

Figure 9.20 shows that the post-covid recovery in Arctic Canada is being led by international visitors, in spite of the findings in Figure 9.19. The international market is much larger than the domestic one, and the rate of increase in international tourists to Arctic Canada has been larger than for domestic tourists since 2021.²⁹

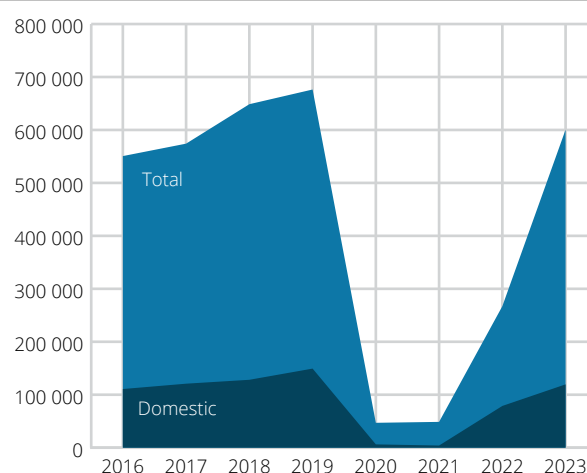
Figure 9.21 shows the seasonal pattern in overnight visitors to Arctic Canada.³⁰ A striking feature is that the number of visitors who stayed at least one night was much larger in 2019 than any of the following years. The flow of tourists to Arctic Canada has not fully recovered from the pandemic. Summer is a particularly important season and figures for 2022 and 2023 show that the number of visitors is increasing. However, data for 2024 indicate that

Figure 9.19. Number of overnight visitors to Arctic Canada. 2019 and 2023



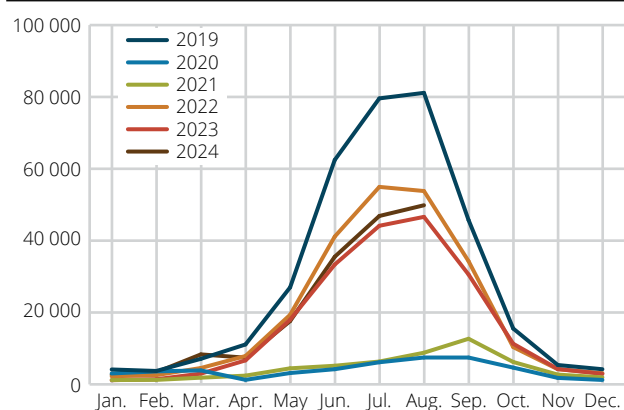
Source: Statistics Canada, Table 24-10-0050-01

Figure 9.20. Domestic and foreign overnight visitors in Arctic Canada. 2016-2023



Source: Statistics Canada, Table 24-10-0053-01

Figure 9.21. Seasonality in overnight visitors to Arctic Canada. 2019-2024



Source: Statistics Canada, Table 24-10-0053-01

the recovery has slowed, with the number of visitors falling compared to the previous year.

Whilst the number of visitors to Arctic Canada has not fully recovered from the pandemic, several initiatives have been taken to secure the future of the tourism industry. In 2022, the Government of Canada and the Government of Yukon announced joint funding of CAD 1.95M to the Yukon Elevate Tourism Program, to support tourism owners and operators in their transition to sustainable practices.³¹ In 2024, the Canadian Northern Economic Development Agency (CanNor) announced a funding initiative of nearly 800,000 CAD aimed at supporting seven key tourism projects in Yukon. These initiatives focus on offering new programs, expanding infrastructure, improving accessibility, and promoting eco-friendly solutions.³² The NWT Tourism 2025: Roadmap to recovery outlines similar aims,³³ while Travel Nunavut seeks to grow its tourism industry to CAD 1B by 2030.³⁴

Arctic US: Alaska

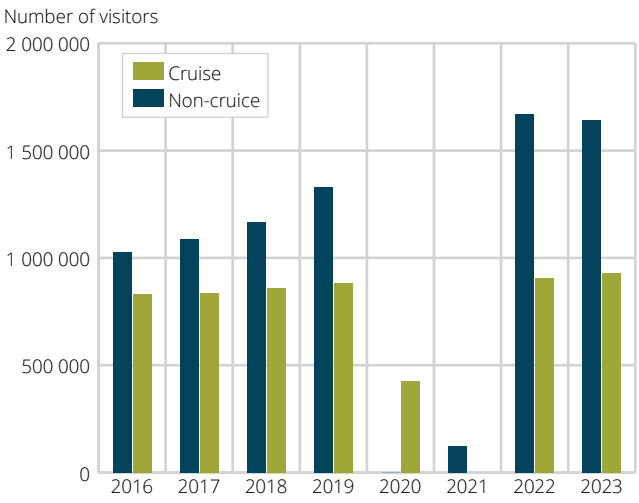
Alaska is characterized by several key destinations. Southeast Alaska is often referred to as a maritime wonderland, with state capital Juneau drawing many visitors, alongside Skagway and Ketchikan. These towns provide unique experiences, ranging from breathtaking glaciers to cultural attractions like totem pole parks. Located just south of Anchorage, the Kenai Peninsula is celebrated for its accessibility and diverse outdoor activities. Popular destinations include Seward, a gateway to Kenai Fjords National Park, and Homer, known as the “Halibut Fishing Capital of the World.” The region offers world-class fishing, hiking trails, and stunning wildlife viewing opportunities. Interior Alaska is defined by its central locations, Fairbanks and Denali National Park. Denali National Park, home to North America’s highest peak, draws nature lovers and adventurers, while Fairbanks offers a vibrant arts scene and opportunities for viewing the Northern Lights.

The Alaska Travel Industry Association views tourism as a renewable natural resource, documenting a total economic impact to Alaska of USD 5.6 billion in 2022-23, supporting 48 000 jobs in 2023 and generating over USD 157 million in revenue to the State of Alaska in 2023 through permits, fees, tickets, and taxes.³⁵

Figure 9.22 shows that the total number of visitors to Alaska has increased post-pandemic, although, mainly due to a large expansion in cruise traffic. Indeed, 2022 was a record-setting year for the number of cruise visitors. Nome welcomed its largest cruise ship in history during the summer of 2024, with around 1700 passengers arriving on The MS Westerdam.³⁶

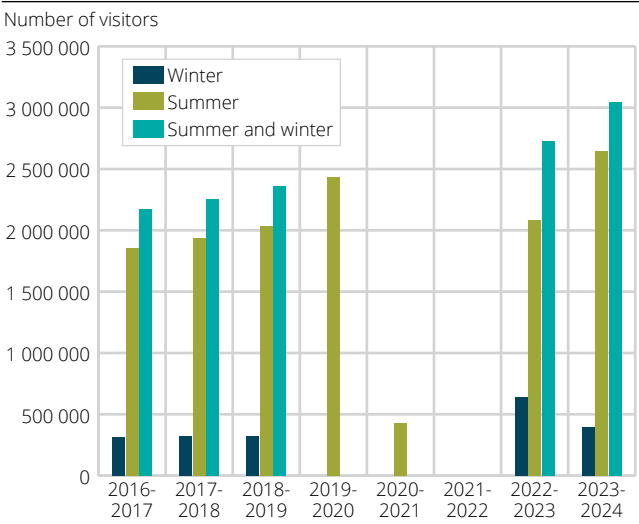
Figure 9.23 divides visitors between the summer and winter seasons for fiscal years (from 1st October to 30th September), showing the importance of the summer season for tourism in Alaska. Visit Anchorage correctly predicted a tourist boom in 2023 compared to previous years, and its vision

Figure 9.22. Summer visitors to Alaska. 2016-2023



¹ Visitor numbers for cruise (2020) is reported as zero, and non-cruise (2021) is not available.
Source: Alaska Travel Industry Association, McKinley Group

Figure 9.23. Visitors to Alaska, fiscal years (1st October to 30th September) 2016-17 to 2023-24



¹ Some data are missing.
Source: McKinley and Alaska Travel Industry Association

of increased winter tourism has materialized for 2022-23 but faltered in 2023-24 according to Figure 9.23.³⁷ Based on this, we cannot yet conclude that Alaska is transitioning to a year-round destination for travelers.

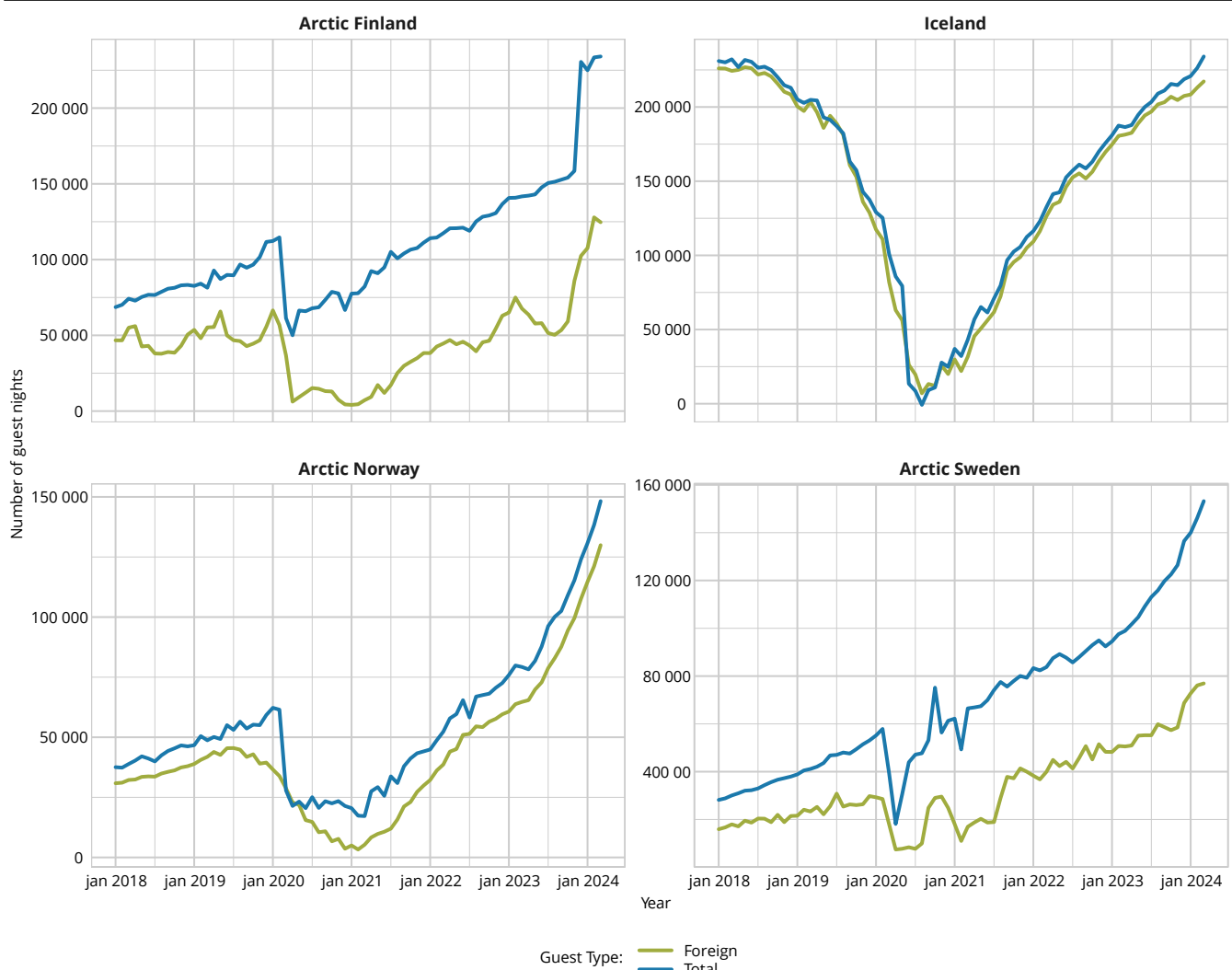
Airbnb and other collaborative platforms

Online collaborative platforms such as Airbnb have grown in prominence as providers of accommodation to tourists across the Arctic as many other places. Eurostat produces experimental statistics on guest nights in Iceland and the Arctic regions of Finland, Norway and Sweden. Figure 9.24 shows the development of guest stays in this type of accommodation from 2018, divided between foreign and domestic stays. The most striking feature is the fact that Icelanders account for few of the guest nights in Iceland, causing near cessation of this type of rental at the beginning of the Covid-pandemic. Recovery in Iceland has of course been led

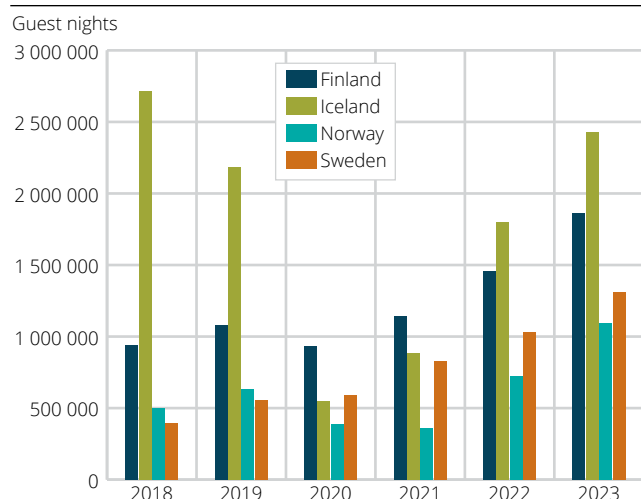
by foreigners in this market, whereas the growth in domestic and foreign stays in Airbnb accommodation has been similar in the three other regions, post-Covid. Arctic Norway has more reliance on foreign visitors than Arctic Sweden and Finland.

Annual figures for total guest stays through online collaborative platforms are depicted in Figure 9.25. Iceland was an early leader in terms of volume in this market, with over 2.7 million guest nights registered in 2018. Finland is rapidly catching up to the Icelandic level in the post-Covid era, whilst Arctic Sweden has overtaken Arctic Norway in terms of night stays organized through online collaborative platforms. This type of accommodation is increasing in all four destinations post-Covid and, with exception of Island, continuing the trend from pre-Covid. In Iceland the total guest stays in 2023 was still not back to the peak year 2018 although higher than in 2019.

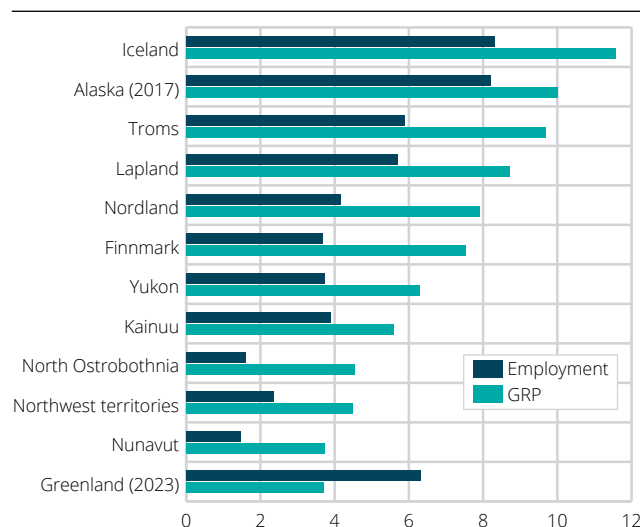
Figure 9.24. Guest nights offered via collaborative platforms. Monthly from Jan 2018. Seasonally adjusted



Source: Eurostat

Figure 9.25. Annual guest nights via online collaborative platforms. Arctic regions. 2018-2023

Source: Eurostat

Figure 9.26. Share of tourism in gross regional product (GRP) and employment for Arctic regions. 2019 unless otherwise stated

Source: Statistics Norway, Ministry of Economic Affairs and Employment Finland, Visit Finland, Rambøll, Statistics Iceland, Statistics Canada, Alaska Travel Industry Association

Final remarks

Figure 9.26 summarizes the economic impact that tourism had on the regions in the Arctic in 2019.³⁸ This year is chosen for comparison for two reasons. First, data is available for most of the regions we have studied, and second, the arctic areas have recovered at different rates from the pandemic, so that 2019 gives a fair comparison. Figures for the economic impact of tourism in Alaska have not been updated since 2017.

Iceland is heavily dependent on tourism, both in employment and as a creator of value. The tourism industry makes a large contribution to employment in all three countries that comprise Arctic Norway, as well as Lapland in Finland (including Rovaniemi, the home of Santa Claus) and Yukon. Troms and Lapland also experience a large contribution to gross regional product from the tourism industry. Tourism is also an important industry in Greenland, although the numbers reported here understate the total effect, since they measure contributions just from foreign tourism.

Figure 9.26 also tells us that the economy in some places is potentially much more vulnerable to negative shocks in demand as opposed to others. For Iceland and Alaska, on one end, the impact when tourism collapsed due to Covid, was substantially larger than for North Ostrabothnia and Nunavut on the other. As seen throughout this chapter, different places have also differed in terms of their ability to mitigate the negative impact through

substituting international and long-haul visitors with domestic and short travel visitors. Another aspect increasing vulnerability is related to the dependence on cruise ships as travel mode. Travel by road to Iceland, Greenland and even Alaska, may not be feasible, but developing the infrastructure for travel by air as now done in Greenland may be an interesting strategy in order to increase resilience in the future.

Notes

¹ We have received excellent assistance from Daniel Fabio Groth and Daniel Johannessen in preparing this chapter. Errors and oversights are our own.

² As documented in ECONOR IV for example.

³ See Glossary of tourism terms, <https://www.unwto.org/glossary-tourism-terms>

⁴ International Recommendations for Tourism Statistics, 2008, <https://www.unwto.org/tourism-statistics/on-basic-tourism-statistics-irts-2008>, Tourism Satellite Account, 2008, https://unstats.un.org/unsd/publication/Seriesf/SeriesF_80rev1e.pdf

⁵ Statistical Framework for Measuring the Sustainability of Tourism (2024), https://unstats.un.org/UNSDWebsite/statcom/session_55/documents/BG-4a-SF-MST-E.pdf

⁶ UN has had a long-standing focus on the sustainability, as evidenced by Making Tourism More Sustainable: A Guide for Policy Makers (2005), https://wedocs.unep.org/bitstream/handle/20.500.11822/8741/-Making%20Tourism%20More%20Sustainable_%20A%20Guide%20for%20Policy%20Makers-2005445.pdf?sequence=3&isAllowed=A A unified statistical framework has, however, not been available for measuring sustainability until recently.

⁷ See Economist Intelligence Unit (27th March 2024), <https://www.eiu.com/n/in-charts-chinas-outbound-tourism-in-2024/> The article further claims that many Chinese have substituted cheaper domestic for foreign travel, since the pandemic

