

Scottish Government Arctic Policy: Mapping Report

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SCOTTISH GOVERNMENT ARCTIC POLICY MAPPING REPORT

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List of Acronyms

AMAP	Arctic Monitoring and Assessment Programme
ARP	Arctic Research Programme
ATS	Antarctic System Treaty
CAFF	Conservation of Arctic Flora and Fauna
CEC	Commission of the European Communities
CTD	Conductivity, Temperature and Depth
CYCLOPS	Carbon Cycling Linkages to Permafrost Systems
DTM	Digital Terrain Models
ERI	Environmental Research Institute
EU	European Union
GHG	Greenhouse gas
GRID	Global Resource Information Database
HIE	Highlands and Islands Enterprise
HYDRA	Hydrological Controls on Carbon Cycling and Greenhouse Gas Budgets
IASC	International Arctic Science Committee
ICE-POPES	Ice-tethered observational platform
ICES	International Council for the Exploration of the Sea
IMO	International Maritime Organisation
IPCC	Intergovernmental Panel on Climate Change
IT	Information Technology
JNCC	Joint Nature Conservation Committee
KTH	Kungliga Tekniska högskolan (Royal Institute of Technology)
MASTS	Marine Alliance of Science and Technology for Scotland
MCCIP	Marine Climate Change Impacts Partnership
MEOP	Marine Mammal Exploration of the Oceans Pole to Pole
MOU	Memorandum of Understanding
MPA	Marine protected area
MSS	Marine Scotland Science
NARP	Nordic Senior Officials' Committee for Regional Policy
NERC	Natural Environment Research Council
NORA	North Atlantic Cooperation
NPA	Northern Periphery and Arctic Programme
NPP	Northern Periphery Programme
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
PRISMA	Preferred Reporting Items for Systematic reviews and Meta-Analyses
SAGES	Scottish Alliance for Geoscience Environment and Society
SAMS	Scottish Association for Marine Science
SAR	Search and Rescue
SFC	Scottish Funding Council
SHAPE	Sustainable Heritage Areas: Partnerships for Ecotourism
SME	Small and medium enterprise
SNP	Scottish National Party
SURGE	Scottish University Research in Glacial Environments
UHI	University of the Highlands and Islands
UK	United Kingdom
UKRI	United Kingdom Research and Innovation
UN	United Nations
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
WNC	West Nordic Council

1. EXECUTIVE SUMMARY

Context and background

Climate-related risks to health, livelihoods, food security, water supply, human security, and economic growth are projected to increase with global warming of 1.5°C and increase further with 2°C (IPCC 2018). This is expected to have significant consequences for the Arctic Region including challenges related to changes in social life and livelihoods, access to food and food production, and biodiversity. At the same time climate change may present opportunities for economic growth through for example trade, tourism and industrial development.

Scotland is the Arctic's closest neighbour and as such is positioned well to help address the Arctic region's challenges and to contribute to the benefits stemming from the 'opening up of the Arctic'. The Scottish Government proposes the development of The Arctic Policy in recognition of Scotland's long history of social, cultural, economic and academic ties with its northern neighbours. To help shape the Scottish Arctic Policy development process, this mapping report was conducted to provide a detailed overview of Scotland's existing links with the Arctic region from 5 perspectives: governance, socio-cultural-community, economic, environment and climate change, and academic-research and to provide insights into the opportunities for future collaborations and partnerships.

A two-pronged approach was used to conduct the mapping report; a desk based review of literature and stakeholder engagement workshops. The study set out to answer the following set of questions:

- What links exist between Scotland and the Arctic Region in the context of governance, socio-cultural-community issues, the economy, environment and climate change and academic-research and education?
- How can critical thinking, insight and feedback by key and wider stakeholders be mobilized for the development and roll out of the Arctic Policy?
- What are the gaps and opportunities for furthering the development of the Arctic Policy?

Key findings

Governance links

The Arctic is becoming increasingly prominent on the international stage due to its scientific, economic and strategic importance and it is predicted that an increasing number of countries will take a strong interest in the region in the upcoming decades. The Arctic Council puts strong emphasis on the human dimension of regional governance, and indigenous and social issues are high on its agenda. Scotland's current policy focus on issues related to social justice, just transition and climate justice readily lend themselves for complementing a future Scottish Arctic policy in this context. Interestingly, while the UK strategy for the Arctic does aim to "protect people and the environment" (HM Government, 2018, p. 15), little to no attention is given to the social and economic inequalities (including those rooted in environmental issues such as climate change) that are affecting the region's indigenous and northern communities. Scotland's experience with supporting local development in remote communities, as discussed below, makes Scotland a natural partner for Arctic and non-Arctic players.

When comparing the different Arctic policies, strategies and guidelines of Arctic and non-Arctic States, it is clear that the overall approach to the Arctic region is similar in the vast majority of cases. These include: recognition of international law to solve any potential disputes, international collaboration in terms of scientific research and technological innovation, and sustainable development. Many of these policy priorities overlap also with the Scottish national interest in the areas of scientific cooperation, peaceful governance, climate change mitigation and adaptation, and sustainable and equitable development.

Interestingly, environmental protection is very high on the agenda in virtually all the policies, with a few exceptions. For example, the importance of climate change is underscored by Nordic countries (e.g. Norway, Iceland and Sweden), but less so in the case of Russia or the United States.

In terms of economic interests, in many Arctic nations such as Canada, Finland and to a lesser extent Norway, the 'opening up' of the Arctic is seen as an opportunity to increase the quality of life for the region's inhabitants, including indigenous groups, in the spheres of employment, health, education, access to physical and digital infrastructure, and other social services which may be currently underdeveloped. However, for their non-Arctic counterparts, the focus is on promoting national industries and businesses. For instance, Germany, France and Italy see potential economic opportunities in their expertise in ship-building technology, mining of resources, and GHG emission reduction technologies, respectively.

Other aspects of policies do not enjoy nearly as uniform a focus, with the possible exception of search and rescue capacity, the need for a more consolidated drive of which is recognized across the region. Countries also seem to differ on the acceptable degree of militarization of the Arctic.

Socio-cultural links

Scotland has many social and community links and similarities with the Arctic Region and Arctic States. There are numerous geographical, historical, cultural, and linguistic ties, in particular between the Highlands and Islands and the Arctic. Importantly, Scotland's geographical, historical and cultural connections to the Arctic are considered to be stronger than those in the rest of the UK.

Scottish-Nordic cooperation has built on this long history of social and cultural ties as reflected in commonalities of language, traditions and outlooks. Peripheral, sparsely populated areas and fragile communities present common challenges related to depopulation, remoteness, inaccessibility, and a harsh climate which are shared across Scotland and the Nordic nations.

Economic links

The bilateral economic links between Scotland and the Arctic are mainly found in the energy, fishing and tourism industries. There are notable Scottish companies operating in the Arctic region, who have achieved commercial success. However, the most significant economic links are found in investment by companies and institutions from Arctic Council member states into Scottish commercial operations and research development based in Scotland. The Scottish Government's Highlands and Island Enterprise plays a key role in accelerating business growth, developing regional attractiveness and strengthening communities.

Environment and climate change links

Scotland has well-established research connections with the Arctic and surrounding countries through collaborative research and participation programs. There are numerous examples of international cooperation and coordinated research activity, much of which has been going on for over 25 years. Scientific collaboration occurs through a number of programmes including EU-funded H2020 (Arctic Cluster), UN conventions and scientific associations (EU-PolarNet, n.d.). Areas of strength and expertise lie across many disciplines. Scottish scientists are leading in scientific and technical advances in oceanographic and ecological data collection, remote sensing and the development of small satellite systems. Scottish universities host Europe's largest glaciology research group; we contribute to the Marine Climate Change Impacts Report, the Arctic Council Circumpolar Biodiversity Monitoring Program and the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR 2018) on marine spatial planning.

Much of the Arctic research conducted in Scotland is currently related to natural sciences. More recently, however, there has been a growing recognition of the importance and significance of social sciences and humanities research to integrate perspectives and needs of rural and remote communities. Given the rapidity of the change, there is an urgent need to better understand the impacts of climate change on the Arctic and their wider implications for Scottish interests, for example in the context of fisheries and pollution, including plastic and noise.

Academic links

Despite a robust Arctic research portfolio in Scotland, only two Scottish universities are members of the University of the Arctic (UArctic) which has as its mandate to promote education, research and outreach on the North, to enhance local human capacity, promote sustainable economies and forge global partnerships

(University of the Arctic, n.d.). External to the higher education section there are notable examples of Scottish-Arctic educational partnerships, such as the West Lothian-based Polar Academy (The Polar Academy, 2018) and the Scottish Arctic Club (Scottish Arctic Club, 2018). There is no institutional centre of excellence of Arctic research in Scotland comparable to the UK's Scott Polar Research Institute in Cambridge.

Funding for Arctic research in Scotland comes from a number of national and international donors. The most significant are the Natural Environment Research Council's Arctic Research Programme and the European Union 2014-2020 Northern Periphery and Arctic Programme (NPA). It is unclear what impact Brexit will have on the availability of EU funding for Arctic research. In the worst case scenario, Scottish research bodies will lose access to the likely successor of the NPA, creating a funding gap in the Scottish research landscape. Moreover, Arctic research heavily depends on strong regional networks which EU funding has facilitated. It is unclear if and to what extent UK funding for Arctic research would compensate the loss of available funds in a hard-Brexit scenario.

Recommendations

Scotland has much to offer to the Arctic region in terms of knowledge, skills, expertise, technology, and business opportunities, and this is enveloped around similarities in our social and cultural heritage. Moving forward, a number of recommendations and practical ideas are suggested for continued future collaboration and the development of partnerships with our Arctic neighbours and other nations with an Arctic outlook. These include:

- Drawing synergies with other sub-national regions located in the Arctic

The development of a Scottish Arctic policy should not only complement but also go beyond the UK Arctic policy. Indirect representation through the UK delegation appears as one of the most cost-effective ways to increase Scottish participation in Arctic governance. Scotland could draw from the experience of Quebec, Greenland, Faroe Islands, and Alaska in seeking an appropriate arrangement with the UK government.

- Increasing Scottish presence through international bodies

Another straightforward way for increasing Scotland's presence in this area is through other international bodies by which it could potentially be considered an eligible candidate. Consideration should be given to some form of potential participation in the Northern Forum, the North Atlantic Cooperation (NORA), and the West Nordic Council (WNC). Strong European presence in the Arctic would benefit Scotland, not least for research funding and economic reasons, including the promotion of Scottish businesses and research initiatives. Other suggestions include a dedicated Arctic office in the Scottish Government's European division to coordinate Scotland's involvement at the international level, a national academic forum, and engaging Scottish councils and municipalities in Arctic governance at the national level.

- Identity

Building on the very strong socio-cultural connections and similarities between Scotland and its Arctic neighbours, Scotland could further articulate its strong affinity with the Nordic nations by, for instance, promoting cultural legacy projects. This could complement the wider strategy of Scotland positioning itself as a 'near-Arctic state'.

- Understanding and protecting the needs of rural and remote communities

Develop a unique multi-disciplinary programme of community-based projects with its Nordic neighbours that has a vision of i) understanding the needs and priorities of rural and remote communities in changing times ii) considering how these needs can be acted on in the form of community-led initiatives to build resilience, platforms of voice, empowerment and representation and iii) identifying ways in which community and local stakeholder engagement can be embedded into local, national and regional planning processes to maintain community cohesion.

- Opportunities for growing the economy

Foreign investment into and the forging of partnerships between Scottish and Arctic-based businesses in oil and gas exploration, renewable energy, fisheries and tourism including green tourism presents itself as a business and economic opportunity for Scottish companies. To take advantage of this, Scotland should be proactive in promoting itself as a global destination of choice for future investment. Some suggestions on how this can be achieved include leading on technology-innovation conferences, Business Expo, or establishing knowledge exchange platforms. However, there is significant opportunity for Scotland to create a positive outlook on transition from oil and gas to renewable energy in export ambitions. This can be done by learning and recreating international examples of governmental support in financing or procurement of contracts to the Scottish renewable energy sector.

- New innovations in multi-disciplinary research – The Scottish Arctic Research Cluster

With the Arctic being the most rapidly changing environment on the planet there are undoubtedly opportunities for Scotland to contribute knowledge and expertise to further understand climate change impacts and to help mitigate and adapt to them. New natural-physical science and socio-cultural-economic multi-disciplinary research is needed to understand the scale of the impacts of climate change and assess how change will affect remote communities and wildlife species and to identify mitigation measures. This could be achieved through the development of a new Arctic Research Cluster which spans all sectors of interest. The Arctic Research Cluster could build on Scotland's globally unique Climate Justice Fund and Climate Justice Innovation Fund, placing a strong emphasis on protecting the poorest and most vulnerable people.

- Distance learning educational models

Scotland could take a leadership role in the development of new educational links with the Arctic region. This could be in partnership with the University of the Arctic through distance learning, joint courses and placements, providing opportunities for Scotland to help nurture future generations and respond to climate change.

- Investing in advances in technical innovation

A number of emerging areas of technical innovation which require continued investments in research and development have been identified. These include satellite remote sensing for monitoring the state of and changes in the sea ice cover and autonomous vehicles that allow for remote collection of oceanographic data and ecological data from hostile environments. Driving research and development funding into these areas could be explored with the business community.

- Consolidation of Arctic Research in Scotland

Virtually all Arctic policies analysed for the purposes of this report contain a very strong scientific research component, and stress the need for increased regional cooperation in this context. There is fertile institutional ground for the much-needed consolidation of Arctic research in Scotland given the existence of a number of multidisciplinary research centres and associations either with a specific focus on the Arctic or with expertise that could be successfully mobilized to this end. At the international governance level, active participation in regional scientific bodies, such as the International Arctic Science Committee (IASC) through the UK delegation, should be pursued by Scottish authorities or by making links to non-Arctic states' research initiatives.

- Fostering educational links

The Scottish government could facilitate increased cooperation in order to capitalize on the already forged research, outreach, and teaching and learning partnerships. Scottish academic institutions could be repositioned as *the gateway to the Arctic* (or to Europe).

Concluding remarks

Scotland as a valuable partner

Scotland has a long history of social and cultural connections with its Arctic neighbours, and shares with them similar challenges in the context of empowering rural and remote communities and protecting their geographical landscapes. Scotland is also excelling in technological innovation through business investments into the sector and leading the way in environmental protection and tackling climate change. As such there is significant interest from Arctic nation states in the contribution that Scotland can make to the governance of the region. This was evident at Scotland's presence at the recent Arctic Circle Assembly in Iceland in October 2018. This provides a huge opportunity for Scotland to show political leadership and position itself as a valuable partner. To achieve this global outlook and to consolidate our strengths in Arctic expertise, a dedicated Arctic Office to coordinate the Scottish Government's involvement at the national and international levels comes highly recommended.

2. INTRODUCTION

The IPCC's recent report on Global Warming of 1.5 °C highlights that human activities are estimated to have caused approximately 1.0°C of global warming above pre-industrial levels and this is likely to reach 1.5°C between 2030 and 2052 if GHG emissions continue to increase at the current rate (IPCC, 2018). The authors further conclude that "warming greater than the global annual average is being experienced in many land regions and seasons, including two to three times higher in the Arctic" (IPCC, 2018), which inevitably will bring with it a number of challenges. Amongst other things, in the Arctic, these challenges relate to changes in social life and livelihoods, access to food & food production and biodiversity, which will ultimately have a bearing on human health, security and economy.

Published recently in the Arctic Report Card 2017, temperatures are increasing in the surface of the Arctic Ocean, contributing to the later formation of sea ice cover in the autumn (Richter-Menge et al., 2017). Temperatures are also on the rise in the permafrost of adjacent countries. These conditions have resulted in: increases in the Arctic Ocean's primary productivity, changes in above ground vegetation which is affecting hydrological dams, changes in carbon and nutrient cycling as well as changes in habits of domestic and wild plant eaters. The impacts of these changes are having implications in terms of resource management which is directly affecting people living in Arctic communities (Richter-Menge et al., 2017).

These impacts will inevitably bring regressive shifts in material and power balances and it is not unreasonable to expect that those who are materially and politically disadvantaged will bear the brunt of climate impacts, while those at the top of the socio-political ladder will steer their lives towards a more climate-proof future (Mikulewicz 2018). On the other hand, climate change may present opportunities for development. Retreating ice and opening up of new sea routes, for instance, may allow for further exploration of trade, tourism, fishing and industry as well as the potential benefits to be gained from untapped natural resources.

To address some of the issues highlighted above, the UK policy towards the Arctic region titled *Beyond the Ice* was published in April 2018 (HM Government, 2018). The policy built on an earlier Arctic policy framework titled *Adapting to Change*, which centred around three pillars: Respect, Co-ordination and Appropriate Leadership (HM Government, 2013). *Beyond the Ice* lays out plans for research, development and international co-operation to benefit the Arctic Region. In addition, the EU has also set out its plans in 'An Integrated European Communication to the European Parliament' where advancing international co-operation is highlighted (European Commission, 2016). However, with the UK's exit from the EU becoming more imminent, the sustainability of funding from the future successor of the Northern Periphery and Arctic Programme is under threat.

Although Scotland is not within the Arctic Circle and cannot describe itself as an Arctic nation, it is the Arctic's closest neighbour and as such is positioned well to help address the Arctic region's challenges and to contribute to the benefits stemming from the 'opening up of the Arctic'. So to protect national interests, safeguard inhabitants, peace and stability in the region, the Scottish Government proposes the development of The Arctic Policy. This policy will build on amongst other things existing Scottish Government involvement at the Arctic Circle Assemblies (2016 & 2017) which came with support from Former President of Iceland and Arctic Circle Chairman Ólafur Ragnar Grímsson.

