

# Arctic Business Analysis

## Bioeconomy



Entrepreneurship  
and Innovation



Creative and  
Cultural Industries



PPPs and Business  
Cooperation



**Bioeconomy**



# CONTENTS

<b>1.</b>	<b>Introduction</b>	<b>7</b>
<b>2.</b>	<b>Background</b>	<b>11</b>
<b>3.</b>	<b>Executive Summary of the Arctic Business Analysis</b>	<b>13</b>
<b>4.</b>	<b>The Nordic Arctic Business Environment: Bioeconomy</b>	<b>17</b>
4.1	Mapping of economic activities and policies	19
4.2	Drivers and enablers of business development	37
4.3	Recommendations	51
<b>5.</b>	<b>Cross-cutting issue across the Arctic Business Analysis</b>	<b>59</b>
<b>6.</b>	<b>Methodology</b>	<b>61</b>
	Bibliography	64
	Endnotes	65



# 1 INTRODUCTION

The Arctic region is increasingly attracting economic and political interest. New business opportunities are on the rise and Arctic stakeholders are playing a key role in facilitating and creating favourable conditions for boosting Arctic economic activity. There is currently a wide spectrum of business activities, of which oil and gas, mining, and shipping are well known. Nonetheless, the Arctic region holds great economic potential to be realised in other areas such as the (blue) bioeconomy, tourism, innovation and entrepreneurship, and indigenous cultural businesses through business activities and policies designed to address specific opportunities and needs of the region.

Business development in the Nordic Arctic must be rooted in its people(s) and have a drive to create innovative development, in which the Arctic's unique resources and human capital become competitive on a global scale. Urbanisation has especially highlighted the necessity of Arctic business development. Rural Arctic communities are under pressure, as younger generations want services, opportunities, and education offered in greater metropolitan areas. Arctic business development is therefore an existential issue because creating economic hubs of a sufficient size and critical mass would offer younger generations the quality of life they desire. In response, new technologies are revising the concept of "remote" and are rendering previously inaccessible projects economically feasible. Moreover, new technologies in transport, communication, raw material processing etc. are disrupting traditional business models and forcing business to innovate and to reinvent themselves.

The Nordic Arctic countries (through the Nordic Council of Ministers) and other Arctic states (through the Arctic Council and the Arctic Economic Council) have shown clear intentions of promoting the agenda

← A hunter from Sisimiut, Greenland.  
Photo: Mads Pihl / Visit Greenland

of sustainable economic development in the Arctic as the logical next step in the work in and for the Arctic. Sustainable development focuses on a balance between economic, social, and ecological dimensions, and aims to ensure that the needs of the present generation are met without compromising future generations' ability to meet their own needs.<sup>1</sup> As such, promoting sustainable economic development in the Nordic Arctic requires an understanding of the region's business environment and policy incentives, as well as the identification of opportunities for unlocking the Nordic Arctic economic potential, and the development of practical enablers to achieve this end – to the benefit of the entire Arctic. With this perspective in mind, the Nordic Council of Ministers, in collaboration with the Arctic Economic Council, has commissioned the consortium of Voluntas Advisory and the Confederation of Danish Industry (DI) to conduct this Arctic Business Analysis.

The Arctic Business Analysis covers the areas of Entrepreneurship and Innovation, Public-Private Partnerships (PPPs) and Business Co-operation, Bioeconomy, and Creative and Cultural Industries. Each area is covered in a separate publication. This report presents the findings for PPPs and Business Co-operation. The executive summary presents the findings across the four areas of the Arctic Business Analysis.

## Nordic Council of Ministers

The Arctic Business Analysis revolves around opportunities to promote sustainable economic development within the Nordic co-operation, specifically the Nordic Council of Ministers (NCM), as well as other Nordic Arctic stakeholders. It is therefore important to understand NCM's Arctic priorities and its organisational structure.

NCM is the official body for Nordic intergovernmental co-operation. The overall responsibility for this co-operation officially lies with the Nordic Prime Ministers. In practice, the Ministers for Nordic Co-operation, on behalf of the Prime Ministers, assume responsibility for the co-ordination of inter-governmental co-operation. Besides the Ministers for Nordic Co-operation, NCM consists of 10 ministerial councils (MRs) that cover different sectors and are supported by 16 committees of senior officials (EK). The work in the Minister Councils are handled within the Nordic Council of Ministers' Secretariat with a Secretary General responsible for the day-to-day operations of the intergovernmental co-operation and its 12 Nordic institutions and 3 Baltic offices.

NCM has since 1996 had an Arctic co-operation programme. A new Arctic co-operation programme, "Nordic Partnerships for the Arctic" for 2018–2021 will enter into force by 1 January 2018. The overall aim is to promote sustainable development in the Arctic with regards to the four themes of 1) peoples; 2) planet; 3) prosperity; and 4) partner-



↑ Raw musk ox wool.  
Photo: Visit Greenland /  
Mads Pihl

ships. Nordic Partnerships for the Arctic is an instrument available to the NCM and Nordic and Arctic stakeholders to promote the themes via project funding to selected projects. As a priority and criterion, the projects need to benefit the Nordic countries' Arctic endeavours and promote Nordic added value in the Arctic related to the stated objectives and themes. Nordic added value is important and can be defined in terms of:

- A project or an initiative that would not have taken place within a national framework, but is achieved with greater positive effects through common Nordic solution;
- A project or an initiative that displays and develops Nordic solidarity;
- A project or an initiative that increases Nordic competency and competitiveness.



## 2 BACKGROUND

In 2016 the Nordic Co-operation Minister (MR-SAM) decided to increase efforts supporting economic development in the Arctic. It was acknowledged that there needs to be more knowledge on the types of actions the Nordic countries and the Nordic Co-operation within the auspices of the Nordic Council of Ministers (NCM) could take. This led to the making of the "Arctic Business Analysis".

The overarching aim of the Arctic Business Analysis is 1) to provide a better understanding of the Nordic Arctic business environment as part of promoting a greater focus on enablers and drivers of sustainable economic activities in the Nordic Arctic and 2) to generate practical recommendations on how the Nordic Co-operation can promote economic activities in the Nordic Arctic through the establishment of a data foundation upon which to draw fact-based conclusions. The findings of the analysis will feed into NCM's Arctic Co-operation Programme in which sustainable economic development is a key theme. Specifically, the analysis will contribute to NCM's focus on economic development and investments in the Arctic – a political priority for the Nordic Co-operation.

In addition to outlining enablers and best practices that can promote sustainable economic activities on behalf of the Arctic population, the analysis is also aimed at contributing to NCM's work with the United Nations Sustainable Development Goals (SDGs). Overall, the analysis will contribute to sustained, inclusive, and sustainable economic growth (SDG 8) in the Nordic Arctic, and an inclusive and sustainable industrialisation and promotion of innovation (SDG 9). Moreover, it will analyse sustainable economic activities related to bioeconomy, creative and cultural industries, and business co-operation, which would promote affordable and clean energy (SDG 7), sustainable cities and communities (SDG 11), and life below water and on land (SDG 14 & 15) among others.

← Iceland.  
Photo: Tim Wright



← Old boys final at the East Greenland soccer football championships in Tasiilaq.  
Photo: Visit Greenland / Mads Pihl

### 3 EXECUTIVE SUMMARY OF THE ARCTIC BUSINESS ANALYSIS

All Nordic Arctic countries are paying more attention to the facilitation and strengthening of **entrepreneurship and innovation**. Denmark, Iceland, Sweden, Norway, and Finland perform very well, whilst limited data makes it difficult to assess Greenland and the Faroe Islands. Nonetheless, there are a number of potential developments which can help improve entrepreneurship and innovation environments across the Nordic Arctic regions. Firstly, entrepreneurial awareness and ability should be developed. This can be facilitated through an increased focus on integrating entrepreneurship education in national strategies, and also implementing such education through local initiatives and local operators. Secondly, collaboration between actors and regions in the Arctic should be ensured. Through such collaboration, the Arctic can improve its ability to diversify and fully utilise each other's entrepreneurial and innovative competitive advantages. Finally, the cultural bias that paints the region as an area with low economic and business development potential challenges Arctic development. This can adversely affect the region's ability to attract investments and capital. Overcoming this challenge through collaboration and branding the Arctic as a single market would therefore be a key driver for future entrepreneurial and economic growth in the region.

In the Nordic Arctic, **Public Private Partnerships (PPPs)** have not been used often as an infrastructure financing model. The region's limited experience with PPPs and the fact that standard PPP models in the market do not necessarily fit Arctic characteristics hamper the increased use of PPPs in the Nordic Arctic. Therefore, the public sector in the Nordic Arctic needs to collect data on PPP best practices and advice from PPP units in international organisations. Furthermore, there is potential to increase the competences of PPPs in the Nordic Arctic as a model to finance large-scale infrastructure projects. Initiatives should be taken to create an overview of Arctic infrastructure needs, expe-

rience, and supervise local governments and municipalities looking to engage in a PPP.

**Business co-operation** in the form of clusters in the Arctic are generally few, undeveloped, and still need to secure financing long-term, though local variations exist. Norway is a leading figure in supporting national cluster development through initiatives like Innovation Norway. Public support and increased cross-border co-operation are some of the drivers that will benefit cluster development in the Nordic Arctic. Public funding should ensure that business clusters can be created and developed while also ensuring a secure exit strategy so the clusters become financially sustainable. Furthermore, clusters can support their members and develop a greater market reach by co-operating across borders, as well as branding the region as a place for doing business.

**Bioeconomy** integrates a number of solutions for a sustainable future, both environmentally, socially, and economically. Bioeconomy is already an important economic segment in the Nordic Arctic, constituting 10% of the overall Nordic economy and moving towards 20% in some countries. Increasing the innovative use of biomass resources from land and sea presents a key opportunity to simultaneously ensure environmental sustainability and economic growth. Bioeconomy development should focus on increasing the value of products derived from biomass, and increasing the uses of sidestreams created by bioeconomy activities. These include practices such as the use of fish sidestreams for pharmaceutical products, wood residues in textile production or fish feed, etc. If bioeconomy in the Arctic is to be harvested, synergies between companies and industries must be built in both public and private sectors as well as across sectors and borders to facilitate the right public support and incentives to drive bioeconomy innovation, commercialisation and growth. Furthermore, the future bioeconomy requires substantial creative capabilities. Rebranding bioeconomy accordingly has the potential to attract a younger generation to an industry perceived as very traditional. As many bioeconomy activities are located in rural areas, developing bioeconomy also counters urbanisation, and promotes rural development and employment in the Nordic Arctic.