- reduced household income drastically, the Chinese currency has depreciated, and the lack of long-haul flights has increased their price. Complicated visa-applications and geopolitical tensions in Europe have also affected the intention of Chinese travelers to visit Europe.
- ⁸ Based on Figure 3.1 in *Tourism Satellite Account: Recommended Methodological Framework 2008*, United Nations Department of Economic and Social Affairs.
- ⁹ The Arctic strategy of the USA, <https://bidenwhitehouse.archives.gov/wp-content/uploads/2022/10/National-Strategy-for-the-Arctic-Region.pdf>, October 2022, mentions tourism only once, apparently delegating responsibility for these policies to the state of Alaska.
- ¹⁰ The Strategic Road Map for Sweden's Arctic Destinations Towards 2030, https://www.swedishlaplandvisitorsboard.com/wp-content/uploads/2024/05/RBS-2030-2405_ENG.pdf
- ¹¹ Paraphrased from Swedish.
- ¹² Quoted on 16th July 2024 at <https://paxex.aero/greenland-new-airport-tourism-boom/>
- ¹³ "Avinor says that the pain threshold is reached: Does not want more tourists to Tromsø", https://www.nrk.no/tromsogfinnmark/avinor-mener-smertegrensa-er-nadd_vil-ikke-ha-flere-turister-til-tromso-1.17038530, NRK 15th September 2024 (in Norwegian).
- ¹⁴ Such as the strategy of the counties of Troms and Finnmark in North Norway, 2023-2032: "Creating powerful experiences together." https://www.tromsfylke.no/_f/p1/i44eec3eb-023e-4637-9e51-9a3982095d4d/sammen-om-a-skape-sterke-opplevelser-reiselivsstrategi-troms-og-finnmark-2023-2032.PDF
- ¹⁵ <https://visitarcticeurope.com/about-aetc/>
- ¹⁶ <https://tem.fi/en/finlands-strategy-for-the-arctic-region>
- ¹⁷ This document contains tourism strategy for the Arctic region of Finland.
- ¹⁸ Troms and Finnmark were merged into one county from 1st January 2020 to 31st December 2023, and then split again.
- ¹⁹ All figures that compare overnight stays in 2019 and 2023 are drawn on a logarithmic scale. The actual number of stays is represented by each data point but the axes are stretched in order to improve readability. The vertical distance of a data point to the diagonal represents the relative (percentage) change in the number of overnight stays between 2019 and 2023. In the figure for Arctic Norway, for example, Poland and Switzerland are the same vertical distance from the diagonal; this means that the percentage change in overnight stays in Arctic Norway has been the same for visitors from these two countries from 2019 to 2023.
- ²⁰ See page 26 in Wiederstrøm Hotel Consulting, https://drive.google.com/file/d/1MfihrmP74XJ2R2_rS203FzCZ0We5acnr/view (in Norwegian).
- ²¹ See Visit Levi, <https://www.levi.fi/en/info/visit-levi/>
- ²² See Santa Claus Village, <https://santaclausvillage.info/>
- ²³ See Finavia, <https://www.finavia.fi/en/newsroom/2024/statistics-growth-passenger-numbers-finavia-airports-continues-steadily-finland?navref=liftup>
- ²⁴ Barents Observer, 7th July 2023, <https://thebarentsobserver.com/en/travel/2023/07/next-winter-seasons-will-see-35-direct-international-flights-rovaniemi-and-tromso>
- ²⁵ See Cruise passenger survey - Reykjavik 2023, <https://www.rmfi.is/en/moya/page/cruise-passenger-survey-reykjavik-2023>
- ²⁶ See PLAY, <https://www.flyplay.com/en/news/local-share-and-passenger-numbers-increase>
- ²⁷ Visit Greenland, <https://visitgreenland.com/articles/new-flight-schedule-makes-greenland-more-accessible/>
- ²⁸ Following Müller (2015) the number of border crossings can be multiplied by five in order to approximate the number of overnight stays. According to Yukon Sustainable Tourism Report 2022, <https://yukon.ca/sites/yukon.ca/files/tc/tc-yukon-sustainable-tourism-2022-annual-report.pdf>, Table 6, the average length of stay in Yukon across all visitor types is 4.3 nights in 2017-18, making this approximation acceptable. Figure 9.19 gives the actual number of international visitors, not the estimated number of stays.
- ²⁹ This could be due to the measurement of tourists in the data set. Statistics Canada registers entry to Arctic Canada by Canadians and foreigners, distinguishing between tourists who stay at least one night and same-day travelers. Our data reports those that stay at least one night. The number of visitors can be multiplied by five to approximate the number of overnight stays. This does not give a full picture of domestic tourism, since overnight stays by Canadians who do not cross the border are omitted. We do not have data for these travelers.
- ³⁰ These data contain both foreigners and Canadians that are registered as tourists.
- ³¹ Press release, May 27, 2022, Canadian Northern Development Agency, <https://www.canada.ca/en/northern-economic-development/news/2022/05/government-of-canada-and-the-government-of-yukon-invest-195m-to-support-yukon-tourism-sector-as-it-adapts-and-grows-beyond-the-pandemic.html>.
- ³² Press release, June 26, 2024, Canadian Northern Development Agency, <https://www.canada.ca/en/northern-economic-development/news/2024/06/mp-hanley-announces-an-investment-supporting-the-diversification-and-growth-of-yukons-tourism-industry.html>.
- ³³ https://www.iti.gov.nt.ca/sites/iti/files/tourism_2025_road-map_to_recovery_april_2021.pdf
- ³⁴ Nunatsiaq News, Nov 17, 2023, <https://nunatsiaq.com/stories/article/nunavut-tourism-could-be-1b-business-industry-officials-say/>
- ³⁵ See Alaska Travel Industry Association <https://www.alaskatourism.org/resources/tourism-works-for-alaska>,
- ³⁶ The Nome Nugget, May 10, 2024, <http://www.nomenugget.com/news/nome-prepares-biggest-cruise-ship-visit-ever-next-month>.
- ³⁷ Alaska's News Source, February 3, 2023. <https://www.alaskasnewssource.com/2023/02/03/tourism-boom-projected-anchor-age/>
- ³⁸ Data at the regional level are not available for Arctic Sweden. The data for Greenland cover different years and measures the impact of foreign tourism only. We have chosen to report this since data on tourism's economic impact have not been freely available previously. The economic contribution of foreign tourism has been calculated by Rambøll, https://tourismstat.gl/wp-content/uploads/2024/04/FINAL_Den-Okonomiske-betydning-af-Udenlandsk-Turisme-i-Gronland.pdf (in Danish), whilst the latest available figures from Statistics Greenland for Gross Domestic Product is 2021 and total employment is 2022.

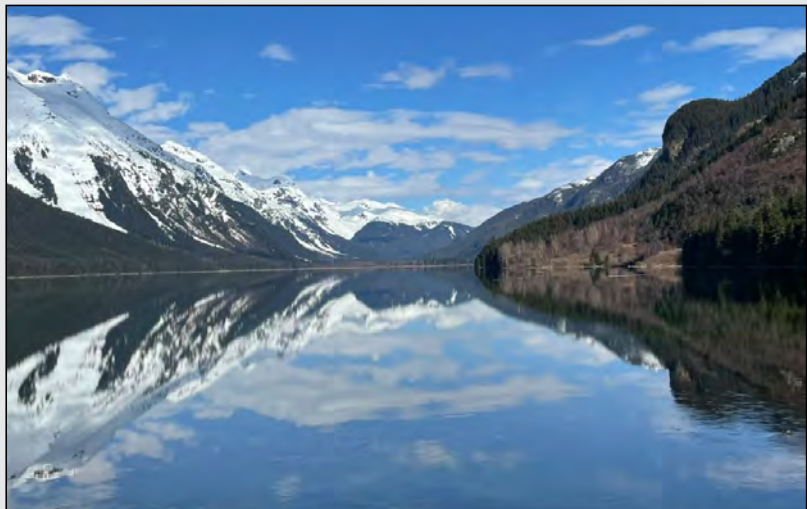
Highlight 9.1. Regulation of tourism in the Arctic

The governance of Arctic tourism involves a multilevel approach, where local, national, and international entities collaborate to address complex environmental and social issues. Increasing visitor numbers, and a desire to regain markets after the COVID-19 pandemic give the impression that policymakers prioritize growth over environmental protection and the interests of the local communities.

Several countries have experienced a backlash against streams of tourists that have put a strain on local infrastructure, including housing for local residents. Many housing units are now being offered over collaborative platforms such as Airbnb. In Rovaniemi, Finland, a public demonstration in 2024 expressed the sentiment against short-term rental accommodation with slogans such as “Homes for residents, hotels for tourists”, and “Secret hotels jeopardize housing security”, and banners calling for sustainable tourism (Lapin Kansa, 06.09.24). In Finland, some large towns have issued guidelines as to when a residential dwelling becomes vacation accommodation (requiring a permit), but the local government in Rovaniemi has had a relaxed attitude to the regulation of short-term rental property. The Finnish government is planning to introduce legislation at the national level in 2025, however.¹

In the second quarter of 2022, the Alaska Department of Labor and Workforce Development noted a significant increase in short term vacation rentals in Anchorage, Mat-Su, Kenai, Fairbanks, Juneau, Kodiak and Sitka.² In Sitka, about 3.5 per cent of the housing stock was being used for short-term let, leading to the Sitka Assembly passing a rule requiring owners to live on the same property for at least six months a year in order to secure a short-term rental permit.³ In Arctic Canada, short-term rental is most tightly regulated in Iqaluit (Nunavut), where a license has been required since 2018, and only rental in the owner's primary residence are allowed for a maximum of 180 nights per year. A license to let short-term has been required in Yellowknife (Northwest Territories) since 2022, whereas no restrictions are in place in Yukon.⁴

In May 2024, the government of Iceland introduced a law limiting the scope to rent out residential housing on the short-term rental market to 90 days a year and 2 million ISK (USD 14300).⁵



Chilkoot Lake, Alaska. Photo: Davin Holen

On January 1st 2024, the government of Iceland introduced a tourism tax where hotel guests pay around 600 ISK (USD 4.30) per night per stay; half this amount is charged for stays at campsites, and 1000 ISK (USD 7.20) for overnight stays for cruise ships. Forbes reports that the Icelandic Prime Minister Bjarni Benediktsson is considering using the tax dynamically in order to combat excessive tourism in the busiest season.⁶ Sweden does not currently have a tourist tax, but a “visitors’ contribution” has been suggested by the government of Norway, consisting of a levy of up to 5 per cent per overnight stay at both commercial and private accommodation; a tax on cruise traffic is still being considered. The duty will accrue to local municipalities, and should be earmarked for use in establishing and maintaining tourism infrastructure.⁷

The Alaska State Legislature is considering adopting a state-wide 6 per cent bed tax on all room rental under 30 days duration.⁸ Several towns have implemented a local bed or room tax (for example, Adlak at 5 per cent, Nome at 6 per cent and Anchorage at 12 per cent). Arctic Canada has no hotel tax or levy.⁹

A new cruise tax was introduced in Greenland in January 2024 with an extra 50 DKK per passenger being added to the existing 1.10 DKK per gross ton. Local communities decide how the tax revenue is to be spent.¹⁰ Airport taxes are also charged in Greenland, depending on route, as a subsidy for the operation of airports.¹¹

¹ Finnish cities to start requiring permits for ‘professional’ Airbnb hosts, YLE, 29th May 2023.

² Alaska Economic Trends, September 2022.

³ Reported in KTOO, 16th September 2022

⁴ See A.I. Cameron and L.M. Tedds, “The State of Short-Term Rental Regulation in Canada”, October 2023.

⁵ Iceland Review, 4th May 2024.

⁶ Iceland Mulls Dynamic Pricing for its Tourist Tax, Forbes 18th June 2024.

⁷ The government wants to allow municipalities to introduce a visitor contribution, press release from Department of Industry and Fisheries, 19th November 2024 (in Norwegian).

⁸ House Bill 220, The Alaska State Legislature.

⁹ Tour guide Canada - Taxes in Canada.

¹⁰ Greenland Implements New Port and Cruise Passenger Taxes Effective January 1, 2024, North Atlantic Agency, 22nd November 2023

¹¹ See Air Greenland.

Highlight 9.2. Tourism in Sámi areas – features and challenges

Arvid Viken

Sámi tourism is used as term for tourists visiting Sápmi, the traditional homeland of the Sámi people, an area covering northern parts of Finland, Norway, Russia and Sweden. About 100 000 people are considered as Sámi, most of them living in Norway. Although most Sámi today have jobs in modern society and live accordingly, their culture rests on strong nature-based traditions that tend to be presented to tourists. Reindeer herding is the most prominent carrier of the nature-based culture. Although less than 10 per cent of the Sámi are involved in reindeer herding it is still a major carrier and marker of the culture, and as foundation for Sámi culture it is the basis for legislation on Sámi rights in Norway.

The economic dimensions of Sámi tourism are unknown. There is, however, an increasing number of tourism companies owned by Sámi, and their culture is part of the experience that almost all tourism providers offer. Thus, most tourists will encounter Sámi culture during their stay in the Arctic, but its value is almost impossible to estimate. What we can stipulate, is that if there are 500 000 tourists (approximately 300 000 visitors to North Cape alone), each paying 1 000 NOK for Sámi services (experiences, food and souvenirs), it represents an activity amounting to half a billion NOK per year. Sámi tourism is without doubt an important part of a multi-billion industry in Sápmi and in the Arctic, providing a significant number of jobs.¹

This industry is dominated by national and international companies, implying that a major part of the revenue from Sámi tourism accrues to companies outside Sápmi. Thus, promoting tourism is often perceived as losing local autonomy. On the other hand, without these companies, the industry might have been less profitable. This illustrates that there are a series of issues, some of them seriously challenging, related to Sámi tourism, many of them documented and discussed in the tourism literature.

The first issue is that we do not really know the volume or values of Sámi tourism for the region or for the Sámi community. What we know is that there are many providers all over the Sámi area, and the number is increasing. For instance, in Tromsø, a major hub for visitors and important Sámi town, there are about 20 companies offering so-called Sámi experiences, often combined with a northern lights safari.

A second issue is that this tourism does not occupy an independent position, being in many ways handled as an extension or a part of Norwegian tourism authorities or tourism organizations, (such as Nordnorsk Reiseliv - North Norway Travel Association), often as a marginal undertaking.² However, there have been a

series of dedicated projects seeking to deal with the issue, but no Sámi tourism board or destination company has been established. A side effect of this is that there is a lack of statistics concerning Sámi tourism.

A third issue is whether or to what degree the Sámi society wants to promote tourism. Is this an industry that will help to sustain the culture? Tourism is international or global and is a tremendous modernizing and culturally standardizing force. A common feature of adapting the culture to tourism is the tendency to change it to a bigger, more profitable, or spectacular venture; this has also been observed for Sámi tourism.³ A related issue is the role of tourism in cultural appropriation. This occurs when actors outside of the culture profit by presenting (Sámi) cultural remedies or markers in ways that hurt or offend people from the culture.⁴

A fourth aspect of Sámi tourism is its relation to the historic oppression of the Sámi people. Until about 1970, the Norwegian state aimed to banish the Sámi culture by assimilating it into the Norwegian culture. As part of this, the Sámi were patronized and harassed, and even today they experience discrimination due to their heritage. Many tourists think that the Sámi are a less modern people, still mostly living in traditional ways, even in tents.⁵ Several research projects have provided evidence of the tendency of majority society, including tourism, to define the Sámi as the 'other'. Viken, Hoeckert, and Greenwood assert that all forms of tourism have a responsibility to counter such tendencies.⁶

However, the Sámi society consists both of an ordinary, modern society, and the traditions of Sámi reindeer herding and other nature-based activities; neither are a showcase for tourism. An unwanted consequence of tourism is the tendency to exoticize or commercialize Indigenous Peoples. This challenge highlights the need to treat the Sámi, and Indigenous cultures in general, in a more sensitive and respectful manner.

There is currently a positive momentum to increase Sámi tourism, but this also brings challenges. The most important is how to engage with tourism without losing control of the cultural aspects. Therefore, there is a need for better systems to discuss, assess and evaluate Sámi tourism, in order to support a robust and future-oriented Sámi tourism as part of Sámi society.

¹ Müller, D. & Hoppstadius, F. (2017). Sami tourism at the crossroads: Globalization as a challenge for business, environment and culture in Swedish Sápmi. In Viken, A. & Müller, D. (eds.) *Tourism and indigeneity in the Arctic* (pp. 71-86). Channel View Publications.

² Viken, A. (2016). Viken, A.: *Reiseliv i samiske områder – nyliberalisme og marginalisering?* I Angell, E., Eikeland, S. & Selle, P. (red.) *Nordområdene i endring. Urfolkspolitikk og utvikling* (pp. 235-257). Gyldendal akademisk.

³ Müller, D. & Pettersson, R. & (2005). What and where is the indigenous at an indigenous festival?: observations from the winter festival in Jokkmokk, Sweden. In Michelle Aicken, M. & Ryan, C. (eds.) *Indigenous Tourism* (pp. 201-218). Routledge. Viken, A. (1997). *Sameland tilpasset turistblikket*. I Jacobsen, J. K. & Viken, A. (eds.) *Turisme. Fenomen og næring* (pp. 174-182). Universitetsforlaget.

⁴ Viken, A. (2024). *Tourism Appropriation: "Taking" land and culture in Sámi areas*. In Butler, D. & Carr, A. (eds.) *The Routledge handbook of tourism and indigenous peoples* (250-261). Routledge.

⁵ Olsen, K. (2006). Making difference in a changing world: The Norwegian Sámi in the tourist industry. *Scandinavian Journal of Hospitality and Tourism*, 6, 54-66.

⁶ Viken, A., Höckert, E. & Grimwood, B. S. R. (2021) Cultural sensitivity: Engaging difference in tourism. *Annals of Tourism Research*, 89, 103223.

Highlight 9.3. The Contaminating Effects of Tourism in Sámi Sacred Sites: A Case of Culturally Sensitive Tourism in Sápmi

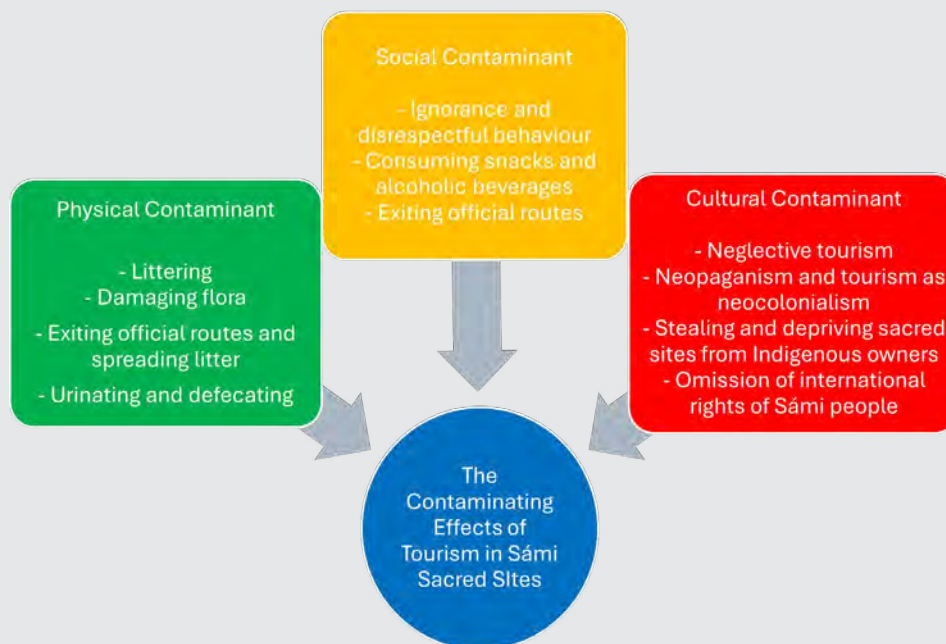
Eleonora Alariesto

Indigenous lands are sacred and hold various cosmologies and worldviews. Actively used landscapes include Sámi sacred sites, sieidis in Northern Sámi, where deep spiritual connections, nature and culture weave together as a relational network with the tangible and intangible dimensions of Sámi landscape¹. Landscapes and sacred sites are also typically ecologically diverse while simultaneously preserving community identities and connection to land.² Sacred sites are thus an essential element of Sámi cultural heritage and are also culturally, historically and archeologically significant places which hold great value maintaining spiritual connections to ancestors, generational stories, livelihoods, traditions and beliefs.³ As sieidis function as gateways or portals to other worlds, the communication with ancestors and spirits of nature is based on reciprocal respect and modesty, and holds the worldview of not taking more than one needs. Even if sacred

sites are no longer in active use, they are respected and considered meaningful to individual and collective Sámi identities.⁴ Offerings and negotiations with sacred sites still, as previously, represent the holistic and relational being with one's environment and landscape. These traditional relations are visible in everyday lives and cosmologies.⁵ And so, the question of protecting sacred sites is also a question of protecting a balance with the environment.⁶

As tourism is one of the fastest growing industries in Sápmi⁷, the rapid growth also accelerates environmental and socio-cultural impacts at sacred sites and areas. When tourism overflows sacred places, their very sacredness itself is endangered. It is a widely held belief that disturbing or treating powerful sacred places with disrespect or ignoring customs related to the sites can lead to bad luck or even lethal conse-

Figure 1. The Contaminating Effects of Tourism in Sámi Sacred Sites (Alariesto, 2021)



¹ Heinämäki, L., & Herrmann, T. M. (2017). Experiencing and protecting sacred natural sites of Sámi and other indigenous peoples: The Sacred Arctic. Springer.

² Heinämäki, L., & Herrmann, T. M. (2017). Experiencing and protecting sacred natural sites of Sámi and other indigenous peoples: The Sacred Arctic. Springer.

³ Ojanlatva, E. & Neumann, A. (2017). Protecting the sacred in the Finnish Sápmi: Setting and Challenges. In L. Heinämäki & T.M. Herrmann (Eds.), Experiencing and protecting sacred natural sites of Sámi and other indigenous peoples: The Sacred Arctic (pp. 83–98). Springer; Kuokkanen, R. & M, Bulmer. (2006). Suttasája: From a Sacred Sámi Site and Natural Spring to a Water Bottling Plant? The Effects of Colonization in Northern Europe. In S. Hood Washington, P. Rosier & H. Goodall, Echoes from the poisoned well: Global memories of environmental injustice. Lexington Books.

⁴ Äikäs, T. (2011). Rantakiviltä tuntureille: Pyhät paikat saamelaiden rituaalisessa maisemassa. Pohjois-Suomen historiallinen yhdistys.

⁵ Heinämäki, L., & Herrmann, T. M. (2017). Experiencing and protecting sacred natural sites of Sámi and other indigenous peoples: The Sacred Arctic. Springer.

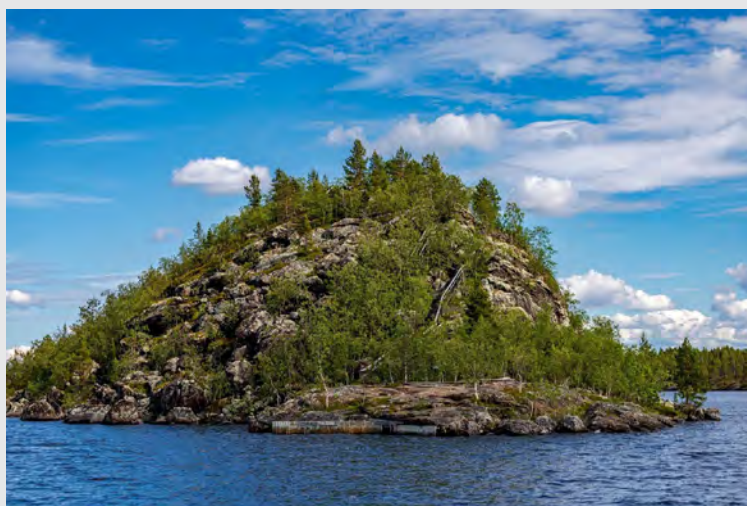
⁶ Heinämäki, L., & Herrmann, T. M. (2017). Experiencing and protecting sacred natural sites of Sámi and other indigenous peoples: The Sacred Arctic. Springer.

⁷ House of Lapland. (2024). Industry Brief: Tourism. House of Lapland.

quences, and cause imbalances in relationality based cultural landscapes.⁸ With sacred places, or in general in Sápmi, when various elements of Sámi cultures are in key positions in tourism businesses, culturally sensitive approaches need to be included in the methods of performing tourism activities.⁹

A valuable example of adapting cultural sensitivity in tourism activities on Indigenous land comes from Anár, at the Finnish side of Sápmi. In 2019 archeologist Eeva-Kristiina Nylander and Inari Sámi ecologist Inka Musta published an opinion piece¹⁰ in the most widespread print media of Finland, *Helsingin Sanomat*, about the generational values of Sámi sacred sites – particularly Äijih, Ukko's Rock in Inari Sámi, at Lake Inari. Nylander and Musta suggested that the same preservation process should be applied there as for Uluru, the sacred rock of the Aboriginal People. After the publication of the piece, various local tourism entrepreneurs one by one announced their decision to stop landing on the sacred rock due to the wishes of the Sámi community in Inari. Not long after the announcements, *Metsähallitus* (Finnish Forest and Park Services) also made the decision to dismantle tourism infrastructure built on the rock, such as a concrete dock and wooden stairs.