To help shape the Scottish Arctic Policy development process, this mapping report was conducted to provide a detailed overview of Scotland's existing links with the Arctic region from 5 perspectives: governance, socio-cultural-community, economic, environment and climate change, and academic-research. It provides insights into the breadth and depth of our existing links with the Arctic, our social and cultural connections, and the opportunities for future collaborations and partnerships.

3. METHODOLOGY

A two-pronged approach was used to conduct the mapping report; a desk based review of literature and stakeholder engagement workshops. The study set out to answer the following set of questions:

- What links exist between Scotland and the Arctic Region in the context of governance, socio-cultural-community issues, the economy, environment and climate change and academic-research and education?
- How can critical thinking, insight and feedback by key and wider stakeholders be mobilized for the development and roll out of the Arctic Policy?
- What are the gaps and opportunities for furthering the development of the Arctic Policy?

Desk-based review of literature

A desk-based review of literature was conducted to identify and document evidence on Scotland's relationship with the Arctic Region. This included both peer-reviewed and grey literature.

The research method adopted for the desk-based review followed the principles laid out by the PRISMA statement (Preferred Reporting Items for Systematic reviews and Meta-Analyses) as described by Moher et al. (2009). This comprised of the following:

- setting research parameters and scope,
- identifying and analysing relevant studies,
- quality assessment,
- data extraction,
- data synthesis,
- data interpretation
- valuation and discussion.

Setting research parameters and scope

The framing for the literature search was built on a number of historical junctures:

- The initiation in 1998 of the Article 10 Northern Periphery Programme, seen as a push for more Nordic-Scottish cooperation.
- As proposed by the Arctic Institute, that Scotland's current interest in the Arctic stems from an article published in 2011 by Angus Robertson, who at the time was the Scottish National Party's (SNP) leader in Westminster, in response to the 2010 Strategic Defence and Security Review.
- A paper published in 2012 by the Scottish law professor, Rachael Lorna Johnstone in the Arctic Yearbook. In it, she claimed that "Scotland has quite distinct [from the rest of the UK] historical, social, economic and political interests in the Arctic", and that the UK Government's apparent disinterest in the Arctic puts at risk Scotland's ability to pursue those interests (Johnstone, 2012).
- The 2017 Arctic Circle Forum which was held in Edinburgh bringing together policy makers, academics, business leaders and others interested in the future of the Arctic region. This was the first Arctic forum to take place in the UK and notably it came with support from Former President of Iceland and Arctic Circle Chairman Ólafur Ragnar Grímsson.

Identifying, analysing, quality assessment

The literature review involved establishing data eligibility criteria and selecting relevant sources of information (databases), defining a search strategy including source selection criteria and limits, and procedures for data collection, analysis and synthesis.

Eligible sources of information included a mix of academic and grey literature: peer-reviewed journal articles, book chapters, reports, official documents, news reports as well as any other reliable sources the project team deemed appropriate and relevant. The search was limited to sources published online between 2008 and 2018 and available in English. The databases selected for the review were ABI inform, Google Scholar, Science Direct, Web of Knowledge, and selected specialist databases, e.g. for industry links. The search involved performing a consistent, repeatable set of queries in each of the databases using a) the eligibility criteria set out above and b) the search terms outlined below.

Key search terms used for the literature review (see Table 1) as well as parameters for inclusion and exclusion were jointly identified by the project team. Queries involved various combinations of geographic terms (e.g. 'Arctic', 'Scottish', 'Norw*') and theme-based terms (e.g. 'governance', 'touris*'). Emphasis was placed on sources that focused directly on the relationship between Scotland and the Arctic region within each of the five major themes. In terms of quality assessment, the search involved identifying studies that have been published in what the project team considered reputable sources. It should be noted that upon conducting the initial queries, each team member further explored links of particular importance through an additional search using the pre-selected databases as well as web search engines such as Google Search which included sources older than 2008. Based on the screening and analysis of extracted data, main sub-themes were identified for each section. Final results of this analysis were condensed into this report comprised of distinct sections based on each of the five major themes.

Theme	Examples of geographic search terms	Examples of theme-based search terms
Governance	Scotland, Scottish, UK, Arctic (Region, Circle), High North, Far North, Canad*, Finland, Faroe*, Iceland*, Norw*, Russia*, Swed*, Alaska*	Policy, governance, strateg*, politic*
Socio-cultural		Social, society, community, civil, culture
Economic		Touris*, business, financ*, trade
Environment & climate change		Environment, climate change, biodiversity
Academic		Research, education, academia, science

Table 1. Examples of geographic and theme-based search terms employed for the purposes of literature review.

Extraction, synthesis and interpretation

A template for data extraction from the papers and publications was developed to ensure alignment with the overall research questions. The extracted data was analysed and synthesised to provide a much wider discussion of the issues. Emphasis was put on both exploring the current links and interpreting their significance.

What and why:

- What is the scale/significance of activity? What do lateral relationships look like? Are there any common points emerging? Is collaboration fragmented? Is there a sense of co-ordination among the stakeholders?

Outcomes:

- What is new/novel/unique? Is there a global outlook, and how can we use this to inform, underpin, direct and focus future development and refinement of the Scottish Government Arctic Policy?

Directions for future policy:

- What are the emerging areas for growth going forward – business, research, other. Where are the gaps? Where are the opportunities? What can we offer? How can we enable buy-in from external stakeholders?
- Where do the challenges lie?

Stakeholder engagement workshops

Stakeholder engagement was an integral part of the mapping exercise and was used for valuation and discussion of the initial literature review findings. The engagement was also used to further explore issues identified in the literature review and to open up the opportunity for stakeholders to contribute new knowledge and insights to complement the desk-based literature.

Two stakeholder engagement workshops were held in Glasgow (12th October 2018) and Inverness (16th October 2018) with representatives from local authorities, universities, research institutions, businesses as well as representatives of civic society. For those who were not able to attend the workshops, the project

team followed up with individual phone calls and over email. The workshops provided the participants with the opportunity i) to learn about the preliminary findings of the literature review and ii) to contribute knowledge and expertise and to influence government policy by providing their own perspective on the past, present and future links between Scotland and the Arctic.

A third opportunity to share the initial findings of the mapping report was at the first Scottish Government Arctic Steering Group which was chaired by Cabinet Secretary Fiona Hyslop. This was held on the 3rd October in St. Andrews House, Edinburgh. Stakeholder input is detailed in Annex VI.

4. CONTEXT

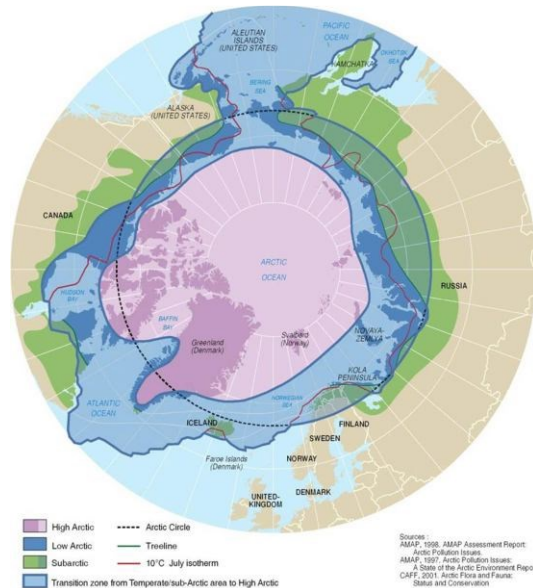


Figure 1. Arctic Definitions - Hugo Ahlenius, UNEP/GRID-Arendal. Source: Rekacewicz 2005.

is characterised by wood-like vegetation such as shrubs, willows, and heather. The Subarctic is characterised as a transitional zone between the tree line (where trees at least two to three metres can grow) and the zone with contiguous boreal forests (Grønnestad 2016).

Due to these different definitions, it is difficult to estimate the population of those living in the Arctic, with the number estimated at around 4 million people (Arctic Council, 2016).

The Arctic Council

The Arctic Council is the main forum for international cooperation on Arctic issues. The Council consists of the eight states with land areas north of the Arctic Circle: Norway, Sweden, Denmark (with the Faroe Islands and Greenland), Iceland, Finland, Russia, the United States, and Canada. The Arctic Council is the only inter-governmental forum where the Arctic states convene to cooperate on the challenges they face. The Arctic Council was formally established in 1996 in Ottawa to promote sustainable development within the environment, social conditions, and the economy (Grønnestad 2016). In addition to the eight member states, six international organisations representing

Defining the Arctic

Although the Arctic may be considered a distinct region, no universally agreed definition of it exists. However, several different technical descriptions are used (see Figure 1). The most commonly used definition is the Arctic Circle found at 66° 34' N, which marks the point at which the sun does not set on the summer solstice or rise on the winter solstice (Grønnestad 2016).

Two other potential definitions include i) the area within the 10 degree July isotherm, where the temperature does not rise above 10 degrees in the summer and ii) the area within the Arctic tree line, the northern limit for tree growth (Grønnestad 2016).

The landmass can also be divided into three zones: the High Arctic, the Low Arctic and the Subarctic. The High Arctic is characterised by flowering plants, grass and grass-like plants (sedges). Moss, and lichen can grow and the vegetation cover is often non-contiguous. The Low Arctic

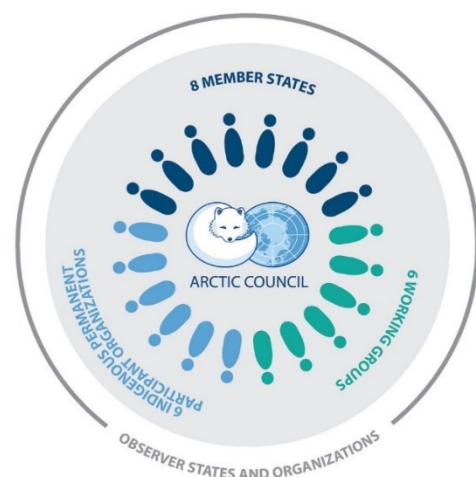


Figure 2. The structure of the Arctic Council. Source: arctic-council.org

indigenous communities have been recognised as permanent participants in the council, while several non-Arctic countries, international organisations and NGOs have observer status (see Figure 2) (Grønnestad 2016).

5. KEY FINDINGS

This section contains an overview of the key findings per theme based on the desk-based review of literature and the stakeholder engagement workshops. In-depth details that underpin these findings are provided in Annexes I-V, while the agenda and the list of workshop participants can be found in Annex VI.

Governance links

Unlike the Antarctic, which in accordance with international law cannot be claimed by any nation-state and is regulated by what is collectively known as the Antarctic Treaty System (ATS), the Arctic is inhabited by people and falls within the legal jurisdiction of eight nations (Canada, Denmark/Greenland, Finland, Iceland, Norway, Russia, Sweden, and the United States) (Bajrektarevic, 2010). Instead, a number of international treaties and agreements on issues related to environmental protection, marine pollution, search and rescue (SAR) capability, resource exploitation, and international cooperation have been adopted. In addition, the region is the focus of a number of international and interregional institutional initiatives. As a result, despite the absence of a comprehensive system like ATS and the sometimes diverging interests of the region's nations, the Arctic is an example of an international governance structure that has favoured cooperation, consensus and peaceful dispute resolution over open conflict and competition for resources. It should be noted, however, that as the Arctic is becoming increasingly prominent on the international stage due to its scientific, economic and strategic importance, it is predicted that a growing number of countries will take a strong interest in the region in the upcoming decades. This section discusses the differences and similarities between the various Arctic policies and strategies from both Arctic Council member and observer states (see Tables 2 and 3). In addition, Annex I maps the key legal and institutional arrangements, which have contributed to the peaceful governance structure in the region and which can be of strategic importance to Scotland's ambitions for an increased involvement in the Far North.

Differences and similarities across Arctic policies

When comparing the different national and sub-national Arctic policies, strategies and guidelines, it is clear that the overall approach to the Arctic region is similar in the vast majority of cases. The recognition of international law as a way to solve any potential disputes among countries and support for collaborative governance in the Arctic is the common thread within the documents. There seems to be a particularly strong consensus on the need to develop deeper international collaboration in terms of scientific research and technological innovation. Most countries, particularly those not located in the Arctic, recognize that conducting research and promoting innovation in the region cannot be done in isolation. Combined with the increasing interest in Arctic studies, this limitation presents an obvious opportunity for establishing new links between Arctic and non-Arctic actors. Importantly, a number of countries have already embarked to consolidate their national research programmes (e.g. Japan, Italy, and the Republic of Korea).

Environmental protection is also very high on the agenda in virtually all the analysed cases. Both Arctic and non-Arctic nations recognize the fragile and often vulnerable nature of the Arctic ecosystem, and advocate for a range of measures to safeguard it. Biodiversity conservation (for instance through establishing new protected areas) and sustainable management of resources (such as fisheries, hydrocarbons, and extractive minerals) are present in almost all documents. However, there are some divergences in this context, with countries deciding to foreground different environmental issues in their policies. For example, climate change is high on the agenda of Nordic countries (e.g. Norway, Iceland and Sweden), but less so in the case of Russia or the United States.

The Arctic Council puts strong emphasis on the human dimension of regional governance, and indigenous and social issues are high on its agenda. Scotland's current policy focus on social justice, just transition and climate justice readily lend themselves for complementing a future Scottish Arctic policy in this context. Since many of the challenges predicted for indigenous populations in the Arctic relate to climate change impacts, Scotland's leadership in climate change mitigation and its growing focus on adaptation can provide important policy and practical support to the mission to make international involvement in the Arctic more attuned to local needs. While the UK strategy for the Arctic does aim to "protect people and the environment" (HM Government,

2018, p. 15) and gives a number of examples on how that could be achieved, little to no attention is given to the social and economic inequalities that are affecting the region's indigenous and northern communities, including those rooted in environmental issues such as climate change. Scotland's experience with supporting local development in remote communities, for instance, makes Scotland a natural partner for Arctic and non-Arctic players.

	Research	Environment	Technology & Innovation	Education	Regional Development	International Law	Indigenous Peoples	Infrastructure	Transport	Shipping	SAR	Tourism	Fisheries	Oil & Gas	Mining	Military Presence
Canada	Green	Green	Green	Green	Green	Yellow	Green	Green	Green	Green	Green	Red	Red	Green	Green	Green
Quebec	Green	Green	Yellow	Red	Green	Grey	Green	Yellow	Green	Red	Yellow	Yellow	Red	Green	Green	Grey
Denmark	Green	Green	Green	Yellow	Red	Green	Green	Red	Green	Yellow	Red	Red	Red	Yellow	Red	Green
Greenland	Green	Green	Green	Green	Green	Yellow	Green	Green	Green	Yellow	Green	Green	Green	Green	Green	Yellow
Faroe Islands	Green	Yellow	Red	Green	Green	Yellow	Red	Red	Green	Green	Green	Green	Green	Green	Red	Grey
Finland	Red	Green	Green	Green	Green	Red	Green	Green	Green	Red	Yellow	Green	Red	Red	Green	Red
Iceland	Grey	Yellow	Green	Yellow	Red	Green	Green	Red	Red	Yellow	Green	Green	Green	Red	Grey	Yellow
Norway	Green	Green	Green	Green	Yellow	Green	Red	Green	Green	Yellow	Green	Yellow	Yellow	Green	Red	Green
Russia	Green	Yellow	Green	Red	Red	Red	Yellow	Green	Yellow	Green	Yellow	Yellow	Green	Green	Green	Green
Sweden	Red	Green	Green	Green	Red	Green	Green	Yellow	Green	Red	Green	Green	Yellow	Yellow	Green	Red
USA	Green	Yellow	Grey	Grey	Red	Green	Yellow	Yellow	Green	Yellow	Green	Grey	Red	Green	Red	Yellow
Alaska	Green	Green	Green	Red	Green	Yellow	Green	Green	Yellow	Green	Green	Grey	Red	Yellow	Red	Yellow

Table 2. Overview of the policies of Arctic states and sub-national governments. Green: major focus; yellow: medium focus; red: little focus; grey: no significant mention. Updated and adapted from Schulze (2017).

	Research	Environment	Technology & Innovation	Education	Regional Development	International Law	Indigenous Peoples	Infrastructure	Transport	Shipping	SAR	Tourism	Fisheries	Oil & Gas	Mining	Military Presence
Germany	Green	Green	Green	Red	Red	Yellow	Red	Red	Red	Green	Green	Red	Red	Green	Green	Red
France	Green	Green	Green	Yellow	Red	Green	Red	Red	Red	Red	Green	Green	Green	Yellow	Green	Red
Italy	Green	Green	Green	Green	Grey	Grey	Grey	Yellow	Grey	Grey	Yellow	Red	Grey	Yellow	Grey	Grey
Japan	Green	Yellow	Green	Yellow	Grey	Yellow	Grey	Yellow	Yellow	Green	Green	Grey	Yellow	Yellow	Yellow	Grey
The Netherlands	Green	Green	Green	Grey	Green	Green	Red	Grey	Grey	Yellow	Green	Grey	Yellow	Yellow	Yellow	Grey
People's Republic of China	Green	Green	Red	Grey	Red	Green	Yellow	Green	Green	Green	Red	Green	Green	Green	Green	Grey
Republic of Korea	Green	Yellow	Green	Green	Red	Green	Red	Yellow	Red	Green	Green	Grey	Green	Yellow	Green	Grey
Spain	Green	Green	Green	Green	Grey	Red	Yellow	Green	Grey	Green	Yellow	Grey	Green	Yellow	Yellow	Grey
Switzerland	Green	Yellow	Green	Green	Grey	Yellow	Red	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey
United Kingdom	Green	Green	Green	Yellow	Red	Yellow	Yellow	Yellow	Red	Yellow	Red	Red	Green	Green	Yellow	Yellow

Table 3. Overview of the policies of non-Arctic states. Green: major focus; yellow: medium focus; red: little focus; grey: no significant mention. Updated and adapted from Schulze (2017).