The Nordic Arctic **creative and cultural industries** of film, tourism, and indigenous cultural businesses are becoming increasingly important platforms through which the Nordic Arctic countries can create value and growth – economically, socially, and culturally. Despite significant variations in size and development, Nordic Arctic film industries are gaining considerable traction across the entire Nordic Arctic region. Policy support such as public funding and production rebates have been instrumental to the success of film industries, but ensuring long-term development requires knowledge sharing and collaboration in developing film production skills e.g. through official training across the Nordic Arctic. Nordic Arctic tourism has grown steadily in the last

decade. Public support, public-private collaborations, and transnational collaborations have been key in developing Arctic tourism. Transnational collaboration shows great potential, as Arctic regions, especially those in Finland, Norway, and Sweden, are generally perceived as one destination by the tourism market. Growth in Sami and Inuit indigenous businesses offer an opportunity for economic growth whilst integrating Arctic indigenous peoples into the regional and international economy. Business opportunities include indigenous tourism, film, and other cultural activities. However, it is important to ensure that Nordic Arctic Indigenous peoples' culture, life, and creative work are promoted and not misrepresented when developing these areas.

↓ Windmills, Hovoyssund, Northern Norway. Photo: Scanpix





## 4 THE NORDIC ARCTIC BUSINESS ENVIRONMENT: BIOECONOMY

In a broad interpretation, bioeconomy includes those parts of the economy based on renewable biological resources from land and sea to produce chemicals, health products, food, energy and many other products and materials. To face the increasing demand and challenges posed by a growing population, the development of bioeconomy coincides with the utilisation of biomass to its maximum potential in a sustainable manner. Utilisation must be sustainable in terms of volume and value. Every possible part of a biological resource should be used intelligently via innovative and efficient technologies, business models, and methods to create sustainable value where there was none before. In turn, this would simultaneously contribute to environmental sustainability, economic growth, and societal benefits including raising employment, rural community engagement, and public health.

The Nordic Arctic countries are at the forefront of global bioeconomy development. Bioeconomy makes up 10% of the overall Nordic economy and is moving towards 20% in some countries. Four key pillars of the Nordic bioeconomy have been identified: Collaborate, Circulate, Upgrade, and Replace.<sup>2</sup> "Collaborate" concerns companies in different sectors co-creating industrial synergies; regional authorities collaborating with industry to provide the right infrastructure and political incentives; and producers and official agencies engaging with civil society to ensure participation and ownership. "Circulate" relates to the creation of a circular approach for the use of biomass stocks that allows resources to be renewed to ensure symbiotic, sustainable solutions. "Upgrade" deals with unlocking the full potential of residues and waste as well as creating new, high value products from previously unexploited biological raw materials. Sustainable development of bioeconomy has the potential to replace unsustainable, often fossil based materials with bio-based

← Bladderwrack seaweed.  
Photo: Scanpix

resources, whilst maintaining a balance between achieving greater economic growth and supporting raw material availability. Together, these four pillars describe and provide a roadmap for the transition to a future economy based on sustainable production and consumption.

This section outlines the bioeconomy in the Nordic Arctic region by providing an overview of the primary trends and developments in the overarching bioeconomic segments: Blue Bioeconomy, Land-Based Materials, and Land-Based Food. The purpose is to provide an overview of the innovative and economic trends within these segments, as well as the political support and initiatives that aim to spur sustainable growth within them. The section will not only focus on traditional practices, such as fish farming in aquaculture or the use of wood for producing bioenergy, but will also identify new opportunities and alternative practices that expand and diversify the potential for bioeconomic growth. Finally, overall drivers and enablers of these bioeconomy trends will be presented.

↓ Westwood Lake Trail,  
Nanaimo, Canada.  
Photo: Laura Lefurgey Smith



## 4.1 MAPPING OF ECONOMIC ACTIVITIES AND POLICIES

### BLUE BIOECONOMY

Fisheries have long provided significant economic benefits in the Nordic Arctic. In 2014 exports of fish accounted for approximately 86.7% of total exports in Greenland, 95% in the Faroe Islands, and approximately 26% in Iceland. In accordance with its economic importance, the fishery industry is also an important provider of employment in the Nordic Arctic region. For example, the fishery industry makes up around 9% of Greenland's employment.

Corresponding to the industry's economic importance, Nordic Arctic governments are supportive of their fisheries. More direct forms of support include market privileges and subsidies. For example, the Faroe Islands provide such support to fisheries through subsidies in the amount of EUR 775 thousand per year. In contrast, Iceland provides

**SUMMARY:** The blue bioeconomy is the part of bioeconomy that is based on the sustainable and intelligent use of renewable aquatic natural resources. In this study, the blue bioeconomy focuses on fisheries, aquaculture, and the utilisation of other aquatic biomass such as algae. Nordic Arctic fisheries and aquaculture are global innovation leaders and are some of the most sustainable of their kind. Fisheries have long been an important industry in the Nordic Arctic region and are currently undergoing significant change. To further increase the sustainability and economic viability of limited fish stocks, recent developments focus on creating higher-value products from marine biomass. Fisheries and fish processors are increasingly utilising what was previously considered waste and increasing

the value per unit of biomass. In turn, aquaculture is rapidly gaining economic prominence. Nordic Arctic governments are dedicating more focused support through funding and legislation related to research to spur growth within the industry. If aquaculture is developed sustainably and coupled with increased utilisation of fish side-streams, the growth of this industry is a valuable opportunity for sustainable bioeconomic development. Furthermore, seaweed is an underutilised resource with great potential for consumer use in food, pharma, cosmetics, bioenergy etc. With these developments in mind, this section will outline primary trends in economic activity, policy incentives and innovations of the blue bioeconomy.



support through granting market privileges to residents and restricting fishing operations by non-residents. Nordic Arctic governments have also focused on the establishment of research institutes and funds, many of which are also dedicated to aquaculture research. These institutes include the Faroese Kalbak Marine Biological Lab, and Iceland's Marine Research Institute as well as NOFIMA (National Facility for Marine Bioprocessing) in Norway. The funding of such institutes has been vital to the development of innovative processes and technologies that allow for upgrading the value of fish products through increased utilisation of side-streams. Further, important prior funding opportunities include Greenland's Department of Business, which has set aside the equivalent of EUR 672 thousand to support the establishment of fishery production facilities in rural districts. Certain research facilities and research funding are also directly connected to the fishery industries. For example, the Faroe Islands have established a Fisheries Research Fund to support innovative projects within the industry. Iceland has established the Icelandic AVS Fund, which has been instrumental in more than doubling the value of Icelandic marine products over the last 20 or so years.

↑ Photo: Scanpix

↓ Source: Calculations based on data from OECD, World Bank and OECD Review of Fisheries – Country Statistics 2015.  
<sup>a</sup> Data from National Bureau of Statistics (no OECD data available).  
<sup>b</sup> Provisional Figures  
<sup>c</sup> Aggregate value (fishing, hunting & agriculture)  
<sup>d</sup> Aggregate value (fishing and aquaculture)  
<sup>e</sup> 2014 figures

Aquaculture is one of the fastest growing industries within the food-production sector, already supplying around 50% of today's fish used for food consumption purposes.<sup>3</sup> With a global growth rate of around 8.8%, the share of aquaculture products used for food will reach above 60% in 2020.<sup>4</sup> In the Nordic Arctic region, aquaculture is becoming an important compliment to traditional fishing activities.<sup>5</sup> In light of climate change and the limited food production capacity of traditional fisheries, creating a sustainable and productive aquaculture sector enables the creation of more food from aquatic environments in combination with increased biomass utilisation of side-streams created from fisheries.<sup>6</sup> A key benefit of aquaculture compared to fisheries is a fixed production location which allows for disease control and a proximity to processing facilities which makes it easier to upgrade side streams as transportation time and costs are lower. Nordic Arctic governments are dedicating increased support to unlock the industry's potential. This support is primarily illustrated through legislative strategies such as "Aquaculture Acts" in Norway and Iceland, the "Helsinki Declaration on Competitive and Sustainable Aquaculture in the Baltic" that is relevant for the entire Nordic Arctic region, and Sweden's "National Growth Objective for Aquaculture Industry". At a more practical level, the increased economic importance and potential growth in aquaculture activities have facilitated the establishment of dedicated research facilities. Government funded institutions, such as Matis in Iceland, NOFIMA in Norway, and the Aquaculture Research Station of the Faroe Islands, either indirectly or directly help foster innovation and development within their respective aquaculture industries.

	SWE	NOR	FIN	ISL	FRO	GRL
Volume of fish landings per capita (tonnes)	0.01	0.39	0.02	4.16	111.65 <sup>a</sup>	1.43 <sup>ab</sup>
% of labour force employed in Fishery (harvest & processing)	0.04% <sup>de</sup>	1.08% <sup>de</sup>	NA	4.7% <sup>de</sup>	9.8% <sup>a</sup>	15.2% <sup>ac</sup>
Exports of Fishery products (% of total exports)	3.2%	7.6%	NA	26% <sup>ae</sup>	95% <sup>ae</sup>	86.7% <sup>ae</sup>
Aquaculture production per capita (tonnes)	0.001436	0.260953	0.002193	0.015193	1.35755 <sup>a</sup>	NA
% of labour force employed in Aquaculture	0.01%	0.23%	NA	NA	3.3% <sup>a</sup>	NA
Aquaculture production (% of GDP)	0.01%	0.2%	0.02%	NA	20% <sup>ac</sup>	NA

## Developments

The fishery industry is undergoing significant change. The primary focus of today's Nordic Arctic fisheries is on creating higher-value products from limited fish stocks in the ocean. Currently, marine biomass is primarily used for the production of fish oil and food, both of which are relatively low value-added products. To create higher-value products, fishery and aquaculture industries now try to utilise what was previously thrown away as waste, such as heads, fins, bones, guts, and tails, for the production of pet food and human consumption. This increases the value per unit of biomass. Yet, even in the best cases, companies only utilise around 75–80% of a fish, leaving room for improvement.<sup>7</sup> An example of this focus includes NOFIMA in Norway. Here, companies can test and optimise their processes to extract all desired components from marine-based biomass and receive help to bring these optimisations to fruition on a larger scale to produce more advanced products. Other examples include Polar Seafood, a seafood exporter in Greenland that changed its business model from only selling filets of halibut to selling all different parts of the fish, which has allowed the company to increase the utilisation of fish from 50% to 90%.<sup>8</sup> Notable product innovations include Royal Greenland's production of flour from waste shells at their prawn factory.

Overall, the fishery industry in the Nordic Arctic region is moving beyond traditional core activities, such as locally practised fishing and fish processing, to a large-scale industry that incorporates technology, logistics, and marketing. The importance of such innovations and research is exemplified by Iceland, where cod landings have fallen by 60% over the past 25 years, but the export value of cod products have tripled in the same period.<sup>9</sup> The production of fish through the land-based aquaculture technology, recirculating aquaculture systems (RAS), has also developed considerably through initiatives such as the Nordic Network on Recirculating Aquaculture Systems.<sup>10</sup> This may provide potential to increase the production of fish in the Nordic Arctic.