Up until the point of local entrepreneurs deciding to stop landing on the rock and *Metsähallitus* deciding to dismantle built infrastructure, the sacred site of Äijih had already been contaminated by the effects of tourism on the island. In 2021 I examined the different forms of contaminant on Äijih in my research "The Conflict of Sacred and Contaminant: The Impurifying Effects of Tourism in Sámi Sacred Sites"¹¹. The research categorized contaminant in three dimensions: 1) Physical, 2) Social and 3) Cultural Dimension (figure 1). Physical dimension includes littering, damaging flora, straying away from official routes and thus spreading litter, and urinating and defecating on the sacred rock. Social dimension contains ignorant and disrespectful behavior, consuming snacks and alcoholic beverages and also exiting official routes. Cultural contaminant comprises neglective tourism ignoring the very sacredness of the rock, neopaganism and tourism as forms of neocolonialism, stealing and depriving sacred sites from traditional Indigenous rightsholders and disregarding international rights of Sámi people.



Äijih (Ukonkivi, Ukko's Rock) at Lake Inari.
Picture: Ninara, Flickr

The contaminating effects of tourism in Sámi sacred sites is in its core a land-use conflict between stakeholders and rightsholders. Thus, the example of Äijih represents a valuable instance of tourism stakeholders expressing respect to the voices and concerns of the local Sámi community. On a larger scale, land-use conflicts in Sápmi are at their root a conflict about different worldviews and a clash of different cosmologies and ways of knowing. The example of Äijih functions as a portal to a much deeper conflict, which is the assimilation of Sámi cultural landscape, languages, livelihoods, traditional ways of life and the threat to existence itself caused by extractive activities and in particular, modern green colonialism¹². Extractive projects in Sápmi, such as mining and wind industry, as well as increasing tourism, transform Sámi cultural environments, reindeer pastures, and sacred sites and landscapes into Green Sacrifice Zones¹³, where the cumulative effects of extractive land-use sacrifice vital and sustainable Sámi ways of life to the global pressure for energy transition and the contaminating effects of tourism. A major example of this conflict is the energy company St1's development plant to build a massive wind industry plant Dávvi in the sacred Rásttigáisá mountain area, which is the topic of my now ongoing research.

⁸ Heinämäki, L., & Herrmann, T. M. (2017). *Experiencing and protecting sacred natural sites of Sámi and other indigenous peoples: The Sacred Arctic*. Springer.

⁹ Kugapi, O., Höckert, E., Lüthje, M., Mazzullo, N., Saari, R., koulutusinstituutti, M. t. j., & Institute, M. T. (2019). *Kohti kulttuurisensitiivistä matkailua: Suomen Lappi*. Lapin yliopisto.

¹⁰ Nylander, E & Musta, I. (2019, October 28.) *Myös Suomessa tulee kunnioittaa alkuperäiskansan pyhiä paikkoja*. *Helsingin Sanomat*.

¹¹ Alariesto, E. (2021). The conflict of sacred and contaminant: The impurifying effects of tourism in Sámi sacred sites. *Matkailututkimus (Verkkoaineisto)*, 17(1), 64-70.

¹² B, Kårtveit. (2022). Green colonialism: The story of wind power in Sápmi. In R, Sørly, T, Khaye & B, Kårtveit (Eds.), *Stories of Change and Sustainability in the Arctic Regions: The Interdependence of Local and Global*. Routledge.

¹³ Össbo, Å. (2023). *Back to Square One. Green Sacrifice Zones in Sápmi and Swedish Policy Responses to Energy Emergencies*. *Arctic review on law and politics*, 14, 112-134.



Svalbard. Photo: Colourbox

Highlight 9.4. Social media hot spots in the Arctic

A significant challenge in planning and managing sustainable tourism growth in the Arctic is the difficulty of mapping where tourists go and how they interact with landscapes and ecosystems due to the scarcity of spatial visitation data in the region. While hotel stay statistics provide a partial view of tourism activity in the Arctic, data on tourists' day-time movements and activities is rarely collected. Social media offers an alternative source of information on tourist visitation patterns.

Geocoded data from Flickr, an image and video hosting service, has been shown to correlate well with visitor statistics at various scales. Consequently, we extracted geotagged and publicly shared photo metadata for 65,000 photos from Flickr (www.flickr.com) taken in the Arctic regions—Alaska, Yukon, Northwest Territories, Nunavut, Greenland, Iceland, Northern Sweden, Northern Finland, Northern Norway, and Svalbard—between 2019 and 2023. The photo metadata included the location and date each photo was taken. See Figure 1.

Figure 1. Most photographed locations in the Arctic, 2019-2023



10. Cost of permafrost degradation and land use impacts of infrastructure development

Dmitry Streletskiy, Maryana Shnitser, Wilbert van Rooij, Philip Burgess, Isak Henrik Eira, Per Arild Garnåsjordet, Erik Engelen, Jørn Kristian Undelstvedt and Iulie Aslaksen

Cost of permafrost degradation

Dmitry Streletskiy and Maryana Shnitser

Permafrost regions cover almost 80 per cent of Alaska, 65 per cent of Russia, 50 per cent of Canada, and are also found in unglaciated mountain regions of Nordic countries. Permafrost affects all aspects of natural ecosystems as well as traditional and industrial economies through its impact on land use and development. It provides services such as natural refrigeration and better slope stability, but it also requires special consideration for buildings and structures at risk of damage or collapse if permafrost degrades. There are approximately 5 million people living in the Arctic Permafrost Circumpolar Region, of which 3.3 million people live in settlements where permafrost will degrade or disappear by 2050.¹

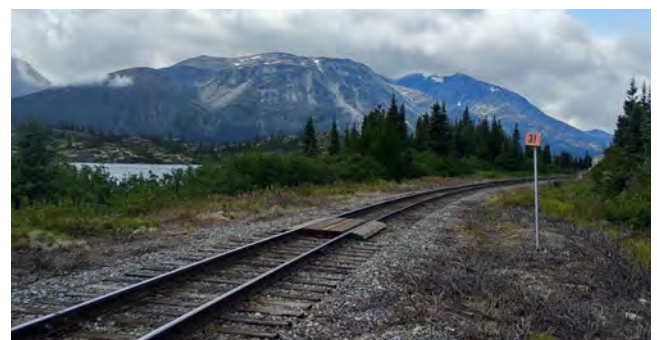
Recent studies have shown that the Arctic has been warming two to four times faster than the global average and the associated changes in warming, precipitation, vegetation properties, and hydrology are affecting permafrost temperature and mechanical strength.² Many observational sites located across the circumpolar Arctic reported an increase in permafrost temperature and an increase in active layer thickness.³ The active layer is the top layer of permafrost that is subject to thawing and refreezing on a yearly basis. Increases in permafrost temperature impact the ability of foundations to support buildings and structures and decrease slope stability in mountain regions promoting landslides. Progressive increases in active layer thickness in areas with ice-rich permafrost results in thaw consolidation and subsidence that negatively impacts linear infrastructure such as roads, railroads, utilidors and pipelines.⁴ Decreasing sea ice duration exposes Arctic coasts to wave activity and erosion making ice-rich permafrost coasts especially vulnerable.⁵ Recent estimates show that 30-50 per cent of critical circumpolar infrastructure

on permafrost is at risk by mid-century.⁶ Thousands of industrial and contaminated sites located on permafrost are exposed to risk of failure.⁷ Other threats associated with permafrost degradation are related to food security and emerging public health safety as mercury, radon, pathogens and viruses in permafrost may emerge.

The diverse risks of permafrost degradation were recently consolidated in the Arctic Permafrost Atlas which combined input from more than a hundred contributors, including scientists, Indigenous Peoples, local residents, and artists who live in permafrost regions.⁸ This multidisciplinary collaboration enabled the creation of graphic and storytelling material that translated permafrost knowledge into a comprehensive yet easily accessible format.

Circumpolar Arctic

While not all aspects of permafrost degradation can be directly evaluated in economic terms, several studies assessed direct costs of potential permafrost degradation on infrastructure at the circumpolar or regional scales. The latest, from 2023, circumpolar assessment of costs associated with permafrost degradation focused specifically on damage to roads, railways, airport runways, and buildings.⁹ It used an improved version of the permafrost-geotechnical model to examine the



White Pass railway in Yukon territory from the time of the «gold rush». Photo: Nadezhda Zamyatina/reprinted from ECONOR 2020.

Highlight 10.1. The Arctic Permafrost Atlas

Tiina Kurvits and Levi Westerveld, GRID-Arendal



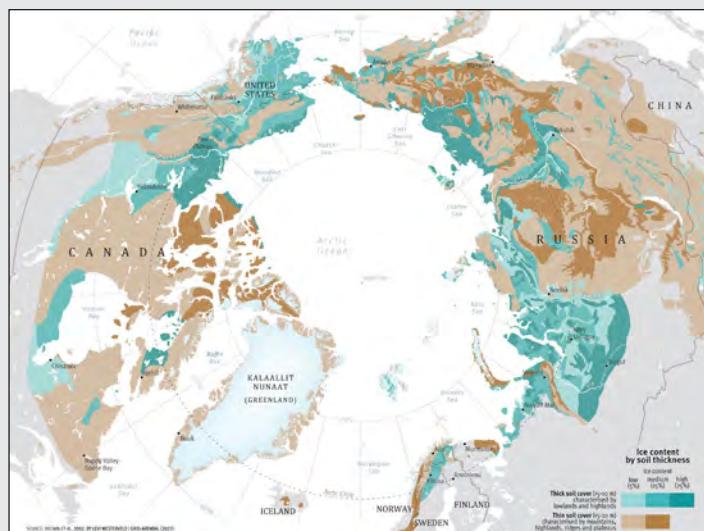
The *Arctic Permafrost Atlas* was an output of the 6-year, EU-funded Horizon 2020 project, *Nunataryuk*. The project focused on permafrost thaw and the changing Arctic coast,

with a strong emphasis on the socio-economic impacts of permafrost thaw. It took a multi-disciplinary approach that included physical and social scientists from 26 partner organizations in 12 countries working together and actively engaging with local communities across the circumpolar Arctic.

The word “nunataryuk” means “land to sea” in Inuvialuktun, the traditional language of the Inuvialuit who live in the western Canadian Arctic. The name reflects both the land-to-sea connection of permafrost coasts and the main goal of *Nunataryuk*, which was to determine the impacts of thawing land, coastal, and subsea permafrost on people living and working in the Arctic, as well as on the global climate. The aim was to give policymakers the information they need to address those impacts, both locally and globally.

An important achievement from *Nunataryuk* was in the way in which the scientific results were communicated. The project generated over 100 peer-reviewed scientific papers, but from the outset, it was also committed to making complex scientific information accessible to policymakers, local communities, and the wider public. The project had high ambitions for this from the very start and the result was the *Arctic Permafrost Atlas*.

This highly visual publication with 82 maps, graphics, and supporting text, as well as art and stories from people who live and work in the permafrost zone. It incorporates the findings from both *Nunataryuk* and oth-



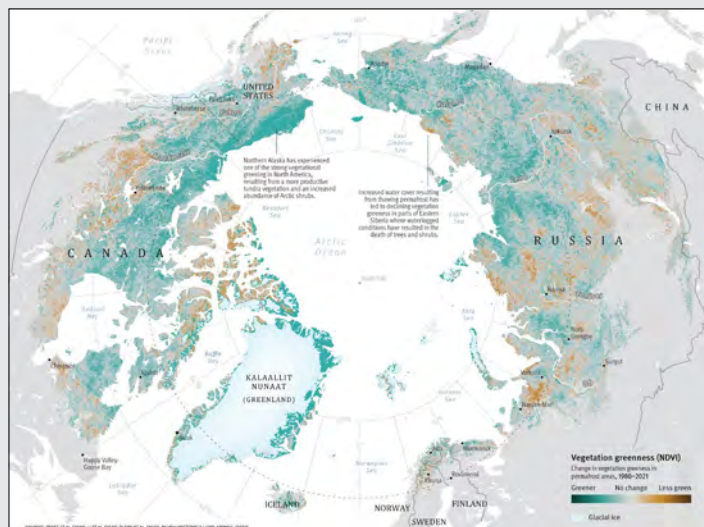
Arctic permafrost physiography

Source: Arctic permafrost physiography | GRID-Arendal. From collection: Maps and Graphics from the Arctic Permafrost Atlas. Cartographer: Levi Westerveld/GRID-Arendal

er permafrost research taking place around the globe and covers the scientific, cultural and socio-economic dimensions of permafrost, and permafrost change. It gives a real sense of the scope and scale of the issue—something particularly important because permafrost is a less visible part of the cryosphere compared to sea ice and glaciers, yet changes in permafrost affect many other systems, including other parts of the cryosphere. It stresses the need for an integrated and participatory approach to the complex issues at the nexus between climate change, permafrost thaw, infrastructure damage, contaminants, and health.

The atlas is divided into seven chapters covering an introduction to permafrost, impacts of climate change, changes occurring in permafrost, impacts of permafrost thaw, adaptation to permafrost thaw, and permafrost outside of the Arctic. There are a total of 54 spreads, with a map or graphic on one side and supporting text on the other. It is designed so the reader can open the book at any page and read the spread independently from the other sections. The atlas also includes nine first-person stories from people living or working on permafrost. Each story is accompanied by an original artwork based on the story that also includes elements of local culture or beliefs.

The atlas brings all of this information together in a final section called “The Big Picture”. In a graphical manner, it illustrates how the physical changes occurring in permafrost lead to six key hazards that have consequences on culture and language, health and well-being, costs and the economy, the ecosystem, recreation, and planning. It concludes with ten broad actions that are needed, ranging from greenhouse gas reductions and monitoring to financial investments and modification of policy frameworks.



The role of vegetation in permafrost landscape

Source: The role of vegetation in permafrost landscape | GRID-Arendal From collection: Maps and Graphics from the Arctic Permafrost Atlas. Cartographer: Levi Westerveld/GRID-Arendal

Table 10.1. Projected average replacement costs of roads, railroads, and buildings in Arctic permafrost regions at risk under the selected Global Climate Models (GCM) based on SSP245 and SSP585 scenarios¹

	Total length (km)	SSP245		SSP585	
		Per cent at risk	Mean cost of replacement (mill USD)	Per cent at risk	Mean cost of replacement (mill USD)
Roads in country					
USA (Alaska)	24 280.4	25	10 057	48	19 113
Canada	43 124.6	17	11 914	33	23 496
Russia	175 724.5	49	50 645	69	71 177
Iceland	15 871.2	0	13	0	13
Sweden	35 255.9	3	5 046	3	5 543
Finland	24 381.9	3	3 645	6	6 941
Norway	39 352.4	10	18 496	16	29 835
Total Arctic	357 990.7	29	99 815	44	156 118
Railroads in country					
USA (Alaska)	1 136.7	18	1 075	33	2 039
Canada	2 989.4	12	2 301	13	2 646
Russia	19 617.3	28	11 573	41	17 403
Iceland	0	0	0	0	0
Sweden	1 876.2	7	1 523	9	2 091
Finland	513.4	0	0	0	0
Norway	1 358.2	12	1 562	21	2 672
Total Arctic	27 491.2	23	18 034	34	26 850
Buildings in country					
USA (Alaska)	27.6	6	3 029	7	3 394
Canada	10.5	13	2 000	15	2 359
Russia	142.8	18	53 000	28	80 477
Iceland	21.3	0	2	0	5
Sweden	25.2	1	1 089	1	1 498
Finland	15.6	2	1 487	3	1 854
Norway	26.6	4	3 502	4	3 367
Total Arctic	269.7	11	64 110	17	92 955

¹ The country-specific costs are calculated using purchasing power parity (PPP) of countries in the Organization for Economic Co-Operation and Development (OECD) and not the currency exchange rates.

Source: Streletskiy et al. 2023, note 9

impacts of permafrost degradation between 2015-2024 and 2055-2064, based on climate data from three Global Climate Models (GCM) under “middle of the road” (SSP245) and “fossil-intensive” (SSP585) scenarios to estimate permafrost bearing capacity, the ability of permafrost to support foundations, and thaw subsidence which is a major issue for linear infrastructure. The study considered infrastructure located in permafrost regions of the USA (Alaska), Canada, Russia, Iceland, Sweden, Finland, and Norway. The Kingdom of Denmark (Greenland) was not considered in the study due to absence of geospatial data on infrastructure. The assessment found that under the “middle of the road” scenario, 29 per cent of roads, 23 per cent of railroads, and 11 per cent of buildings will be affected by permafrost degradation, costing USD 182 billion (Table 10.1). Under the “fossil-intensive” scenario, 44 per cent of roads, 34 per cent of railroads, and 17 per

cent of buildings will be affected with an estimated cost of USD 276 billion, with airport runways adding an additional USD 0.5 billion. Russia was found to have the highest mean replacement costs, for roads, railroads and buildings, with a total of about USD 115 billion in the “middle of the road” scenario and about USD 169 billion in the “fossil-intensive” scenario (Table 10.1).

An earlier circumpolar assessment from 2019 was based on temperature and snow data from six selected Global Climate Models (GCM) used in the IPCC Fifth Assessment Report as input to the permafrost geotechnical model.¹⁰ The study compared two decades, 2006-2015 and 2050-2059, using 2006-2015 as a baseline climatology and 2050-2059 as a near-future scenario based on lifespan of existing infrastructure under a fossil intensive scenario (RCP 8.5). The results showed

that permafrost degradation will result in a 27 per cent increase (USD 15.47 billion) in infrastructure replacement costs across circumpolar permafrost regions and that more than 14 per cent of total fixed infrastructure (USD 21.6 billion) are at risk of damages due to loss of bearing capacity and thaw subsidence.¹¹ Substantially lower estimates in the previous study, especially for Russia, were due to the lack of available geospatial data on infrastructure. The increased availability of geospatial data, particularly through crowd-sourced open platforms such as OpenStreetMap, allowed the more recent study to overcome some of the data limitations identified earlier. However, economic estimates should be used cautiously, with the understanding that there is uncertainty in future climate trajectories, the spatial resolution and parametrization of the permafrost model, large variability in construction costs within and between the countries, and improving but still incomplete geospatial data on infrastructure. These are just a few factors influencing the final cost estimates. The availability of high resolution commercial imagery and improvement in detection algorithms to extract infrastructure data and properties from remote sensing imagery, together with cloud assisted AI technologies, will help fill the gaps existing in infrastructure databases.¹² As these infrastructure databases will have more complete coverage, the total costs of permafrost degradation will likely increase as some of the previously undetected infrastructure will be affected.

North America

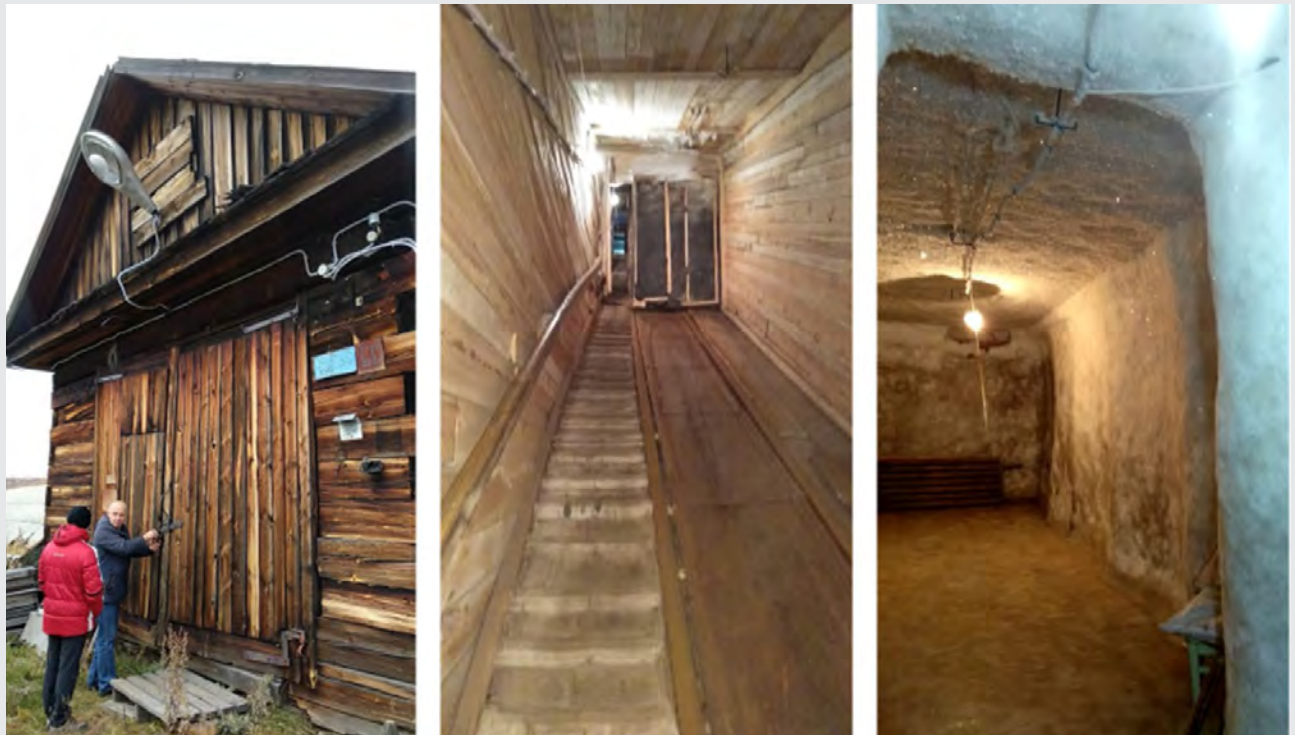
Permafrost underlies approximately 80 per cent of Alaska and approximately 50 per cent of Canada, including areas in Yukon, Northwest Territories, Nunavut, and the northern part of Quebec. There are 300 settlements on permafrost in Arctic Canada and Alaska, 63 of which are on continuous permafrost, 69 are on discontinuous permafrost, and 168 are on sporadic permafrost. In Alaska, 154 000 people live in permafrost areas, and in Canada, 94 000.¹³ Extraction of oil and gas and other mining operations are important economic activities, however many indigenous people rely on subsistence economies that are usually not expressed in market economic terms. Numerous studies conducted in North America confirm the increases in permafrost temperature especially in the northern “cold” permafrost regions, while increases in thaw depth

are mostly attributed to the southern permafrost regions with warm permafrost.¹⁴ Under projected climate warming, discontinuous near-surface permafrost will disappear in the Subarctic regions of North America by the end of the century.