Importantly, stakeholder feedback indicates that this is one of the contexts in which the Scottish Arctic policy should not only complement but also go beyond the UK Arctic strategy. Stakeholders indicate the need for

Scotland to listen to the voices of the disempowered and to commit to pursue the UN sustainable development goals (SDGs). Here, there is also mention of respect for cultural heritage and an opportunity for capitalizing on Scottish friendliness, openness and Scotland's positive reputation in the region, which can pave the way to mutually beneficial partnerships. In general, stakeholders' views are in line with the priorities of the Arctic Council and stress the need for bringing out the human dimension of a future Arctic policy for Scotland.

In terms of economic interests, in many Arctic nations such as Canada, Finland and to a lesser extent Norway, these are framed not just in terms of the benefits stemming from the exploitation of the Arctic's living and non-living natural resources, but also (quite understandably) as issues of regional development. The 'opening up' of the Arctic is seen as an opportunity to increase the quality of life for the region's inhabitants, including indigenous groups, in the spheres of employment, health, education, access to physical and digital infrastructure, and other social services which may be currently underdeveloped. For their non-Arctic counterparts, the focus is on promoting national industries and businesses. For instance, Germany, France, and Italy see potential economic opportunities in their expertise in ship-building technology (and particularly in ship propulsion systems and ice-class ships), mining of resources, and GHG emission reduction technologies, respectively.

One of the common tensions in the analysed documents is between the prospect for economic development and the imperative to protect the Arctic environment. References to sustainable development abound, which demonstrate the widespread necessity to ensure not just economic and social but also environmental sustainability in the region. Various proposals are being put forward in this context, from the aforementioned protected areas, strict environmental regulations for shipping (for example through the IMO Polar Code) and resource exploitation, and ensuring consultations with local and indigenous communities on land and sea stewardship. While these measures echo a joint sense of preoccupation with the Arctic environment and its changing future, it remains to be seen if this near-universal call for the sustainable development of the region manages to avoid the negative consequences of the concomitant anticipation for the Far North's opening up for economic opportunities. Close cooperation between Arctic and non-Arctic state in this area is essential.

Other aspects of policies do not enjoy nearly as uniform a focus, with the possible exception of search and rescue capacity, the need for a more consolidated drive of which is recognized across the region. This, it is argued, is essential for the future development of Arctic shipping and the growth of safe tourism. In fact, virtually all countries recognize the enormous potential for increased trade resulting from the opening of new sea routes in the Arctic region (the Northeast Passage and the Northwest Passage). Apart from the development of necessary SAR capabilities, key Arctic coastal states such as Russia and Norway have committed to preparing adequate land and sea infrastructure to accommodate the future freight and passenger (tourist) traffic along their shores. A number of non-Arctic states, particularly in Asia, have indicated their readiness to support these endeavours, which they see as a key economic opportunity.

One of the key divergent points when analysing the different policies – particularly by not exclusively between Arctic and non-Arctic nations – is the issue of the demilitarization of the region. Certain countries have asserted their intention to maintain a stable military or even combat presence (Canada, Norway, Russia, and to a lesser extent the UK and France), which in the case of the Arctic nations is considered a step towards asserting their sovereignty and safeguarding their national interests in the region. On the other hand, certain nations advocate for the region's demilitarization, including Iceland and to a lesser extent Denmark.

Many of these policy priorities overlap also with the Scottish national interest in the areas of scientific cooperation, peaceful governance, climate change mitigation and adaptation, and sustainable and equitable development for the region's people and for Scotland, itself.

Socio-cultural links

Scottish-Nordic Cooperation before NPP and NPA

Scottish-Nordic cooperation has built on this long history of social and cultural ties reflected in commonalities of language, traditions and outlooks. Peripheral, sparsely populated areas and fragile communities present common challenges which are shared between Scotland and the Nordics. There is also shared high prioritisation of state-led social and economic development using public agencies and instruments. These challenges are often not understood or appreciated across other areas of Europe (Böhme et al 2003).

The push for more Nordic-Scottish cooperation came about through proposals for the 'fourth enlargement' of the European Community to include Finland, Norway and Sweden, as well as Austria. Applicant countries were keen to explore Scotland's experience in using Structural Funds, and there was considerable spontaneous activity surrounding this issue (Böhme et al 2003).

The Scottish Office at the time identified a long-term strategic interest in establishing relationships with the applicant countries to increase the profile of peripheral sparsely populated areas (such as the Highlands and Islands) within the European Union. The intention was to steer the European Union away from grouping the Highlands and Islands with rural or upland areas of Greece, Southern Italy, and north-eastern Portugal and towards recognising its distinct character (CEC 1991).

A meeting took place in Ackergill Tower near Wick in October 1994, during which senior government officials from Scotland, Finland, Norway, Sweden and Iceland jointly recognised that there were "great commonalities of interests between the Nordic Countries and the Highlands and Islands of Scotland" (Bachtler et al., 1999, p. 7). These commonalities centred around environment, climate, geography, environmental quality, sparsely populated areas, fragmented settlements, a preference for SMEs for economic development, prospective reliance on quality education and training, transport and communication challenges, and common culture and community structures (Böhme et al 2003).

A number of key recommendations and areas of interests were agreed on around SME development, IT development, education cooperation, and a forestry network. The Nordic Senior Officials' Committee for Regional Policy (NARP) and Highlands and Islands Enterprise (HIE) agreed to make funds available to the sum of £480,000 for a 3-year period to formalise cooperation across the thematic areas (Böhme et al 2003).

A second meeting was convened in Kittilä in Finnish Lapland aiming to repeat the success of the Ackergill seminar in April of 1996. The conclusions of the meeting reaffirmed that cooperation should continue and opened up the government department and inter-agency partnership to also include local and regional authorities (Böhme et al 2003). Annual reviews confirmed that despite some funding difficulties, at the end of the three year period project cooperation had made significant progress in all areas (Böhme et al 2003).

The ad hoc Nordic – Scottish cooperation projects across the four original themes developed in 1998 into the Article 10 Northern Periphery Programme. The programme accepted applications up until the end of 1999. Following on from this initial period of funding the INTERREG IIIB Northern Periphery Programme ran from 2000 to 2006. The following Northern Periphery Programme ran from 2007 to 2013. For the latest round of funding an Arctic dimension was added and this led to the Northern Periphery and Arctic Programme 2014 to 2020.

Social and community connections

Scotland has many social and community links and similarities with the Arctic Region and Arctic States. There are numerous geographical, historical, cultural, and linguistic ties, in particular between Scotland (and the Highlands and Islands, in particular) and the Arctic, which are considered to be stronger than those in the rest of the UK (Johnstone, 2012). Much of the shared historical and cultural links come through, for example, 'Viking' connections, Scottish emigrant populations in Canada, and 19th and 20th century polar explorers John Rae and Thomas Abernethy (Mikkola, 2014). Nova Scotia in Canada received large numbers of Scottish emigrants, and these links are still maintained through the celebration of the Canadian Highland Games annually (Menezes et al 2016). Visitors from the Scottish diaspora, and in particular Canada, are a valuable part of the tourism industry in Scotland. Scotland is reliant on the marine environment for social integrity much like the Nordic nations, with which it is closely connected through the ongoing climate, economic and social changes in the Arctic.

Linguistically, Shetlandic and Orcadian dialects are replete with Norse words, and Scottish town names like Wick and Tinwald have their origin in a language once shared with other Nordic Arctic states (Menezes et al 2016). These linguistic similarities can again be traced back to the Viking influence. Until 1472, Shetland and Orkney belonged to Norway and Denmark until they were pawned as a wedding dowry.

Scotland faces all the major security challenges (military, economic, functional and societal) inherent to an Arctic opening with other non-sovereign players including Greenland and the Faroe Islands (Bailes 2015). Scotland also faces similar issues experienced by Arctic and near-Arctic countries in terms of sparse population, remoteness, inaccessibility, and a harsh climate (Mikkola 2014). These issues have been explored over the past 20 years, through Scotland's cooperation within the framework of EU mechanisms and largely through the Northern Periphery and Arctic Interreg Programme and its predecessors.

A number of social trends that are driving development in the in Arctic are global. These include increasing world population, demographic changes, development of the service economy, the rapidly growing demand for welfare services and the development of multi-cultural societies (Mikkola 2014). Although global issues may be a driving force behind the need for an Arctic policy, socio-cultural links and similarities that exist between Scotland and the Arctic should be of paramount importance in its development (Mikkola 2014).

The European Union's Northern Periphery and Arctic 2014-2020 Programme and Horizon 2020 are critical to providing funding to support community-based programmes, including links and exchanges between Scotland and its Arctic neighbours. The programmes facilitate collaboration between regions to find practical solutions to common problems. Current projects range from social innovation, eco-tourism and economic growth, climate change and community engagement, heritage and just transition. The UK's exit from the EU raises the risk of losing access to this collaborative source of funding. Should that occur, the UK Government will need to consider whether and how it wishes to maintain levels of support and continue to develop comparable partnerships with the countries of the High North.

Economic links

The economic links between Scotland and the Arctic are mainly found in the energy, fishing and tourism industries. There are notable Scottish companies operating in the Arctic region, which have achieved commercial success. However, the most significant economic links are found in investment by companies and institutions based in Arctic Council member states into Scottish commercial operations and research development.

Oil exploration

As global average temperatures rise, and Arctic summers grow longer, the energy industry has been increasingly interested in the prospect of exploring oil and gas reserves under the retreating Arctic ice. Scottish energy firms based in Edinburgh and Aberdeen are at the forefront of oil exploration with licences being granted by Arctic nations, including by Greenland and Norway. With production operations in the North Sea, Barents Sea, Celtic Sea, Faroe, Shetland and Norwegian waters, Scottish companies are one the largest acreage holders of exploratory licences competing with energy giants in Norway and Denmark.

Offshore Engineering and Supply Chain

Coupled with oil and gas exploration is the need for current rig designs that can operate in colder climates. Current designs are more suitable for use in warmer climates and lack the modifications needed to operate in an Arctic climate. This lack of suitably designed drill rigs and ships capable of operating in Arctic conditions has caused delays in exploration projects. Scottish offshore engineering and supply chains engineering expertise, for instance, can be found in an Aberdeen-based company which supplies sensors and underwater cameras.

Decommissioning

Scotland has been earmarked for developing offshore deep-water decommissioning infrastructure. A forecast of £60 billion worth of decommissioning work in the UK Continental Shelf could be a reality over the coming decades as the UK's North Sea hydrocarbon deposits reach their end life. Decommissioning requires the construction of deep-water coastal harbours and transshipment hubs. Investment in ports and transfer-freight capabilities in Northern Scotland (in particular Scapa Flow and Sullom Voe) would be increasingly important for securing future supply chains and develop the infrastructure needed for decommissioning. Aberdeen has been recognised as a strategic location to benefit from the opening up of transport routes in the Arctic – but

prerequisites in appropriate infrastructure in ports and construction yards are required to fully realize the economic potential of ship maintenance, module construction, dismantling and decommission.

Renewable energy

The Scottish renewable energy sector, and marine energy development in particular, has seen considerable interest and investment by companies based in Arctic states. In 2016, Scottish renewable generation projects secured £910 million in investment and the sector generated £277.5 million worth of exports in goods and services (Scottish Government 2017). Successes in Scotland can be attributed to local engineering expertise and innovation and commercialisation in renewable technologies in wind, tidal and wave including the recent developments of 'super-grids'. At the same time, Scotland and many Arctic Council nations also face similar geographical challenges in the remoteness of some of their communities from energy grids calling on the need to provide professional services in developing economically viable energy projects for remote communities in Arctic region that could offer an alternative to diesel generators (e.g. biomass-derived energy).

Fisheries and fishing

The economic importance of fisheries and fishing activities to Scotland is significant. It is estimated that fisheries contribute £400 million to the Scottish economy and 68% of the UK's total catch is harvested in Scottish waters. The most matured economic link in this sector between Scotland and the Arctic region is found in the salmon industry. Salmon is the largest food export of Scotland with £600 million worth of exports in 2017. Although, Norway dominates the global salmon trade, Norwegian companies have invested heavily in the Scottish salmon industry and the growth of Salmon farming in Scotland has created a high value export product and provided employment, particularly in remote areas of Scotland. Scotland and Norway have signed a memorandum of understanding on cooperation and best practice in aquaculture which means that Scottish companies do not compete with the volume of salmon sold by Norwegian companies but rather diversify into a range of specialised or niche salmon products such as salmon with higher omega-3 levels cornering this part of the salmon market as well as sustainable fishing.

Tourism

There is significant cooperation between tourist agencies based in Scotland and the Arctic region. For example, VisitScotland and the Icelandic Tourist Board signed a Memorandum of Understanding (MOU) to cooperate on best practice and knowledge exchange in areas such as sustainable tourism.

VisitScotland is also developing relationships with the West Sweden Tourist Board, Innovation Norway, VisitDenmark, Visit Faroe Islands and Finnair. Collaboration with other tourist agencies is earmarked by VisitScotland as a means to raising the profile of Scotland as a tourist destination and showcase the agency's services in key fields of tourism development, quality assurance and digital marketing. There is opportunity to use these existing relationships to seek collaboration beyond VisitScotland to other networks in Scotland's tourism industry to develop mutually beneficial relationships and innovative ideas to boast Scotland as an attractive tourist destination.

Scotland's cruise and ferry industries have a well-established tourist link between Scotland and many of the Arctic nations. The Scottish commercial cruise sector is worth approximately £100 million annually to the economy, with 761 vessels (carrying 680,000 passengers) visiting Scottish ports in 2017. One of the most innovative developments in Scotland's cruise and ferry industry is Ferguson Marine Engineering Limited, a Glasgow-based ship building company, that was awarded €9.3 million (of a €12.6 million project) in June 2018 to construct the world's first hydrogen-powered car and passenger ferry. This is a key opportunity for Scotland to promote hydrogen fuel cell technology in transportation, and showcase Scotland as both an innovator in renewable technologies and a promoter of green tourism.

The concept of ecotourism, visitor experiences building on natural and cultural assets, conserving the environment and sustaining the well-being of the local people, has been around for a long time. For rural and sparsely populated areas it is seen as a key factor in sustainable development, providing employment and income, whilst conserving the fundamental qualities of traditional life (SHAPE 2018).

Fostering local economic development – Highlands and Islands Enterprise

Highlands and Islands Enterprise is an organisation with a remit from the Scottish government to foster economic and social development in the Highlands and Islands – a region covering more than half of Scotland's landmass which is home to 450,000 people (Highlands and Islands Enterprise, n.d.). The organisation's four priorities include accelerating business growth, strengthening communities, supporting growth sectors, and developing regional attractiveness, with the vision to make the Highlands and Islands a region where an increasing number of people choose to live, work, study and invest. The organisation was created recognising the particular development challenges of this sparsely populated region which also boasts almost 100 inhabited islands. These issues are similar to those faced by similar regions in Arctic states, such as Norway, Russia, and Canada. Thus, there is much potential for further fostering cross-regional cooperation between HIE and its Arctic counterparts in this context.

Environment and climate change links

Throughout the literature, project websites, funding calls and in personal communication, there is one recurring issue which underpins recent interest in the area and provides impetus for future Scottish connection to the region- *the impacts of climate change*. The increasing change in physical, biological and chemical parameters within the Arctic environment has implications not only for the inhabitants of the Arctic region but for all of us. The scale of change is best highlighted by the following statements:

'The Arctic is the most rapidly changing environment on the planet supporting diverse yet still poorly understood ecosystems. The Arctic Ocean, whilst small in size, has extensive shelf regions and contributes between 5 and 14% to the global balance of CO₂ sinks and sources. The Arctic is also intrinsically tied to global processes, whether they are climatic, environmental or socio-economic. Consequently, the Arctic is responding in unknown ways to profound changes in the physical environment as well as to multiple natural and anthropogenic stressors. The scale of these challenges facing the Arctic is immense and is further compounded by the rate of change' (NERC 2015).

'Environmental conditions in the Arctic are currently changing at an unprecedented rate. Most prominently, temperature rise leads to a decrease in sea ice cover and thickness, resulting in a fundamental increase in the amount of light in the water. This has far-reaching implications for Arctic marine ecosystems' (FAABulous project 2015).

'The interconnected nature of the environment, wildlife, and human health in the Arctic has long been recognized, but perhaps never so clearly as it is today in face of global climate change. Warming temperatures and other environmental changes are expected to promote the emergence of new pathogens and the northward spread of insects and other vectors of disease into the Arctic. Fish and wildlife, already compromised by chemical contaminants and other changing ecosystem dynamics, may be at heightened risk for infection and contribute to the spread of zoonotic diseases through the Arctic environment and to its human inhabitants' (AMAP 2018b).

Scotland has well- established connections with the Arctic and surrounding countries, through collaborative research and participation in environmental monitoring and assessment programs. There are numerous examples of international cooperation and coordinated research activity, much of which has been going on for over 25 years.

However, with confirmation that ice extent across the Arctic Ocean is continuing to decline in October (Arctic Today, 12 October 2018), we are effectively entering uncharted waters. Further, recent investigation by Arctic Monitoring and Assessment Program (AMAP 2018a) has highlighted the increasing threat to Arctic communities and wildlife posed by pollutants – a consequence of a rapidly changing environment.