Seaweed is generally a highly underutilised resource in the Nordic Arctic region, but with great potential. Marine seaweed contains a palette of unique compounds that have many uses in consumer products. Nordic Arctic countries are in a unique position to create significant value from the region's abundant seaweed resources, in part due to the region's strong competence within aquaculture, offshore construc-

**“To create higher-value products, fishery and aquaculture industries now try to utilise what was previously thrown away as waste, such as heads, fins, bones, guts, and tails, for the production of pet food and human consumption. This increases the value per unit of biomass. Yet, even in the best cases, companies only utilise around 75–80% of a fish, leaving room for improvement.”**

→ Photo: Scanpix





↓ Note: Based on a qualitative assessment of data on the level of support and economic activity for each country

tion, and biotechnology. Seaweed has been valued at EUR 13. billion as a global commodity and as a result, many countries outside of the Nordic Arctic have recognized the great potential of seaweed-based products.<sup>11</sup> For example, the seaweed species known as *bladderwrack* contains extremely bioactive antioxidants with multiple uses. Products developed from this and other types of seaweed include food ingredients, feed for fish farming, health supplements (e.g. vitamins), cosmetics, pharmaceuticals, and bioenergy, especially 3rd generation biofuel production (this could also help increase overall use of biofuel in the Nordic Arctic). Despite this positive potential, the Nordic Arctic regions have been slow to create value and value-added products based on seaweed, particularly on an industrial scale.

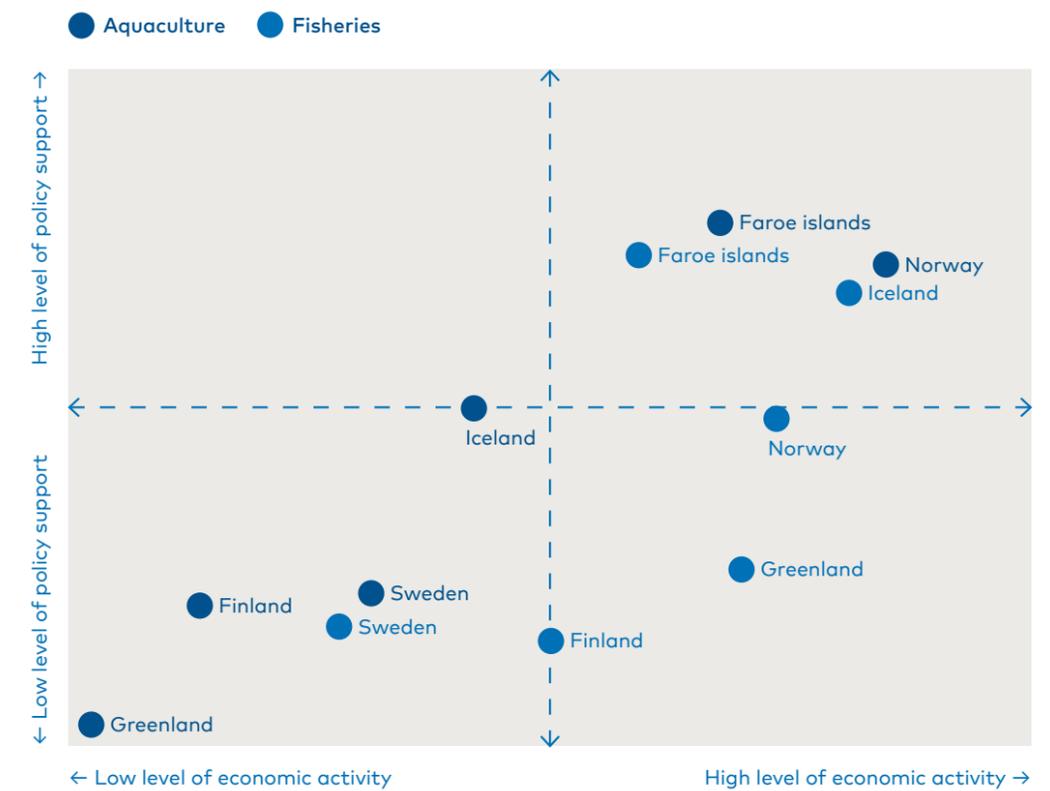
There are multiple barriers to the development of a profitable seaweed industry in the Nordic Arctic. One barrier is that many of the fjords suitable for the production of seaweed are already utilised by aquaculture companies for fish farming. This may limit the production

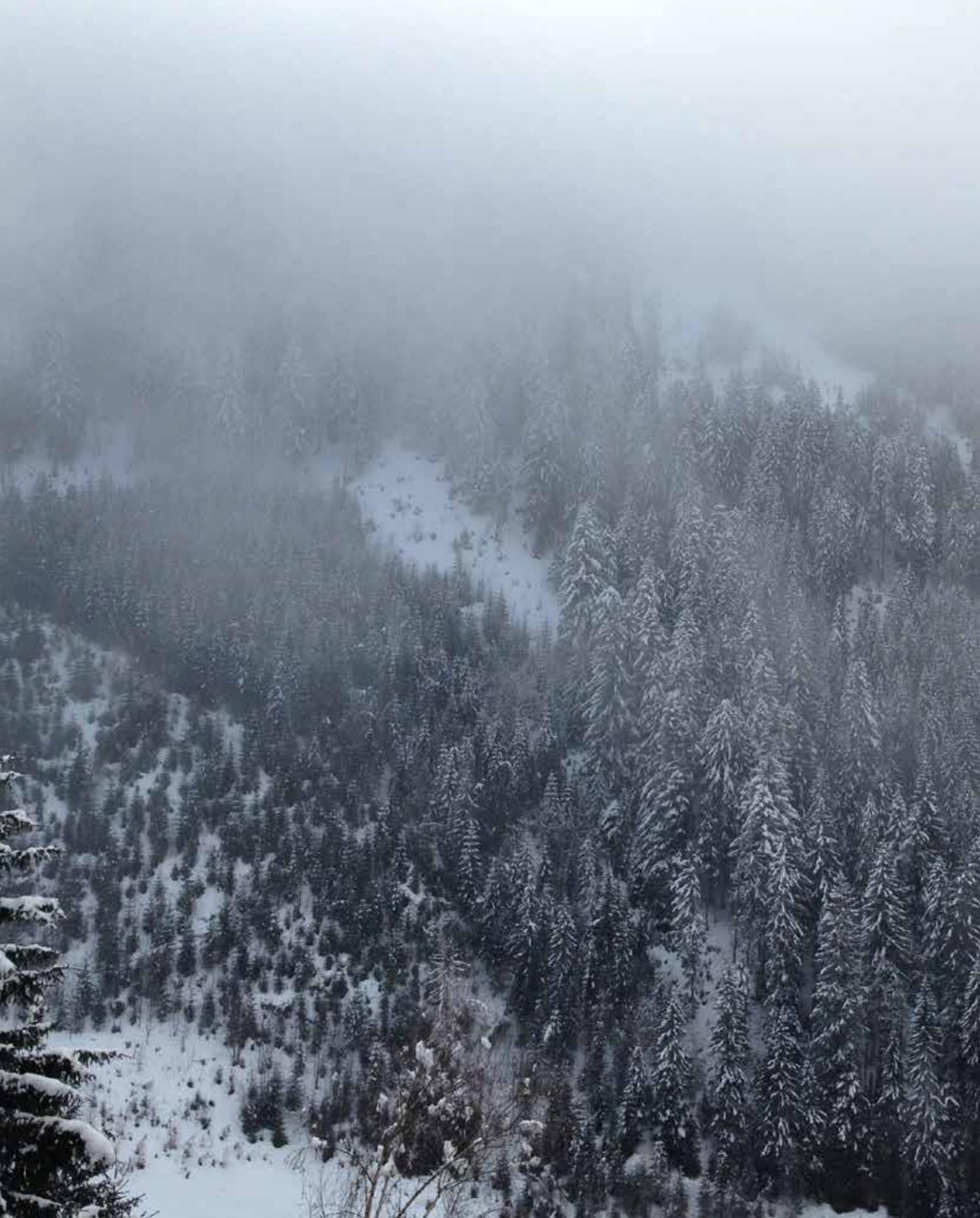
↑ Bladderwrack seaweed. Photo: Scanpix

and scalability of seaweed. A possible solution to this issue has been presented by the company Ocean Rainforest in the Faroe Islands, which intends to bring the harvesting of seaweed into the open ocean, significantly increasing the viable area for seaweed cultivation. Another key challenge to the increased use of seaweed is a lack of knowledge and expertise. Firstly, there is a need to identify the types of seaweed that are most suitable for cultivation in the Nordic Arctic and are still economically viable. Thereafter, functional cultivation techniques must be developed. Finally, the most prominent challenge to the implementation of large scale seaweed cultivation is demonstrating its profitability to potential investors, since previous analyses have shown that direct profits are relatively low.<sup>12</sup> Important to the future growth of the industry is the need for developing cost-effective, pre-processing technology, but also investment support and political action on spatial planning and licensing.<sup>13</sup>

## BLUE BIOECONOMY SUPPORT AND PERFORMANCE

INDICATIVE





## LAND BASED MATERIALS

The bioeconomic segment of land-based materials (mainly forestry) in the Nordic Arctic is largely limited to Finland, Sweden, and Norway. Iceland, Greenland, and the Faroe Islands have very limited forests and, therefore, have no or very limited forestry industries. In Iceland, there is however a grant programme originally administered by the Icelandic Forest Service that intends to promote afforestation, but the industry is still small. In the northern regions of Finland and Sweden, the forest industry has been an economic cornerstone for a long time as a significant supplier of employment opportunities (e.g. forestry supplies around 11% of male employment in the Kainuu region in Northern Finland) and gross value-added. Furthermore, the forest-based bioeconomy constitutes around EUR 43 billion (16%) a year in the Finnish econ-

← Photo: Emily Morter

**SUMMARY:** Land-based materials refers to the segment of bioeconomy relating to the sustainable use of land-based biomass materials to produce such things as energy, building materials and textiles. In this report, the land-based bioeconomy will mostly refer to forestry, as this industry accounts for the lion's share of land-based materials that can be produced from bioeconomy. Although the increased use of digital mediums points to a phasing out of wood-based materials, recent innovation has expanded the palette of possible uses for wood, reinvigorating the forestry industry in the process. Everything made using fossil fuel-based materials today can potentially be made using wood-based materials. Alternative wood uses include lignin-based carbon fibre in areas such as wind turbines, aircraft and vehicle chassis, windows, textiles made from wood fibre, pharmaceuticals

made from cellulose powder, fish feed made from wood residue, and nanocellulose. However, innovative uses of wood still only represent a rather small part of the value derived from wood, whereas more traditional products such as paper and paperboard, pulp, softwood, and sawn wood still make up the majority of value of forestry activities. A more traditional but increasingly important use of wood-based materials is bioenergy. Bioenergy serves as an important renewable energy source in Finland and Sweden. Bioenergy is currently Sweden's leading energy source excluding fuels used for transport. In Finland, bioenergy supplies around a quarter of total energy consumption. With these developments in mind, this section will outline primary trends in economic activity, policy incentives, and innovations relevant to the land-based materials segment of bioeconomy.

omy, where forest-based products make up EUR 39.9 billion of this per year. In northern Norway, the forest industry has also been important, but less so than in Finland and Sweden.