The assessment from 2023 of the effects of permafrost degradation on Alaskan roads and railroads estimated damages from USD 11.0 to 21.2 billion under moderate (SSP245) and high (SSP585) emission scenarios by 2055-2064 (Table 10.1), which is about 275 to 530 million per year.¹⁵ Replacing buildings and structures will cost an additional USD 3.0 to 3.4 billion by mid-century or USD 75 to 85 million per year. This study did not account for the high rates of coastal erosion that threaten many indigenous communities in Alaska. It also relied on a crowd sourced infrastructure database that does not include all the structures that may be affected, therefore the cost of infrastructure at risk from permafrost degradation is likely higher. Based on the latest assessment, the total annual costs are therefore from 0.7 to 1.2 per cent of Alaskan GDP in 2023.

The study from 2019 estimated the costs of damage to transport infrastructure ranged from USD 14.2 to 26.2 billion and replacement of damaged residential and commercial housing ranged from USD 2.0 to 2.4 billion depending on the climatic scenario.¹⁶ This is higher than the recent study that estimated a cost of USD 5.2 billion by 2050-2059 and from USD 4.2 to 5.5 billion by the end of the century.¹⁷ Another assessment for Alaska estimated economic costs of USD 340 to 700 million per year for additional maintenance and repair of public infrastructure damages in Alaskan permafrost areas.¹⁸

Replacing buildings and structures in Canada will cost USD 2.0 to 2.4 billion by mid-century with roads and railways adding an additional USD 14.2 to 26.1 billion.¹⁹ While permafrost degradation, especially in areas with ice-rich permafrost, may threaten Canada’s infrastructure, their long history of permafrost research, engineering, permafrost monitoring at industrial sites, and updated standards related to construction on permafrost will help to minimize the risk of permafrost degradation.²⁰



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/reprinted from ECONOR 2020.

Scandinavia and Iceland

Permafrost in the region is mostly attributed to high elevation unglaciated environments and northern parts of the Nordic countries that have small populations and greater exposed infrastructure compared to the southern parts. Permafrost is present in Iceland, Greenland (Denmark), Lapland, Northern Ostrobothnia, and Kainuu (Finland); Finnmark, Nordland, and Troms (Norway); Norrbotten and Västerbotten (Sweden). Permafrost plays an important role in supporting ecosystems used by traditional and subsistence economies, such as reindeer herders, and in promoting slope stability in mountain terrains. With the exceptions of Greenland, Svalbard, and high-elevation unglaciated mountain areas, permafrost in the region is relatively warm ($>-2^{\circ}\text{C}$). Under projected temperature increases, it will continue to warm and thaw towards the mid-21st century, leading to a higher risk of rock and debris flows which threaten the operational safety of infrastructure, especially in areas with ice-rich permafrost.

On average, the cost of impacts in the region were estimated to be USD 36.4 billion and USD 53.9 billion under moderate and fossil-intensive scenarios respectively, assuming that deep freeze/

thaw cycles may cause damage to infrastructure, even if permafrost is no longer present with specifics listed in Table 10.1.²¹ These estimates do not include Greenland due to a lack of reliable geospatial infrastructure data available at the time of the assessment, however another study noted scarce permafrost data and maps as a barrier to knowledge driven policy making to improve the adaptive capacity in the region.²² The complexity of terrain in the Nordic region adds to higher uncertainty and lower confidence in this region. The absence of readily available raw materials (such as sand) and high costs of construction in the region also increased the potential cost of permafrost degradation on infrastructure.

Russia

Permafrost occupies more than 60 per cent of the Russian territory and plays an important role in all aspects of economic development. In Russia, more than 65 per cent of oil and more than 80 per cent of gas comes from permafrost regions with NAO, Yamal Nenets, Khanty-Mansi, and Krasnoyarsk Krai which continue to be major producers of oil in Russia. Upstream production and operation on permafrost requires adapted engineering solutions to build infrastructure. For example, buildings are



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/reprinted from ECONOR 2020.



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/reprinted from ECONOR 2020.



Building damaged by permafrost degradation, Norilsk, Russia. (Photo from 2013, now the building is dismantled). Photo: Nadezhda Zamyatina/reprinted from ECONOR 2020
Detail of façade: Building damaged by permafrost degradation, Norilsk, Russia. (Photo from 2013, now the building is dismantled). Photo: Nadezhda Zamyatina/reprinted from ECONOR 2020.

commonly built on piles frozen into permafrost and oil pipelines are constructed above ground. A substantial number of oil spills were reported on permafrost in Russia, with a catastrophic spill of 20,000 tons of diesel oil near the city of Norilsk.²³ A study of the oil industry in Russia assessed the additional costs required to minimize risks from thawing permafrost under various production scenarios.²⁴ They found that if oil production levels remain at similar levels between present and 2050, the total cost needed to support foundations, buildings, and facilities will be USD 6.2 billion without thermal stabilization and USD 8.3 billion using thermal stabilization to adapt foundations to warming climatic conditions.

Considering the impact on other economic sectors, another study reported that extractive industries and transport account for over 40 per cent and 24 per cent of the regions' fixed assets respectively at moderate and intensive scenarios of permafrost thawing.²⁵ The most significant damage by the economic sector was expected to be in the mining and extractive industry USD 29.18-37.27 billion (56 per cent of total costs of damage to all fixed assets), followed by transport USD 12.84-16.33 billion, and the residential sector USD 4.47-1.70 billion. Geographically, YNAO had the highest expected damage (USD 25.13-36.02 billion), with 60 per cent of damages in the extractive industry, while the Komi Republic had a significantly lower absolute value of damages (USD 2.78 billion), but 59 per cent came from transport. Adaptation measures such as thermal stabilization systems at local scales to federally operated permafrost monitoring were needed to decrease the impacts of permafrost degradation and minimize the cost of damages.

In the recent assessment, from 2023, the total cost of combined impacts of permafrost degradation on buildings, roads, and railroads in Russia was estimated to be USD 115.2 billion under SSP245 and USD 169.1 billion under SSP585, with buildings alone contributing from USD 53.0 billion to USD 80.5 respectively (Table 10.1).²⁶ The previous assessment from 2019 found that 20 per cent of buildings and 19 per cent of infrastructure in Russian permafrost regions will be affected, with costs of USD 16.7 billion and 67.7 billion respectively. Additionally, 54 per cent of residential buildings will be affected with an estimated cost of 52.6 billion making the total cost of USD 137 billion.²⁷ Other

studies found the total value of buildings and structures affected by permafrost degradation up to USD 133.5 billion²⁸ and 132 billion USD by mid-21st century.²⁹

The geographic disconnect between Arctic resources and consumers located primarily in the European part of Russia or abroad requires continuous investment and support of infrastructure on permafrost for the continued transport of those resources. Permafrost degradation on road infrastructure under various development scenarios outlined in Russia's Transportation Strategy, estimating damages from USD 0.6 billion to 0.9 billion (2018 PPP) per year from 2020 to 2050 with Sakha Republic bearing the highest costs.³⁰

Considering that 80 per cent of the Russian Arctic population is urban, cities built on permafrost are hot spots of permafrost degradation and, therefore, require special attention. While metal and mining and oil and gas companies operating in Russia have technological, financial, and operational means to combat the effects of permafrost degradation, the lack of adequate investment in aging infrastructure and years of neglecting geotechnical monitoring of municipal buildings is concerning as Russian cities on permafrost have already shown substantial numbers of buildings with deformations.³¹ The impacts of permafrost degradation on the housing sector were estimated under RCP 8.5 for eight Arctic regions of Russia on permafrost using the total size of the housing stock and the cost of housing construction in each region.³² The assessment found that the annual average cost of maintenance and restoration of lost housing from 2020 to 2050 is USD 1.2 billion to 1.4 billion per year using 2018 PPP. The highest loss of housing value was found in Yamal Nenets AO and north of Krasnoyarsk Kray. The same eight regions on permafrost were also assessed for risk of permafrost degradation on healthcare facilities.³³ They found damages of USD 0.07 to 0.27 billion (2021 PPP) between 2021 and 2050 is required to support this type of critical infrastructure depending on the scenario. In a follow up study, the damage to healthcare facilities was estimated at USD 0.04 to 0.33 billion, the study also pointed out other risks of permafrost degradation to public health such as decreased access of transport to healthcare services, deteriorating drinking water quality, mercury pollution, and the release of pathogens

and infectious diseases from permafrost in places of cattle burials in permafrost regions.³⁴

Despite Russia's historical position as a leader in permafrost research and engineering worldwide, there is a lack of proper attention to permafrost at the municipal level and neglect at the federal level manifested in years-long implementation of permafrost monitoring that is still not fully operational. This suggests that permafrost degradation under projected climate warming will likely be amplified in areas with a presence of substantial populations and that costs will exceed existing projections that currently do not account for the role of non-climatic factors (inadequate snow removal, water ponding, chemical contamination, water quality, infection, diseases outbreaks, etc). The investment needed for adaptation of the Russian economy to overcome the negative consequences of permafrost degradation found 13.3 per cent of total Russian fixed assets (USD 1961 trillion) were in permafrost regions in 2020, with economic sectors of mining and transportation having the largest shares of 64 per cent and 21.2 per cent of Russia's total assets.³⁵ The proportion of fixed assets directly affected by permafrost was



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/reprinted from ECONOR 2020.

Highlight 10.2. Thermosyphons

Thermosyphons are commonly used in the permafrost regions to provide additional ground cooling under the large residential or office buildings, pipelines, railroads, bridges, and dams. They commonly consist of the sealed pipe filled with liquid carbon dioxide under pressure (also ammonia and some other gasses were used in the past). Depending on the specific location, the pipe length and diameter can substantially vary (see examples below), but part of the pipe is inserted in permafrost and part sticks above the ground to the height at least twice higher than the snow cover thickness. If no power source is used the system is called passive thermosyphon and works based on temperature gradient and phase changes. When a thermosyphon is installed into permafrost the pressurized carbon dioxide boils and rises vertically removing heat from the ground to the atmosphere. During cold winter

months, the vapor condenses at the top part and flows down under the influence of gravity along the pipe walls establishing the convection system that effectively removes heat from relatively warm permafrost to the cold winter atmosphere. During the summer warm months, the vapor at the top does not condense so there is no convection. Thermosyphons are very effective, but only allow the cooling around the immediate vicinity of the installation (first meters), at the same time they come at the cost associated with production, installation and maintenance, so not really applicable to the individual residential buildings.



Thermosyphons are installed at the side of the building to provide additional cooling to permafrost under the buildings. Ventilated crawl spaces designed to protect permafrost from heat from the building above, as they limit snow accumulation in the winter and provide shade in the summer, Nome. Photo: Maryana Shnitser.

estimated at USD 518.5 billion, of which USD 183.7 billion in damages by 2050. The study concluded that a 5 per cent investment in adaptation costs is the most cost-effective scenario because it sustains economic growth and avoids the accumulation of the cost of damages.³⁶

Discussion

Arctic regions are disproportionately affected by climate change. Projected climate warming and permafrost degradation will continue to challenge the existing and future infrastructure.

Despite uncertainty resulting from potential trajectories of human development and climate change, the absence of high-quality geospatial

datasets of infrastructure, and a limited number and high variability of construction costs within and between the Arctic countries, it is evident that permafrost degradation will impose substantial costs of damages to critical infrastructure in Arctic countries with Russia having to bear the majority of the costs. These damages, while they may not be significant in comparison to the GDP of the Arctic state, may still make up a significant portion of GRP in Arctic regions.

Although southern regions of Arctic countries tend to be more densely populated and have more developed infrastructure, the extractive industries require continuous investment in infrastructure impacted by permafrost thaw. While historically the



Light structures are built on top of adjustable frame foundations placed directly on top of the ground, Nome. Photo: Maryana Shnitser

extraction of gold, coal, oil, and natural gas played an important role in the Arctic economy, the transition to green economy and the race for the rare earth minerals will likely have a significant footprint in the trajectories of economic development. These developments on land will be constrained by the decline in terrestrial accessibility as permafrost degradation coupled with thinner lake/river ice and shorter cold periods will make remote populations and industrial centers more isolated by land, while coastal erosion and increased storminess may challenge port infrastructure and diminish accessibility by water.

Adaptation measures, including land use (snow compaction or removal, water drainage) and engineering solutions (such as the use of crawl spaces and thermosyphons) can be very effective in preserving the permafrost, but are expensive and provide individual solutions that are not scalable to cover all infrastructure that is being affected.³⁷

No Arctic country is fully prepared to deal with the consequences of permafrost degradation, however, the following considerations can help to minimize the costs.³⁸ Monitoring of permafrost is needed in populated and industrial centers, supplemented by permafrost monitoring in undisturbed natural environments. This includes early warning systems in large population centers or community-supported permafrost monitoring in smaller settlements and Indigenous villages. It is crucial to ensure exchange of information among various stakeholders, including municipalities, research and educational centers, industries, and

Indigenous communities. Permafrost degradation as a hazard needs to be recognized, and establishing legal and operational frameworks are called for to combat the impacts and minimize costs for affected communities at the country, regional and municipal levels. Recognition that not just proper construction, but infrastructure maintenance over the entire lifespan, are among the factors that may completely prevent or at least offset the risks of infrastructure failure in permafrost regions.

Impacts of infrastructure development in Sámi reindeer grazing areas

Erik Engelen, Iulie Aslaksen and Jørn Kristian Undelstvedt³⁹

Reindeer herding is the material basis for Sámi culture

Reindeer herding in Norway is regulated by the Reindeer Herding Act of 2007. The Act emphasizes the importance of areas for reindeer herding: «Reindeer herding shall be preserved as an important basis for Sámi culture and social life. The Act shall contribute to securing the reindeer husbandry areas in the Sámi reindeer herding area as reindeer herding's most important resource base".⁴⁰

Sámi reindeer herding is based on the reindeer's adaptation to northern mountain areas. The reindeer owners follow the reindeer through the seasons and between the seasonal pastures. This is the basis for the reindeer herding culture with a partly nomadic mode of operation, and reindeer herding is based on traditional knowledge about the use of grazing areas.

Sámi reindeer grazing area

The reindeer grazing areas where Sámi reindeer herding is carried out comprise about 40 per cent of Norway's land area, from Finnmark in the north to Engerdal in Hedmark in the south. The 40 per cent is a gross figure also including large areas not used for reindeer grazing, such as lakes, glaciers, cities, towns, roads, and planted forests.⁴¹ The Sámi reindeer herding area is divided into six regional reindeer herding areas: East Finnmark (Nuorta-Finnmárku), West Finnmark (Oarje-Finnmárku), Troms (Romsa), Nordland (Nordlánda/Nordlaante), Nord-Trøndelag (Noerhte-Trööndelage), and Sør-Trøndelag/Hedmark (Åarjel-Trööndelage/Hedmaarhke) (Figure 10.1).

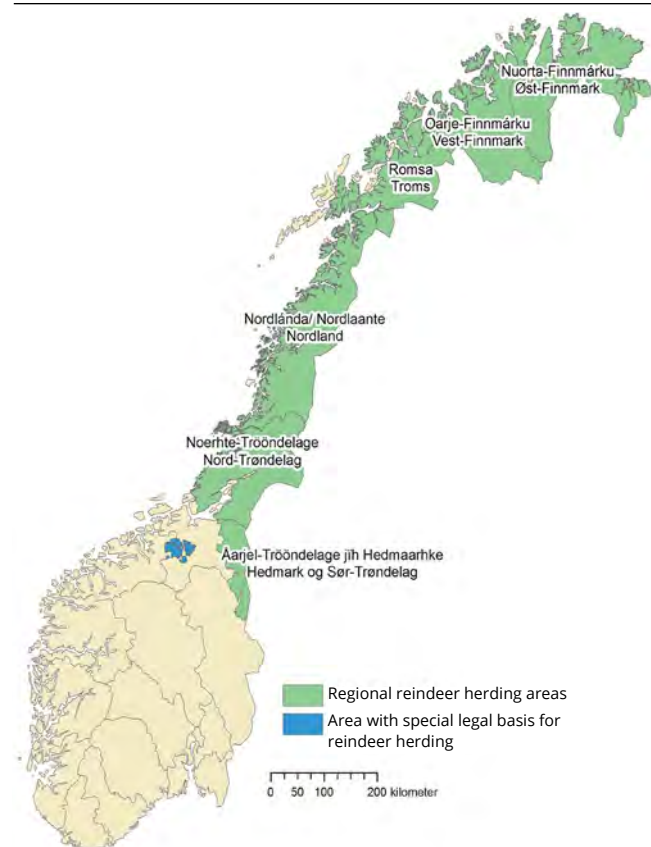
Physical interventions affect reindeer

Reindeer herding depends on large and contiguous areas, with pasture for different seasons and migration routes between seasonal pastures. The seasonal pastures can be located far apart, and there is therefore a need for migration routes where the reindeer can move between the seasonal pastures. Such routes follow the wild reindeer's ancient migratory routes determined by topography, lakes and waterways. Studies from the Swedish University of Agriculture (SLU) point to loss of grazing areas as the largest threat to reindeer herding.⁴²

Studies show that within 5 kilometers of infrastructure and human activity, the activities disturb the reindeer, and it was estimated that the reindeers' use of the pastures was reduced by 50 to 95 per cent, depending on the type of disturbance, type of landscape and season.⁴³ Although reindeer in Sámi reindeer herding are semi-domesticated, they live freely and can react like wild reindeer to disturbances. Reindeer are particularly vulnerable during calving in the spring.

Interventions, such as buildings, roads, hydro-power plants, high-voltage power lines, mines and wind power plants can affect reindeer in different ways. A study from the Norwegian Institute for Nature Research (NINA) explored how wind power development can affect reindeer and emphasize that there is a need for long-term studies to assess how variation between years affects reindeer grazing.⁴⁴

Figure 10.1. Map of regional reindeer herding areas in Norway



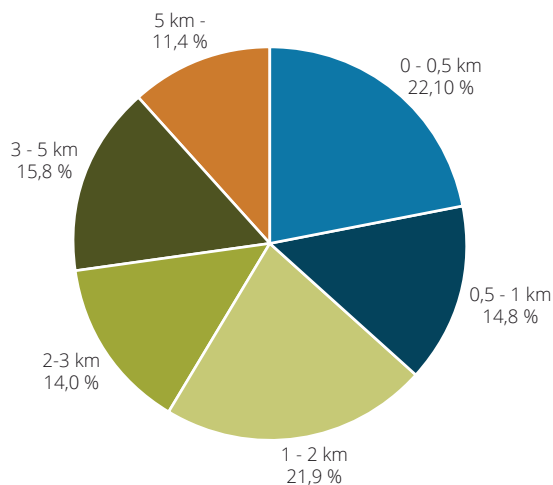
Source: Norwegian Agriculture Agency

Studies of wind power plants in Norway and Sweden have found that reindeer have reduced their use of areas up to 5 km from the plant. In other studies, impact zones of up to 15 km have been observed for wind power plants, 15 km for tourist facilities and 30 km for hiking trails.⁴⁵

A study in Sweden found that reindeer moved to areas where wind power plants were out of sight, hidden by the terrain.⁴⁶ At a distance of 5 km from the wind power plant, there was an increase of 79 per cent in use of areas where the wind power plant was not visible. The study found that reindeer were more affected in the operation phase than in the construction phase, and noise from the turbines seems to have disturbed reindeer more than human activity during construction.

Roads will hinder the reindeer's natural movement in the landscape. An exception may be roads in areas that already have a lot of infrastructure or roads with very little traffic. Interventions can therefore disturb much larger areas than those physically developed by buildings and infrastructure.