In terms of understanding how change in the physical environment (ice and ocean) will affect the large-scale ecosystem structure and biogeochemical functioning of the Arctic Ocean, the five-year £16 million 'Changing Arctic Ocean' Programme, funded by Natural Environment Research Council (NERC/UKRI) and German Federal Ministry of Education and Research, aims to develop a fundamental and quantified understanding (Changing

Arctic Ocean 2018). This Program is coordinated through the University of Edinburgh, allowing institutes from across the UK to work with partners in the Arctic states. The ultimate goal of 'Changing Arctic Ocean' is to generate a better understanding of the Arctic so models can more accurately predict future change to its environment and ecosystem. Within the programme, there are four main projects with more than 80 scientists combined, from 18 UK research institutes.

Provided below is a summary of areas of collaboration between Scotland and the Arctic region.

Technical innovation

Technical innovation in the form of robotic and autonomous marine observation systems (University of St. Andrews and SAMS Scottish Marine Robotics Facility) have facilitated monitoring of the Arctic Ocean during winter and under extreme conditions. Animal borne data loggers (Sea Mammal Research Unit) relay information via satellite and allow to investigate at-sea ecology as well as to collect oceanographic data from hostile marine environments (Boehme et al., 2009). The portal for ocean data (MEOP-CTD, 2015) collected by marine mammals has over 300,000 oceanographic observations.

Research into use of micro satellites (University of Strathclyde/KTH Sweden) for remote sensing has been ongoing since 2003. Bathymetric data collected via Satellites is available through a transnational portal (EMODnet 2014) with Digital Terrain Models (DTM) available for Arctic seas.

In terms of business links, Clyde Space – supplier of CubeSats and other small satellite systems - recently merged with AAC Microtec, a spinoff of Uppsala University, Sweden (Clyde Space 2018). These companies develop nanosatellites for commercial, military and scientific use and are currently working to deploy nanosatellites to improve communication where global connectivity is poor due to frequency band width, network technology and remoteness. Such innovation could provide vital safety links for remote communities which become isolated due to climate change and sea ice melt. It will also allow high data volumes to be transported from remote, environmental monitoring stations within the Arctic.

The limited availability of consistent, longitudinal data for marine traffic in Arctic Canada presents significant challenges (Dawson et al., 2018). As ship traffic increases, these areas are becoming ever more important to the global economy. However, there are significant barriers that continue to hinder economic expansion. Among these is the absence of good telecommunications solutions available to vessel operators, researchers allowing accurate weather forecasting and sea ice tracking.

Other environmental links have been facilitated through Scottish Funding Council pooling activities such as Scottish Alliance for Geoscience Environment and Society (SAGES 2018), a partnership between Scottish Universities which hosts Europe's largest glaciology research group – SURGE. This coordinated international network for advances in glaciology has a particular focus on the Greenland Ice Sheet and glaciers of Svalbard.

Climate change

The Marine Climate Change Impacts Partnership (MCCIP -UK) has been collating scientific evidence on coastal and marine climate change impacts since 2006. Regular report cards highlight impacts on coastal and marine interests and have recently highlighted that changes in the Arctic will influence storm events and coastal flooding in Scotland (and UK). Scottish organisations such as Scottish Natural Heritage; Environmental Research Institute, UHI; Marine Scotland Science and SAMS all contribute to the Marine Climate Change Impacts report card (MCCIP 2017).

Biodiversity

In terms of Arctic biodiversity, again there are long established links with Arctic states, with Scottish researchers contributing to Arctic Council working groups. Scotland also provides important overwintering locations for protected migratory species – contributing to winter tourism (Islay Blog 2018), species monitoring and international tracking schemes (Fox et al., 2017).

Staff from Joint Nature Conservation Committee (JNCC) in Aberdeen contribute to the Arctic Council Circumpolar Biodiversity Monitoring Program (CAFF 2018). This Program is an international network of scientists, governments, indigenous organisations, and conservation groups working to monitor the Arctic's living resources. JNCC contribute to CBird, as populations of seabirds in the circumpolar region are large and diverse. These species are important components of Arctic ecosystems, and are culturally and economically important for local communities. Since seabirds travel great distances over both marine and terrestrial environments, they are excellent indicators of overall ecosystem health. Arctic countries often share the same seabird populations. Consequently, there is a joint and equal responsibility for the conservation of seabirds in and outside the Arctic (CAFF 2015).

Protected areas

Protecting and conserving the Arctic marine environment and biodiversity is an important Arctic Council priority, due to the role of Arctic waters in moderating the global climate, protecting marine biodiversity, and providing food security, income and cultural identity for Arctic peoples and communities. There is a proposal to develop a pan-Arctic network of marine protected areas (MPAs) that would set out a common vision for regional cooperation in network development and management, based on international best practices. Closely aligned with the ecological benefits are the cultural and socio-economic values and benefits stemming from Arctic MPA networks. Marine Scotland Science (MSS) has provided data that is used in assessments conducted by inter-governmental organisations such as Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR 2018) and the International Council for the Exploration of the Sea (ICES). The scientists, engineers and socio-economists at MSS collaborate across the UK and contribute to marine spatial planning.

Between multidisciplinary research programs (e.g. Changing Arctic Ocean), transnational collaboration (INTERREG Programs, n.d.); participation in Norwegian Research Council projects and Scottish contribution to Arctic Council monitoring programs, Scotland is already making a considerable contribution to environmental matters in the Arctic. These are just some of the examples which demonstrate that Scotland has well established and credible links to the Arctic in relation to environmental and climate change activity. Broader connections through environmental courses and the University of the Arctic provide further opportunity to develop educational and socio economic links.

Many of the environmental links identified have cross reference to other areas of interest to Scotland – fisheries, transport and shipping, natural resource development and tourism. Despite the coordinated approach to environmental research, given the unprecedented rate of change in the Arctic environment, there is further need for understanding its future impact on the Arctic and the resulting wider implications for Scottish interests.

Fisheries

Fisheries for Arctic freshwater and diadromous fish (e.g. Atlantic salmon) contribute significantly to northern economies. Climatic vulnerability and extreme weather will have an impact on these fisheries and it is documented that increases in sea temperature are leading to increased parasites and disease. This will have economic impacts and implications for fish processors and the Scottish fishing fleet. This is an area where little research has been conducted but clearly needs to be better understood.

Pollution including plastics and noise

Scottish Universities are involved in collaborative research which seeks to understand the impact of pollutants on Arctic wildlife, fish and people. Specifically, research into the impact of marine plastics on wildlife (O'Hanlon et al., 2017) and the analysis of the impact of emerging chemicals in marine mammals (Hall et al., 2018) indicate an increasing need for research in this area, especially given the potential for bioaccumulation and cultural links to wildlife across the Arctic region.

Many indigenous communities of the Arctic rely on locally harvested fish, seabirds, and marine mammals as part of their traditional diets. The observation that some populations of these Arctic species contain levels of

polychlorinated biphenyls (PCBs) and mercury sufficient to place them at a higher risk of biological effects serves as a reminder that there may be a coincidental human health risk to consider as well (AMAP 2018b).

Anthropogenic underwater noise is also recognized as a world-wide problem, and recent studies have shown a broad range of negative effects. Underwater noise from shipping is increasingly recognized as a significant and pervasive pollutant with the potential to impact marine ecosystems on a global scale (Williams et al., 2015). Studies have been carried out to better understand the efficacy of wastewater treatment and the hazard posed to receiving waters containing nutrients and contaminants (i.e., pharmaceuticals, antibiotic resistance genes).

Academic links

Scottish universities and research centres have a long tradition of conducting world-class research on the Arctic. From the literature review and subsequent stakeholder workshops, we have identified that most of the Scottish Universities have links to the Arctic either through participation in research programs or as partners in transnational collaboration projects. There are numerous examples of international cooperation and coordinated research activity, much of which has been going on for over 25 years.

Education and academic excellence

Over the years, strong educational links between Scotland and the Arctic have been established. Two Scottish higher education institutions – the University of Aberdeen and the University of the Highlands and Islands – have a particular relationship with the Arctic and the region’s academic institutions as members of the University of Arctic (UArctic). UArctic is a cooperative networks of research bodies that has as its goal the promotion of education, research and outreach on the North to enhance local human capacity, promote sustainable economies and forge global partnerships (University of the Arctic, n.d.).

There are long held links with the region through the Scottish Arctic Club – a group of enthusiasts with a common interest in the Arctic (Scottish Arctic Club, 2018). The Club was founded in 1970 to encourage expedition to the area and many members have travelled extensively throughout the region.

A unique example of a Scottish-Arctic educational partnership is the West Lothian-based Polar Academy. The Academy specialises in organising polar expeditions to eastern Greenland for “invisible’ 14-17 years old secondary school children, crushed by a lack of self-esteem” and offers them an opportunity to redefine themselves in physical and mental terms (The Polar Academy, 2018). Participants are subjected to what is considered Europe’s toughest youth training programme. Upon their return, pupils become local and national advocates for the Arctic, including its people and their environment, and engage with thousands of peers across Scotland. The Polar Academy is also planning to invite Inuit teenagers and hunters to Scotland for educational purposes to demonstrate the similar environmental and climate change challenges faced by local communities in both Greenland and Scotland. Importantly, many of the teachers, medical staff, and those on the operations are locals, as one of the purposes of the trips is to empower the Inuit and show them they can take control of their own country with the support from ‘neutral’ visitors.

Coordination and institutional links

Despite the high level of Arctic research being undertaken at Scottish universities, it appears that this activity often remains dispersed and uncoordinated. While project partnerships do take place on a regular basis, stakeholders often noted that there is no institutional centre for Arctic research in Scotland comparable to the UK’s Scott Polar Research Institute in Cambridge (although ambitions for creating a similar hub exist at the University of St. Andrews through its Arctic Research Centre or at SAMS). Similarly, student exchange between Scottish universities and their Arctic counterparts outside the Erasmus Programme appears to have been limited.

Disproportionate focus of Arctic research on natural sciences

Arctic research conducted in Scotland is heavily dominated by natural sciences but social sciences are of growing importance in this context. Notable examples of this change include the *Arctic Domus* project at the

University of Aberdeen (University of Aberdeen, n.d.), SAMS' work focused on the blue economy (SAMS, n.d.), and the activities of the Scottish Alliance of Geoscience, Environment and Society (SAGES). SAGES has a Transformations in Society and Environmental Policy theme, through which it seeks to ensure "translation between the latest scientific developments and the needs of policy makers, industry and business, and other users" (SAGES, n.d.). Finally, the establishment of the Arctic Research Centre (The Arc) at the University of St. Andrews in partnership with the Moscow State Institute of International Relations has marked another important step towards developing Scottish social scientific expertise on the Arctic (The Arc, 2015).

There is a need for research donors – including public bodies (e.g. Scottish Funding Council and Scottish Enterprise) – to create more funding channels for Arctic research that includes or foregrounds social sciences. That, it is argued, would better reflect the aforementioned focus of the Arctic Council and many existing national Arctic policies on local lives and livelihoods. This is particularly important given the unclear future of funding for social development projects and the related research initiatives currently supported by European funds.

Funding

Funding for Arctic research in Scotland comes from a number of national, bilateral and multilateral sources. At the European level, a number of projects have been financed through the 2014-2020 Northern Periphery and Arctic Programme (NPA) and earlier through the 2007-2013 Northern Periphery Programme (NPP).

A major UK funder of Arctic research has been the NERC Arctic Research Programme (ARP), a £15 million initiative with the goal of supporting projects that seek to understand the changing nature of the Arctic environment. Five Scottish universities – Aberdeen, Dundee, Edinburgh, Heriot-Watt and Stirling – have been involved in three ARP projects to date (Landslide-Tsunami, HYDRA and CYCLOPS) (NERC, n.d.). Long established relationships have also created opportunity for researchers to act as evaluators for funding calls (Norwegian Research Council) and to contribute visiting lectures.

It is unclear what impact Brexit will have on the availability of EU funding for Arctic research. In the worst case scenario, Scottish research bodies will lose access to the likely successor of NPA, creating a funding gap in the Scottish research landscape. Moreover, Arctic research heavily depends on strong regional networks which EU funding has facilitated. It is unclear if and to what extent UK funding for Arctic research would compensate the loss of available funds in a hard-Brexit scenario.

6. RECOMMENDATIONS

This report has provided an overview of Scottish links to the Arctic Region. The mapping report clearly demonstrates what Scotland has to offer in terms of knowledge, skills, expertise, technology, business opportunities, and this is enveloped around similarities in our social and cultural heritage. Consolidating the evidence in this mapping report has enabled the development of practical ideas that can be built on for future collaboration. These are identified below.

Scottish Participation in Arctic Governance: From indirect representation to public diplomacy

Through the mapping of current governance links within the Arctic region, a number of ways to increase Scottish engagement in the Arctic can be identified. These pertain to actions at both international and national levels.

- Drawing synergies with other sub-national regions located in the Arctic

It should be noted that Scotland's participation in international Arctic governance is heavily constrained by virtue of foreign policy being a matter reserved to the UK government. The United Kingdom is an observer nation to the Arctic Council and party to most international agreements pertaining to the Arctic region and issues, and any Scottish representation must follow UK channels. However, this situation is far from unique, even in the Far North. In this context, there is much scope for Scotland to learn from other sub-national regions located in the Arctic region: Greenland, Faroe Islands, Quebec, and Alaska.

In the case of the first two, their regional strategies are largely incorporated into the overarching Arctic policy of the Kingdom of Denmark, produced jointly by the three parties. Moreover, the Faroese government has commissioned a national-level assessment in complement to the Danish Realm's policy which focuses on questions specific to the Faroe Islands (see above) – demonstrating the feasibility of a more local Arctic strategy co-existing with its national counterpart. In the case of Scotland, there was limited involvement of the devolved administrations in the drafting of the UK Arctic Policy published in 2018, where the word 'Scotland', for instance, is mentioned a mere six times. This further justifies the need for a Scottish Arctic policy, especially given the UK government's stated support for developing appropriate regional connections by the devolved administrations (HM Government, 2018).

It appears that the example of Quebec may be even more pertinent for Scotland, as the Canadian province has developed its own International Policy document, in which it outlines its relationship with the Arctic (despite foreign policy lying largely within the purview of the Canadian government). More importantly, Quebec has also produced a province-level strategy on the sustainable development of its Arctic territory called *Plan Nord*. As part of the Plan, a new governance body – *Société du Plan Nord* – was established, which promotes the involvement of all stakeholders to encourage joint political initiatives and business, scientific, technological and cultural partnerships to ensure the region's sustainable development. While Scotland obviously does not have jurisdiction over any part of the Arctic, Quebec's experience in balancing between its own interests and those of the Canadian government in setting economic, social, and environmental priorities in the Far North can provide a valuable input in drafting the Scottish Arctic policy.

That said, at the international level, and with the exception of the International Organisation of La Francophonie, the province participates in multilateral organisations as part of the Canadian delegation. To ensure Quebecois interests are adequately represented, it has secured an agreement with the federal government thanks to which the Permanent Delegation of Canada to UNESCO must include at least one member nominated by the province. A similar arrangement between Holyrood and Westminster on Arctic matters could increase the visibility of Scotland on the Far North's international arena. Indeed, pursuing indirect representation through the UK delegation appears as one of the most cost-effective ways to enhance Scottish participation in Arctic governance. Scotland could draw from the experience of Quebec, Greenland,

Faroe Islands, and Alaska with their respective federal or central government in seeking an appropriate arrangement with the UK Government.

- Increasing Scottish presence through international bodies

Another straightforward way for increasing Scotland's presence in this area is through other international bodies by which it could potentially be considered an eligible candidate. Scotland's active role in Arctic Circle events between 2016 and 2018, for example, has served to successfully assert the Scottish Government's interest in the Arctic and provide a momentum – both nationally and internationally – for further involvement in regional matters. For instance, the Nordic Horizons side-event to the Arctic Circle Forum 2017 hosted by Scotland in Edinburgh opened a dialogue between representatives from Scotland and the Far North on commonalities, cooperation and shared challenges. Consideration should also be given to potential participation in the Northern Forum, which groups 13 sub-national governments from five countries (both Arctic and non-Arctic), West Nordic Cooperation (WNC) or the North Atlantic Cooperation (NORA), which brings together Greenland, Iceland, Faroe Islands and Coastal Norway (Johnstone, 2012). Other governance arrangements in a Nordic-plus format could also be devised (Bailes et al., 2013).

Given the paucity of information on the UK's relationship with the EU post-Brexit, it is at this time impossible to ascertain what kind of role Scotland should envision for the European Union in the Arctic. The EU seeks an Arctic Council observer status and is strongly supported by Germany and France (but not necessarily by the UK) in doing so. Since at the time of writing Scotland stills forms part of the EU and the UK, it appears that a strong European presence in the Arctic would benefit Scotland, not least for research funding and economic reasons.

A number of other, more indirect ways appear to exist for increasing Scottish participation in Arctic affairs. The promotion of Scottish businesses and research initiatives in the region by means of public diplomacy and advocacy (following Denmark's example, for instance) can also go a long way in this context. As will be mentioned later in the report, many of Scotland's higher education institutions and research centres already have firmly established and internationally acclaimed Arctic research programmes, including the University of the Highlands and Islands, the University of Aberdeen, or the University of St. Andrews. Similarly, there is a number of Scottish businesses operating in the Arctic, and Scottish companies' vast oil, gas, renewable energy and tourism portfolios – to name but a few examples – can further strengthen Scottish presence in the Arctic.