The Finnish and Swedish forestry industries are especially known as global technological leaders with a competitive edge based on expertise and an industrial core that provides growth opportunities for companies and business sector services connected to the industry. In the two countries, national forestry acts govern the forestry industry and promote economically, ecologically, and socially sustainable management and utilisation of forests. Finland and Sweden also provide substantial support mechanisms to the industry. Finland has established several institutions such as Luke, the Finnish Natural Resources Institute, which helps develop solutions to challenges posed by the forest utilisation, products, services, and intangible value of forests, and Tapio, a state-owned company that produces expert services for forestry operatives. Sweden also supports forest research at universities, colleges, and institutes like Skogforsk, whose mission is to furnish Swedish forestry with the knowledge it requires to remain competitive and sustainable. Norway also carries out similar support mechanisms but on a smaller scale and scope. An important Norwegian support mechanism to mention is the Forest Trust Fund, which is an obligatory reserve that provides forest owners with a means for financing measures that are aimed at sustainably managing forest resources in the long term. Despite having potential to grow, Norwegian forestry has experienced several challenges, including low profitability, which the government is combatting with measures aimed at enhancing innovation and R&D, increasing efficiency in transport, and stimulating new uses of wood in buildings and other products.<sup>14</sup> Overall, despite potential to sustainably increase the utilisation of forestry reserves, it is important to keep in mind the availability of raw materials and the effects of its utilisation on surrounding stakeholders. For instance, forestry in Lapland has to

↓ Source: World Bank & EUROSTAT (2015 data)  
<sup>a</sup> Data from National Bureau of Statistics (no OECD data available).  
<sup>b</sup> Provisional Figures  
<sup>c</sup> 2016 figures

	SWE	NOR	FIN	ISL	FRO	GRL
% of population employed in forestry (% of total labour force)	1.7%	0.48%	2.4%	NA	NA	NA
Forest industry exports (% of total exports)	10.5% <sup>c</sup>	NA	23% <sup>a</sup>	NA	NA	NA
Exports of secondary wood products (% of total exports)	0.8%	0.17%	0.4%	NA	NA	NA

**“The advent of innovative uses of forestry products increases potential scalable business opportunities within the Nordic Arctic bioeconomy, whilst contributing to employment and environmental sustainability.”**

consider that a sizable segment of the productive forests is restricted, due to protection of ecosystems, tourist activities, and Sami reindeer herders, who have a right to all Arctic forests in Finland. In many ways, this dilemma can be solved through the increase in value and use of forestry side streams, reducing the need for growth through increased utilisation.

### Developments

The advent of innovative uses of forestry products increases potential scalable business opportunities within the Nordic Arctic bioeconomy, whilst contributing to employment and environmental sustainability. The idea is that everything made using fossil fuel-based materials today can be made using wood-based materials. Such uses include: lignin-based carbon fibre in areas such as wind turbines, aircraft and vehicle chassis, windows, packaging materials, textiles made from wood fibre, pharmaceuticals made from cellulose powder, fish feed made from wood residue, nanocellulose, etc.<sup>15</sup> Borregaard Biorefinery in Norway and UPM in Finland are prominent examples of companies attempting to diversify products made from wood.<sup>16</sup> UPM has been able to use residues from paper and pulp production to produce biofuels. This innovation simultaneously replaces fossil fuels, whilst upgrading the value of side streams from pulp and paper. Other uses of forestry-related material include cosmetics. An example includes the company called Forest of Lapland Ltd, which utilises the side streams of the sawmill industry, as well as Arctic organic ingredients, plants, and berries for the production of cosmetics. The Finnish start-up Paptic has also developed a material that can be used to replace plastics from sustainable wood fibre. Uses include packaging, carrying bags etc.

Building with wood has also received increased attention, as it is significantly more environmentally friendly than using concrete. Finland is at the forefront of building with wood, where some 40% of new buildings are made from wood. However, at the European level, wood represents only about 4% of construction, serving as an area with great potential for growth.<sup>17</sup> In Norway, the project named Trefokus is trying to increase the use of wood in construction by establishing a network through which stakeholders in the building sector can connect and collaborate.

Production of textiles from wood is an area of great potential. Although the textile industry is partly bio-based, a great deal of fossil based synthetic materials is used in textile manufacturing. With a

growing global demand for textiles due to population growth and increased purchasing power, there is a large potential to profitably leverage the use of cellulose-based materials originating from the pulp and fibre industry, such as viscose and bio-based polyester. This would help replace the use of environmentally unsustainable cotton production for textiles (it takes 20,000 litres to produce one kilogram of cotton) as well as fossil-based textiles.<sup>18</sup> Finland and Sweden are on the forefront of this development. Interesting examples include the Swedish research project ForTex conducted by Innventia. An important aspect of Innventia's research is to develop textile production that uses existing processing equipment and increasing the early stages of scalability. In Finland, FIBIC34 is conducting research into creating new markets for cellulose-based textiles. Once again, this is a notable example of simultaneously upgrading the value of side stream materials, replacing the use of non-renewables in textiles, and leveraging renewable resources that can be circulated in a sustainable fashion.

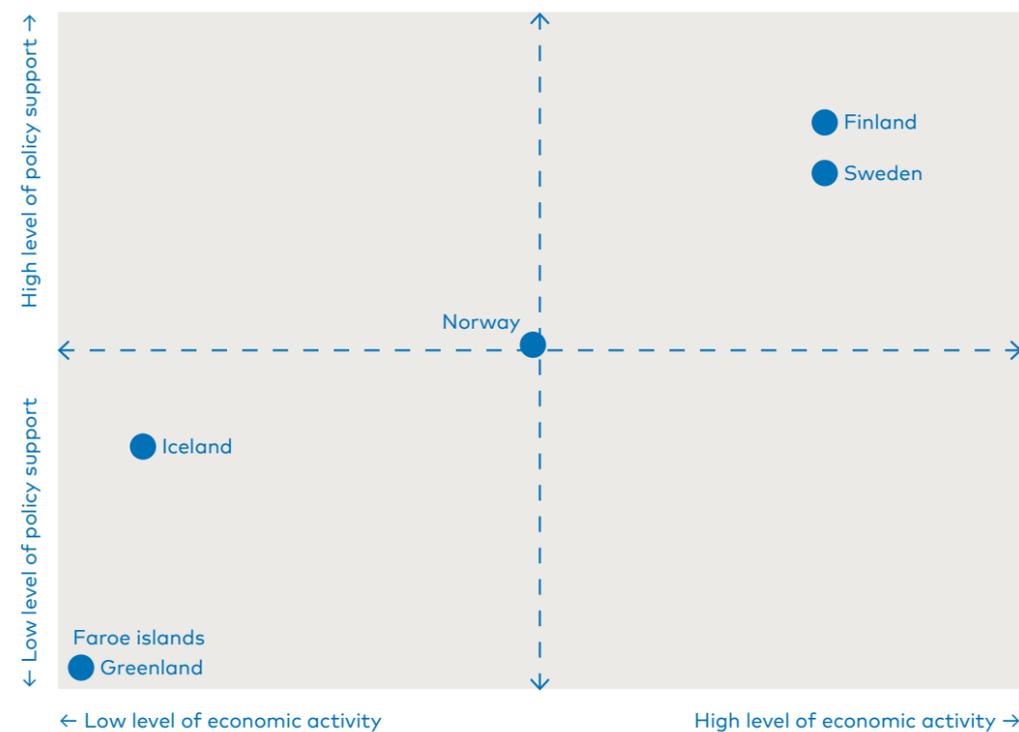
↓ Note: Greenland, Faroe Islands and Iceland are not part of the cross-analysis due to their lack of forests. Based on a qualitative assessment of data on the level of support and economic activity for each country

## LAND BASED FOOD

The foundation of land-based food is the agriculture industry. Agriculture in the Nordic Arctic region is generally constrained due to the harsh weather and sparse geographical conditions. Therefore, in the Nordic countries, agricultural activities are mainly located in southern regions. In the Faroe Islands, Iceland, and Greenland, agriculture heavily concerns the production of livestock. In Greenland, farming is mainly limited to the southern region and 80% of farming activities relate to the farming of sheep. The Greenlandic government supports such sheep farming through a direct subsidy of around EUR 1.3 million per year. Iceland is self-sufficient with all animal-based foodstuffs. Sheep and cattle comprise the largest segment of livestock, with more than 450,000 sheep, while the production of milk is the most valuable from an economic standpoint. Herding of reindeer also makes up a significant part of the Arctic agriculture industry; however, this will be expanded upon in Indigenous cultural business in the Cultural Industries section. Climate

### FORESTRY SUPPORT AND PERFORMANCE

INDICATIVE



**SUMMARY:** There are large numbers of underutilised resources in bioeconomy that offer opportunities for innovation, especially with regards to food. It is therefore important that food and meals remain part of the bioeconomy debate and a contributor to its progress, rather than focusing the debate only on biorefineries, technologies, economic benefit etc. Essential to the development of a sustainable New Nordic Food (NNF) chain is involvement from a broad range of actors, including cultural and creative industries, as well as cross-sectional co-operation. Promoting the production and consumption of NNF contributes to developing innovative agricultural activities, such as the use of new crop variants more adaptable to the harsh climate, and niche business activities. Since the establishment of the New Nordic Food movement in 2004, the promotion of the use of

sustainable, healthy, and traditional foods that can be grown in and across the Nordic Arctic has been widely successful. The New Nordic Food (NNF) movement relates to bioeconomy through the aim of making the movement into a lifestyle that is beneficial for nature, people, and the Nordic society as a whole. As a result, a considerable part of the founding document of the NNF movement, the NNF Manifesto, has to do with the development of sound production processes and new applications of traditional Nordic food products and to facilitate collaboration across the entire food chain for the purpose of economic and environmental sustainability. This adheres to SDG 12 of promoting sustainable food production and consumption, while simultaneously providing valuable employment opportunities in Nordic Arctic region such as in food and eco-tourism.



	SWE	NOR	FIN	ISL	FRO	GRL
% employed in agriculture (as % of total labour force)	1.9%	1.9%	3.8%	4.1%	0.3% <sup>a</sup>	NA
Agriculture value added (% of GDP)	1.3%	2.5%	2.5%	6.2%	NA	15.5%

change is also affecting agricultural production in the Arctic, as higher temperatures have made crop production more reliable with greater yields. Such an example includes the increased production of wheat and barley production in Þorvaldseyri.<sup>19</sup>

Closely related to the agriculture industry is the NNF movement. This movement stresses the importance of using locally grown food while it is in season, and emphasises organically grown and non-genetically modified foods.<sup>20</sup> Two programmes have been instrumental to the success of the NNF Movement. These are the New Nordic Food I (NNF I) and New Nordic Food II (NNF II) programmes. Sponsored by the Nordic Council of Ministers, these programmes have covered a wide range of food activities, engaging thousands of people across the Nordic Arctic and beyond. NNF I started in 2007 with a budget of 23 million DKK. NNF II ran from 2010 to 2014 with the aim of bringing Nordic cuisine ideology into Nordic homes and institutions, as well as innovative product development and local food production. The NNF movement's focus on Nordic Arctic food has led to a number of success stories of increased use of Nordic ingredients in a sustainable manner.