Figure 10.2. Area of all seasonal pastures and migration route by distance to buildings and infrastructure. 2018. Per cent



Source: Statistics Norway

Impacted area in reindeer grazing areas

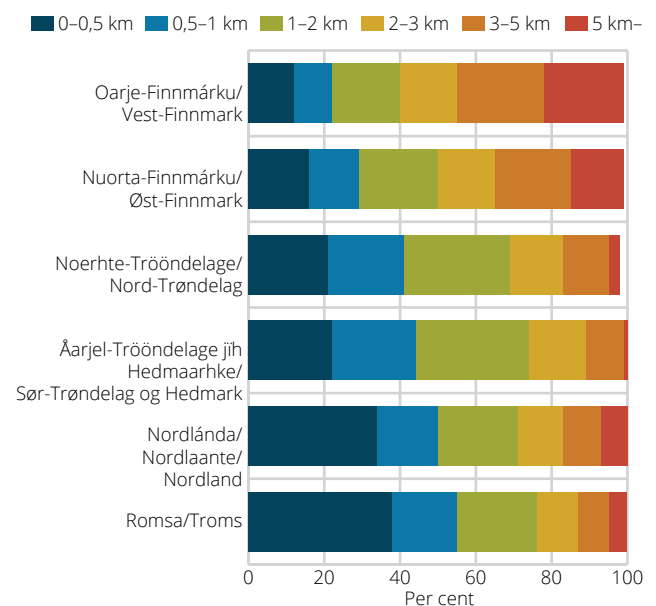
The impact analysis for 2018 calculates what percentage of the area of each type of seasonal pastures and migration routes that are affected by physical interventions such as buildings and infrastructure.⁴⁷

Since the impacted area can be much larger than the area occupied by the intervention itself, the impact analysis has been carried out for a standard set of impact zones (the distance from the intervention): within 500 meters, 1 km, 2 km, 3 km and 5 km from the intervention.⁴⁸

The impact analysis is carried out for the reindeer grazing areas as mapped by the Directorate of Agriculture, delineating all grazing areas used in different seasons and the migration routes between them.⁴⁹ Data for buildings and infrastructure in reindeer grazing areas are available as maps in accessible national databases.⁵⁰ This analysis comprises existing, not future planned interventions.

The calculation is based on two types of maps, where the first show the area of each type of seasonal pasture and migration route, and the second show impacted area, as impact zones around buildings and infrastructure, in a geographic information system (GIS). The results show how large share of each type of seasonal pasture and migration route that is within each impact zone.⁵¹ The calculation can be interpreted as sum effect (cumulative effect) of the interventions that the data base includes.

Figure 10.3. Share of area of all seasonal pastures and migration route by distance (in kilometers) to buildings and infrastructure. Reindeer grazing area. 2018. Per cent



Source: Statistics Norway

About 89 per cent of Sámi reindeer grazing areas (seasonal pastures and migration routes) are within 5 kilometers of physical interventions such as buildings and infrastructure. Of this, 16 per cent is between 3 and 5 km, 14 per cent is between 2 and 3 km, 22 per cent is between 1 and 2 km, 15 per cent is between 0.5 and 1 km, and 22 per cent is within 500 meters.

Even if grazing areas are affected as far away as 5 kilometers from an intervention, this does not mean that the area has been destroyed as reindeer grazing and can be considered available for development or use for other purposes.

The results are distributed among the regional reindeer grazing areas (Figure 10.3). Reindeer grazing area Troms (Romsa) has the largest share of grazing land within 1 km of buildings and infrastructure, followed by Nordland (Nordlândia/Nordlaante). The lowest share of grazing land near buildings and infrastructure is in West-Finnmark (Oarje-Finnmárku) and East-Finnmark (Nuorta-Finnmárku).

The impact analysis is carried out for seasonal pastures and migration routes between them. The seasonal pastures that are most affected by buildings and infrastructure within 1 km are the winter pastures that are most intensively used in mid- and

Highlight 10.3. Impacts of planned wind power developments in reindeer grazing areas

Erik Engelién, Iulie Aslaksen and Jørn Kristian Undelstvedt

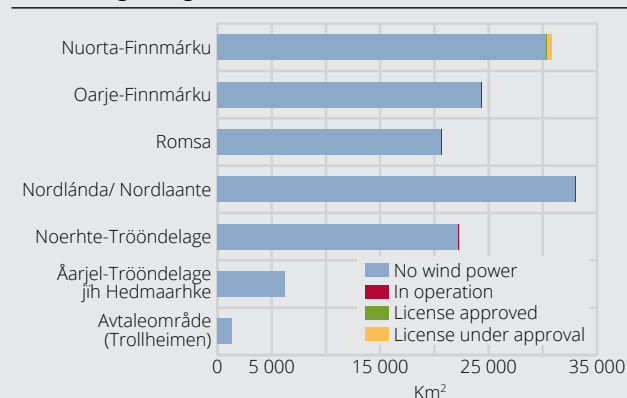
Extensive development of wind power, as part of the energy transition, will have major consequences for the Sámi reindeer grazing areas. The impact analysis of existing infrastructure development has been followed up by an analysis of planned wind power development in reindeer grazing areas.

The data set from the Norwegian Water Resources and Energy Directorate (NVE) gives a complete overview of wind power plants subject to licensing, with licenses approved or under approval, and wind power plants completely or partially built and in operation. Data sets from the Norwegian Agriculture Agency on reindeer grazing areas and agreement areas for reindeer grazing have been included, as well as seasonal grazing areas for spring pastures, winter pastures, and reindeer migration routes.

The total area where reindeer grazing is possible is about 140 000 km². The area set aside for wind power plants, about 850 km², is relatively small compared to the total area (Figure 1). Much area is under license approval, about 620 km², compared to the area with wind power plants in operation, about 230 km² (Figure 2). The category “no wind power” does not appear in Figure 2 as the total area (about 850 km²) is the area set aside for wind power, i.e. with wind power plants approved or under approval, or in construction and in operation. Most of the area under license approval is in East-Finnmark reindeer grazing area, while most of the area with wind power plants in operation is in Nord-Trøndelag.

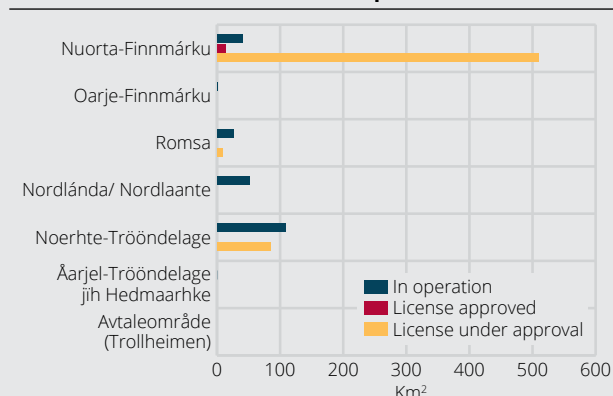
The area set aside for wind power in spring pastures is about 240 km². East-Finnmark has the most area under license processing, followed by Nord-Trøndelag. Troms has the largest area with wind power in operation (Figure 3). The area set aside for wind power in winter pastures is about 70 km². Nord-Trøndelag has the largest area with wind power in operation in winter pastures (Figure 4).

Figure 1. Area set aside for wind power in reindeer grazing areas



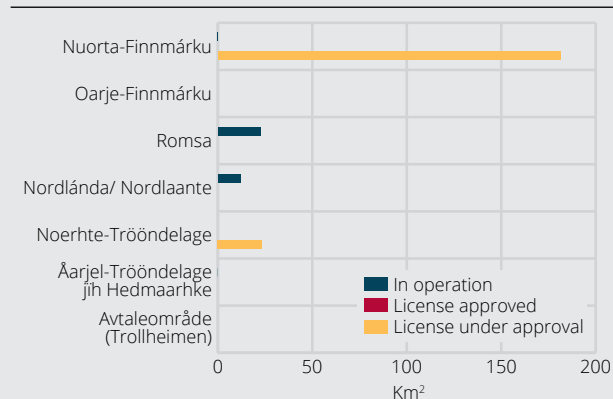
Source: Statistics Norway and data from Norwegian Water Resources and Energy Directorate (NVE) and Norwegian Agriculture Agency

Figure 2. Area of wind power plants in reindeer grazing areas set aside for wind power



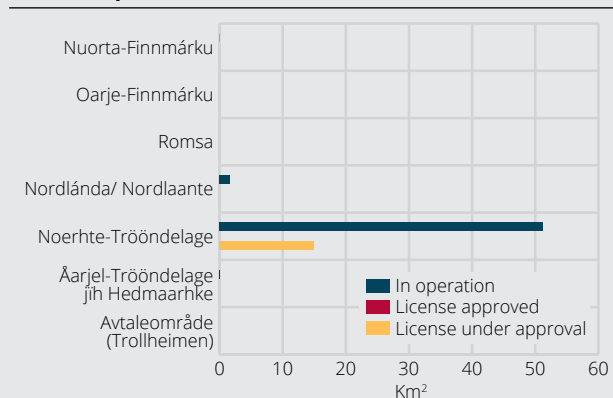
Source: Statistics Norway and data from Norwegian Water Resources and Energy Directorate (NVE) and Norwegian Agriculture Agency

Figure 3. Area set aside for wind power in spring pastures



Source: Statistics Norway and data from Norwegian Water Resources and Energy Directorate (NVE) and Norwegian Agriculture Agency

Figure 4. Area set aside for wind power in winter pastures



Source: Statistics Norway and data from Norwegian Water Resources and Energy Directorate (NVE) and Norwegian Agriculture Agency



Reindeer herding, Finnmark. Photo: Tom Nicolaysen

late winter. This result indicates a considerable pressure on winter pastures.

The high-altitude summer pastures, where the reindeer stay in midsummer, are least affected by buildings and infrastructure. Since these are typically located in mountain areas, they have so far been less impacted by physical interventions, however, this may change, since planned wind power development may take place in mountain areas.

Calculations for the impact of the seasonal pastures in the regional reindeer grazing areas show that for calving land and early spring grazing land, Troms (Romsa) has the largest share of impacts within 1 kilometer, with over 20 per cent within 500 meters, while West-Finnmark (Oarje-Finnmárku) has the lowest share. West-Finnmark (Oarje-Finnmárku) has the lowest share of winter pasture close to buildings and infrastructure, while Troms (Romsa) has around 40 per cent of winter pastures within 500 m of buildings and infrastructure.

Each type of seasonal pasture has qualities that make it suitable for the reindeer's needs for grazing throughout the seasons. It is also important to have access to reserve pastures, i.e. areas not used regularly, but that are needed for example, in case pastures freeze and become

inaccessible for the reindeer as a result of mild weather and subsequent frost.

The analysis of impact zones near buildings and infrastructure in reindeer grazing areas, together with reindeer herding's traditional knowledge of grazing areas, can be useful for strengthening the knowledge base for land use planning and environmental impact assessments and for following up on national and international obligations to secure the material basis for Sámi culture.

Loss of reindeer grazing land in Finnmark, Norway, and effects on biodiversity: GLOBIO3 as decision support tool at Arctic⁵²

Wilbert van Rooij, Iulie Aslaksen, Isak Henrik Eira, Philip Burgess and Per Arild Garnåsjordet

Livelihoods based on Arctic biodiversity are increasingly impacted by 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.⁵³

Reindeer pastures are 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, a core area for Sámi reindeer herding in Norway. The analysis incorporates impact of pressure from land use change, infrastructure development, fragmentation, and climate change.

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 intact (original or reference) state.⁵⁴

The GLOBIO3 study of Finnmark was made in collaboration with the Nomadic Herders Sápmi project.⁵⁵ 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 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 long-term impacts of climate change.

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.

Figure 10.4 shows the total remaining biodiversity (MSA) in Finnmark in 2011 as estimated by

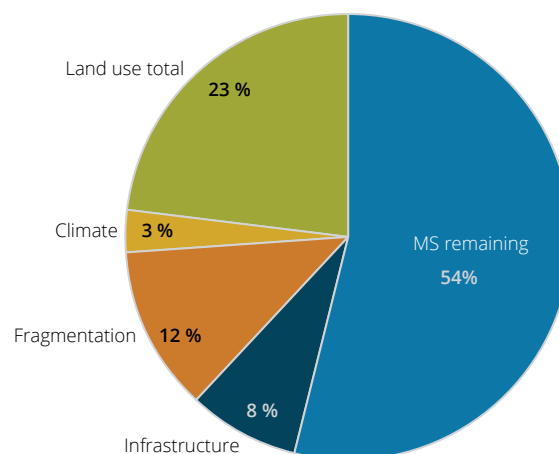
GLOBIO3 and the relative biodiversity loss caused by different pressure types. The analysis shows that the remaining biodiversity in Finnmark was 54 per cent of the intact situation. The largest biodiversity loss is caused by land use (23 per cent), followed by fragmentation (12 per cent), infrastructural developments (8 per cent), and climate change (3 per cent). Although the impact of infrastructure might seem relatively small for entire Finnmark, the local impact can be very high.

Figure 10.5 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 per cent, 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.

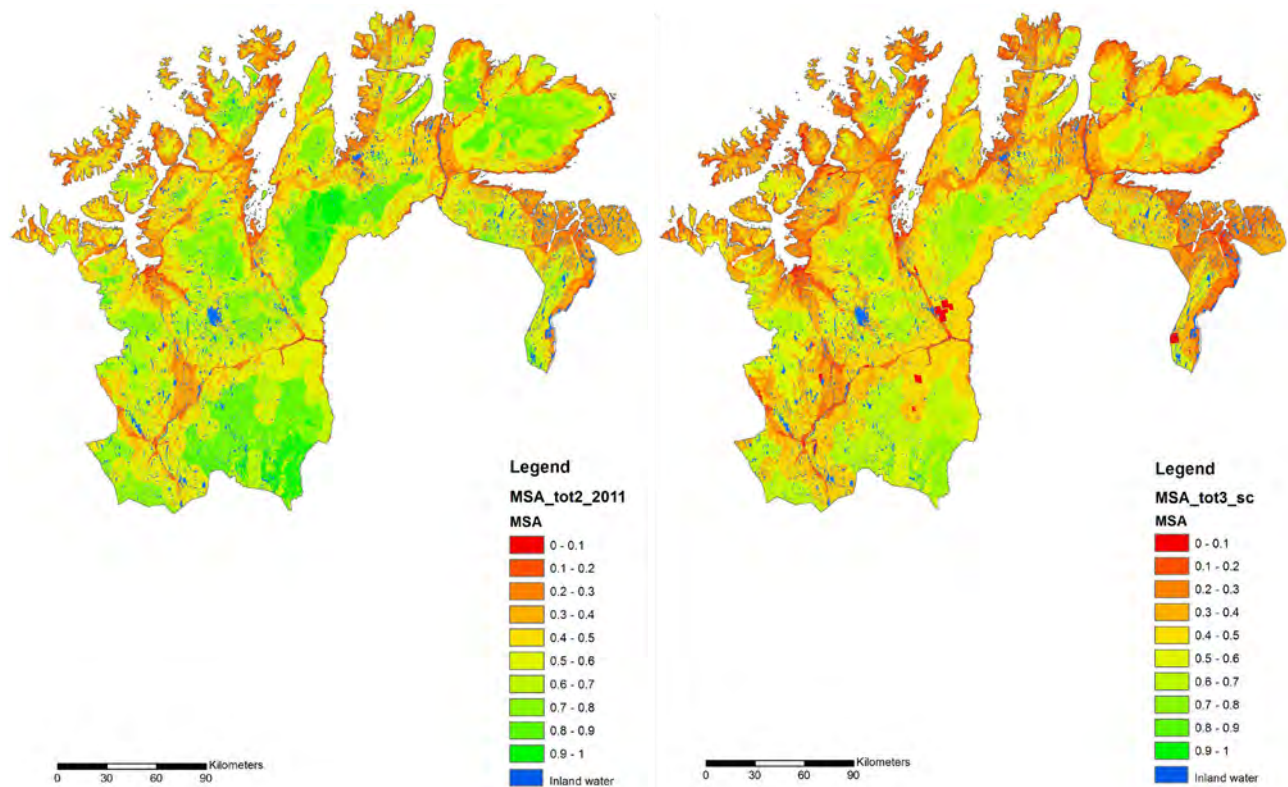
Reindeer husbandry depends on the availability of suitable pastures. Reindeer herds use ancient migration routes to move from one seasonal pasture to another. Physical changes due to urban expansion, increased mine exploration and construction of new infrastructure are not only causing loss of biodiversity 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 10.6 shows the total impact on MSA for 2011 and projected for 2030 biodiversity in Finnmark

Figure 10.4. Share of remaining biodiversity and biodiversity loss per pressure for Finnmark. 2011



Source: GLOBIO3 analysis, van Rooij et al. (see note 52)

Figure 10.5. Current (2011) versus projected total MSA in 2030 for Finnmark

Source: GLOBIO3 analysis, van Rooij et al. (see note 52)

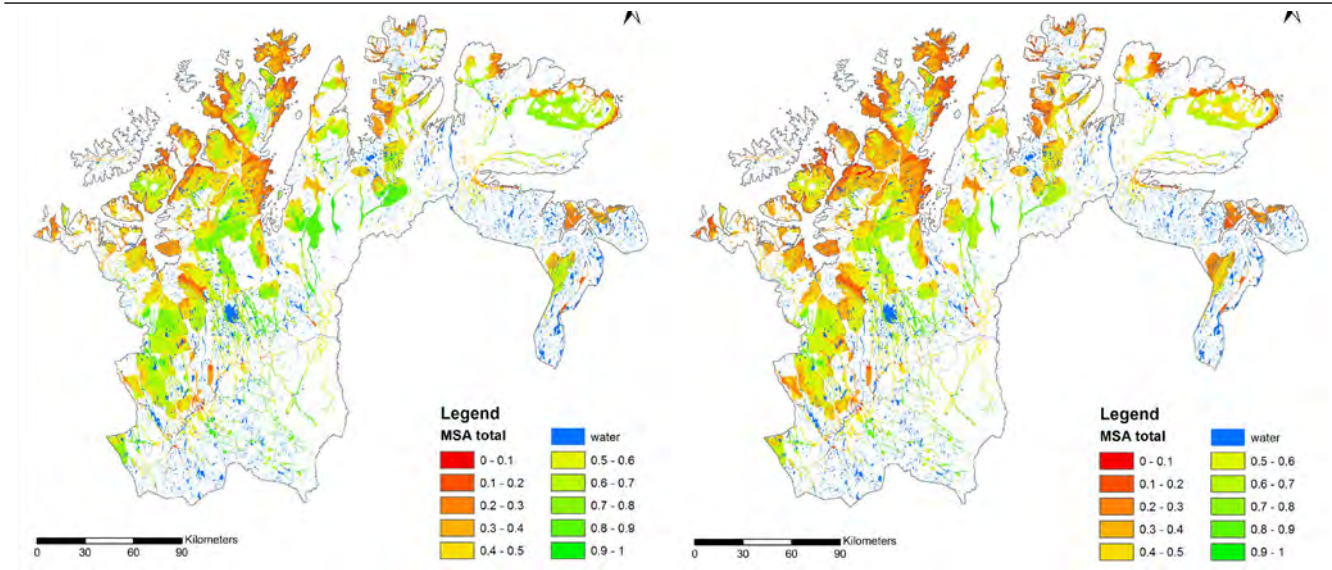
within calving grounds and migration routes. The average MSA value of calving grounds in 2011 is 0.5 with a standard deviation of 0.18. In other words, 50 per cent of the original biodiversity on the calving grounds is already lost. The average MSA of the calving grounds is expected to be reduced with another 10 per cent to 0.4 according to the future scenario. The biodiversity loss within the migration routes is somewhat less severe, but still significant with an average MSA of 0.57 in 2011 and 0.46 according to the future scenario. As these numbers are average biodiversity loss, much higher losses may occur locally.

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 this dialogue is that biodiversity loss, illustrated in red color on the maps, must be interpreted with caution. While red color on the maps is clearly a warning that planned developments may be detrimental to biodiversity in these grazing areas, it does not mean that the highly impacted areas should be considered as completely lost to reindeer herding, and thus be opened to further development, as they are still important for seasonal reindeer migration and grazing at certain times of the year. There is a risk that people might incorrectly assume red zone areas should be open to development because they perceive them to be of no use to reindeer. This is not an issue of scale, but of the need for continuity in the landscape of reindeer herding, to ensure the passage between the seasonal pastures.

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

Figure 10.6. MSA total for calving grounds and migration routes in Finnmark for 2011 and projected future scenario

Source: GLOBIO3 analysis, van Rooij et al. (see note 52)

use and protection of biodiversity. Sámi reindeer herding in Norway is framed as the economic basis for carrying Sámi culture.

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.

Warming climate in the Arctic and re-growth of forest on the tundra directly impairs reindeer herding as the composition of species on pasture land is changed under forest re-growth.⁵⁶ The changes affect livelihoods and cultures of Indigenous communities and challenge the adaptive capacity and resilience of nature-based livelihoods that depend on Arctic biodiversity.⁵⁷

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.

Although the GLOBIO3 model is not designed to analyze impacts on a single species such as reindeer, the impacts of infrastructure development and climate change on will affect the potential for reindeer herding. Loss of biodiversity of grazing areas imply changes of its vegetation, and the warming climate and regrowth of birch forest will have negative impact on reindeer pastures.

Infrastructure development near or in the important areas of calving grounds and migration routes will severely disturb the reindeer. In total, loss of biodiversity is an indication of various threats that negatively affect reindeer husbandry.

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 with the RenGis model.⁵⁸ 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.

Highlight 10.4. Case study: Projected impacts of the Nussir mining project

A case study of the proposed development of the Nussir copper mine in Kvalsund, Finnmark, impacting the reindeer herding districts Fiettar and Fálá, is carried out by *Foundation Protect Sápmi*.¹ The study applied a model for assessing cumulative impacts, with calculation of impact zones, combined with traditional knowledge of reindeer owners. The model of cumulative impacts has been developed in cooperation between mining industry and Sámi reindeer herding in Sweden, building on models from Sweden, Canada and USA.²

The analysis by *Foundation Protect Sápmi* shows that 54 per cent of the area of Fiettar reindeer herding district is already impacted, within an impact zone of 10 km. The projected future impacted area will increase to 63 per cent, by construction of a new high voltage power line. With the planned mining activities, the impacted area will increase to 70 per cent. Both 63 per cent and 70 per cent impacted land are far above the threshold for sustainable reindeer herding, assessed as 65 per cent remaining natural land.