- Domestic efforts

At the national level, however, political, economic, academic and social initiatives that focus on the Arctic appear scattered, and there is much potential for consolidating them in institutional terms. First, the Scottish Government's European division should feature a dedicated Arctic office to coordinate the Government's involvement at the international level, including liaising with the UK Minister of State for the Polar Regions (Johnstone, 2012). The recent launch of the Arctic Steering Group is certainly a positive development in this context. Second, a national forum should be established to provide an arena for discussion and cooperation between Scottish academia, civil society, business and government bodies at all levels. The setup of such a body could be either formal (such as the aforementioned *Société du Plan Nord* in Quebec or the Icelandic Arctic Cooperation Network) or more informal (as in the case of the Italian *Tavolo Artico*). Scotland may also want to explore ways to engage its councils and municipalities in Arctic governance as in the case of the Regional Forum in Norway. The experience of Scotland hosting the aforementioned Arctic Circle Forum in Edinburgh which brought together various Scottish organisations with an active interest in the Arctic clearly demonstrated the need for a more institutionalised form of national-level cooperation on the Arctic.

Building on Scottish-Nordic Socio-cultural Connections

It is clear that there are very strong socio-cultural connections and similarities between Scotland and its Arctic neighbours and this a significant foundation on which Scotland could build its Arctic Policy.

- Identity

With an eye on independence, it would be important for Scotland to have more strategic, political, economic and societal support network (Bailes et al 2013) and this could be forged through the creation of an Alliance shelter between Scotland and the Arctic nations. This would allow Scotland to benefit from having a closer relationship with its neighbours through free exchanges of ideas and innovations and would prevent cultural stagnation (Thorhallsson and Bailes 2017).

Building on the very strong socio-cultural connections and similarities between Scotland and its Arctic neighbours, Scotland could further articulate its strong affinity with the Nordic nations by, for instance, promoting cultural legacy projects. This could complement the wider strategy of Scotland positioning itself as a 'near-Arctic state'.

- Understanding the needs of rural and remote communities

With future changes expected in terms of geo-political interest in the Arctic region together with climate change, it is critical that in Scotland we take stock of these changes and the implications this may have on our rural and remote communities. Importantly, with current funding from the European Union's Northern Periphery and Arctic 2014-2020 Programme and Horizon 2020 coming to an end and with the uncertainty on what Brexit is likely to bring, the potential for detrimental impacts on community-led projects supported with such funding is evident. Going forward, it would be opportune for Scotland to develop a unique multi-disciplinary programme of projects in partnership with its Nordic neighbours that has a vision to i) understand the needs and priorities of rural and remote communities in these changing times, ii) to consider how these needs can be acted on in the form of community-led initiatives, platforms of voice, empowerment and representation, and iii) identify ways in which community and local stakeholder engagement can be embedded into local, national and regional planning processes.

- Building Resilience of rural and remote communities

Going forward, a key area that is emerging is the need to assist rural and remote communities in adapting to climate change impacts but also to allow them to benefit from wider developments that may be taking place from the 'opening up' of the Arctic. With climate action becoming more of an imperative as per the Sustainable Development Goal 13 which mandates urgent action to combat climate change and its impacts, there is a growing urgency for every country to move towards a low carbon economy. With that in mind issues of just transition, social and climate justice and inclusive growth become paramount and should be a central focus of the Scottish Government's Arctic policy.

Decommissioning is an important part of the transition process that is likely to take place in the Arctic region, which may have implications for rural and remote communities. With that in mind it would appear that there is opportunity, for example, to ensure that these communities are central to the dialogue taking place. A recommendation here is that The Oil & Gas Technology Centre which has been awarded grant funding of £1.9 million from the Scottish Government's Decommissioning Challenge Fund to invest in the recently-announced National Decommissioning Centre in partnership with the University of Aberdeen, be pro-active in ensuring that rural and remote communities are an integral part of the newly created centre for excellence.

Opportunities for growing the economy

- Oil and gas exploration

Exploring the oil and gas reserves under the retreating Arctic ice is a new and emerging challenge, which is accompanied by the need for rig designs that can operate in colder climates. This presents itself as a business and economic opportunity for Scottish offshore and supply chain engineering expertise. Scotland is currently leading the way in this area of work which could be capitalised on. This can perhaps be enabled through a technology-innovation conference, Business Expo, and establishing knowledge exchange platforms. This could perhaps be facilitated by the Scottish Government's Highlands and Islands Enterprise, among others.

However, there is considerable interest by a range of stakeholders to create a positive outlook on transition from oil and gas to renewable energy in export ambitions by learning and recreating international examples of governmental support in financing or procurement of contracts within the oil and gas export industry but applied to the Scottish renewable energy sector.

- Renewable energy

Scottish innovation and expertise has driven foreign investment and the forging of partnerships between Scottish companies from Arctic countries such as Sweden, Norway and Canada in the provision of renewable energy. This provides a strong platform for continuing to build on our Scottish expertise for future developments and investment in the advancement of technology but also in addressing current gaps in the needs of rural and remote communities.

- Fisheries and Fishing

The economic importance of fisheries and fishing activities to Scotland is significant and diversification within the sector is key to maintaining this economic advantage. There exists a gap in scientific research, on which Scotland could become a world leader. The presence of sea lice threatens fish stocks and is a persistent issue, for which salmon farmers are hoping research can find a solution. While the salmon companies themselves invest in research and development, this presents Scottish research institutions that specialise in aqua-culture, such as the Institute of Aquaculture at The University of Stirling, with an opportunity to offer research and development (R&D) services in Scotland and beyond, as the issue of sea lice threatens stocks across the Arctic region (Powell et al 2017).

- Tourism

Scotland-Nordic tourism is a potential area for growth, creating jobs and contributing to the Scottish and the wider economy, with a potentially significant contribution from VisitScotland. Perhaps a blended approach that brings in the voices of people who live in rural and remote communities could help shape a new vision for this type of tourism.

- Green tourism

The first hydrogen-powered car and passenger ferry is currently under development. This is a key opportunity for Scotland to promote hydrogen fuel cells technology in transportation, and showcase Scotland as both an innovator in renewable technologies and a promoter of green tourism.

Scotland's Approach to Environmental Protection and Climate Change

The Arctic is the most rapidly changing environment on the planet supporting diverse yet still poorly understood ecosystems. The Arctic and its inhabitants are having to respond in new ways to profound changes in the physical environment as well as to multiple natural and anthropogenic stressors. Climate change is by far the most serious threat to the Arctic, which further compounds other environmental issues, such as pollution from both long-range transport and local sources, including chemicals and plastics threatening Arctic

species, ecosystems and human health. It is evident that the challenges facing the Arctic environment are interconnected, requiring multi-disciplinary solutions and international cooperation.

There are undoubtedly opportunities for Scotland to contribute knowledge and expertise to further understand climate change impacts and to help mitigate against them through research, innovation and collaboration. This includes collaborations with academia, industry, NGOs, CBOs and Scottish Government-led initiatives such as the Highlands and Islands Enterprise.

- New innovations in multi-disciplinary research – The Scottish Arctic Research Cluster

New natural-physical science and socio-cultural-economic multi-disciplinary research is needed to understand the scale of the impacts of climate change and assess how change will affect remote communities and wildlife species and to identify mitigation measures. Given the track record of individual Scottish research collaboration initiatives with Arctic states and successful participation of a number of Scottish institutes in multidisciplinary, global research programs, we might usefully build on the model of Scottish Funding Council (SFC) pooling activity such as the Scottish Alliance for Geoscience Environment and Society (SAGES) or the Marine Alliance of Science and Technology for Scotland (MASTS 2018). Likewise, the interdisciplinary research and diverse educational provision within the collegiate University of Highlands and Islands (UHI) could provide a basis for a new Arctic research cluster which spans all sectors of interest.

The Arctic Research Cluster could build on Scotland's globally unique Climate Justice Fund and the Climate Justice Innovation Fund as well as Scottish Centres of Expertise. For instance, Glasgow Caledonian University's Centre for Climate Justice can ensure a continued strong emphasis on indigenous and social issues, while the Universities excelling in technological innovation (Universities of Edinburgh, Aberdeen, St. Andrews, Strathclyde, Glasgow, Stirling, Heriot-Watt, UHI – SAMS, UHI-ERI) and in Arctic education (University of the Highlands and Islands) could also provide significant inputs in allied key areas.

- Distance learning educational models

UHI have developed numerous online and distance learning modules and have a track record of delivering courses which include Arctic content. A number of transnational projects have highlighted the need for training and support for remote communities to help them adapt to climate change. University of the Arctic has indicated interest in expanding links in Scotland to create educational opportunities for future generations. There would appear to be merit in considering ways to combine this expertise to develop new educational links with the Arctic region. The University of the Arctic links, distance learning (UHI), joint courses and placements provide opportunities for Scotland to help nurture future generations and help respond to the challenge of climate change.

- Advances in technical innovation

Satellite remote sensing is an important tool for monitoring the state of and changes in the sea ice cover in the Arctic from the safety of an office in any global location. Information on daily and weekly changes will be essential for marine traffic and operations in ice-covered waters. Such techniques can also be used to improve the understanding and forecasting of short-term interactions between atmosphere, ice, and ocean. Technological developments such as autonomous vehicles, Ice tethered Platform cluster (ICE-POPEs) and Sea Ice Mass Balance buoy deployed under sea ice allow remote collection of oceanographic data and ecological data from hostile environments which can then be used to model and forecast change. These are emerging areas of technical innovation which require continued investments in research and development.

Other emerging gaps range from increasing understanding of multiple stressors on biodiversity, understanding of oil spill threat, impact of marine plastics on seabirds and marine life, identification and analysis of emerging chemicals and impacts on marine mammals and human and resilience planning for rural and remote communities.

Academic excellence

- The need for consolidation of Arctic research in Scotland

The last decade has seen a renewed interest in Arctic matters, and science and technology have been at the forefront of this new drive towards the North. Virtually all Arctic policies analysed for the purposes of this report contain a very strong scientific research component, and stress the need for increased regional cooperation in this context. As a small nation, Scotland has limited resources to, for instance, maintain its own research station in the Arctic. However, a number of other countries find themselves in a similar situation, including the Netherlands (Netherlands Organisation for Scientific Research, 2014). Others, such as Italy, actively seek to further internationalize scientific activities in the region (Government of Italy, 2016). There is therefore ample scope for international collaboration for developing both infrastructure and partnerships in the Far North. At the international governance level, active participation in regional scientific bodies, such as the International Arctic Science Committee (IASC) through the UK delegation, should be pursued by Scottish authorities.

In the same vein, a number of non-Arctic states (Germany, Italy, France, Japan) have set out to consolidate their domestic research initiatives on the Arctic, for instance by planning to establish an Arctic research consortium (as in the case of South Korea) or by launching similar research forums to facilitate knowledge exchange at the national level. In addition, the Government may consider assuming a brokering role in developing contracts and partnerships between research actors and businesses interested in pursuing economic opportunities in the Arctic (for example in the areas of transport, aerospace, shipping, energy, mineral resources, insurance, communications, health), as set out by the French Arctic policy (Government of France, 2016). In general, it is clear that Scottish research activities on and in the Arctic require consolidation and coordination, an issue that should be considered by a future Scottish Arctic policy. There is fertile institutional ground for this kind of consolidation given the existence of a number of multidisciplinary research centres and associations either with a specific focus on the Arctic or with expertise that could be mobilized for Arctic research, including SAGES, MAST, the Arc, UHI's Environmental Research Institute, and SAMS. In the UK context, the Scott Polar Research Institute in Cambridge and the UK Science and Innovation Network could provide valuable guidance in this context.

- Fostering educational links

At the educational level, it appears that there is much scope for increased cooperation between universities and research centres in Scotland and its Arctic and near-Arctic partners. The Scottish government should facilitate increased cooperation in this context in order to capitalize on the already forged research, outreach, and teaching and learning partnerships, particularly by the Scottish members of the UArctic. Membership of other Scottish universities in UArctic should also be explored. Scottish academic institutions could in this way be repositioned as the gateway to the Arctic (or to Europe). The design for a revamp of the current partnership between the universities of Scotland and those in the Arctic produced during an interactive workshop with BuroHappold and the Scottish Government demonstrates how this could be achieved without an excessive level of financial investment (BuroHappold Engineering, 2018). At the pre-university level, there is scope for widening the activity of entities such as The Polar Academy, which could facilitate exchanges with young people from local communities who do not have immediate access to higher education institutions.

7. CONCLUSION

This mapping report has provided an overview of existing links between Scotland and the Arctic. The evidence speaks for itself. The breadth and depth of collaborations, partnerships and mutual understanding is extensive.

There is significant interest from Arctic nation states in the contribution that Scotland can make to the governance of the region. This was evident at Scotland's presence at the recent Arctic Circle Assembly in Iceland in October 2018. Scotland has much to offer in terms of knowledge, skills and expertise, which provides a strong platform for enabling wider collaborations. The proposed Scottish Arctic Policy should look towards exporting key messages such as '*Scotland as a valuable partner*' and continue to support building relationships and synergies with a multitude of external stakeholders with its Arctic neighbours who have a long history of social and cultural connections and face similar challenges with protecting rural and remote communities and geographical landscape. This is more pressing than before, with uncertainty around Brexit and the implications this may have for Scottish communities and economy.

Scotland is excelling in technological innovation through business investments into the sector. Of note is the significant interest by international companies to invest in Scottish industries such as oil and gas exploration, renewable energy, fisheries and tourism. Driving this investment are the potential opportunities that the opening up of the seas may bring to economic and social development in the region. Going forward, it is important that Scotland not only maintain this level of investment but see it growing and expanding. Securing business representation at relevant platforms will be important for this. This is also an opportunity for Scotland to be leading in initiating conferences, knowledge exchange platforms and exhibitions.

Scotland is already leading the way in tackling climate change and environmental protection through advances in natural science research. However, more can be done to take advantage of the Scottish Government's position on climate justice, including its Climate Justice Fund, and the Scottish expertise in social sciences and humanities to foster co-ordination, multi-disciplinary research and enable the voices of rural and remote communities to be an integral part of the solution to addressing climate change. Consolidating Arctic research, development and education in Scotland which features community engagement at the core of its mandate is highly recommended. This may take the form of the Scottish Arctic Research Cluster.

There is opportunity in Scotland to galvanise, consolidate and co-ordinate our strengths in Arctic expertise through the development of a dedicated Arctic Office; to coordinate the Scottish Government's involvement at the national and international levels. This office could be positioned to have a global outlook but with remits based on Scotland's National Performance Framework nationally and on the Sustainable Development Goals and the UNFCCC 2015 Paris Agreement, internationally.

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9. ANNEXES

Annex I – Overview of Governance

Arctic Governance: Institutional and legal arrangements

Unlike the Antarctic, which in accordance with international law cannot be claimed by any nation-state and is regulated by what is collectively known as the Antarctic Treaty System (ATS), the Arctic is inhabited by people and falls within the legal jurisdiction of eight nations (Canada, Denmark/Greenland, Finland, Iceland, Norway, Russia, Sweden, and the United States) (Bajrektarevic, 2010). Instead, a number of international treaties and agreements on issues related to environmental protection, marine pollution, search and rescue (SAR) capability, resource exploitation, and international cooperation have been adopted. In addition, the region is the focus of a number of international and interregional institutional initiatives. As a result, despite the absence of a comprehensive system like ATS and the sometimes diverging interests of the region's nations, the Arctic has been an example of an international governance structure that has favoured cooperation, consensus and peaceful dispute resolution over open conflict and competition for resources. It should be noted, however, that as the Arctic region is becoming increasingly prominent on the international stage due to its scientific, economic and strategic importance, it is predicted that an increasing number of countries will take a strong interest in the region in the upcoming decades. This section maps the key legal and institutional arrangements, presented in Tables below, that have contributed to this peaceful governance structure in the region which can be of strategic importance to Scotland's ambitions for an increased involvement in the Far North.

Institutional arrangements

Table 1 below outlines the main institutions from the Arctic governance standpoint, including inter-governmental bodies, scientific organisations, conferences and gatherings, and institutionalized partnerships. Within this list, the Arctic Council stands out as the most significant international forum for Arctic cooperation. The body, as shown in Figure 1, groups eight Arctic members (Canada, Denmark, Finland, Iceland, Norway, Russia, Sweden, and the United States), six indigenous permanent organisations, and 13 non-Arctic nations or observers (including the United Kingdom), the latter group having no right to vote but nevertheless able to participate in the Council's six working groups, task forces and expert groups (the latter two established by the

rotating national chairmanship). There are a number of other governance initiatives of note to the Scottish context. The Northern Forum is a regional organisation currently grouping 13 sub-national governments from the Arctic and non-Arctic regions from Finland, Iceland, the Republic of Korea, Russia, and the United States. Northern Forum's working groups focus on issues such as regional adaptation to climate change, development of energy in the North, housing, transport, health and social issues, culture, education and research. North Atlantic Cooperation (NORA) is an organisation under the Nordic Council of Ministers which brings together Greenland, Iceland, Faroe Islands and Coastal Norway, with the goal of fostering regional cooperation and sustainable economic development in the North Atlantic. Finally, West Nordic Council is a parliamentary cooperation

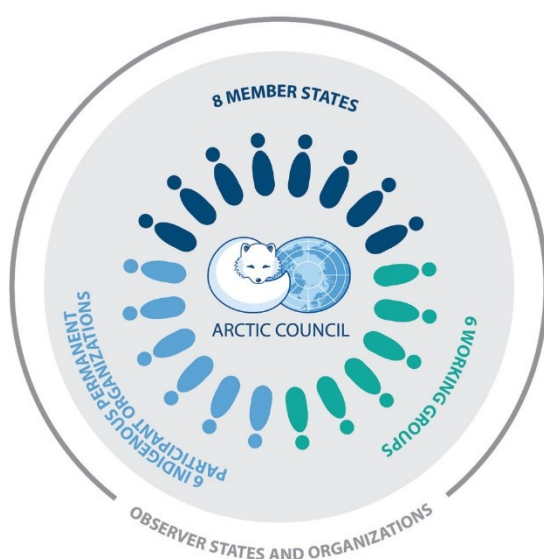


Figure 1. The structure of the Arctic Council. Source: arctic-council.org

between Iceland, Greenland and the Faroe Islands which fosters regional cooperation in the areas of sustainable development, environment, transport, SAR, climate change, public health, youth, education, among others.