## Developments

Promoting the production and consumption of Nordic Arctic food contributes to developing agricultural activities and opportunities in Nordic Arctic regions. Firstly, such opportunities include the commoditisation of research related to crop variants that are more adaptable to the harsh climate of the Nordic Arctic and the development of greenhouses that can produce local fruits and vegetables. Considering the effects of climate change, there is significant potential for an extended growing season and the production of a larger variety of crops.<sup>21</sup> Secondly, promoting and developing the production of Nordic Arctic food and agricultural activities are crucial from a food security perspective. Factors including high global food commodity prices, trade barriers, and remote location make adequate distribution of food difficult in the Nordic Arctic.

<sup>19</sup> Source: World Bank & EUROSTAT (2015 data)  
<sup>a</sup> Data from National Bureau of Statistics  
<sup>b</sup> Provisional Figures

<sup>20</sup> Faroe Islands.  
 Photo: Scanpix

Many of the agricultural opportunities in the Nordic Arctic can be achieved through niche businesses. One notable example comes from Iceland, where Matis helped facilitate the production of innovative food products. This was achieved through supporting co-operation between farmers and food processing companies by introducing those with the necessary materials and machinery to people or organisations with innovative food ideas. A similar example can be found in the Faroe Islands where the Faroese government has partnered with the Outer Islands Association to create two funds to help foster innovation and develop infrastructure related to agriculture in rural areas. The Outer Islands Association has also entered a co-operation with the Faroese research park iNova to create educational opportunities for small scale agricultural producers.<sup>22</sup> Another notable initiative includes the project named, "The Arctic as a Food producing Region", which is a collaboration between Norway, Canada, Iceland, Denmark, and the Faroe Islands. The aim is to assess the potential for increased food production and added-value of food from the Arctic.<sup>23</sup> The point of departure of this initiative is the view that consumers prefer healthy food that tastes good, has been produced sustainably, and tells a unique story. Arctic food fulfils all these properties. The project focuses on primary industries, including agriculture, aquaculture, fisheries, herding, and gathering, to develop a range of realistic development potentials.

One of the primary developments that will benefit both the Nordic Arctic bioeconomy and New Nordic Food is to scale New Nordic Food from a niche industry to a critical mass. Firstly, Nordic food looks to create additional value through refinement as history shows that processed foods enjoy greater commercial success. Raw materials used for the development of these foods should be locally produced or grown to produce local food. Secondly, close collaboration throughout the entire food value chain will ensure closer interaction between primary producers, food manufacturers, retail, and consumers. This will enable valuable knowledge and innovative production processes to be leveraged. Further synergies can be created through co-operation between large and small food producers. In relation to the abovementioned example of Matis, small producers have potential to contribute to large producers through their innovative energy and flexibility, whilst larger producers can give smaller actors access to expertise and distribution chains. Finally, the Nordic Arctic public sectors must use their purchasing power to support local and sustainable food production by buying and utilising Nordic Arctic food products through public food supply in hospitals, elderly homes, schools etc.

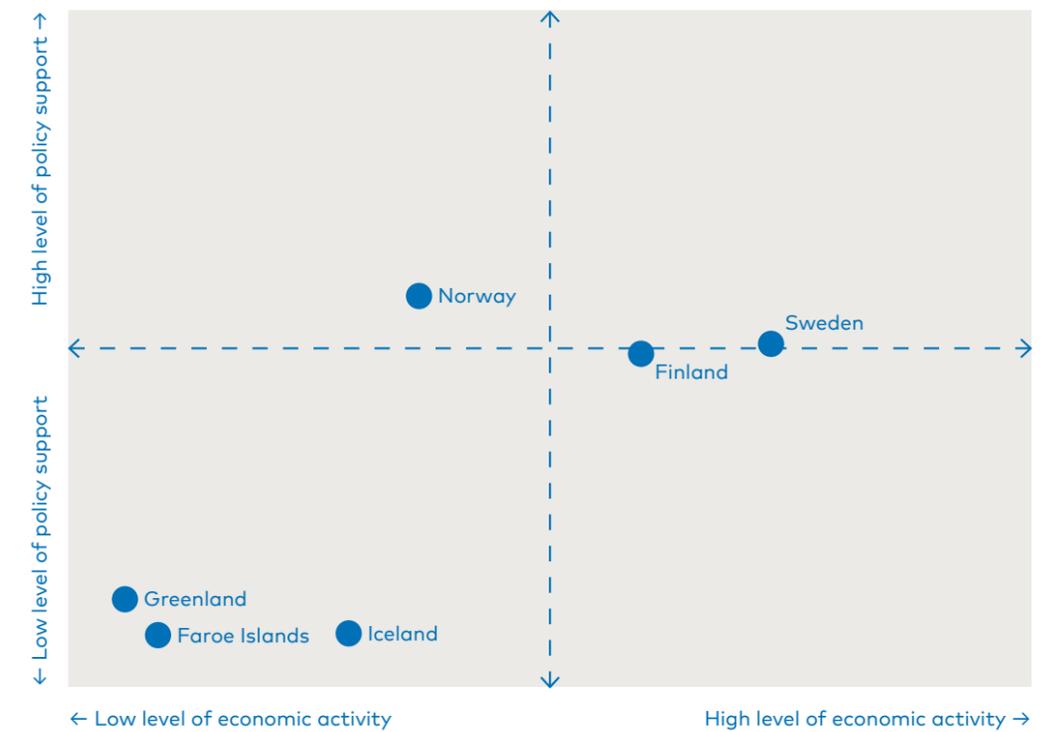
An example of how NNF can be developed into a social and economic business concept for the many is the way Hurtigruten in Norway has implemented the concept in its tourism business. Seeing the major opportunity in New Nordic Food, Hurtigruten created a strategy

around NNF and has focused on providing local Norwegian culinary experiences to their passengers. Today 80% of all food and drink served by Hurtigruten is Norwegian. The rise in demand for locally-sourced ingredients has created considerable opportunities for local actors. This includes the egg producer Andvik Hoenseri & Hytteutleie located only 2 km away from one of Hurtigruten's passages. Andvik Hoenseri & Hytteutleie delivers 3 million eggs to Hurtigruten every year. Furthermore, chickens that no longer lay eggs, which were previously just wasted, are now sold to Hurtigruten for consumption. Other ingredients include salmon, cod, reindeer, cheese, and many more. To reap the benefits of the sustainable concept, Hurtigruten makes sure to highlight it in its marketing and to include visitors in the story that comes with the food. Hurtigruten thereby serves as a shining example of successful collaboration and synergies across industries. In this case, the culinary, rural agriculture, and tourism industries benefited economically in a sustainable manner.

↓ Note: Based on a qualitative assessment of data on the level of support and economic activity for each country

## AGRICULTURE SUPPORT AND PERFORMANCE

INDICATIVE





## 4.2 DRIVERS AND ENABLERS OF BUSINESS DEVELOPMENT

Bioeconomy in the Nordic Arctic is undergoing significant change. International competition and technological developments decrease the need for traditional labour and instead demand a more diverse set of skills and innovative approaches to develop this part of the economy. It is therefore important to highlight some of the key scalable drivers and enablers of innovative bioeconomy processes, products, and business opportunities that can benefit the Nordic Arctic region and potentially the pan-Arctic business environment.

Innovative initiatives carried out by the private sector have been central to the development of the Nordic Arctic bioeconomy. Larger companies in the primary industries, including fisheries, aquaculture, forestry, and agriculture are investing heavily in innovation in bioeconomy. This includes their own innovations as well as those of newer start-ups. Numerous, previously mentioned and other, examples exist, across every facet of bioeconomy.

Collaboration between the public sector, business, and academia, often in the form of the triple helix model,<sup>24</sup> has been fundamental to successful bioeconomy development.<sup>25</sup> SME's, universities, and research centres often carry out research that can be commercialised in collaboration with private and public actors, and often come up with new ideas for products and processes that can quickly be implemented but lack the resources to scale up. As the bioeconomy is becoming more technology and human capital driven, further development and testing of innovations require sophisticated technologies and specialised skills that individual companies may not possess. Co-operation between businesses and academia with strong support and effective coordination from public actors can leverage such ideas and drive economic growth and business development. Furthermore, there are also opportunities for co-operation between public, private, and academic actors to occur across the Nordic Arctic region. There are areas of

← Sweden.  
Photo: Fredrik Ohlander

the Nordic Arctic where research facilities are not available but where bioeconomy companies could benefit greatly from the knowledge and services that triple helix structures produce. This could be done by extending networks to rural areas or developing innovation vouchers for companies in other parts of the Nordic Arctic region to use for specific innovation services. Nevertheless, it is important for the actors engaged in such forms of collaboration to understand and respect each other's needs. In academia, researchers are measured by other things than economic benefit, so business actors need to be flexible and patient. Although researchers understand that innovations need to be economically sound, they may not have knowledge of the place their research fits into an industrial context.

**“Bioeconomy has the potential to maintain and create valuable jobs in regions where other employment opportunities are limited.”**

There are many positive examples of collaboration across private, public and academic sectors fostering innovation and business development. In Iceland, a notable example is the project named MacroFuels, which aims to produce advanced biofuels from seaweed and macro-algae through collaborative efforts between public and private actors, including Matis.<sup>26</sup> Another example includes the company Calanus AS, which aims to produce a range of consumer products from the marine zooplankton named Calanus in co-operation with the research cluster Biotech North located in Tromsø.<sup>27</sup> This is a triple helix biotechnology cluster involving enterprises, R&D organisations, and public institutions to support such innovations. Examples of the possible utilisation of seaweed include the interdisciplinary research project named Seafarm Sweden. This project is a collaboration of four universities who aim to grow, cultivate, and use macro-algae (seaweed) for the production of food, feed, bioenergy, and other bio-based materials.<sup>28</sup>

Human capital is another important facet of bioeconomy development. Bioeconomy is changing fast and provides new opportunities for employment. The industry shows promising opportunities for attracting young people, especially compared to business development in the primary sector, like fisheries, which is limited in its ability to expand employment due to technological developments among other things. Bioeconomy has the potential to maintain and create valuable jobs in regions where other employment opportunities are limited. However, a major challenge is that developing the bioeconomy requires a mix of existing, traditional skills and new high and low-tech skills, which the Arctic regions lack. Young people in the Arctic are generally less interested in bioeconomy and often look to settle down in places with economic diversification such as large cities, which can provide opportunities for the whole family. Moreover, stories that focus mainly on the negative developments in, for example, fishery and forestry give young

people the impression that bioeconomy does not offer future career opportunities. Hence, recruiting adequately trained and educated young people represents a serious challenge to the development of the Arctic bioeconomy.