The report by *Foundation Protect Sápmi* on the Nussir project concluded that disturbances and physical barriers will fragment the landscape and lead to cumulative effects in Fiettar reindeer herding district and in

the eastern migration route (*Nuortajohtolat*). This may cause pressure (*doldi*) on pastures to be used later in the seasons, if different reindeer herds reach the migration corridor earlier in the autumn. Increased pressure on the spring pastures may occur if mining development takes place in the calving grounds, and calving must take place in inland areas.

Altogether, increased pressure on pastures occurs as a result of pastures having to be over-utilized at the wrong time of the season, due to the barriers created by mining development. Pressures also disturb the well-established system of sequential moving along the migration route. Thus, during autumn migration, coastal grassland pastures will be under-utilized, while inland lichen pastures will be over-utilized.

The cumulative long-term effect can be disastrous, especially if expected warming climate lead to warmer autumns when dry lichen pastures may be harmed by trampling (*duolmmastuvvon*). The consequences include cascading impacts on winter pastures, weight loss for reindeer, and reduced chance of survival through the winter. All together this means weaker economy and higher operational risk in reindeer herding. The report by *Foundation Protect Sápmi* concluded that there is great concern among reindeer owners that cumulative impacts on vulnerable lichen pastures in the Fiettar reindeer herding district may also cause collapse of reindeer herding in the Fálá district.

¹ <https://protectsapmi.com/engelsk/about-protect-sapmi/>

² Eira, A. J., S. O. Granefjell, I. H. Eira, E.-R. Tuorda (2020) Analyse av virkningen for reindriften ved planlagt gruvedrift i Nussir og Ulveryggen i Kvalsund kommune. Del 1. Inngrepskartlegging og reindrifsfaglig vurdering. Utredning på oppdrag fra Sametinget av Protect Sápmi. August 2020

Qualitative discussion of land use impacts and biodiversity loss from future planned developments

Wilbert van Rooij, Plansup

Land use conflicts are increasing with existing and proposed wind power plants in Sámi reindeer grazing areas. For this study it has not been possible to update the GLOBIO3 analysis, based on recent wind power plans and municipal plans, and the following discussion provides some qualitative points based on previous GLOBIO3 analysis.

The GIS impact zones analysis of current and future wind power and infrastructural developments could be included in the infrastructure module of GLOBIO3 in the near future. The impact of these zones is independent of the impact of the other included pressure types such as land use and the climate change impacts that give a broader picture of the overall impacts on biodiversity.

Migration routes of wildlife or of reindeer herds are difficult to include in a model like GLOBIO3. Ideally, they should be included in the fragmentation calculation, but cause-effect relations are not yet collected. However, it is obvious that impact to migration routes is likely to have serious consequences for migrating species, especially when there will be few or no alternative routes available to migrate. Reindeer depend on seasonal availability of food and calving grounds. While a lower biodiversity along these routes do not directly impede the use of these routes, an increase of disturbances caused by windmill and infrastructural developments might reduce the number of suitable migration routes. Research will be required to investigate if migrating species such as reindeer are limited in their migration with serious consequences for their offspring. A spatial multi criteria analysis including spatial layers of all variables would be a good instrument to quantify the impact of migration impediments.

Highlight 10.5. Lessons for the future from the era of Swedish hydropower expansion in Sápmi*Åsa Össbo, Umeå University*

Hydropower expansion in the north of Sweden has had large impacts on Sámi reindeer herding.¹ Impacts from hydropower development include dammed residences, destroyed, deteriorated and fragmented grazing grounds, aggravated and often destroyed fishing, and insecure migration routes for reindeer on or along the waterways due to more unreliable ice conditions. Positive aspects, such as obtaining electricity, did not embrace all who suffered the consequences. Roads built for hydropower development opened previously inaccessible areas for tourism which disturbed the reindeer.

Loss of grazing land resulted in a need for rationalization and efficiency measures, which in turn required motorization and capital which demanded increased profitability in reindeer herding. Reindeer herders had to own larger herds, but with less grazing lands, and this system involved fewer reindeer herders.

Swedish state expansion of hydropower began with the establishment of the Royal Hydropower Board, today known as Vattenfall AB, in 1909. With the Porjus power plant at Bårjås, in 1915, Vattenfall solved its first mission: to electrify the Iron Ore Railway. To secure Porjus power plant with water, the Suorvvá reservoir was constructed 1919-1923, including the damming of seven interconnected lakes located within a national park. This landscape transformation impacted reindeer herding, fishing and small-scale farming livelihoods of Sámi communities along the river.

Swedish land use policy during the 19th century had set aside large forest areas and waterscapes in the northern mountains for the state. Due to a significant neglect of Sámi lands rights during the 19th century, areas that were first secured for reindeer herding could then be used for industrial purposes. The Water Act of 1918 had been elaborated during World War I with the aim to cover Sweden's energy needs with domestic hydropower. To safeguard livelihoods in local communities, rules protected farming, forestry with timber rafting, and fishing industry, however, reindeer husbandry was omitted from protection even though the greatest potential for hydropower development were in its vicinity.²

At the outbreak of World War II, the hydropower industry proposed less strict rules to increase hydropower production during the war and sustain the supply of energy for industrial production. The parliament approved the temporary law of temporary water regulation, an exemption law also called the Crisis Act of 1939. In addition to faster handling and reduced legal security, the temporary law involved a condition: it could only apply to existing dams, as there were no damage assessments and no compensations for injuries of new projects carried out under the temporary water regulation.

Since all hydropower potential in southern Sweden had been utilised, the focus was directed northwards. During

the 1930s, local distribution lines had been interconnected and it became possible to build dams and plants in the north, transferring electricity to industries and households at the coast or southwards. This prompted Vattenfall to use the streamlined rules of the Crisis Act of 1939 to build new dams, in violation with the conditions in the same law. Due to the impacts and the secrecy surrounding these hydropower projects, this procedure raised opposition in Jämtland county and subsequently led to several changes in the law. Nevertheless, the Crisis Act remained until 1954, and for some water court cases in reindeer grazing lands, like the Third Suorvvá-damming and the damming of the Buvriejaevrie lakes, the rules were applied until the 1960s.

After World War II, attention to human rights became mandatory, however the infringement from energy production on Sámi human rights were not yet recognised. Instead, the heydays of Swedish hydropower expansion really began. In 1950, the Swedish national Sámi organisation, Sámiid Riikkasearvi was established and engaged in supporting Sámi who were faced with hydropower projects. Allied with nature protection organisations, they formed opinion on and resistance against hydropower expansion. In 1960, Sámiid Riikkasearvi sued the state over water rights, in a case that went all the way up to the supreme court. Other results from water court cases were the precedent on Málmiesjávrre in 1961, approving the right of the reindeer herding Sámi community to file a lawsuit and receive compensation for lost reindeer grazing lands. At the Norwegian side, the case of Altevåtn in 1968 was important for Sámi rights.

The reindeer farming act of 1971 equated the reindeer herding Sámi community with economic organizations, enabling more self-determination. During the 1970s and 1980s, reindeer husbandry became included in the coordination of larger infrastructural projects.

When state-owned energy companies in Sweden, Finland, and Norway describe their hydropower activities in Sápmi, the companies at best recognise Sámi experiences of hydropower as something that occurred in history, not something that is connected to present day wind power expansion or so-called green transition re-industrialisation.³ Swedish Vattenfall and Norwegian Statkraft highlight the impact on the Sámi from hydro power development in Suorvvá and Álttá respectively, while Finnish Kemijoki omit impacts on the Sámi in their description of the large reservoirs of Lokka and Porttipahta which have received attention in media and research ever since the 1970s.

Today, decision-makers lack knowledge on the impacts for Sámi reindeer herding and neglect to include and consider Sámi expertise when water and wind power policies are revised. If hydropower impact in Sápmi would have been presented as a policy issue that requires attention, further energy expansion in Sámi areas, in the same way as for hydropower, would be difficult. The crucial question is if Swedish energy policy will continue ignoring Sámi rights?

¹ Össbo, Å. (2023). Hydropower histories and narrative injustice: state-owned energy companies' narratives of hydropower expansion in Sápmi. *Water History*, Springer Nature 2023, 15:201-219

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³ Össbo, Å. (2023). Back to Square One. Green Sacrifice Zones in Sápmi and Swedish Policy Responses to Energy Emergencies. *Arct. Rev. Law Polit.* 14:112-134.

Notes

Notes for Streletskiy and Shnitser: Cost of permafrost degradation

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- ⁴ Streletskiy D. (2021). Permafrost Degradation. Snow and Ice-Related Hazards, Risks, and Disasters. In: Haeberli W. and Whiteman C. (ed.). Oxford, Elsevier.
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- ¹³ Westerveld et al. 2023, op. cit.
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⁴⁷ The analysis presented here was prepared specifically for the study by Engelién & Aslaksen (2019), op. cit., and does not represent recurrent land use statistics.

⁴⁸ The impact zones are linear. They can be modified to take into account terrain and other factors. How far away from the intervention the grazing is reduced depends on local conditions such as terrain, vegetation type, type of intervention, and how much activity there is in connection with the intervention.

⁴⁹ In Trollheimen, outside the administratively defined Sámi reindeer herding area, there is Sámi reindeer herding on a separate legal basis. This is designated the Reindrift Agreement Area in the map database in Geonorge and marked in blue in the map (Figure 10.1). In addition to Sámi reindeer herding, there is domestic reindeer herding in mountain areas in southern Norway, based on a special permit through the Reindeer Herding Act. These areas are not marked on the map.

⁵⁰ Information about data sources can be found in Engelién and Aslaksen (2019), op. cit.

⁵¹ Seasonal pastures may partly overlap, but all seasonal pastures and the area of migration routes between them, as defined in the Directorate of Agriculture's map, have been

combined into one delineation in order to create statistics for the impact on the different types of pastures.

Notes for van Rooij et al. Loss of reindeer grazing land

⁵² This text builds on van Rooij, W., Aslaksen, I., Eira, I.H., Burgess, P., Garnåsjordet, P.A. 2022. Loss of Reindeer Grazing Land in Finnmark, Norway, and Effects on Biodiversity: GLOBIO3 as Decision Support Tool at Arctic Local Level. Chapter 9 in: Mathiesen, S.D., Eira, I.M.G., Turi, E.I., Oskal, A., Pogodaev, M., Tonkopeeva, M. (red.): *Reindeer Husbandry. Adaptation to the Changing Arctic*, Volume 1, s. 223 - 254. Springer Polar Sciences, Springer and the ECONOR IV report, *The Economy of the North 2020*, Box X, p. 184-185.

⁵³ International Centre for Reindeer Husbandry.

⁵⁴ Alkemade et al. (2009) GLOBIO3: A Framework to Investigate Options for Reducing Global Terrestrial Biodiversity Loss. *Ecosystems*.

⁵⁵ <https://reindeerherding.org/nomadic-herders/about-nomadic-herders>

⁵⁶ Arctic Biodiversity Assessment (2013) Arctic Council.

⁵⁷ 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.

⁵⁸ <https://www.sametinget.se/111684>. Sandström, P (2015) A toolbox for co-production of knowledge and improved land use dialogues. PhD Dissertation. Umeå: Swedish University of Agricultural Sciences.



Highway running through Alaska wilderness/Crestock

11. Sustainable Development Goals and the Arctic

Live Margrethe Rognerud, Cara Williams, David Natcher

The Arctic is strongly impacted by climate change, experiencing some of the most rapid environmental transformations on the planet. Rising temperatures, melting sea ice, permafrost thaw, and changes in precipitation patterns are altering ecosystems and livelihoods, posing significant challenges to sustainability and resilience. The Arctic is also impacted by global economic development, with increasing demand for natural resources causing an additional pressure potentially impacting the development within the biospheric goals negatively.

The remote and sparsely populated land of the circumpolar region encompasses a diversity of ecosystems, from tundra and boreal forests to icy coastlines and permafrost landscapes. The Arctic is home to Indigenous Peoples and other Arctic residents. Indigenous Peoples and communities, with unique languages, knowledge systems, and ways of life, have rich cultural traditions and deep connections to the land. The nature-based way of

life of the Indigenous Peoples is the basis for their food security. The environmental changes, coupled with socio-economic disparities, infrastructure limitations, and governance complexities, underscore the multifaceted nature of the Arctic regions and the unique challenges for sustainability of the Arctic.

It can easily be argued that all the chapters in ECONOR are linked to sustainable development, given that the work on the ECONOR reports is anchored in the Arctic Council Sustainable Development Working Group. ECONOR presents knowledge on the economy, socio-economic conditions and impacts on the nature-based way of life, that enables the reader to look at these conditions through a sustainable development lens. Nonetheless, a dedicated chapter to the Sustainable Development Goals (SDGs) could foster further discussions about how the SDGs and possible future development agendas may be implemented in the Arctic regions to avoid that the Arctic is left behind.



Kangamiut village, Greenland. Photo: Colourbox

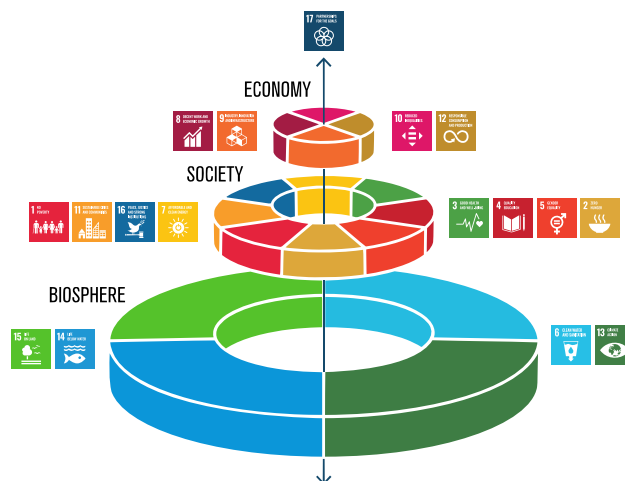
A global development agenda

The 2030 Agenda with the SDGs provide a universal framework for addressing pressing global challenges and advancing sustainable development. While often associated with developing countries and regions, the relevance of the SDGs extends to all countries regardless of development status and hence Arctic regions too where distinctive environmental, social, and economic factors shape the development dynamics. Thus, understanding the unique context of the Arctic regions in the three domains of sustainable development can help shape the path forward for policymakers as they look to grow the economy and preserve the environment for the people of the north.

The SDGs represent a global commitment to tackle the most pressing challenges facing humanity. Adopted by all United Nations Member States in 2015, the goals provide a comprehensive framework for achieving a more sustainable, equitable, and prosperous future for all by 2030. Comprised of 17 interlinked goals and 169 targets the SDGs address a wide range of issues, including poverty (SDG1), hunger (SDG2), health (SDG3), education (SDG4), gender equality (SDG5), clean water and sanitation (SDG6), affordable and clean energy (SDG7), decent work and economic growth (SDG8), industry, innovation, and infrastructure (SDG9), reduced inequalities (SDG10), sustainable cities and communities (SDG11), responsible consumption and production (SDG12), climate action (SDG13), life below water (SDG14), life on land (SDG15), peace, justice, and strong institutions (SDG16), and lastly the overarching and enabling goal of partnerships (SDG17). At its core, the SDGs embody a holistic approach to development, recognizing the interconnectedness of social, economic, and environmental dimensions. By addressing these dimensions simultaneously, the SDGs aim to foster integrated and sustainable solutions that *leave no one behind*.

Following the SDG Goals and Targets is a globally agreed upon indicator framework for monitoring global progress.¹ While international organizations with their sector specific responsibilities are custodians of these indicators, the efforts of measuring and reporting from the countries are often coordinated by national statistical offices. Well beyond the halfway point to 2030, there remain significant data gaps and measurement issues to be resolved. This is particularly germane in relation

Figure 11.1 Illustration of the 17 SDGs linking the three major dimensions – biosphere, society, and economy. Model by Stockholm Resilience Centre



to the notion of leaving no one behind. Being a key ambition of the 2030 Agenda it requires comprehensive coverage of statistical measurement across various population groups and geographies. This novel chapter of ECONOR highlights current reporting related to the SDGs and the challenges of measurement in the remote areas of the Arctic with official statistics.

The 17 Goals cannot be examined in isolation. Each *Goal* is interconnected and action towards one may have impacts, positive or negative, for the possibility to succeed in another. The Stockholm Resilience Institute illustrates a concise way to describe how the goals are interconnected and interdependent. Each of the goals is grouped in the three domains of sustainable development; biosphere (environment), society and the economy, as illustrated in Figure 11.1. With the placement of the economic and societal goals as the inner circles with the biosphere goals surrounding them, the model illustrates how goals in each of the domains are intertwined and interdependent and that actions in one domain have spillover effects in another.

The challenge of balancing the goals

There has been a significant amount of research conducted on the interlinkages of the SDGs.² In general, this research highlights that there are both positive and negative externalities of policy actions taken. Hence it is imperative that policy makers understand how policy actions in one domain reverberate across the goals. Even the FAO has noted that eradication of hunger and malnutrition will

affect land, water, energy, biodiversity and climate as food production generates greenhouse gas emissions.³ At the same time elimination of hunger will reduce food-related non-communicable diseases and health expenses. More specifically, in the context of the Arctic regions, where resource development is often a key component of economic growth, expansion or development of resource industries will have positive impacts on the economic and social well-being of the population. At the same time, there are negative externalities of resource industry development on the environment that impact societal well-being and threatens a nature-based way of life. While it is impossible to eliminate negative externalities, it is important to understand and balance the trade-offs of all policy interventions as they may have impacts locally, regionally and even globally.

While the SDGs may align with sustainable development priorities in the Arctic at the *Goal* level, the policy priorities of the region may differ somewhat from the global targets and subsequently how progress is measured. This relates to the unique characteristics of Arctic nature and population and the issues faced by its inhabitants, the economy and environment. However, with the impacts on the Arctic of climate change and global natural resource demand, the importance of measuring sustainable development, as basis for informing policy, cannot be underemphasized.

The lived experience of the Indigenous Peoples, and the unique nature of the Arctic economies, need to be better reflected in international discussions of regional relevance of the global SDG framework. Policy efforts to promote sustainable development in the Arctic must be grounded in an understanding of the unique challenges and opportunities of the Circumpolar Arctic with its large variations in nature and livelihoods, and considering the interplay of environmental, social, cultural, and economic factors in shaping the path of the Arctic towards a more resilient and equitable future.

However, measuring progress on the SDGs in many of the Arctic regions is not easy for several reasons. The remoteness and severe weather conditions, combined with a sparse yet diverse population presents unique challenges which makes it difficult to measure and monitor the SDGs as data



Mining, Svalbard. Photo: Colourbox

collection in these conditions is challenging. Focusing directly on the global targets and monitoring could easily make implementation of the SDGs at lower geographic levels and in these regions more difficult to approach. Still, it is at the national, regional and local level that many of the actions need to be taken. An important prerequisite in the 2030 Agenda is that the SDG Targets are defined as *aspirational and global, leaving it up to governments to set its own national targets taking into account national circumstances*. This is also reflected when it is encouraged to complement the global indicators with regional and national indicators.⁴ It leaves a flexibility in the implementation that may not have been utilized to its full potential in national and regional operationalization of the SDGs.

The challenge of the interlinkages between the Goals and how an achievement in one of the dimensions can hinder the ability of reaching another is something well-known. Given the complexity and interlinked nature of the economy, society and the environment, it is virtually impossible to achieve all the goals by 2030 at the global, national, regional or local levels. However, keeping an eye on the overarching ambition of the SDGs with continued and consistent metrics may be helpful for the implementation at all levels.

The follow-up of the SDGs in Arctic countries

The adoption of the 2030 Agenda and the SDGs in 2015 came with an expectation that countries, regardless of development status, would act at the national level according to the ambitions set out in the plan. In many countries, new governance structures were created, or existing governance was adapted to address the SDGs. To a various degree Arctic countries have made follow-up strategies



Hiking trail path in Greenland. Photo: Colourbox

and implementation plans. The SDGs emphasize the importance of collaboration, partnership, and collective action – from local communities to national governments to international organizations – in order to achieve meaningful progress towards the goals.

A report from the research institute Nordregio from 2023 provides an overview of national approaches to the 2030 Agenda in the Nordics.⁵ It finds that a common approach by all states is the establishments of dedicated bodies or councils to oversee SDG implementation involving multiple ministries and stakeholders and with strong emphasis on cross-sectoral coordination and collaboration among government agencies, civil society, and the private sector. Annual reporting mechanisms to the parliamentary level are used by many of the Nordic governments while in Canada an annual report is made public. While national reviews provide a macro-level perspective on a country's progress towards the SDGs, local reviews offer a micro-level view, focusing on the specific contributions and challenges at sub-national levels. Both types of reviews are essential for a holistic un-

derstanding of SDG implementation. Ultimately the solutions to how the SDGs are implemented will necessarily be an interplay with public and private sector, academia and civil society.

In Canada, domestic implementation of SDGs began in 2018, with the establishment of a Sustainable Development Goals unit housed within Employment and Social Development Canada. The unit was established to enable better coordination among all levels of government, civil society and the private sector in the achievement of the SDGs. In 2021 a national strategy with five core objectives was created, followed by a Federal implementation plan which outlines the roles and responsibilities of all Federal departments and agencies and assigns policy leads to Goals.⁶

Key to the strategy and one of the five objectives in the National Strategy is Reconciliation with Indigenous Peoples and the 2030 Agenda. This objective notes that the Government of Canada's approach to implementing the SDGs is founded upon respecting the right of Indigenous Peoples self-determination and respecting the distinction

between First Nations, Inuit and Métis Nations governments, institutions and people. The annual SDG report prepared each year highlights the results of consultations with Indigenous groups related to SDGs and actions taken by National Indigenous Organizations.

Localization of SDGs has been undertaken by some provinces and municipalities and community groups. Campaign 2000 is a set of community-based indicators that have been developed to supplement the Canadian Indicator Framework.⁷ This indicator set is centered on Goal 1 (No Poverty) and indicators are organized by 12 interdependent dimensions which link to other SDG goals such as Education, Decent Works, Food Security, Equality and Justice. Several Communities in the Yukon, Northwest Territories, and Nunavut are highlighted noting their priorities for indicators under the twelve dimensions.