Initiative name	Acronym	Description
Arctic Business Forum	ABF	A periodical forum fostering economic cooperation between Arctic countries
Arctic Circle Forum & Assembly		Network of international dialogue and cooperation on the future of the Arctic
Arctic Council	AC	A high-level intergovernmental forum and the most prominent governance institution in the Arctic focusing on sustainable development, human development, environmental protection, emergency prevention and response
Arctic Economic Council	AEC	An independent organisation facilitating Arctic business-to-business activities and responsible economic development in the region
The Arctic Five		A forum of the five states bordering the Arctic Ocean (Canada, Denmark/Greenland, Norway, Russia and the US)
Arctic Frontiers		A regular conference coupling academia with decision makers from government and business
Arctic Observing Summit		A high-level summit that provides community-driven, science-based guidance for the design, implementation, coordination and sustained operation of international Arctic observing systems
Arctic Regional Hydrographic Commission	ARHC	An international organisation to for capacity building and the wider use of marine data gathering
Arctic Security Forces Roundtable	ASFR	A semi-annual gathering of 12 nations focused on improving communications and maritime domain awareness in the Arctic Circle
Atlantic Ocean Research Alliance	AORA	A cooperative forum between Canada, the EU and the US for promoting the health, well-being and productivity of the Atlantic Ocean
Barents Euro-Atlantic Council	BEAC	An international forum for intergovernmental cooperation on issues concerning the Barents region
Barents Regional Council	BRC	A forum for counties and indigenous people's representatives in the Barents Sea region
EU-PolarNet		A consortium of expertise for polar research aiming to improve co-ordination between EU member polar research institutions
European Polar Board	EPB	An independent organisation that focuses on major strategic priorities in both the Arctic and Antarctic regions
Expert Mechanism on the Rights of Indigenous Peoples	EMRIP	A UN Human Rights Council expert mechanism for providing expertise and advice on the rights of indigenous peoples
Inuit Circumpolar Council	ICC	A multinational NGO representing Inuit people and promoting their unity, rights, interests and culture
International Arctic Science Committee	IASC	A non-governmental, international scientific organisation encouraging and facilitating all aspects of Arctic research
International Council for the Exploration of the Sea	ICES	A multidisciplinary scientific forum for knowledge exchange with a focus on the North Atlantic. ICES holds observer status at the Arctic Council.
International Maritime	IMO	A UN agency responsible for regulating shipping

Organization		
International Organization for Standardization	ISO	An international body to promote worldwide proprietary, industrial and commercial standards
International Union for Circumpolar Health	ICCH	An international scientific body focused on health issues in the circumpolar region; holds an annual scientific congress
International Whaling Commission	IWC	An Inter-governmental Organisation whose purpose is the conservation of whales and the management of whaling
Nordic Council and Nordic Council of Ministers		An inter-parliamentary and inter-governmental cooperation among Nordic nations. The Nordic Council of Ministers holds observer status at the Arctic Council.
North Atlantic Cooperation	NORA	An intergovernmental organisation under the aegis of the Nordic Council of Ministers aiming to reinforce regional cooperation in the North Atlantic Ocean region
North Atlantic Marine Mammal Commission	NAMMCO	An international body for co-operation on conservation, management and study of marine mammals in the North Atlantic. NAMMCO holds observer status at the Arctic Council.
North Atlantic Salmon Conservation Organization	NASCO	An international organisation to conserve, restore, enhance and rationally manage Atlantic salmon through international, science-based cooperation
North Atlantic Treaty Organization	NATO	An intergovernmental military alliance which includes five Arctic nations (Canada, Denmark, Iceland, Norway and the United States)
North East Atlantic Fisheries Commission	NEAFC	An intergovernmental fisheries science and management body for the long-term conservation and optimum utilisation of the region's fishery resources
Northern Dimension		A joint policy between EU, Russia, Norway and Iceland to promote dialogue, stability and economic integration
Nordic Environment Finance Corporation	NEFCO	An international financial institution established by Nordic governments engaged in green growth and environmental protection initiatives. NEFCO holds observer status at the Arctic Council.
Northern Forum		An international cooperation forum for sub-national Arctic regions
Northern Periphery and Arctic Programme	NPAP	An EU-funded socio-economic development programme for people living in Europe's Far North
Northwest Atlantic Fisheries Organization	NAFO	An intergovernmental fisheries science and management body for the long term conservation and sustainable use of the region's fishery resources
Saami Council		A voluntary Saami NGO with Saami member organisations promoting Saami rights and interests in Norway, Sweden, Finland and Russia
Standing Committee of Parliamentarians for the Arctic Region	SCPAR	Parliamentary body with delegations from Arctic states and the EU. SCPAR holds observer status at the Arctic Council.
Sustaining Arctic Observing Networks	SOAN	An international initiative to support and strengthen the development of multinational engagement for sustained and coordinated pan-Arctic observing and data sharing systems
United Nations Permanent Forum for Indigenous Peoples	UNPFII	A UN coordinating body for the concerns and rights of the world's indigenous peoples

University of the Arctic	UArctic	A cooperative network of universities, colleges, research institutes and other organisations concerned with education and research in and about the North
West Nordic Council	WNC	A parliamentary co-operation between Iceland, Greenland and the Faroe Islands on issues such as natural resources, culture, West Nordic interests, and cross-organisational collaboration. WNC holds observer status at the Arctic Council.

Table 1. Overview of selected key international and regional initiatives with an Arctic focus.

Legal arrangements

As noted above, there exists no formal treaty system to govern Arctic matters at the international level. The region thus relies on a number of international and regional treaties and agreements – both global and more regional in scope – which regulate various scientific, environmental, commercial, political and governance issues of relevance to the Far North (see Table 2 below). One of the most prominent ones is the 1982 United Nations Conventions on the Laws of the Sea (UNCLOS), signed and ratified by all but one Arctic nation (the United States). The Arctic being a predominantly marine environment, the stipulations of the Convention on the limits of territorial sea, the freedom of navigation, marine environmental protection, marine scientific research, and peaceful dispute resolution are of particular salience to the region and have governed international relations in the Arctic for decades. UNCLOS also allows for coastal states to extend their continental shelves beyond 200 miles, which in the Arctic context will result in decreasing the area of the ‘Arctic Commons’ in favour of exclusive national jurisdictions. More recently, the IMO Polar Code adopted in 2014 has set out much-needed standards for the design, construction, and equipment of ships operating in polar regions (IMO, n.d.). Other issues of particular significance for the Arctic covered by international law are, among others, biodiversity protection, search and rescue operations, climate change, and the rights of indigenous peoples.

Treaty/Agreement name	Acronym	Issues covered
Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic		Marine oil pollution
Agreement on Enhancing International Arctic Scientific Cooperation		Scientific research cooperation
Arctic Search and Rescue Agreement		Search and rescue coverage and response in the Arctic region
Ballast Water Management Convention	BWM	Ballast water and sediments
Convention for the Protection of the Marine Environment of the North-East Atlantic	OSPAR	Environmental protection in the North Atlantic (incl. dumping, incineration, pollution from land and offshore sources). OSPAR Commission holds observer status at the Arctic Council.
Convention on Biological Diversity	CBD	Conservation of biological diversity, sustainable use of its resources, sharing of genetic resources
Convention on Long-range Transboundary Air Pollution	LTRAP	Air pollution, including transboundary air pollution (e.g. Sulphur, nitrogen oxide, heavy metals, POPs)
Ilulissat Declaration		Protection of marine environment, maritime safety, emergency response
Intergovernmental science-policy Platform on Biodiversity and Ecosystem Services	IPBES	Biodiversity conservation, sustainable development, human well-being

International Convention for the Prevention of Pollution from Ships	MARPOL	Marine pollution such as sewage, garbage, oil & oily water, noxious liquid substances and air pollution
International Convention for the Safety of Life at Sea	SOLAS	Minimum safety standards in the construction, equipment and operation of merchant ships
Polar Code		Shipping regulations for Arctic regions
Protocol on Preparedness, Response and Co-operation to pollution Incidents by Hazardous and Noxious Substances	OPRC-HNS Protocol	Marine pollution (including hazardous and noxious substances)
Stockholm Convention on Persistent Organic Pollutants		Eliminating or restricting the production of persistent organic pollutants (POPs) such as aldrin, chlordane, DDT and hexachlorobenzene
UN Declaration on the Rights of Indigenous Peoples	UNDRIP	Indigenous peoples' rights (e.g. self-determination, health, culture, land rights, economic development)
United Nations Convention on the Laws of the Sea	UNCLOS	Nations' rights and responsibilities with regard to the use of the world's oceans
United Nations Framework Convention on Climate Change	UNFCCC	Climate change adaptation and mitigation (stabilization of carbon dioxide concentration levels)
Universal Declaration of Human Rights	UDHR	Fundamental human rights
World Health Organization	WHO	International public health

Table 2. Overview of selected key international and regional agreements applicable to the Arctic.

Arctic policies of Arctic and non-Arctic nations

Reflecting the growing international interest in the Arctic, an increasing number of countries have established new strategies and policies towards the region or elaborated their existing ones. The process seems to have received momentum in the early 2000s alongside the gradual formation of the Arctic Council, with many states delivering their policy documents within the last ten years. Short overviews of each of the analysed documents are provided below and divided into two groups: eight Arctic states and ten non-Arctic states plus the EU (India, Poland and Singapore, while having been granted observer status at the Arctic Council, do not have official Arctic policies). The overviews are followed by a comparative analysis of these policies.

Arctic states

Canada

It is important to underline that Canada views the Arctic as fundamental to its national identity, and as such its approach to a large extent focuses on asserting sovereignty over the Canadian Arctic and fostering local and regional development, which are largely seen as domestic issues (Government of Canada, 2010). The four pillars of the Canadian Arctic policy are promoting economic and social development, encouraging a greater understanding of the human dimension of the Arctic, protecting the Arctic environment, and improving and devolving governance. At the international level, Canada supports cross-border collaboration through bilateral relations with its Arctic neighbours, regional mechanisms (e.g. Arctic Council), and multi-lateral institutions. However, while Canada recognizes the growing interest of non-Arctic nations in the region, it will work to ensure that the role of the Permanent Participants in the Arctic Council (which represent the interests of indigenous peoples) is not diminished or diluted in the process.

Quebec

The government of Quebec has devised a province-level strategy for the Arctic parts of its territory called *Plan du Nord (The Northern Plan)* (Province of Québec, 2015). The Plan has created a

coordinated project to foster cross-sectoral partnerships called *Société du Plan Nord* (The Northern Plan Society) and emphasises sustainable development, the responsiveness of government action and policy to local northern contexts, and a “harmonious and ethnical approach to development” for aboriginal and non-aboriginal communities, with focus on gender inequality. Key strategic directions include the development of the North’s economic potential (e.g. mining, forestry, energy, tourism, bio-food), improving the wellbeing of local and aboriginal communities, and environmental protection and biodiversity conservation. Conditions for success mentioned include the development of transport and telecommunications infrastructure and scientific exchange.

Denmark

The Danish Arctic strategy is a joint document by the three constituent parts of the Kingdom of Denmark: Denmark, the Faroe Islands, and Greenland (Kingdom of Denmark, 2011). The strategy recognizes the ‘opening up’ of the Arctic region and the need to handle the related challenges and opportunities in a proactive and accountable manner with respect to the region’s societies, climate and the environment. The four main themes of the Danish strategy are a peaceful, secure and safe Arctic, self-sustaining growth and development, respect for the Arctic’s climate, environment and nature, and close international collaboration. In particular, exercising sovereignty and surveillance, the respect of international law and ensuring maritime safety are fundamental priorities indicated by the document. Living and non-living natural resources, including fisheries and minerals, are to be exploited under the strictest international standards, and the need for increasing renewable energy production is also stressed. The Nordic, European and international research collaboration is to receive priority, particularly with regard to health and social sustainability. At the international level, Denmark wishes to enhance the role of the Arctic Council, with particular attention given to the human dimension of cooperation. To achieve the goals of the strategy, the Kingdom has set up a Steering Committee, and wishes to enhance multilateral dialogue through global international organisations as well as public diplomacy and advocacy initiatives.

Faroe Islands

In recognition of the fact that certain elements of the Kingdom of Denmark’s strategy relate to areas within which the Faroe Islands have exclusive competence, the Faroese government decided to undertake a national assessment identifying and expanding on the key areas of interest for the Faroe Islands (Bailes and Jákobsstovu, 2013; Government of the Faroe Islands, 2013). Key elements of this assessment include promoting international collaboration (most notably through the Arctic Council), new economic opportunities due to shipping and the opening of the Northern Sea Route, ensuring Faroese participation in a sustainable use of Arctic fisheries, developing the Faroese research and education capacity, environmental protection (particularly in the context of oil and chemical pollution), and enhancing the maritime safety and emergency response capacity of the Islands.

Finland

Finland’s Strategy for the Arctic Region is focused on local residents, education, research, the economy, infrastructure, the environment, stability and international cooperation in the Arctic (Government of Finland, 2013). Specifically, Finland – as an Arctic nation without access to the Arctic Ocean – sees itself as a proactive player with the “ability to reconcile the limitations imposed and business opportunities provided by the Arctic environment in a sustainable manner” through international cooperation (Government of Finland, 2013). Finland thus emphasises what it can offer to regional Arctic cooperation and development, for instance through its innovativeness and cold-climate expertise. Examples of key areas of interest for Finland are the maritime industry and shipping, transport, energy, technological applications, innovations and efficient services, welfare of the local population, environmental issues (sustainable development of resources and biodiversity protection) and international cooperation at various levels (state, regional and local).

Iceland

The Icelandic Arctic policy puts particular emphasis on international governance and Iceland’s role in this process (Althingi, 2011). Iceland aims to secure its position as an Arctic Coastal State, underlining that the

Arctic region refers not only to the North Pole proper, but also “the part of the North Atlantic Ocean which is closely connected to it” (Althingi, 2011). In this context, Iceland wishes to increase international cooperation among states, and particularly with the Faroe Islands and Greenland, promote and strengthen the Arctic Council, and ensure that international disputes are resolved based on the stipulations of UNCLOS. At the socio-economic level, prevention of human-induced climate change, sustainable use of resources, environmental protection and support for the Arctic indigenous peoples’ right are also part of the agenda. Iceland supports the need to strengthen research and education on the Arctic, and wishes to promote itself as a preferred venue for meetings, conferences and initiatives on Arctic matters (as demonstrated by its hosting of the annual Arctic Circle Assembly). Finally, the country expresses a strong preference for ensuring security via civilian means and opposes the militarization of the region.

Norway

Norway’s vision is to ensure a peaceful, innovative and sustainable North, with a focus on green growth based on economic, social and environmental sustainability (Government of Norway, 2017). Norway has five priority areas in this regard: international cooperation, business development, knowledge leadership, infrastructure, and the environment. First, Norway is to actively engage in cross-border collaboration on matters concerning the region (e.g. health and maritime safety, climate change, sustainable development and growth) with other Arctic and non-Arctic states. Second, sustainable business is to be ensured, particularly through increasing the value creation by companies in North Norway and facilitate dialogue between academia and the business sector. Third, targeted investment in northern counties is to ensure well-connected infrastructure for sustainable development (e.g. power supply, digital infrastructure). Finally, in the context of environmental protection, safety, emergency preparedness and response, Norway plans to focus on the issues of marine litter, microplastics and toxic substances, ensure the sustainable use of natural resources, reduce greenhouse gas emissions, and increase its surveillance and emergency (e.g. oil spill) response capacity in the region. Cooperation with other states on search and rescue capacity and the adoption and implementation of the Polar Code is also stressed.

Russian Federation

Russia’s key national interests included in its policy on the Arctic include the use of the Arctic zone to foster socio-economic development in the country, maintaining the Far North as a zone of peace and cooperation, preserving its unique ecological system, and taking advantage of the possibilities offered by the Northern Sea Route (Government of the Russian Federation, 2009). These interests are to be secured by a number of strategic objectives, including socio-economic development (through the exploitation of hydrocarbons, minerals and living resources), military security (by maintaining “a necessary fighting potential” of the Armed Forces), environmental security, IT & communication (e.g. by establishing a uniform IT area), science and technology (by maintaining sufficient levels of research funding) and international cooperation through bilateral and multilateral agreements and treaties (Government of the Russian Federation, 2009). To this end, Russia will cooperate with sub-Arctic states in various spheres (e.g. maritime sea area delimitation and SAR), assist in managing cross-polar air and sea routes, and become more engaged on Arctic issues internationally. Moreover, attention is also placed on improving the quality of life of the Arctic region’s indigenous populations, the development of prospective technologies, and the modernization of infrastructure and of the Arctic transport system.