Examples of attempts to attract people to bioeconomy include collaboration between Matis and University of Iceland in developing a M.Sc. in Food Science. The programme has prioritized involving private companies in guest lectures and offers opportunities for students to connect with and visit companies. The aim is to facilitate practical training as well as academic knowledge to prepare them for a job in bioeconomy. The case of Siglufjörður provides another example of successful talent attraction to rural areas where most bioeconomy activity takes place. This small town located in Northern Iceland has transformed from an old fishing village to a blossoming economy where funds have been invested in restaurants, hotels, various outdoor activities, and a museum. Moreover, residents have renovated some of the old houses and the town has cleaned up the docks, all with the purpose of making the city attractive and offer the quality of life that young educated people want. Besides driving business developments in tourism, services, and other industries, this transformation has also enabled Genis, a biotechnology company, to locate its headquarters in the town. Facilitating and supporting the development of institutions, companies, and activities that offer the demanded quality of life and that ensure a positive image of the developments of rural towns can attract bioeconomy companies and employees who look for opportunities for the whole family.

Finally, creativity is a key driver of development in bioeconomy. To fulfill the bioeconomy criteria of replace, upgrade, circulate, and collaborate, the industry needs to be creative. Creativity is the foundation of bioeconomy and the industry is starting to promote the creative element even more. This relates to bioeconomy education, in which projects such as Biophilia use creativity as an educational and scientific tool. However, bioeconomy is still challenged by its image as a traditional industry and there is a need to ensure proper branding of the industry to attract employees and public attention to the innovative solutions that bioeconomy can offer.

# ARCTIC NATURAL ACTIVE SUBSTANCES AS A BUSINESS OPPORTUNITY

**Company:** Forest of Lapland  
**Sector:** Land-based materials  
**Region:** Finland

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 CEO  
**Mail:** Antti.kuivalainen@forestoflapland.com

Using Arctic plants to combat health issues and diseases, while trying to develop a new sustainable industry around herbal extracts and natural active substances in Lapland.

Forest of Lapland Ltd. is a producer of standardised herbal extracts and natural active substances for pharmaceutical, health, food, and cosmetic industries. Extracts may be used e.g. to substitute antibiotics, as they are antibacterial, rich in antioxidants and rich in flavonoids. The company uses and has developed Pressured Hot Water Extraction (PHWE) technology, which is carried out without chemicals. They use compounds from berries, herbs, and wood, specifically the knots and the layer just beneath the bark, which are considered waste by the forestry industry. They get their raw materials from the forests just around them, and from a sawmill 200 meters away. As there is no supply chain, it is important to be close to the raw materials.

For now, its main products relate to cosmetics but the company plans to enter other areas related to health and medical products, and it currently has filed a patent application

for a treatment of allergic reactions. However, regulatory approvals for these types of products take time, which in turn slows down the business development process.

## Success factors

Forest of Lapland is still a young company, and its current success relates closely to its location. First, the Arctic climate with the Gulf Stream and the many hours of sun during the summer allow Arctic plants to produce more antioxidants, flavonoids, and antibacterial compounds than southern plants. Second, Lapland has vast amounts of raw materials (i.e. forests), and even certified organic picking areas. Finally, the Nordic Arctic region offers a great marketing platform, as it is perceived as a healthy place with clean air.



↑ Angelica in Greenland.  
 Photo: Mads Pihl / Visit Greenland

More, Forest of Lapland has developed a process that enables them to extract the specific compounds. It conducts its own research but also collaborates closely with the University of Tampere on impact on health, extraction technology, and the discovery of new raw materials.

## Drivers and challenges

The key drivers for Forest of Lapland is the increased demand for natural health products and natural substitutes for chemicals, as well as large amounts of international academic research exploring the health benefits of natural compounds.

The biggest challenge for the company is financing. It currently has a soft loan from Tekes, the Finnish Funding Agency for Innovation, and without this loan, it would not have

been possible to start the company. Getting external financing is difficult, especially in an industry that has not fully materialised. A major challenge is that the business area is so new that the supply chain is not yet in place. There is no technical infrastructure (e.g. for specific analyses), no wholesalers, limited Arctic specific research related to the field etc. Furthermore, it is challenging to find employees to positions such as finance and operations, as people with these professions are often located in the south. To enable the company to grow, it is important that it is able to establish contact with larger businesses that, through collaboration, can support the final product development, and take lead on distribution, marketing and sales.

# THE ROLE OF SUSTAINABLE REGULATIONS IN THE FISH FARMING INDUSTRY

**Organisation:** Faroese Fish Farming Industry  
**Sector:** Blue bioeconomy  
**Region:** Faroe Islands

**Contact:** Niels Winther  
 Adviser  
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**Demonstrates how a regulatory framework has driven the development of a sustainable and profitable aquaculture industry in the Faroe Islands.**

In the 1980s, the Faroese aquaculture industry was made up of many small producers who used the fjords to produce fish in an industry that was not strictly regulated in terms of sustainability. This eventually led to the spread of diseases, and around the turn of the century the production of salmon collapsed. As a reaction to these developments, new regulations were introduced, and today the aquaculture industry is flourishing and accounts for almost 50% of the total export value of goods from the Faroe Islands.

## Success factors

The new stricter veterinary system that has been introduced in the industry since the crisis is an important foundation of the success of the Faroese aquaculture industry in later years. Some important elements of the Faroese veterinary system are:

- "All in, all out": only one generation for each location. When the fish are harvested, the area must lie fallow for a certain period of time.
- One farmer per area: each fjord can only have one producer to ensure that activities in the fjord are managed and controlled by a centralised unit i.e. the company with the aim of strengthening disease control.
- Closed well boats: rules stipulating closed well boats to ensure that no infections spread in the water, and no waiting cages to limit stress.
- New sea lice regulation: New sea lice regulation introduced in 2016 stipulates mandatory counting of sea lice at certain intervals. If thresholds are continuously exceeded, it may result in early harvesting of fish and/or reduced number of fish in the next release of juveniles in the area.



↑ Salmon fish farm, Hordaland, Norway.  
 Photo: Scanpix

Finally, a tax incentive that allowed certain taxes to be paid later were also introduced to make it more attractive to invest in the industry.

## Drivers and challenges

The new regulatory framework was a key driver of the successful turnaround in the aquaculture industry. The initiative came from the fish farmers who demanded a framework that could ensure a financial and environmental sustainable foundation. Collaboration between actors was seen as key to the regulatory success as it ensured input and commitment to the new rules, and expert consultancies played an important role in terms of sharing best practices. Finally, the regulatory framework is also driven by a set of long-term guiding principles that enables rules to be updated and adapted to new realities,

while still ensuring a long-term sustainable foundation.

A key challenge for the industry is a recent revision of a tax on fish farmers. Before 2016 the tax consisted of a 0.5% tax on turnover and 4.5% tax on profits. However, since 2016 the tax consists only of a 4.5% tax on turnover. This means extra costs for fish farming companies regardless of their profits, and may affect the ability to make investments in the future. Though acknowledging the tax, the industry believes it should be based on profits to ensure a sustainable growth, especially in times with low or negative earnings.

Finally, sea lice challenge the global salmon farming industry. Various sustainable methods are being tested and used e.g. keeping the juvenile salmon "on land" for longer time to ensure larger and more resilient fish, but further research and collaborations need to take place.

# AGILE AND DYNAMIC COLLABORATION THROUGH A SMALL TRIPLE HELIX CLUSTER

**Organisation:** Biotech North Cluster  
**Sector:** Blue bioeconomy  
**Region:** Norway

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 Cluster Marketing Manager  
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**Developing an agile triple helix structure to strengthen innovation, commercialisation, and internationalisation of the blue biotech sector.**

Biotech North is a triple helix biotechnology cluster with 38 members, comprised of 22 companies and 16 R&D organisations, located in and around Tromsø in Norway. It aims to be the hot spot for blue biotech and to drive this, its services aim to strengthen innovation, commercialization, and internationalization of blue biotech. A principle reason for its foundation was a demand from industry – many start-ups and SMEs had a need to share experiences and access certain infrastructure services e.g. research labs. Today, the need for knowledge and cost-sharing is still the foundation of the cluster, although the cluster now caters to both larger and smaller companies.

## Success factors

The success of Biotech North comes from its modern labs, business incubator, knowledge

sharing activities, and the Arctic's marine resources. The Arctic marine resources play a vital role in creating a competitive advantage compared to other non-Arctic areas. For example, certain enzymes work best in cold temperatures, and can therefore be used to make different processes more effective and save energy. Another example is algae that are able to grow in cold water, which can be used to capture CO2 emissions and fish feed.

## Drivers and challenges

The central driver of Biotech North is the ability to uncover transferable knowledge from which other companies can benefit. They do this by facilitating and meeting the need to collaborate within the cluster and promoting the cluster internationally. Due to the cluster's relatively small size, it is able to stay agile and



↑ Photo: Matt Palmer

access knowledge more easily. This creates more dynamic collaborations where knowledge and needs are more clearly communicated. The dynamic collaboration is facilitated through different activities such as focus groups related to specific themes e.g. sales and marketing, where members are actively engaged and work together. Another example is the establishment of panels that peer review applications for funding and provide feedback for each other. All these initiatives stimulate a closer collaboration and knowledge exchange, whilst acknowledging the limited time members have.

A major challenge for the cluster is its Arctic reach. It is currently focused on the Tromsø region and mostly engages with actors from the southern part of Norway, as this is where knowledge is more institutionalised. However, due to its Arctic biotech scope, the cluster is searching for ways to increase collaboration

with other Arctic stakeholders who are not necessarily as institutionalised as those in the south. For instance, there is an opportunity of getting access to byproducts from fishermen who either throw away byproducts or use it for lower value-added products/processes, often because they are not aware of its value or how to take advantage of the opportunity.

Finally, attracting talent is also a challenge for the biotech companies in the cluster. Although the oil industry has created a more diversified economy in the north, there is a need to make biotech more attractive as a career path, and furthermore make the Arctic regions attractive to live in e.g. offering cultural activities or sports activities.

# GENIS AND SIGLUFJORDUR – INCREASING QUALITY OF LIFE TO ATTRACT HUMAN CAPITAL

**Company:** Genis  
**Sector:** Blue bioeconomy  
**Region:** Iceland

**Contact:** Robert Gudfinnsson  
Chairman  
**Mail:** robert.gudfinnsson@genis.is

**Developing a successful biotech company in a small Arctic town, while attracting human capital through initiatives that aim to increase quality of life and create a positive image of the town.**

Genis is a biotechnology company located in Siglufjordur in Northern Iceland. It was founded in 2005 as a spinoff of the applied research carried out by IceTech in the 1990s. It focuses on the discovery, development and commercialization of crustacean derived supplements and medical devices. Currently, it has two products on the market: Benecta, which is a natural food supplement that can help alleviate symptoms associated with getting older e.g. stiffness and aches, and BoneReg-Inject which induces scar-less healing in bone defects. It has 31 employees and 50% of these have a university degree e.g. bio-engineers and bio-chemists.