Specific to Canada's North is the Arctic and Northern Policy Framework.⁸ The 2030 Agenda for Sustainable Development poses one of the key international commitments that inform the Framework. The ambitions of the Arctic Framework match the ambitions laid out in the SDGs. Under the Arctic Framework there are eight goals with several objectives linked to the goals. Specific to measurement, under Goal 4 of the Arctic Framework, one of the objectives relates to support development of data collection, production and measurement specifically focused on Arctic and Northern populations. Another objective linked to Goal 4 relates to creating and storing knowledge in a manner consistent with the self-determination of Indigenous peoples, balancing ethics, accessibility and culture.

There are several examples of how the SDGs are utilized at regional and local levels to inspire local policies in the Arctic. However, the comprehensive nature of the SDGs makes it impossible to cover them all within the priorities of municipality or local community. The importance of the different goals will also vary to a large degree, and in the Nordic context it has been pointed out the low perceived relevance of *SDG 1 No Poverty* and *SDG 2 Zero Hunger*. While this may be the case in relatively wealthy regions of the Nordic countries, poverty and food security may be of high importance in other Arctic regions.



Kangerlussuaq airport, Greenland. Photo: Colourbox

This can be further related to the traditional way of life of Indigenous Peoples of the Arctic, with food security based on the Arctic food systems and based on traditional use of land and sea. This is increasingly challenged by the global need for transitioning towards sustainable energy sources (*SDG 7 Affordable and clean energy*) with less carbon footprint (*SDG 13 Climate action*). At the same time *SDG 14 Life below water* and *SDG 15 Life on Land* calls for increased regulation, conservation and protection.

Another example of where goals can be directly in conflict at a regional and local level is the forestry sector as a core economic activity in Finnish Lapland (*SDG 8 Decent Work and Economic Growth*) which provides solutions for *SDG 11 Sustainable Cities and Communities* while at the same time is challenging *SDG 13 Climate Action*. Simultaneously, it could pose a conflict regarding land use as well as require improvements towards a more sustainable forest management (*SDG 15 Life on Land*) which in the short run could have negative impact on economic profitability.

Localizing the SDGs

While the global indicators have been developed by applying a global lens to the issues described in the respective goals and targets, the 2030 Agenda encourages the development of additional indicators to be used at regional and national levels.⁹ There is thus an acknowledgement of the large variations and differences in regional and national, including sub-national, challenges and needs in the follow-up of the SDGs. This also applies to the circumpolar Arctic as one global geographical region as well as within the countries and their sub-national Arctic regions.

Highlight 11.1. A territorial approach to the SDGs – example from Kópavogur in Iceland

From 2018, the OECD has been supporting cities and regions across the world with their project *Territorial approach to the SDGs*. The OECD states that the SDGs represents a common framework that neighboring municipalities can use to strengthen collaborations and to co-ordinate actions as well as being a vehicle to enhance accountability and transparency through engaging all territorial stakeholders, including civil society, citizens, youth, academia and private companies, in the policy-making process¹. The framework has been developed by the OECD in collaboration with administrative regions in several OECD member states with the result that the OECD is also able to present a selection of the SDG indicators at territorial level made available in their data explorer².

One community in the Arctic that has used this approach is the municipality of Kópavogur in Iceland that actively participated in the process and has subsequently formulated new plans and strategies based on the SDGs.

Kópavogur has prioritized 15 of the SDGs and 36 of its targets in their strategy based on the objectives of the government of Iceland, on SDG targets that falls within the scope of municipalities as well as other commitments such as to implement the UN Convention on

the Rights of the Child³. In addition, relevant context-specific targets have been added. Performance on the selected goals and targets are measured using an index consisting of 94 indicators where they follow their own performance over time⁴.

Kópavogur is located in a booming central area of Iceland, one of the fastest growing economies among OECD countries. Despite the positive developments in many areas, there are also structural challenges for the community as it is heavily reliant on tourism and the fishery as well as facing rising pressure on their social services due to population growth, only to mention a few⁵. One of the benefits of the SDGs is that they are comprehensive enough to allow for developments such those in Kópavogur to be measured and also enables the impacts (both positive and negative) of these developments to be assessed and measured through the localization of relevant goals, targets and indicators in the SDG framework.

³ Kópavogur. The method for Kópavogur. Retrieved 20.11.2024 from <https://www.kopavogur.is/sdg#the-method-for-kopavogur>

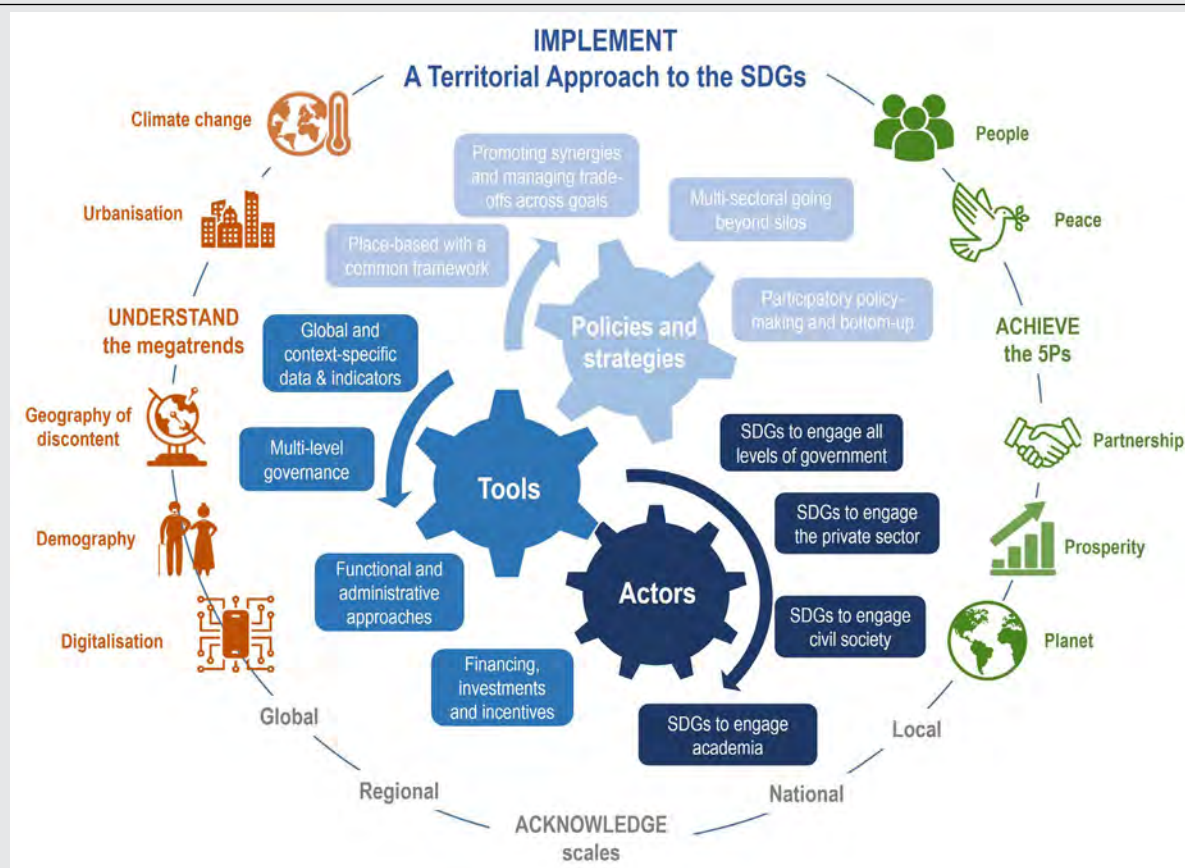
⁴ Kópavogur. Performance indicators. Municipality of Kópavogur. Retrieved 20.11.2024 from <https://kopavogur.nightingale.is/Sdg/Ring?origin=1>, Kópavogur. Sustainable Kópavogur. Retrieved 20.09.2024 from <https://www.kopavogur.is/sdg#performance-measurements>

⁵ Kópavogur. Performance indicators. Municipality of Kópavogur. Retrieved 20.11.2024 from <https://kopavogur.nightingale.is/Sdg/Ring?origin=1>, Kópavogur. Sustainable Kópavogur. Retrieved 20.09.2024 from <https://www.kopavogur.is/sdg#performance-measurements>

¹ OECD. (2020). A Territorial Approach to the Sustainable Development Goals. <https://doi.org/doi:https://doi.org/10.1787/e86fa715-en>

² <https://www.oecd-local-sdgs.org/index.html>

Figure 1. An Analytical Framework for a Territorial Approach to the SDGs



Source: A Territorial Approach to the Sustainable Development Goal, OECD

In recent years there has been a stronger focus on localizing the SDGs including the development of regional and sub-national monitoring systems. In 2024 it was reported collectively from the Nordic regions in a Nordic Voluntary Sub-National Review, edited by Nordregio.¹⁰ The report based its conclusions on surveys deployed to all the regions and municipalities in the Nordic countries throughout 2023. Important success factors and key challenges in implementing the 2030 Agenda were identified. Political prioritization and the capacity to work with the agenda are two factors mirrored as success factors and key challenges.

Where local authorities have been successful, the 2030 Agenda is anchored in the administrative management systems and efforts that have been done to translate the global goals into a local context. However, the lack of resources and capacity in terms of people and money was identified as serious obstacles across all the Nordic countries. SDG monitoring seem to be linked to the development of regional and local indicators that reflect the issues and priorities at local level.

The conclusions of the Nordic Voluntary Sub-National Review could inspire regional and local authorities across the Arctic to translate the goals and targets into their local context. However, considering that most Arctic regions are sparsely populated, the potential lack of resources to work with the SDGs must be considered.¹¹ On the other side, a strength is the culture of collaboration, sharing of good practices and comparing as well as the relatively strong local level self-governance model. The project also made available a Nordic Toolbox where a large variety of initiatives relevant for the SDGs are shared.¹² Examples stretching from a report on climate change in Sápmi published in 2023 by the Sámi Parliament in Norway and the Saami Council in Norway¹³ to the Sermersooq Youth Municipal Council in Greenland, from development of methodology and guidelines for climate adaptation in five Icelandic municipalities, to the decision by the municipality of Luleå in Sweden to set gender equality requirements in their procurements.

National reporting on the SDGs

The UN member countries deliver progress reports on their national and sub-national to the UN on a voluntary basis.¹⁴ This is an opportunity to highlight developments and challenges within all the SDGs,



The Norwegian UN Association has translated the SDGs into north, south, and lule Sámi languages. Here from the launch of the north Sámi language translation in Tromsø, October 2019. Photo: The Norwegian UN Association

and the involvement of stakeholders can shed light on remaining issues seen from several perspectives. Since 2016, Canada, Finland, Iceland, Norway, Russia and Finland have reported once or twice about their implementation of the 2030 Agenda through *Voluntary National Reviews (VNRs)* to the UN. Finland and Norway are planning for a third round in 2025 and Canada in 2027. Since Greenland and Faroe Islands has no direct reporting to the UN they are in dialogue with The Kingdom of Denmark about future progress reporting to the UN.¹⁵

Available global indicators are often presented as annexes to the VNRs based on statistics and other information compiled by the national statistical offices. Nonetheless, the format of such annexes in form of reports limits the visibility of disaggregated information and hence information about sub-national levels and various breakdowns will need to be obtained from reporting platforms or special focused reports.

Based on the global indicators, statistical indicator platforms or regular indicator reports have been established by all the countries in the Arctic region, including Greenland and Faroe Islands. Several of these are also populated by indicators beyond the global indicator framework to better monitor the SDGs in a national context. This is regarded as an important tool for the national follow-up of the SDGs. Yet, the lack of necessary geographical breakdowns leaves several of the Arctic regions without indicators either measured or reported at their level.



In total, 13 000 inhabitants in Northern Norway did the “hike for the SDGs” in Bodø in 2019 and Tromsø in 2020. The campaign was initiated by the Norwegian Aid Agency (Norad) to spread knowledge about the SDGs. Photo: Norad.

The level of disaggregation of reported indicators in official SDG reporting varies much across the region and except for the states fully located in the Arctic (Greenland, Faroe Islands and Iceland), only Russia presents disaggregated data for all their regional divisions for at least a sub-set of the global or national indicators. Where data are available for the 3 northern territories in Canada, disaggregation is provided for the Global and domestically developed SDG indicators. Additionally, disaggregation for various populations, including the Indigenous population, can be found on the national data hub where data are available.

The three Nordic countries Finland, Norway and Sweden, are all reporting on the globally decided indicators. To a various degree, nationally determined indicators are reported on and used as a supplement. As of 2024 there is however a lack of official and systematical geographically disaggregated indicators for regions and municipalities presented in the context of the SDGs. However, their statistical systems are largely built on administrative data sources and by this the national statistical offices should be rather well placed to make sev-

eral of the relevant SDG indicators available at sub-national levels. It is also likely that several of the SDG indicators, or the statistics needed to produce them, are already published within their respective statistical domains although not presented collectively as SDG indicators. Though it should be noted that variables on ethnicity is not collected for the purpose of official statistics in the Nordics and is therefore neither to be expected available from official SDG monitoring.

From Rosstat, data for the Russian regions are reported regularly for 31 of the 231 global indicators and 112 of the currently 176 nationally decided indicators in annually updated tables and reports.¹⁶ All the Russian Arctic regions (chapter 1 for overview) Arkhangelsk, Chukotka, Karelia, Khanty-Mansii, Komi, Magadan, Murmansk, Sakha, Yamal-Nenets, are represented in the statistical handbooks published by the national statistical office Rosstat.

In Canada, a set of Canada specific indicators that measure Canada’s domestic SDG priorities has been developed and released in a separate Cana-

dian Indicator Framework data hub.^{17,18} In addition to periodic reporting through the UN Voluntary Review of SDGs, the policy department responsible for SDG implementation in collaboration with the national statistical office releases an annual report on SDGs.¹⁹ These reports highlight Federal policy actions that are linked to the SDGs and also highlight select indicators related to the goals. However, data availability for the Canadian Arctic territories is limited. This is in part a result of the vast geographic areas of the three northern territories coupled with their small populations which makes it difficult to collect the same level of information as is available in the more populated provinces of Canada. Much as is in the case of the Nordic countries, there are various degrees of reporting on both the global and national SDG indicators.²⁰ In the case of Canada specific SDG indicators, the level of geographic disaggregation has increased for the three territories but there is still limited data availability for the global SDG indicators.

The lack of systematical disaggregation of the globally harmonized indicators presents a challenge when presenting performance on the SDGs across the Arctic. At the same time, not all global indicators will be either measurable or provide useful information for implementation of the SDGs at a regional and local level. On the other hand, there is a need for making regionally disaggregated data for indicators where these are applicable if Arctic issues are to be highlighted or discussed. Although some research or more ad-hoc data collection exists in some of the regions, using them for comparing over time or in space is challenging. Then the importance of qualitative assessments should not be underestimated as especially important for remote Arctic communities where collection of quantitative data can be challenging. Creating common knowledge bases combining qualitative and quantitative information and indicators fit for local level implementation together with indicators that better address relevant issues across the Circumpolar Arctic, could be a powerful tool for advancing on the SDGs in the Arctic regions.

Measuring progress on the SDGs in the North

The SDGs have the potential to help address challenges faced by Arctic residents, including poverty, limited access to basic services, food insecurity, vulnerability to the impacts of climate change, and



Lapland, Finland. Photo: Colourbox

limited participation in political decision-making processes. Yet the extent to which this potential translates into reality depends in part on the extent to which the SDGs are appropriate and traceable. To date, no Arctic state is measuring and reporting on the full global SDG indicator set. Partly because not all indicators have a significant relevance to allocate resources to nationally and partly because data is difficult or resource demanding to collect.

The lack of data coverage will in most cases be even more incomplete at regional or local levels than at the national level. The variable conditions of remote and sparsely populated regions are at particular risk of being obscured through the aggregation of national level reporting. For Arctic nations, this might include the numerically small populations, many of whom are Indigenous, who reside in the most northerly and remote regions of Arctic states.

Studies by Bogdan et al (2023) found that in northern Canada only half of the global indicators for *SDG 2 Zero Hunger*, *SDG 6 Clean Water and Sanitation*, and *SDG 7 Affordable and Clean Energy* are publicly available. Indicator data for *SDG 2 Zero Hunger* were found to be most underrepresented, with no data available for the prevalence of undernourishment (2.1.1), prevalence of stunting (2.2.1), prevalence of malnutrition (2.2.2), and the proportion of agricultural area under productive and sustainable agriculture (2.4.1).

Although the Indigenous Peoples represents less than 5 per cent of the total Canadian population, this group does represent a large proportion (about 50 per cent) of northern residents who suffer disproportionately from food insecurity.²¹

Highlight 11.2. Youth awareness of the SDG in the Arctic

Studies conducted outside the Arctic have found that youth, even when operating without government support, have demonstrated the ability to effect real change in support of the SDGs^{1,2} Notwithstanding this potential, studies have also found low to very low awareness of the SDGs among youth in nations of the world³.

In 2023, an on-line survey was administered to youth (ages 16-24) in Alaska and northern Canada to gauge their awareness of the Sustainable Development Goals. This survey was an initial stage of research supported by the Finnish Foreign Ministry under the title Youth and Indigenous Peoples’ involvement in climate change adaptation in the Arctic and Barents Region. Overall, 86 per cent of respondents feel the sustainable development of the Arctic is important. However, only 65 per cent are aware of the Sustainable Development Goals. This awareness is differentiated by state/country of residence and by gender. The results of the survey indicate that 80 per cent of respondents in northern Canada are aware of the SDGs, whereas 53 per cent of Alaska respondents have the same awareness. Simi-

larly, 73 per cent of female respondents said they are aware of SDGs, compared to 56 per cent of men (Table 1).

Indigenous governments and organizations across the Arctic have called upon “States, governmental authorities, corporations, research institutions and civil society to weigh heavily the messages, priorities, and perspectives of youth and to empower them for leadership and success”⁴. However, unless the youth of the Arctic are aware of the SDGs, why they exist, or the urgency with which we must achieve them – it is not likely they will be in the position to take informed action⁵.

Table 1. Youth awareness of the Sustainable Development Goals. Per cent

Statement	Over-all	State/Country		Gender	
		Alaska	Canada	Female	Male
I am aware of the United Nation's 17 Sustainable Development Goals	65	53	80	56	73
Sustainable development of the Arctic is very important to me	86	82	91	87	87

¹ Barber, K., & Mostajo-Radji, M. A. (2020). Youth Networks: Advances Toward the Sustainable Development Goals During the COVID-19 Pandemic. *Frontiers in Sociology*, 5. <https://doi.org/10.3389/fsoc.2020.589539>

² Bastien, S., & Holmarsdottir, H. (2017). The Sustainable Development Goals and the Role of Youth-Driven Innovation for Social Change. In (pp. 3-22). https://doi.org/10.1007/978-3-319-66275-6_1

³ Annadurai, D. (2020). Knowledge of youth on sustainable development goals (SDGs). *Global Journal for Research Analysis*, 1-2. <https://doi.org/10.36106/gjra/4508729>

⁴ Inuit Circumpolar Council (ICC, 2023). Statement of the Arctic Peoples’ Conference 2023 – Inuiaat Issittormiut Ataatsimeersuarnerat. <https://www.inuitcircumpolar.com/news/statement-of-the-arctic-peoples-conference-2023-inuiaat-issittormiut-ataatsimeersuarnerat-2023/>

⁵ SDSN. Youth and Sustainable Development: The Case for Student Action on the SDGs. Retrieved 21.11.2024 from <https://www.sdsnyouth.org/blog-posts/04-30-youth-and-sustainable-development-the-case-for-student-action-on-the-sdgs>

However, data collection for northern Canada excludes Indigenous peoples living on reserve or other indigenous settlements, thereby obscuring the conditions those who are often most vulnerable.²² Other data omissions were found for Indicator 6.1.1, which measures the number of long-term public drinking water advisories. These advisories are used to warn people not to drink water that may be unsafe. These data, however, only apply to publicly funded drinking water systems and do not include private systems, such as residential wells or water that is transported privately from springs, streams, and other water bodies, which is a common practice in many Indigenous communities.

Furthermore, the data used for water advisories are derived from communities south of the 60th parallel, thereby excluding Canada’s northern territories. This is problematic given the frequency of which water advisories are being issued annually in northern communities yet are not accounted for in Canada’s SDG reporting.²³ The challenges of data availability are also compounded by data quality

and specifically the timeliness of data collection and updating. Again, specific to SDG 2 Zero Hunger, SDG 6 Clean Water and Sanitation and SDG 7 Affordable and Clean Energy, only 61 per cent of indicator data were collected since 2020, with 19 per cent collected between 5–10 years ago and 20 per cent collected and published more than a decade ago.

Despite the measurement challenges of the Arctic, there has been work done on examining sustainable development in the Arctic regions. In terms of the SDG indicators specifically, Nilsson and Larson (2020) examined previous research to determine the appropriateness of the Global SDG indicator framework to the North. They found that generally the goals, targets and indicators are relevant and applicable but note that heterogeneity across the Arctic, making a single regional framework for the Arctic difficult. However, they noted issues that are specific to the Arctic that could be added to the framework. One overarching theme that was common across the goals and missing from the current

framework is the lack of attention to the lived experience of the Indigenous population, the impact of climate change across the goals, and the unique nature of the northern economies themselves. This could be better reflected if developing an SDG framework for the North.²⁴

Other work that has been undertaken that relates to Sustainable Development is the Arctic Social Indicators (ASI).²⁵ The origin of the ASI was the creation of the Arctic Human Development Report process. For the first iteration of the social indicators, indicators were developed under three domains of well-being: Fate control, Cultural vitality and Contact with nature. Under its second iteration (ASI II), three domains related to Health and population, material well-being and education were added to the three existing domains. Indicators were established to measure the domains based upon data availability and affordability, ease of measurement, robustness, scalability and inclusiveness.²⁶

Seven indicators came out of this process that allow for the assessment of human development in the Arctic. Several case studies show that there are differences in data availability across the areas of the Arctic and ASI-II highlights the data challenges as well as the heterogeneity of the region. This will be directly comparable to the situation of measuring the SDGs.