Sweden

The Swedish Arctic Policy focuses on three thematic areas: climate and the environment, economic development, and the human dimension (Government of Sweden, 2011). Within the first theme, the policy stresses issues related to climate (GHG emission reductions and adaptation to climate change impacts), environmental protection (e.g. eco-system based marine management and spatial planning and the need for an international agreement on mercury pollution), biodiversity (e.g. establishment of new protected areas), and climate and environmental research. In terms of the second theme – economic development – the need for social, economic and environmental sustainability is stressed, as is ensuring free trade in the Arctic. Resources are to be exploited in accordance with international law, and Sweden should promote its economic

and industry interests in the region, and particularly in the Barents region. The human dimension, which forms the third part of the policy, stresses human and environmental health, the impact of climate change on indigenous cultures, industries and languages, and the need for a greater knowledge transfer at the local level, including research on Sámi society. To meet all these objectives, Sweden wishes to strengthen the mandate of the Arctic Council by introducing joint security, infrastructure and social and economic development to its agenda, not least to counterweigh the importance of the Arctic Five (of which Sweden, as a non-coastal Arctic nation, is not part).

United States of America

Since the United States is one of the countries that have somewhat lagged behind in developing a comprehensive policy for the Far North, it is sometimes referred to as a “reluctant Arctic actor” (Nilsson, 2018). However, in a national strategy document from 2013, the US identifies three ‘lines of effort’ with regard to the Arctic: security interests (respect for international law, promotion of lawful commerce, surveillance), responsible stewardship (protecting the environment, conserving natural resources, charting the region and using scientific and local knowledge to understand the Arctic), and strengthening international cooperation (by advancing collective interests, enhancing regional security and collaboration through international bodies and bilateral and multilateral agreements, and working towards joining UNCLOS) (Government of the United States, 2013). The guiding principles of this policy are to safeguard peace and stability in the Arctic, make decisions based on best available information, pursue innovative arrangements (e.g. with the State of Alaska and other Arctic nation-states), and consult and coordinate with Alaska Natives in a timely and meaningful manner. In 2016, the US Department of Defense (DoD) complemented the policy by establishing a vision of a secure and stable region where US interests are safeguarded, the US homeland defended, and where national work cooperatively to address common regional challenges. In order to achieve it, the DoD stresses the need to enhance the capability of US forces, preserve the freedom of seas, support human and environmental security, and increase awareness on Arctic issues at the domestic level.

Alaska

In order to ensure Alaska’s interests are adequately considered in the development of the federal Arctic policy, state legislature established the Alaska Arctic Policy Commission comprised of 10 state legislators and 16 experts (Alaska Arctic Policy Commission, 2015). The resulting Final Report and Implementation Plan contains four vision statements. First, stress is put on economically vibrant communities and a healthy environment (e.g. ensuring local communities benefit from regional development, and promoting investment and industrial and technological innovation). Second, collaboration at all levels of government and stakeholders is to be strengthened (especially with Canada and Russia and through the Arctic Council, and the Permanent Participants, in particular). Third, Alaska’s security should be enhanced by pursuing a vision of a safe and secure Arctic (e.g. improving disaster and emergency prevention and response, oil spill prevention, SAR capabilities and safe maritime transportation). Fourth, the document focuses on strengthening the resilience of communities in the Arctic, by recognizing indigenous cultures and their relationship with the environment, conducting scientific research to advance innovation, and safeguarding the region’s environment. The related implementation plan rests on economic and resource development, developing response capacity, working towards healthy communities, and the promotion of science and research.

Non-Arctic states and the EU

People’s Republic of China

China has described itself as a ‘near-Arctic’ state, clearly asserting its growing ambitions for the region (Lanteigne, 2017; People’s Republic of China, 2018). The Chinese Arctic policy prioritizes scientific research, environmental protection, rational use of resources, and law-based governance and international cooperation. China is committed to “maintaining a peaceful, secure and stable Arctic order” (People’s Republic of China,

2018). In particular, the policy aims to deepen the exploration and understanding of the Arctic, protect the region's ecosystem, and take action to address climate change. China is also interested in the development of Arctic shipping routes to complement its Belt and Road Initiative, participating in the development of oil, gas, mineral and other non-living resources, as well as in the conservation of fisheries and other living resources. Tourism is also of growing importance to China. The policy underscores the need for the country to actively participate in Arctic governance and international cooperation with the goal of promoting peace and stability in the region.

France

The French Arctic strategy is a result of extensive inter-departmental and inter-agency collaboration (Government of France, 2016). France's priorities with regard to the Arctic are to identify the country's various interests in the region, enhance France's legitimacy in Arctic affairs and forums, work to balance national with international interests in the context of Arctic Ocean governance, and environmental protection. These four priorities are broken down into seven themes: 1) scientific research and academic cooperation, 2) France's economic interests and opportunities in the Arctic (especially promoting French companies in the region), 3) Arctic marine environment protection policy (maritime safety, mining regulations, biodiversity protection and sustainable management of fisheries), 4) France's defence and security interests (including the development of the capacity of French forces to operate in the Arctic), 5) France's presence in international forums (e.g. Arctic Council, IMO, ISO), 6) the role of the European Union in the region (which should be increased), and 7) balancing national interests and the global common interest in the Arctic.

Germany

The German government sees the Arctic as a region 'in transition' and aims to make it one of the central foci of German policy (Government of Germany, 2013). The priorities set out by the country's Arctic policy include seizing economic opportunities (e.g. maritime technologies and sustainable development of living marine resources), setting exemplary environmental standards (including the adoption of the precautionary approach, oil pollution, and biodiversity conservation), freedom of navigation (particularly in the context of new shipping routes, shipping regulations, maritime surveillance) and freedom of scientific research (the International Arctic Science Committee being based in Potsdam). Importantly, Germany is concerned about the shrinking area open to scientific research due to the extended continental shelf process initiated by a number of Arctic states (Government of Germany, 2013). Significant emphasis is also placed on Germany's engagement at the European and international levels. For instance, Germany supports the strong role of the Arctic Council and wishes to increase its participation in the body's working groups. Moreover, it advocates for increasing the rights of Arctic Council observer nations on an ad-hoc, case-by-case basis.

Italy

The overall goal of the Italian Arctic policy is to reinforce Italian presence in the region (Government of Italy, 2016). In order to achieve this goal, the strategy is divided into four different dimensions: political, environmental and human, scientific, and economic. First, Italy sees the Arctic Council as the main forum for the Arctic and underscores its respect for the sovereignty of Arctic nations in the region. It also supports the strong role of the EU in Arctic governance. An informal, open-ended consultation group called *Tavolo Artico* (The Arctic Roundtable) has recently been reactivated to facilitate the exchange of information and coordination of activities undertaken by Italian actors in the Arctic. Second, the environmental and human dimension is to be supported by Italian scientific and technological research. Particular focus is placed on the marine environment, air pollution and climate change, biodiversity protection, urban areas and indigenous peoples. Third, the scientific dimension stresses the need for increased Italian participation in Arctic research, reinforcing internationalization, and promoting and strengthening collaboration among national actors, among other measures. Finally, the economic dimension is dominated by information on how Italian technological expertise can be used to foster development in the region (for instance in the fields of oil and gas exploitation, climate change research, renewable energy, and geothermal in particular).

Japan

Japan's ambition is to become an important Arctic player on the international area (Government of Japan, 2015). The country's Arctic policy defines strategic initiatives in the fields of diplomacy, national security, environment, transportation, resource development, information and communications, and science and technology. In terms of the most pressing Arctic issues, Japan's focus is on global environmental change, ensuring sustainable development for the region's indigenous peoples, expanding Japan's Arctic research, and leading global discussions on the Arctic. Special attention is given to ensuring the continued respect for international law in the region, the opportunities associated with the Arctic Sea Route (especially given the country's expertise in safe navigation science and technology), natural resource development (including marine and mineral resources), and national security (Japan wishes to prevent tension and confrontations in the region stemming from increased military presence). Among specific initiatives mentioned are the establishment of a national Arctic research network, continued contribution to the activities of the Arctic Council, and work towards a greater involvement of Japanese companies in regional economic activities.

Netherlands

While the Dutch policy for the polar regions does mention future economic opportunities (e.g. the Northern Sea Route, natural resources and tourism), it is for the most part concentrated on the country's research potential and activities in the region (Netherlands Organisation for Scientific Research, 2014). The key research themes identified are ice, climate and rising sea levels, polar ecosystems, sustainable exploitation, and social, legal and economic landscapes. Emphasis is put both on understanding the current human and natural processes in the region and long-term system monitoring. It is recognized in the policy that the Netherlands is not able to conduct Arctic research on its own, and international research collaboration (which the country has established with Germany and the UK), should be further promoted. Opportunities for public-private partnerships are also mentioned. The above goals, it is suggested, will hinge on strong policy support to be ensured through national representation in relevant international bodies on the one hand, and adequate infrastructure (e.g. polar stations) and research partnerships, on the other.

Republic of Korea

According to the national Arctic policy, the Republic of Korea's goals are to strengthen international cooperation, encourage scientific and research capacity, and pursue sustainable Arctic business (particularly through its involvement in the Arctic Council and its Working Groups), and to secure an institutional foundation for achieving them (Government of the Republic of Korea, 2013). In terms of implementation, the Republic of Korea will expand its participation in international forums, build academia-led networks, cooperate with indigenous groups, expand its Dasan Arctic research station, and build an Arctic Research Consortium to foster international activities focused on the region. Of particular interest to the Republic of Korea are the economic opportunities offered by the future Arctic Sea Routes. Here, the country wishes to accumulate Arctic sea route navigation experience, provide incentives to use the route, conduct research on the matter, develop its sea operators' capacity, and revamp its ports to meet the demands of an Arctic Sea Route, including ship-building capacity. At the institutional level, a Polar Information Service Center will be established for the benefit of various domestic actors involved in Arctic matters.

Spain

The Spanish polar policy advocates Spain's continued involvement in international polar organisations, promoting the conservation of polar environments, and the sustainable use of their natural resources (Government of Spain, 2016). In this context, the policy stresses issues such as respect of Arctic countries' influence over the region, the need to foster peacekeeping, environmental protection and security, climate change, the importance of action in the social and human spheres, becoming increasingly involved in international organisations such as the Barents Euro-Atlantic Council, and the need to promote free, safe and environmentally-friendly trans-Arctic maritime transit. Much emphasis is also put on scientific research, including the promotion of geographic mobility of researchers through access agreements, researcher exchange programmes, and strengthening the National Polar Data Centre. With regards to sectoral issues, attention is placed on sustainable exploitation of natural resources in the region (including minerals and fisheries) and protecting its biodiversity. Spain also sees its role in trans-Arctic navigation by virtue of its

geographic location on the Strait of Gibraltar and the North-South maritime axis and its overcapacity of turnkey transport and logistical infrastructure. This also applies to the potential Northwest Passage to the West Coast of the United States.

Switzerland

Switzerland does not have a policy towards the Arctic that goes beyond the country's scientific research (Swiss Federal Department of Foreign Affairs, 2015). Switzerland also has no polar institute as such. Instead, its science community engages in international collaboration through various science programmes and active participation in non-governmental organisations such as IASC. Of particular relevance from the Arctic standpoint is the expertise of Swiss scholars in glaciology, stemming from the impact of glaciers and ice on everyday life in Switzerland.

United Kingdom

The current Arctic policy of the UK rests on three major areas: projecting global influence, protecting people and the environment, and promoting prosperity (HM Government, 2018). First, the UK will continue to send appropriate representation to the Arctic Council, explore potential bilateral arrangements with Arctic and non-Arctic nations, and support multilateral engagement of the devolved administrations and organisations in the UK in developing "appropriate connections in their region" (HM Government, 2018, p. 9). Moreover, the policy underscores the importance to support UK research, most notably via the NERC Arctic Office and the UK Science and Innovation Network (SIN). With regard to the second area, attention is placed on climate change, the respect for the region's indigenous peoples and their inclusion in the work of the Arctic Council, marine conservation, biodiversity conservation (e.g. migratory birds), and marine litter and pollution. The UK is also committed to maintaining a peaceful, stable and well-governed Arctic, and to ensuring safety for sustainable tourism, including the promotion of SAR initiatives. Third, the UK is interested in developing economic opportunities in the areas of shipping and trade routes, energy and extractives (including support for oil and gas exploration), fisheries (using a precautionary approach to their management), connectivity (improving transport links), and financial services (in terms of green finance standards and the UK's position as a centre of commercial expertise).

European Union

In its Joint Communication to the European Parliament and the European Council, the European Commission set out the case for an EU policy for the Arctic (European Commission, 2016). The Commission identified three priority areas for the EU, with a cross-cutting emphasis on research, science and innovation. First, EU stresses the importance of climate change and safeguarding the Arctic environment. Measures proposed for addressing these issues include climate change adaptation and mitigation strategies (funded through European Structures Investment Funds, among other sources) as well as multilateral agreements on issues such as biodiversity protection, marine areas, pollutants, invasive species and oil and gas activities. Second, the EU puts a strong emphasis on sustainable development in and around the Arctic. A number of work streams are mentioned in this context, including the support for sustainable innovation (innovative technologies, access to single market), the establishment of a European Arctic stakeholder forum to "combat underinvestment and enhance collaboration and coordination between different EU funding programmes" (European Commission, 2016), financial investment (e.g. into infrastructure), space technology, and maritime safety and security. Underpinning the first two is the third priority – international cooperation on Arctic issues. Here, the EU wishes to become more active at the UN and other international organisations and forums, foster bilateral cooperation with countries such as the United States, Canada and Russia, engage in a dialogue with the region's indigenous people, become involved in fisheries management, and enhance scientific cooperation, for instance through the Atlantic Ocean Research Alliance (AORA). The European Union has also unsuccessfully sought observer status at the Arctic Council.

Differences and similarities

When comparing the different Arctic policies, strategies and guidelines outlined above, it is clear that the overall approach to the Arctic region is similar in the vast majority of cases. The recognition of international law as a way to solve any potential disputes among countries and support for collaborative governance in the Arctic is the common thread within the documents. There seems to be a particularly strong consensus on the need to develop deeper international collaboration in terms of scientific research and technological innovation (see Tables 3 and 4). Most countries, particularly those not located in the Arctic, recognize that conducting research and promoting innovation in the region cannot be done alone. Combined with the increasing interest in Arctic studies, this limitation presents an obvious opportunity for establishing new links between Arctic and non-Arctic actors. Importantly, a number of countries have embarked to consolidate their national research programmes (e.g. Japan, Italy, and the Republic of Korea).

Environmental protection is also very high on the agenda in virtually all the analysed cases. Both Arctic and non-Arctic nations recognize the fragile and often vulnerable nature of the Arctic ecosystem, and advocate for a range of measures to safeguard it. Biodiversity conservation (for instance through establishing new protected areas) and sustainable management of resources (such as fisheries, hydrocarbons, and extractive minerals) are present in almost all documents. However, there are some divergences in this context, with countries deciding to foreground different environmental issues in their policies. For example, climate change is high on the agenda of Nordic countries (e.g. Norway, Iceland and Sweden), but less so in the case of Russia or the United States.

In terms of economic interests, in many Arctic nations such as Canada, Finland and to a lesser extent Norway, these are framed not just in terms of the benefits stemming from the exploitation of the Arctic's living and non-living natural resources, but also (quite understandably) as issues of regional development. The 'opening up' of the Arctic is seen as an opportunity to increase the quality of life for the region's inhabitants, including indigenous groups, in the spheres of employment, health, education, access to physical and digital infrastructure, and other social services which may be currently underdeveloped. For their non-Arctic counterparts, the focus is on promoting national industries and businesses. For instance, Germany, France, and Italy see potential economic opportunities in their expertise in ship-building technology (and particularly in ship propulsion systems and ice-class ships), mining of resources, and GHG emission reduction technologies, respectively.

One of the common tensions in the analysed documents is between the prospect for economic development and the necessity to protect the Arctic environment. References to sustainable development abound, which demonstrate the widespread necessity to ensure not just economic and social but also environmental sustainability in the region. Various proposals are being put forward in this context, from the aforementioned protected areas, strict environmental regulations for shipping (for example through the IMO Polar Code) and resource exploitation, and ensuring consultations with local and indigenous communities on land and sea stewardship. While these calls echo a joint sense of preoccupation with the Arctic environment and its changing future, it remains to be seen if this near-universal call for the sustainable development of the region manages to avoid the negative consequences of the evident anticipation for the region's opening up for economic opportunities. Close cooperation between Arctic and non-Arctic state in this area is essential.

Other aspects of policies do not enjoy nearly as uniform a focus, with the possible exception of search and rescue capacity, the need for a more consolidated drive of which is recognized across the region. This, it is argued, is essential for the future development of Arctic shipping and the growth of safe tourism. In fact, virtually all countries recognize the enormous potential for increased trade resulting from the opening of new sea routes in the Arctic region (the Northeast Passage and the Northwest Passage). Apart from the development of necessary SAR capabilities, key Arctic countries such as Russia and Norway have committed to preparing adequate land and sea infrastructure to accommodate the future freight and passenger (tourist) traffic along their shores. A number of non-Arctic states, particularly in Asia, have indicated their readiness to support these endeavours, which they see as a key economic opportunity.

One of the key divergent points when analysing the different policies – particularly by not exclusively between Arctic and non-Arctic nations – is the issue of the demilitarization of the region. Certain countries have asserted their intention to maintain a stable military or even combat presence (Canada, Norway, Russia, and to

	Research	Environment	Technology & Innovation	Education	Regional Development	International Law	Indigenous Peoples	Infrastructure	Transport	Shipping	SAR	Tourism	Fisheries	Oil & Gas	Mining	Military Presence
Canada																
Quebec																
Denmark																
Greenland																
Faroe Islands																
Finland																
Iceland																
Norway																
Russia																
Sweden																
USA																
Alaska																

a lesser extent the UK and France), which in the case of the Arctic nations is considered a step towards asserting their sovereignty and safeguarding their national interests in the region. On the other hand, certain nations advocate for the region's demilitarization, including Iceland and to a lesser extent Denmark.