To begin with the company was located in Reykjavik and focused on research to drive product development. However, in 2014 the company moved to Siglufjordur to take advantage of the potential that the small north-

ern town had to offer. Genis has since then attracted good and well-educated employees and are part of the turnaround that Siglufjordur is experiencing.

## Success factors

Genis' success is based on its mission and its location. Its mission is to leverage world-class scientific research with the aim of providing life-changing benefits for individuals. Partners, employees and customers find this very meaningful and it creates an excitement about the company and its products, which is beneficial for Genis' development. Furthermore, Genis is successful because Siglufjordur provides the right infrastructure and quality of life that attract educated talent to the town.



↑ Siglufjordur.  
Photo: Scanpix

## Drivers and challenges

There are many opportunities in Arctic bioeconomy but a key challenge for bio-tech companies, like Genis, is a lack of skilled people to utilise opportunities. In Siglufjordur this has been addressed by looking at the features young, educated people are looking for in life and accommodating this through investments in infrastructure and initiatives that improve quality of life. This could be improving schools and kindergartens, offering outdoor activities, and creating a vibrant social life in the town. Moreover, Siglufjordur has also focused on fixing the roads, cleaning the city, and painting the houses, all to make the city look attractive and to drive a positive picture of the town and its future.

Creating a positive image of the Arctic areas is key to promoting business development.

As the Chairmann of Genis, Robert Gudfinnsson, argues, "People often fail to recognize that money does not always go where profit is maximized. Money goes where it feels good and safe – at a reasonable return". Hence, investors need to feel secure and have faith in the development of the Arctic areas. If not, they will not make any investments in the areas.

Part of driving a positive image of Arctic towns or areas is finding the answers to questions like, "Who are we?" and "How can we be different?" and then brand the area accordingly. Furthermore, change is often driven by locals who take the lead and are passionate about a cause. It is therefore key to find the right individuals, and support them in utilising different opportunities, rather than initiating public projects to drive business development.

## COLLABORATION EFFORTS TO INCREASE VALUE OF NATURAL RESOURCES

**Organisation:** Mátis  
**Sector:** Blue bioeconomy  
**Region:** Iceland

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 Chief Impact Officer  
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**Close public-private collaboration through an independent research company with a demand and value creation focus drive the improvement of food utilisation, based on public strategy and stakeholder participation.**

Mátis is a government-owned, non-profit, independent research company founded in 2007. It provides partners with support for value creation, food safety and public health, and is built on a strong foundation of science, knowhow, infrastructure, and collaboration to maximize impact of investment in research and innovation. In 2016, its turnover was made up of only 25% government funding (service contract), a decrease from 42% when it was founded in 2007. Otherwise, its turnover came from international research funds (30%), Icelandic research funds (15%), Icelandic companies (14%), public bodies (9%), and international companies (7%).

### Success factors

Iceland has experienced important improvements in the raw value chain, as the value of

exported fresh fish has increased significantly due to improved packaging, handling, and chilling methods. Mátis has played a key role in this development by translating research into practical knowledge and products. For example, Mátis developed a new Styrofoam box that enabled a prolonged "shelf life" by 2–3 days in collaboration with Sæplast Promens (packaging company) and seafood producers.

### Drivers and challenges

A key driver of Mátis' success is the integrated co-operation with domestic and foreign companies, and educational and research institutions for leadership roles in projects. Co-operation concerns external ideas as well as Mátis' own research. Mátis offers companies access to its laboratories and provides services such as safety testing, genetic analysis, and product



↑ Fresh Saithe fish.  
 Photo: Scanpix

development. This especially helps companies who cannot afford their own research facilities, or entrepreneurs who need to test ideas.

Another important driver of Mátis' success is the company's strong focus on demand and value creation. Mátis' projects are driven by demand to ensure that it caters to clients' needs – whether it is global demand to improve the utilisation of fish or a company's demand for the development of new drugs, fresh food products, or dog feed. Furthermore, Mátis' focus on value creation ensures that its clients gain from collaborating with Mátis. As such, Mátis focuses on reducing clients' costs or increasing their profits, and constantly emphasising sustainability as an explicit company focus.

Mátis also finds expectation management challenging especially in relation to research and innovation. Trust can be a barrier to introducing opportunities to a new audience,

and the focus should be on function and applicability of solutions rather than decorative formalities. Building a track record of excellent science with peer reviewed publication is important, however, application of knowledge is more important in creating value, as the valuables are the economic force of our societies. Alignment of interest starts with the fact that safety and integrity are prerequisites of sustainable value creation in the bioeconomy. Training talents capable of applying new knowledge across the region is important. Safeguarding and improving the quality of products of the bioeconomy is a common goal as it is mutual interest to enlarge markets for commercial products and thus contribute to quality of life and public health.



## 4.3 RECOMMENDATIONS

The recommendations and tools presented below concern opportunities to promote sustainable economic development within the Nordic Co-operation, specifically the Nordic Council of Ministers (NCM), as well as other Nordic Arctic stakeholders.

### Support to open access research facilities

**RECOMMENDATION:** Continued support and funding of existing open access research facilities and institutions to promote the creation of new, higher-value products from biomass sources.

**EXAMPLE:** At Norway's National Facility for Marine Bioprocessing (NOFIMA), companies can test and optimise their processes to extract all desired components from marine-based biomass and receive help to bring these optimisations to fruition on a larger scale to produce more advanced products. Another notable example includes the Research Park iNova in the Faroe Islands. The facility, located in Torshavn, allows private enterprises and public institutions to access state-of-the-art labs, instruments, and offices.

← Iceland.  
Photo: John Salvino

- **Why:** Today marine biomass is primarily used for the production of low value-added products, such as fish oil and food. To create higher-value products, bioeconomy tries to utilise all parts of biomass resources, including what was previously thrown away as waste, e.g. fish heads, fins, bones, guts, and tails. This increases the value per unit of biomass. Considering the increasing demands of a growing population, the development of new and innovative ways to utilise renewable biological material is a vital way of facing challenges of sustainability whilst contributing to employment and rural community engagement.
- **What:** The development of higher-valued products can be facilitated through support for research facilities whose knowledge can provide valuable insights for companies. Such research facilities can also provide an open platform upon which companies and stakeholders can test innovations and take R&D activities to new heights.
- **Who:** The Nordic Council of Ministers for Fisheries and Aquaculture, Agriculture, Food and Forestry (MR-FJLS) has the ability and the expertise to advocate for the continued funding of such research facilities and institutions. MR-FJLS is already focused on addressing the demand for these research facilities through

their Co-operation Programme 2017–2020. Specifically, focus on supporting institutions promoting innovative development of the Nordic Arctic bioeconomy should be sustained to support the development of valuable R&D resources for SMEs and larger companies. Furthermore, MR-FJLS could potentially take the lead in promoting the value of such research facilities to governments and regional authorities to ensure continued support and funding.

- **Next steps:** To facilitate continued support and development of the current open research facilities, MR-FJLS and particularly Nordforsk could potentially promote a mapping of Arctic research facilities and facilitate sharing of best practices across borders and between bioeconomy sectors. This can be done by connecting research facilities in an Arctic network, for example.

### Strengthened public-private collaboration

**RECOMMENDATION:** Co-operation between academia, public institutions, and businesses should be strengthened to promote the commercialisation of innovative products and processes in the Nordic Arctic bioeconomy.

- **Why:** Bioeconomy in the Arctic is being driven more by technology and human capital, as it aims to innovate and increase the competitive advantage of the region. Research as well as development and testing of innovations require sophisticated technologies and specialised skills that individual companies may not possess or cannot afford. Furthermore, research institutions and universities generate knowledge useful for new products and processes that carry great potential. However, a lack of resources or know-how prevents them from commercialising and scaling up. Finally, the drive for innovations in the bioeconomy often comes with great risks of failure. Companies may not be willing to take on this risk without public support, for example, in terms of innovation grants.
- **What:** Co-operation between businesses and academia with strong support and effective coordination from public actors can leverage ideas and drive economic growth and business development in the Nordic Arctic.
- **Who:** Not all Nordic Arctic areas have easy access to research institutes or academic institutions. The Nordic Council of Ministers for Fisheries and Aquaculture, Agriculture, Food and Forestry (MR-FJLS) and the Nordic Council of Ministers for Education and Research (MR-U) in co-operation with the Nordic institutions

**EXAMPLE:** There are already a number of such triple-helix examples. Most notable is Biotech North, a triple helix cluster within the biotechnology and biomarine sectors located in Tromsø in Northern Norway. This industry cluster combines the unique marine resources of the Arctic with modern labs, highly advanced equipment, local infrastructure and a well-organized business incubator to make it possible for start-up companies to successfully scale and leverage their innovations and ideas.

→ Photo: Fabrizio Conti

Nordic Innovation and Nordforsk could potentially help promote access to knowledge derived from research institutions by private actors located in regions without a triple helix structure. This could potentially be through advocating for increased digitalisation or offering services to rural areas even across borders, for example, through systems like innovation vouchers that give access to triple helix services in other countries. In this way, Norwegian companies would be able to access specialised services in Iceland. The Arctic Economic Council can potentially also help facilitate knowledge and data exchange between industry and academia at the greater Arctic regions, not only restricted to the Nordic Arctic region.

↓ A hunter from Tasiilaq in East Greenland. Photo: Visit Greenland / Mads Pihl



- **Next steps:** To facilitate continued support and development of triple helix structures, Nordic and Arctic stakeholders could potentially promote a mapping of triple helix structures and facilitate sharing of best practices across borders and between bioeconomy sectors. This could be done by connecting structures in an Arctic network or by hosting events with the aim of connecting actors.

## Promote bioeconomy sector to attract human capital

**RECOMMENDATION:** Make the bioeconomy sector more attractive for human capital through the promotion and branding of bioeconomy education and improved quality of life in rural areas.