There are other geographical regions where the SDG framework has been modified to better reflect the region's unique features and issues. One example is the Caribbean Community (CARICOM) where among these 15 small islands developing states (SIDS), the regional statisticians have determined that 125 (initially 113) of the global SDG indicators can be considered "core indicators" for the region.²⁷ These indicators also align to the SAMOA Pathway which was developed to address the unique challenges in SIDS countries. There were four specific criteria for the selection of the CARICOM Core Indicators which included: indicators must reflect the unique vulnerabilities of CARICOM SIDS; the ability to measure SDGs in the context of leaving no one behind; indicators must be comparable at the national, regional and international level and; indicators should be linked to the national and regional planning program and priorities for CARICOM countries.



Fishing cutter in the North fjords of Iceland. Photo: Colourbox

The Arctic region could consider undertaking a similar exercise such as was done in the SIDS countries to determine sustainable development priorities (targets) and how to measure them. A set of Arctic specific goals and targets will benefit from being developed in an inclusive process where Arctic specific challenges and inter-dependencies are outlined. Such a process could comprise the development of Arctic sustainability indicators. But even a set of Arctic specific goals and targets would have to be operationalized in the regions of the Arctic, and indicators will also be most useful if associated with some priorities and needs at the level it is intended to apply.

Weak involvement of Indigenous Peoples in the formation and monitoring of SDG

Unlike the Millennium Development Goals (MDGs), the SDGs sought to actively encourage the participation of Indigenous peoples in all stages - from conceptualization to monitoring overall progress. The involvement of Indigenous peoples was considered particularly warranted given their shared history of marginalization and poor socioeconomic and health conditions compared to non-Indigenous populations.²⁸ For example, despite comprising only 6 per cent of the world's population, Indigenous peoples account for 19 per cent of those living in extreme poverty.²⁹ The deliberate inclusion of Indigenous peoples therefore played a pivotal role in extending the scope of the SDGs, which span multiple dimensions of sustainability (UNPFII, 2015). Despite this seeming progress, the SDGs have not escaped criticism, with the practical, conceptual, and ideological bases that inform the SDGs being scrutinized by Indigenous peoples and scholars alike. This criticism is discussed below in terms of exclusion, framing, and Indigenous rights.

Highlight 11.3. CARE Principles for indigenous data

Indigenous data governance and data sovereignty are centered around the CARE principles which have been formulated by the Global Indigenous Data Alliance (GIDA). These principles were developed to address what was seen as a gap in the FAIR principles related to open, accessible and reusable data. The CARE principles are people oriented and seek to ensure the responsible use and control of data related to Indigenous populations, where the principles ensure Collective Benefit, Authority to Control, Responsibility and Ethics related to the Indigenous data usage.



Source: CARE Principles — Global Indigenous Data Alliance (gida-global.org)

From the outset of goal setting, some Indigenous peoples indicated a sense of alienation, suggesting that to be included required conformity to the values and interests of those framing the SDGs.³⁰ As Mulindwa (2020) notes, they failed to heed the lessons of the MDGs, where diverse realities, needs, and concerns of Indigenous peoples went unaccounted for.³¹ Others have noted that the engagement of Indigenous peoples was not only ineffectual but rather openly resistant to Indigenous participation which was made apparent through the withholding of funding, resourcing, and other exclusionary tactics.³² The consequences of this exclusion have been the negating of opportunities for Indigenous peoples to offer self-determined forms of development that are grounded in their own conceptualizations of sustainability.³³

In the absence of meaningful Indigenous involvement in the development of SDGs, including their worldviews and conceptual understandings of development, it is no surprise that the final selection and wording of the SDGs has been criticized for conveying a more dominant and colonial narrative³⁴. Cummings et al. (2018) found that developed countries and corporate interests had a significant influence on the final language of Agenda 2030

and the ultimate shaping of the SDGs.³⁵ This most often involved the exclusion of transformative and participatory language in favor of techno-scientific-economic approach. With an emphasis placed on statistical measures, SDGs reinforce negative stereotypes.³⁶ Yap and Watene (2019) note that the use of quantitative indicators often depicts Indigenous peoples as ‘underperforming’, which leads to the imposition of targeted interventions designed to improve the conditions of Indigenous communities based on the preferred outcomes of government.³⁷

Whereas some scholars were optimistic that the inclusion of human rights principles in the SDGs would afford greater opportunities for Indigenous peoples, most have come to accept that “the collective rights to land, health, education, culture and ways of living” will not likely be advanced by the SDGs.³⁸ The exclusion of Indigenous rights in the SDGs has in effect compounded the existing threats Indigenous peoples confront in the arrogation of Indigenous lands and practices. Some authors suggest that the SDGs are being used by public and private interests to legitimize the continued incursion and control of Indigenous lands, either through the dislocating effects of resource extraction or conservation efforts.³⁹ Not unlike the MDG, those framing the SDGs proved resistant to accept Indigenous peoples as rights holders, including the inherent Indigenous right to land and ancestral estates.⁴⁰ Treated as mere ‘stakeholders’ and parcel to the ‘public interest’, the SDGs have had disempowering effects, where the legacies of colonial encounters continue to manifest in Indigenous communities today.⁴¹

Positioning of the Arctic in a Post-2030 Agenda

In recent years, the developments towards the SDGs are challenged at many fronts. Increasingly, climate change makes livelihoods difficult in many corners of the world and imposes large costs for societies. The global pandemic of Covid 19 set many of the SDG targets back. This led to the need for renewed commitments from the UN member states. This was formulated in the *Pact for the Future* and adopted by the UN General Assembly in 2024 – to ensure that no one is left behind and includes a Declaration on Future Generations.⁴²

Highlight 11.4. A Taxonomy for SDG indicators

A taxonomy for classification of indicators related to the Sustainable Development Goals (SDG) was developed and published in 2021 by Statistics Norway in collaboration with the The Norwegian Association of Local and Regional Authorities (KS)¹.

The taxonomy can be a helpful tool when embarking at choosing indicators related to the SDGs or similar frameworks. By applying the same taxonomy to all indicators, it helps to clarify and compare both their uses and their usability, for users who work in different sectors or at different geographical levels. It can also make it easier to reuse indicators that have already been classified and evaluated by others.

There are three main dimensions in the taxonomy which provides a clear and logical structure:

- Goal, which tells us what an indicator is about, i.e., which SDG goals and targets.
- Perspective, which clarifies why or in which context the indicator is used and hence taking a user perspective.
- Quality, which measures how useful the indicator is, or to which extent it is fit-for-purpose, for example whether it is comparable at a given administrative level.



¹ https://www.ssb.no/en/natur-og-miljo/artikler-og-publikasjoner/_attachment/448340?_ts=1807042d9d8

The Pact for the Future is organized in action points. For Arctic communities especially action 32 about *protecting, build on and complement indigenous, traditional and local knowledge* and the decision to *foster synergies between science and technology and traditional, local, Afrodescendent and Indigenous knowledge, systems, practices and capacities* could be an important lever for engaging in the SDGs.

Closer to 2030, there will be decisions about a Post-2030 Agenda and possibly future development goals. Challenges highlighted in this chapter, such as unique nature of the region, its economy and

National SDG indicator platforms

Canada: <https://www144.statcan.gc.ca/sdg-odd/about-apercu-eng.htm>

Faroe Islands: <https://sdg.hagstova.fo/sdg-site/en/>

Finland: https://stat.fi/tup/kestavan-kehityksen-yk-indikaattorit-agenda2030_en.html

Greenland: <https://stat.gl/dialog/mainTheme.asp?lang=en&sc=VM&tname=t1>

Iceland: <https://heimsmarkmidin.hagstofa.is/en/>

Norway: <https://www.ssb.no/en/sdg>

Russia: <https://eng.rosstat.gov.ru/sdg>

Sweden: <https://www.scb.se/hitta-statistik/temaom-raden/agenda-2030/>

United States: <https://sdg.data.gov/>

society, the environmental sensitivity of the region, and coupled with a lack of data and the development of global indicators that may not be applicable to the Arctic, may still pose a risk to future commitments of such frameworks.

Indigenous communities and organizations are mobilizing self-determined movements, as called for by the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP), that challenge universal frameworks.⁴³ This includes developing Indigenous-centered goals and indicators to inform their own development priorities and mitigate the detrimental governance effects of international and national goal setting. Through these efforts, Indigenous peoples are reshaping the conversations and conceptions of what it means to be 'sustainable' and the cultural virtues of self-determined development. In advance of what comes after the 2030 Agenda, the Arctic region can have significant contributions to future development plans, also to ensure that the unique nature of the region is considered.

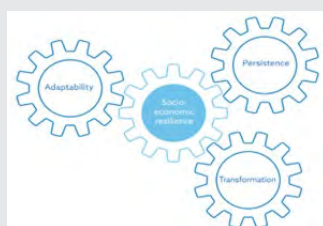
Regardless of whether the Arctic region embraces a global agenda and measurement framework after the 2030 Agenda for Sustainable Development, or whether the regions decide to build an Arctic specific set of indicators or use a subset of indicators in the spirit of possibly new agendas, the measurement of the three domains of sustainability is incredibly important to the region and could contribute to raise awareness of its challenges and opportunities.

Highlight 11.5. On resilience from BIN/Nord Universitet

Bjørn Olsen, Sissel Ovesen, Erlend Bullvåg and Andrey Mineev – BUSINESS INDEX NORTH (BIN-ARCTIC)

What is Resilience?

Resilient communities, regions and socio-economic systems are a prerequisite for developing a sustainable Arctic. The concept of resilience has undergone an essential development, moving from understanding it via the original meaning of “returning to the original state (bounce back), toward an understanding that a different and possibly better state can be achieved through adaption and transformation (build back better/bounce forward). Hence, what proved resilient in the past may or may not be resilient tomorrow.



BIN-Arctic¹ approach to assess Socio-Economic Resilience in the Arctic includes a combination of a region's capacities to cope with challenges (Persistence), adapt to changing conditions (Adaptability), and

transform its socio-economic systems (Transformation). We consider resilience as a process of mobilizing and developing all the three capacities simultaneously.

Hence, we define Arctic resilience as: “The capacity of Arctic regions and local communities to create a sustainable development path through dynamic processes of persistence, adaptability, and transformation, through activating the latent property of the natural, environmental, economic, human and social resources they possess or have access to, in response to global, regional and local challenges and opportunities.”

How to measure Arctic resilience?

Arctic resilience can be measured through a set of social, economic, demographic and environmental indicators. It is important to consider longer time series and analyze how indicators' values change in association with various “shock” events and factors (e.g. covid-19). Such a dynamic view is needed to understand resilience of the Arctic regions and socio-economic systems. The BIN-Arctic Online Resilience Monitor² have so far applied 10 comparable indicators of socio-economic resilience of the Arctic regions:

These indicators are selected based on the reviews of academic literature on socio-economic resilience.

¹ <http://www.businessindexnorth.com/>

² <https://app.powerbi.com/view?r=eyJrIjoiazDdjZTVINjMtZjg4Yi00OTg2LThmMjktOGRlZDA4ZDA2ODY1IiwidCI6IjNmNTA2MzdkLWZkMzYtNGVIM-S04NjAylWE4MzYxMjQ1NDE2MyIsImMiOj9>

OVERALL ASSESSMENT OF REGIONAL DEVELOPMENT

Population change (historical trend)
Population change (forecast)

PERSISTENCE

Community stability (share of regional population living in municipalities with positive demographic change)
Long-term economic growth (change in gross value added)
Out of Poverty (income distribution)

ADAPTABILITY

Attractiveness (net-migration trend)
Long-term job creation trend (change in employment)
Education attainment (level above basic education)

TRANSFORMATION

Share of employees in knowledge intensive services
R&D in business (number of staff)

Although the literature suggests a larger numbers of indicators, in practice, blind spots in open data as well as different statistical standards among Arctic countries are significant limitations. The project BIN-Arctic will continue to address these limitations by working toward extending the set of resilience indicators. So far, it is focused on socio-economic indicators. Among further steps are inclusion of environment and resource related indicators from the Water-Energy-Food Index³ framework as well as inclusion of social resilience indicators related to culture and tenants belongingness.

Leadership at the core of the relationship between Resilience and Sustainability

In developing the capacity of Arctic regions and communities to create a sustainable development path, we need leadership, Arctic leadership. Arctic leadership involves leadership for and with sustainability purposes and values, leadership in partnership, trust and dialogue-based leadership, engaging leadership, and innovation leadership. Arctic Leadership is at the core of the relationship between Arctic Resilience and Sustainability. To build resilient Arctic regions and communities, we need Arctic leadership to be able to respond to global, regional and local challenges and opportunities. Metaphorically, Resilience can be associated with a vehicle, and Leadership is about navigating and driving the vehicle on the strategically chosen road of Sustainable Development.

³ <https://wefnexusindex.org/>

Notes

- ¹ <https://unstats.un.org/sdgs/indicators/indicators-list/>
- ² See for example Pradhan, P., Costa, L., Rybski, D., Lucht, W., & Kropp, J. P. (2017). A Systematic Study of Sustainable Development Goal (SDG) Interactions. *Earth's Future*, 5(11), 1169-1179.
- ³ See: FAO Presentation_understanding trade-offs and synergies
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- ⁶ 2021, Her Majesty the Queen in Right of Canada. Canada's 2030 Agenda National Strategy - Moving Forward Together. ESDC-PUB-050-2030Agenda-EN-v9.pdf. Accessed December 5, 2024, and Canada's Federal Implementation Plan for the 2030 Agenda. Implementation-Plan_layout_EN_Web.pdf. Accessed December 5, 2024.
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- ⁹ United Nations General Assembly. (2015). Op.cit
- ¹⁰ Nordregio. (2024). The Nordic View on Sustainability - Learnings from the Local Level (2024:16).
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- ¹² <https://experience.arcgis.com/experience/f6674a8cb9f249fe8bb72b22ade8608b/page/Homepage/?draft=true>
- ¹³ <https://www.saamicouncil.net/en/climate-change-in-sapmi>
- ¹⁴ Nations, U. Voluntary national reviews.
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- ¹⁶ Rosstat. (2023). Sustainable development goals in the Russian Federation.
- ¹⁷ <https://sdgcif-data-canada-oddci-donnee.github.io/>
- ¹⁸ <https://www150.statcan.gc.ca/n1/pub/11-26-0004/112600042024001-eng.htm>
- ¹⁹ <https://www.canada.ca/en/employment-social-development/programs/agenda-2030.html>
- ²⁰ Statistics Canada is currently migrating its global SDG indicator hub to Open SDG which should be completed before the publication of this version of ECONOR.
- ²¹ Council of Canadian Academies. (2014). Aboriginal food security in Northern Canada: An assessment of the state of knowledge.
- ²² Bogdan, A.-M., Shah, T., Sidloski, M., Lu, X., Li, M., Ingram, S., & Natcher, D. (2023). What Gets Measured Gets Done: Challenges in Monitoring Water, Energy, and Food Security in Northern Canada. *ARCTIC*, 76(2), 225-233.
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Gjogv village on Eysturoy, Faroe Islands. Photo: Colourbox

12. Concluding remarks

Solveig Glomsrød, Gérard Duhaime and Iulie Aslaksen

The purpose of the ECONOR V project has been to give a comprehensive overview of the economy in the Arctic, including the traditional and emerging economies 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 states and from other relevant sources. 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 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 states. However, in natural resource-based economies, using data for GRP, or GDP at national level, to evaluate the well-being of the population can be especially misleading. A large part of GRP in resource-rich regions comprises normal return to fixed capital and resource rents, that can be taken out of the region. 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 in this report, to give a better picture of the consumption potential. The change in income during 2019-2022 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.

For the Indigenous Peoples, traditional economic activities are very important for providing nature-based food, as well as maintaining social relationships and cultural values. Traditional 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 the traditional economy and its importance for the well-being of Arctic Indigenous Peoples, policy-makers need more systematic knowledge on the traditional nature-based economic activities.

To deepen the understanding of the importance of the Indigenous Peoples' relation with the land and their traditional economic activities, this ECONOR report includes a chapter based on the dialogues with the Indigenous Peoples organizations that are Permanent Participants to the Arctic Council. The aim is to provide insight into both traditional and emerging Indigenous economies in an evolving Arctic.

Future ECONOR projects will aim to further strengthen the partnerships with the Indigenous Peoples represented in the Arctic Council, and other Indigenous Peoples in the Arctic, to achieve more insight into concepts of subsistence and food security that have different meanings in different cultural perspectives. More knowledge is needed on different roles of the Indigenous Peoples in Arctic economies. Indigenous economies are not only traditional nature-based economies, but also comprise Indigenous-led economic development corporations. In this report, this topic is highlighted with examples from the National Indigenous Economic Development Board in Canada, the Canadian Northern Economic Development Agency, EntrepNorth and other Indigenous-led enterprises. The increasing role and prominence of Indigenous-led economic development will be further acknowledged and explored 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 issues, such as long-range transported pollution, will limit the possibilities for the traditional nature-based economic activities in the Arctic. GRP is not adjusted for environmental damage, and the task remains to develop environmental statistics and indicators that can be applied complementarily with economic indicators.

Based on the experiences from the ECONOR projects, we see in particular a need to emphasize a direct focus on the 2030 Agenda and the Sustainable Development Goals. This is addressed in a new chapter discussing the Sustainable Devel-

opment Goals (SDGs) and the Arctic context and exploring challenges for localizing SDG indicators for Arctic regions. Despite the limited adaption of SDG indicators to Arctic regions, a great number of the indicators presented in this report have direct relevance for measuring progress towards the SDGs. The discussion of the relevance of the SDGs for the Arctic and the positioning of the Arctic in a Post-2030 Agenda will be continued in future ECONOR projects.

Among recent improvements in available statistical data, we point to the development of satellite accounts for tourism, that contribute to highlight the importance of tourism for Arctic regions. 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. In particular, one can aim to:

- Continue dialogue with national statistical offices of Arctic states to enhance statistical cooperation and establish an institutional basis for providing statistical information on the economy, livelihood and environmental impacts in the circumpolar Arctic.
- Further develop partnership with the Indigenous Peoples represented in the Arctic Council, and other Indigenous Peoples in the Arctic, 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.
- Create a space for partnership with the Indigenous Peoples, working in respect for the protocols of Sharing Circles. There is a need to meet in Sharing Circles, with Indigenous Peoples and researchers and other participants, sharing stories of how wealth and economic aspects of well-being are understood from Indigenous perspectives on their relation with the land.
- Establish statistical indicators for the traditional nature-based economy of Indigenous Peoples and local Arctic residents, to document the importance of nature-based livelihoods for economy, well-being, nutrition and culture. Such indicators could be developed as supplementary accounts (satellite accounts) to the national accounts. Discussions should take place with Indigenous Peoples Organizations about how indicators might be developed. These indicators 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.
- Explore economic and institutional characteristics of Indigenous-led corporations, including ownership structures, institutional contexts, Indigenous involvement, corporate governance, and how they contribute to serving the economy and well-being of Indigenous Peoples.
- Improve statistical indicators for social conditions, well-being, and inequalities, and among them, in particular, the risk of poverty rate and the wage share in total income in the Arctic economies.
- Present time series for core economic indicators in diagrams, to visualize development trends. Examine the development of demographic indicators over longer time periods.
- Improve indicators of disposable income of households by adjusting for in-kind transfers as public provision of health, social, and education services from the public sector, as presented for Canada and Iceland in this report.
- Call for research and statistical effort to provide regionally based price indices for Arctic regions for improved assessments of cost of living and livelihoods.
- Call on the national and international statistical community to secure access to separate data for the extraction and harvesting of natural resources and for the industrial processing of the resources, despite the increasing vertical integration of industries.
- Continue to improve and present statistical indicators relevant for the Sustainable Development



Kindergarden, Nuuk, Greenland. Photo: Birger Poppel

Goals, that set out a wide range of economic, social, cultural, and environmental objectives.

- Continue to link national account based industry data with environmental and climate data to facilitate a comprehensive analysis aligned with the 2030 Agenda and the possible development of a Post-2030 Agenda.
- Harmonize and present statistics communicating progress in the green transition, aligned with Sustainable Development Goals.
- Facilitate research on impacts of climate change and biodiversity loss on the Arctic economy and socio-economic conditions, by providing spatial data on population, capital assets and nature-based activities, in maps, to make socio-economic and economic data compatible with output from regionally downscaled climate models and ecosystem accounting.

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. To pursue these aims, ECONOR cooperates with the Canadian partnership Wealth of the Arctic Group of Experts (WAGE). The Economy of the North ECONOR 2025 has updated the earlier versions of the ECONOR reports and demonstrated the potential for both regular updating of statistics and expanded coverage of topics, to strengthen the knowledge base for informing policies for sustainable development in the circumpolar Arctic.

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The Economy of the North – ECONOR 2025

The Arctic regions belong to different national regimes and a consequence of this is that information on social and economic issues has been dispersed and not easily available at the circumpolar level.

This clearly applies to the information on the 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 global policies and trends and climate change. A central task of *The Economy of the North – ECONOR 2025* is to contribute to filling this gap by presenting a comprehensive overview of the scale and structure of the circumpolar Arctic economy