- **Why:** An important driver of bioeconomy in the Nordic Arctic is the continued innovative and creative approach to developing the industry. The industry needs to promote interest in bioeconomy education, and attract human capital to Arctic areas, which are often rural and not so economically diverse.
- **What:** Promoting bioeconomy education could potentially be done through increased awareness of bioeconomy potential and a focused effort to change the perception of bioeconomy from a traditional industry related to catching fish or logging wood to the innovative and creative industry that it really is in the Nordic Arctic. Furthermore, to attract human capital to the bioeconomy regions in the Nordic Arctic, an increased focus on framework conditions, relating to the collective quality of life that families can enjoy, needs to be promoted. Efforts can support the creation of different facilities such as kindergartens, schools, restaurants, and the possibility of different activities e.g. mountain biking. Even simple efforts such as painting houses and keeping streets clean can change the perception of rural communities to make them more attractive for both companies and employees. Today younger generations generally seek education away from rural areas and often do not return for reasons such as limited job opportunities and isolation. A concrete idea could be to establish centres of excellence in secondary sectors connected to innovation in research and further processing of raw materials from the primary sector. An interdisciplinary "Centre of Excellence" would co-operate with experts in other Nordic Arctic countries as well as other countries engaged in Arctic research. Not only would this create additional innovative products and value in the economy, but also it would alter the trend of young people,

especially women, moving from rural areas to larger towns, cities, and countries.

- **Who:** Projects related to attracting human capital to the bioeconomy industry and rural areas often rely on efforts by Nordic Arctic universities, research institutions, companies, and local communities, who should pay particular attention to the innovative and creative dimensions of bioeconomy as well as the quality of life that rural areas can potentially offer. However, promoting awareness of what the bioeconomy entails and what kind of career possibilities it can offer, can potentially take place on a Nordic-level through initiatives such as Nordbio.<sup>29</sup> Nordbio was a Nordic bioeconomy initiative that focused on close multidisciplinary collaboration and had an objective of bringing together science, technology, education, and culture at various school levels, in institutions, and the economy. Nordbio demonstrates that bioeconomy could be promoted in an innovative and creative way through its Biophilia project, which uses creativity as an educational and scientific tool.
- **Next steps:** As part of promoting a modern view of bioeconomy, education institutes and companies should pay particular attention to branding bioeconomy as an innovative and creative industry. Closer work with creative industries could potentially take place to increase awareness of the creative opportunities this sector offers. To initiate this, institutions need to develop a strategic narrative that tells the story of bioeconomy's purpose, uniqueness, and vision. This should be implemented in all bioeconomy activities as well as communicated internally and externally. MR-FJLS could support this process through knowledge sharing and guidance.

## Tools

**Challenge:** A challenge to the increased cultivation of seaweed is that many of the fjords suitable for the production of seaweed are already utilised by aquaculture companies for fish farming.

- **Tool:** Aim to bring the harvesting of seaweed into the open ocean. The company Ocean Rainforest is currently testing this in the Faroe Islands.

**Challenge:** Increasing the use of wood as a sustainable building material, as currently wood only represents 4% of construction in Europe.

- **Tool:** Facilitate the development of a network through which stakeholders in the building sector can co-operate with the forestry sector. The key is to use a broad approach in which interac-

tion between local communities, municipal planning processes, public procurement, building projects, education, and competency development is ensured. An example includes Trefokus in Norway.

**Challenge:** Ensuring the development of a sustainable and healthy aquaculture sector.

- **Tool:** The introduction of strict veterinary and environmental regulations and a tax incentive that ensure that needed investments in production facilities will be made (see case: *The role of sustainable regulations in the fish farming industry*, under bioeconomy chapter).

↓ Brown seaweed on the coast of the Barents Sea.  
Photo: Scanpix





## 5 CROSS-CUTTING ISSUE ACROSS THE ARCTIC BUSINESS ANALYSIS

Desk research, case studies, and interviews have uncovered a variety of recommendations and practical tools to promote sustainable economic development for each focal area in the Arctic. These are presented in the individual reports, this one focusing on bioeconomy. However, the study also reveals a cross-cutting issue related to Arctic-specific data related to business development. Hence, presented below is a cross-cutting recommendation on data collection and dissemination

### A need for Arctic-specific data

**RECOMMENDATION:** Promote and support a regular collection and dissemination of Arctic specific data related to business and societal development within the Nordic region by supporting national and Nordic statistical offices in data collection and dissemination or Arctic specific data gathering projects.

→ **Why:** The Nordic Arctic region offers great potential for business development but has limited Nordic Arctic-specific data to uncover the conditions in which companies operate, social and business opportunities and challenges, resources, future investment

← Faroe Islands.  
Photo: Joshua Cowan

# 6 METHODOLOGY

opportunities, as well as other aspects of the Arctic business environment. The limited data makes it challenging for stakeholders such as businesses, academics, governments, authorities, and media to engage in more nuanced and accurate discussion on the Arctic-specific needs in business development.

- **What:** There is a need to supplement existing statistical information with systematic and recurring information gathering to develop knowledge of the Arctic specific socio-economic developments and business opportunities.
- **Who:** To strengthen and promote the collection and dissemination of Arctic specific data, the Nordic Co-operation could consider supporting the expansion and long-term sustainability of projects like Business Index North, and ensuring knowledge and awareness of the data by including it in the Nordic Statistical Bank.
- **Next steps:** To promote Arctic-specific data, the national statistical offices or the Nordic Statistical Bank could reach out to the Arctic data collection projects e.g. Business Index North to discuss possible collaborations on how to collect and disseminate data on the Arctic. Furthermore, a dialogue with Arctic business clusters, like the AEC, could be initiated to map the specific information needed.

**EXAMPLE:** Arctic-specific data gathering e.g. include the Arctic Business Forum Yearbook developed by Lapland Chamber of Commerce, the Economy of the North (ECONOR) publication by statistics Norway, and the Business Index North project implemented mainly by High North Center at Nord University Business School in Norway in Bodø. The Yearbook presents an overview of certain European High North investments and business developments, and discusses actions to be taken to overcome barriers of business and trade. It also presents data on specific investment opportunities and projects. The Business Index North initiative is a project

that runs from November 2015 to December 2018, and is developed through a strategic partnership between academic and research organizations, authorities, and commercial partners from Norway, Russia, Finland, and Sweden. It presents knowledge and statistics on the northern areas of Norway, Sweden and Finland but will gradually expand its analysis to cover the northern regions of Russia, USA, Canada, Denmark (Greenland), and Iceland. ECONOR presents an overview of the circumpolar Arctic economy, including traditional production activities of indigenous peoples, and has been published three times since 2006.

## Objectives & Definitions

The overall goal of this study is to provide a better understanding of the Nordic Arctic business environment with a focus on sustainable economic activities; and to generate practical recommendations to the Nordic co-operation and other Arctic actors on increasing economic activity in the Nordic Arctic. To this end, the research scope includes four focal areas selected by the steering group as areas of particular interest for sustainable business development in the Nordic Arctic. The Nordic Arctic and the four focal areas are defined below.

The Nordic Arctic is defined as the states of Iceland, Norway, Finland, Sweden and the countries Faroe Islands and Greenland (part of The Kingdom of Denmark).<sup>30</sup> The study will include an overall analysis of the areas mentioned, but for Sweden, Norway, and Finland emphasis will be placed on the northern regions of these countries.

### Entrepreneurship and innovation

- Entrepreneurship is when actions take place on the basis of opportunities and good ideas, and are translated into economic, social and/or cultural value for others.<sup>31</sup> Along similar lines, innovation is the process of promoting changes in technologies, products, or administrative practices. It is important, however, that the understanding of entrepreneurship, innovation, and an entrepreneurial mind-set is embedded within regional and cultural contexts.

### Public-private partnerships (PPPs) and business co-operation

- PPPs are an interaction between public and private institutions for the delivery of pre-defined services. The aim is to provide public service delivery from a mutually beneficial partnership, though the partnership remains founded in public oversight.<sup>32</sup>

→ Business co-operation is, in this report, defined as industry clusters, where the seminal definition is a "...geographical concentration of interconnected companies, specialised suppliers, and associated institutions (e.g., universities, standards agencies, trade associations) in a particular field that compete but also co-operate." This definition is combined with the European Cluster Excellence programmes labelling to specify the clusters.<sup>33</sup>

**Bioeconomy**

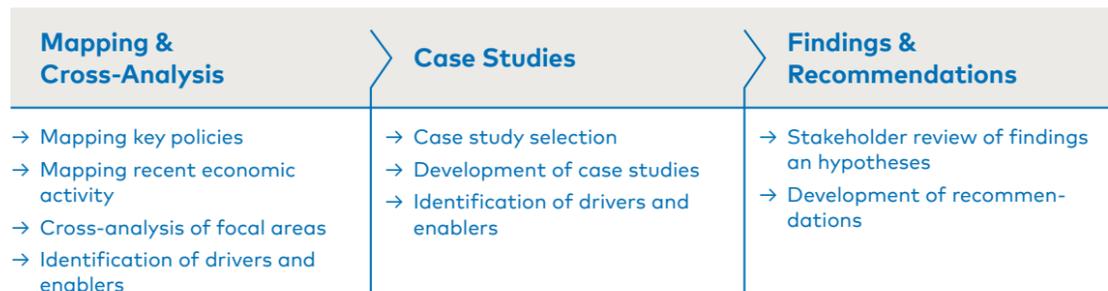
→ Bioeconomy consists of the management of renewable biological resources and their conversion into food, livestock feed, bio-based products, and bioenergy via innovative and efficient technologies. It means using biomass intelligently and creatively through the four pillars of bioeconomy: collaborate, circulate, upgrade, and replace.<sup>34</sup>

**Creative and cultural industries**

→ Creative and cultural industries encompass a broader range of activities that include creative and cultural production. In an Arctic context, it often emphasises human creativity as a way to leverage cultural heritage and translate it into a business.<sup>35</sup>

**Research Approach**

To achieve the aim of this study, a three-phase research approach was developed as illustrated below.



**Mapping & Cross-Analysis**

The mapping sought to identify policies and recent economic activity within the focal areas through extensive desk research. The key insights from the mapping were consolidated in a cross-analysis framework that assessed and correlated the level of policy support with the level of economic activity. The combination of factors indicated opportunities concerning policy and economic activity and gaps for sectors in each focal area. This generated hypotheses on enabling and constraining factors, as well as developed an overview of business development potential in the Nordic Arctic. Considering the challenge in quantifying and measuring the topics of this study, a score-based method was developed based on a qualitative assessment of the policies promoting economic activity and available data on actual economic activity in the Nordic Arctic. The multiple scoring method relied on a pre-defined assessment scale and estimations from various project collaborators.

**Case Studies**

Enabling and constraining factors identified in the cross-analysis were further examined through case studies of selected businesses, organisations, and projects identified during the desk research and the cross-analysis. Case studies were selected based on their ability to enrich the analysis of gaps and enablers, and ability to scale potential learnings to other businesses, industries, and potentially other Arctic areas.

**Findings & Recommendations**

Findings and hypotheses from the mapping, cross-analysis, and case studies were assessed and reviewed by several stakeholders in the Nordic Arctic region for evaluation, further development, and final assessment. Finally, knowledge and conclusions were synthesised to develop recommendations on ways in which the Nordic Co-operation, specifically Nordic Council of Ministers (NCM), and other Arctic actors can support specific initiatives in the future to facilitate economic growth, investment, and business development in the Nordic Arctic region.

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Iceland.  
Photo: Jon Flobrant