Many of these policy priorities overlap also with the Scottish national interest in the areas of scientific cooperation, peaceful governance, climate change mitigation and adaptation, and sustainable and equitable development for the region's people and for Scotland, itself.

Table 3. Overview of the policies of Arctic states *and sub-national governments*. Green: major focus; yellow: medium focus; red: little focus; grey: no significant mention. Updated and adapted from Schulze (2017).

Table 4. Overview of the policies of non-Arctic states. Green: major focus; yellow: medium focus; red: little focus; grey: no significant mention. Updated and adapted from Schulze (2017).

Scottish Participation in Arctic Governance

Scotland's unique contribution to social development in the Arctic

The Arctic Council puts a strong emphasis on the human dimension of regional governance, and indigenous and social issues are high on its agenda. This has pushed a number of countries – particularly but not exclusively those with Arctic populations – to align their Arctic policies with the social or human dimension of the Arctic Council's work. One of Canada's goals, for instance, is to “encourage a greater understanding of the human dimension of the Arctic to improve the lives of Northerners” (Government of Canada, 2010). This is to be done through international bodies and activities (e.g. Canada organized the 2008 Arctic Indigenous Language Symposium – first of its kind), a focus on health (e.g. through a review of health systems and nutrition guidelines), and an overall emphasis on respecting indigenous knowledge, work, and cultural activities. Moreover, one of the basic principles of Quebec's *Plan Nord* is “a harmonious and ethical approach to development that remains respectful of aboriginal and non-aboriginal communities and consistent with equality between men and women” (Province of Québec, 2015). One of the three pillars of the Swedish Arctic policy is the human dimension, and particularly the negative health and social effects of climate change, hazardous substances and natural resource exploitation on Sweden's Saami population. In this context, Sweden plans to concentrate on issues such as human and environmental health, impacts on indigenous

	Research	Environment	Technology & Innovation	Education	Regional Development	International Law	Indigenous Peoples	Infrastructure	Transport	Shipping	SAR	Tourism	Fisheries	Oil & Gas	Mining	Military Presence
Germany	Green	Green	Green	Red	Red	Yellow	Red	Red	Red	Green	Green	Red	Red	Green	Green	Red
France	Green	Green	Green	Yellow	Red	Green	Red	Red	Red	Red	Green	Green	Green	Yellow	Green	Red
Italy	Green	Green	Green	Green	Grey	Grey	Grey	Yellow	Grey	Grey	Yellow	Red	Grey	Yellow	Grey	Grey
Japan	Green	Yellow	Green	Yellow	Grey	Yellow	Grey	Yellow	Yellow	Green	Green	Grey	Yellow	Yellow	Yellow	Grey
The Netherlands	Green	Green	Green	Grey	Green	Green	Red	Grey	Yellow	Green	Green	Grey	Yellow	Yellow	Yellow	Grey
People's Republic of China	Green	Green	Red	Grey	Red	Green	Yellow	Green	Green	Green	Red	Green	Green	Green	Green	Grey
Republic of Korea	Green	Yellow	Green	Green	Red	Green	Red	Yellow	Red	Green	Green	Grey	Green	Yellow	Green	Grey
Spain	Green	Green	Green	Green	Grey	Red	Yellow	Green	Grey	Green	Yellow	Grey	Green	Yellow	Yellow	Grey
Switzerland	Green	Yellow	Green	Green	Grey	Yellow	Red	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey
United Kingdom	Green	Green	Green	Yellow	Red	Yellow	Yellow	Yellow	Red	Yellow	Red	Red	Green	Green	Yellow	Yellow

cultures and languages, knowledge transfer, and research programmes on the Saami society. Finally, Denmark wishes to give the human dimension extra attention in international cooperation on Arctic issues.

Since many of the challenges predicted for indigenous populations in the Arctic relate to climate change impacts, Scotland's leadership in climate change mitigation and its growing focus on adaptation can provide important policy and practical support to the mission to make international involvement in the Arctic more attuned to local needs. More specifically, the increasing national policy focus on issues related to social justice, just transition and climate justice readily lend themselves for complementing a future Scottish Arctic policy in this context. While the UK strategy for the Arctic does aim to “protect people and the environment” (HM Government, 2018, p. 15) and gives a number of examples on how that could be achieved, little to no attention is given to the social and economic inequalities that are affecting the region's indigenous and northern communities, including those rooted in environmental issues such as climate change. Scotland's

experience with supporting local development in remote communities, as discussed in the previous sections, makes Scotland a natural partner for Arctic and non-Arctic players.

Importantly, stakeholder feedback indicates that this is one of the contexts in which the Scottish Arctic policy should not only complement but also go beyond the UK Arctic strategy. Stakeholders indicate the need for Scotland to listen to the voices of the disempowered and to commit to pursue the UN sustainable development goals (SDGs). Here, there is also mention of respect for cultural heritage and an opportunity for capitalizing on Scottish friendliness, openness and Scotland's positive reputation in the region, which can pave the way to mutually beneficial partnerships. In general, stakeholders' views are in line with the priorities of the Arctic Council and stress the need for bringing out the human dimension of a future Arctic policy for Scotland.

International engagement: From indirect representation to public diplomacy

Through the mapping of current governance links within the Arctic region, a number of ways to increase Scottish engagement in the Arctic can be identified. These pertain to actions at both international and national levels.

It should be noted that Scotland's participation in international Arctic governance is heavily constrained by virtue of foreign policy being a matter reserved to the UK government. The United Kingdom is an observer nation to the Arctic Council and party to most international agreements pertaining to the Arctic region and issues, and any Scottish representation must follow UK channels. However, this situation is far from unique, even in the Far North. In this context, there is much scope for Scotland to learn from other sub-national regions located in the Arctic region: Greenland, Faroe Islands, Quebec, and Alaska.

In the case of the first two, their regional strategies are largely incorporated into the overarching Arctic policy of the Kingdom of Denmark, produced jointly by the three parties. Moreover, the Faroese government has commissioned a national-level assessment in complement to the Danish Realm's policy which focuses on questions specific to the Faroe Islands (see above) – demonstrating the feasibility of a more local Arctic strategy co-existing with its national counterpart. In the case of Scotland, there was limited involvement of the devolved administrations in the drafting of the UK Arctic Policy published in 2018, where the word 'Scotland', for instance, is mentioned a mere six times. This further justifies the need for a Scottish Arctic policy, especially given the UK government's stated support for developing appropriate regional connections by the devolved administrations (HM Government, 2018).

It appears that the example of Quebec may be even more pertinent for Scotland, as the Canadian province has developed its own International Policy document, in which it outlines its relationship with the Arctic (despite foreign policy lying largely within the purview of the Canadian government). More importantly, Quebec has also produced a province-level strategy on the sustainable development of its Arctic territory called *Plan Nord*. As part of the Plan, a new governance body – *Société du Plan Nord* – was established, which promotes the involvement of all stakeholders to encourage joint political initiatives and business, scientific, technological and cultural partnerships to ensure the region's sustainable development. While Scotland obviously does not have jurisdiction over any part of the Arctic, Quebec's experience in balancing between its own interests and those of the Canadian government in setting economic, social, and environmental priorities in the Far North can provide a valuable input in drafting the Scottish Arctic policy.

That said, at the international level, and with the exception of the International Organisation of La Francophonie, the province participates in multilateral organisations as part of the Canadian delegation. To ensure Quebecois interests are adequately represented, it has secured an agreement with the federal government thanks to which the Permanent Delegation of Canada to UNESCO must include at least one member nominated by the province. A similar arrangement between Holyrood and Westminster on Arctic matters could increase the visibility of Scotland on the Far North's international arena. Indeed, pursuing indirect representation through the UK delegation appears as one of the most cost-effective ways to enhance Scottish participation in Arctic governance. Scotland could draw from the experience of Quebec, Greenland, Faroe Islands, and Alaska with their respective federal or central government in seeking an appropriate arrangement with Westminster.

Another straightforward way for increasing Scotland's presence in this area is through other international bodies by which it could potentially be considered an eligible candidate. Scotland's active role in Arctic Circle events between 2016 and 2018, for example, has served to successfully assert the Scottish Government's interest in the Arctic and provide a momentum – both nationally and internationally – for further involvement in regional matters. For instance, the Nordic Horizons side-event to the Arctic Circle Forum 2017 hosted by Scotland in Edinburgh opened a dialogue between representatives from Scotland and the Far North on commonalities, cooperation and shared challenges. Consideration should also be given to potential participation in the Northern Forum, which groups 13 sub-national governments from five countries (both Arctic and non-Arctic), West Nordic Cooperation (WNC) or the North Atlantic Cooperation (NORA), which brings together Greenland, Iceland, Faroe Islands and Coastal Norway (Johnstone, 2012). Other governance arrangements in a Nordic-plus format could also be devised (Bailes et al., 2013).

Given the paucity of information on the UK's relationship with the EU post-Brexit, it is at this time impossible to ascertain what kind of role Scotland should envision for the European Union in the Arctic. The EU seeks an Arctic Council observer status and is strongly supported by Germany and France (but not necessarily by the UK) in doing so. Since at the time of writing Scotland stills forms part of the EU and the UK, it appears that a strong European presence in the Arctic would benefit Scotland, not least for research funding and economic reasons.

A number of other, more indirect ways appear to exist for increasing Scottish participation in Arctic affairs. The promotion of Scottish businesses and research initiatives in the region by means of public diplomacy and advocacy (following Denmark's example, for instance) can also go a long way in this context. Many of Scotland's higher education institutions and research centres already have firmly established and internationally acclaimed Arctic research programs, including the University of the Highlands and Islands, the University of Aberdeen, or the University of St. Andrews. Similarly, there is a number of Scottish businesses operating in the Arctic, and Scottish companies' vast oil, gas, renewable energy and tourism portfolios – to name but a few examples – can further strengthen Scottish presence in the Arctic.

At the national level, however, political, economic, academic and social initiatives that focus on the Arctic appear scattered, and there is much potential for consolidating them in institutional terms. First, the Scottish Government's European division should feature a dedicated Arctic office to coordinate the Government's involvement at the international level, including liaising with the UK Minister of State for the Polar Regions (Johnstone, 2012). The recent launch of the Arctic Steering Group is certainly a positive development in this context. Second, a national forum should be established to provide an arena for discussion and cooperation between Scottish academia, civil society, business and government bodies at all levels. The setup of such a body could be either formal (such as the aforementioned *Société du Plan Nord* in Quebec or the Icelandic Arctic Cooperation Network) or more informal (as in the case of the Italian *Tavolo Artico*). Scotland may also want to explore ways to engage its councils and municipalities in Arctic governance as in the case of the Regional Forum in Norway. The experience of Scotland hosting the aforementioned Arctic Circle Forum in Edinburgh which brought together various Scottish organisations with an active interest in the Arctic clearly demonstrated the need for a more institutionalised form of national-level cooperation on the Arctic.

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Annex II – Overview of Socio-cultural Links

Overview

Scotland has many social and community links and similarities with the Arctic Region and Arctic States. There are numerous geographical, historical, cultural, and linguistic similarities between Scotland, and in particular the Highlands and Islands, and the rest of the Arctic. The geographical, historical and cultural connections to the Arctic are stronger than those in the rest of the UK (Johnstone, 2012). Much of the shared historical and cultural links come through, for example, 'Viking' connections, Scottish emigrant populations in Canada, and 19th and 20th century polar explorers such as John Rae and Thomas Abernethy (Mikkola, 2014). Nova Scotia in Canada received large numbers of Scottish emigrants, and these links are still maintained through the celebration of the Canadian Highland Games annually (Menezes *et al*, 2016). Visitors from the Scottish diaspora, and in particular Canada, are a valuable part of the tourism industry in Scotland. Scotland, like the Nordic nations, is reliant on the marine environment for social integrity and as such are closely connected by climate and economic changes in the Arctic.

Linguistically, Shetlandic and Orcadian dialects are replete with Norse words, and Scottish town names like Wick and Tinwald have their origin in a language once shared with other Nordic Arctic states (Menezes *et al*, 2016). These linguistic similarities can again be traced back to the Viking influence and until 1472 Shetland and Orkney belonged to Norway and Denmark until they were pawned as a wedding dowry.

Scotland faces all the main types of security challenges inherent in Arctic opening. These include military, economic, functional and societal with other non-sovereign players including Greenland and the Faroes (Bailes, 2015).

Scotland also faces similar issues experienced by Arctic and near-Arctic countries in terms of sparse population, remoteness, inaccessibility, and a harsh climate (Mikkola, 2014). These issues have been explored over the past 20 years, through Scotland's cooperation within the framework of EU mechanisms and largely through the Northern Periphery and Arctic Interreg Programme and its predecessors.

A number of social trends that are driving development in the in Arctic are global. Some of these have been identified and include, increasing world population, demographic changes, development of the service economy, the rapidly growing demand for welfare services and the development of multi-cultural societies (Mikkola, 2014). Although global issues may be a driving force behind the need for an Arctic policy, socio-cultural links and similarities that exist between Scotland and the Arctic should be of paramount importance in the development of the Scottish Government's Arctic Policy (Mikkola, 2014).

The European Union's Northern Periphery and Arctic 2014-2020 Programme and Horizon 2020 are critical to providing funding to support community based programmes, links and exchanges between Scotland and its Arctic neighbours. The programmes facilitate collaboration between regions to find practical solutions to common problems. Current projects range from social innovation, eco-tourism and economic growth, climate change and community engagement, heritage and just transition. The UK's exit from the EU raises the risk of losing access to this collaborative source of funding. Should that occur, the UK Government will need to consider whether and how it wishes to maintain levels of support and continue to develop comparable partnerships with the countries of the High North.

Sparsely Populated Areas

Scotland faces similar social challenges as with its Arctic neighbours in that some of the area is sparsely populated. With a population of around 360,000 and an area of 39,050 km², the Highlands and Islands is one of the most sparsely populated parts of the European Union. Its population density of 9 persons per km² (this falls to 7.8 if the city of Inverness is excluded) compares with an EU average of 116 per km², and is on a par with the northern parts of Finland and Sweden. The Scottish average is 64.8 km² and the UK figure 242.4

persons per km². In addition to a very low population density, 23% of the population of the Highlands and Islands (some 99,000 people) live on more than ninety inhabited islands. Over 60% of its residents live in rural areas or settlements below 5,000 people (Bryden and Richards, 2000).

Linguistic

Scotland has linguistic links with some Arctic states through the now extinct language of Norn. Norn was spoken in the Northern Isles as well as in Caithness in the Far North of the Scottish mainland. Norn, together with Faroese, Icelandic and Norwegian belongs to the West Scandinavian group of the North Germanic branch of the Germanic languages. Norn is generally considered to have been closer to Faroese and the Vestnorsk dialects of Norway than Icelandic and would have been mutually intelligible by them. Norn is to be distinguished from the present day dialects of the Northern isles, termed by linguists as Orcadian or Shetlandic (Heddle, 2009). This Norse and Norn heritage can still be found in Shetland and Orkney such as in the names of vessels operated by Northlink Ferries. The Scrabster; Stromness Ferry MV Hamnavoe is named after the Old Norse name for Stromness whilst two Shetland ferries are named MV Hjatland and MV Vrossey which are the Old Norse names for Shetland and Orkney respectively (Northlink Ferries, 2018). Scottish town names like Wick and Tinwald also have their origin in a language once shared with other Nordic Arctic states (Menezes *et al*, 2016).

Cultural Links

There are a number of cultural connections between Scotland and its Arctic neighbours which complement social research establishments in Scotland. The Arctic Research Centre at the University of St Andrews University in partnership with Moscow State Institute of International Relations to conduct social science research on Arctic and Sustainability and the Institute for Northern Studies, part of the University of the Highlands and Islands, is engaged in interdisciplinary research based across three locations in Orkney, Shetland, and at Perth College UHI where research is conducted across a number of areas related to the Arctic including: Viking studies, links between Scotland and the Nordic world, the history and culture of the Scottish islands within the North Atlantic region, island studies, and the languages and dialects of Orkney and Shetland (UHI, n.d.).

Historical whaling in Scotland and Nordic nations has been reflected in folk songs and Norwegian influence has a noticeable impact on words used in east of Scotland. There is also the Russian Arctic Convoy Museum which celebrates the convoys that travelled between the UK and Russia during WW2.

Orkney Norway Friendship Association - Orkney became part of Scotland in 1468. For about 500 years before it had been ruled by Norse Earls, whose influence stretched as far as Ireland and who travelled as far as the Holy Land. Their influence can be seen in Norse derived place names, surnames and dialect. Their most visible monument is the 12th Century St. Magnus Cathedral in Orkney. Through the Orkney Norway Friendship Association, Orkney continues to mark Sjøttende Mai, the anniversary of Norway's independence in 1814. Orkney Islands Council also has a twinning agreement with Hordaland. At Christmas a Norwegian tree is lit outside St Magnus Cathedral as part of a winter programme of events reflecting all things Norwegian. St Magnus Cathedral, in the heart of Kirkwall, was founded in 1137 by the Viking, Earl Rognvald, in honour of his uncle St Magnus. Our centuries-old link with Norway was strengthened following the visit by Crown Prince Haakon and Crown Princess Mette-Marit in 2017 to the St Magnus International Festival, marking the 900th anniversary of the death of St Magnus. A delegation from Orkney Islands Council travelled to Norway in 2018 to mark 35 years since the twinning agreement was signed between the local authority and Hordaland County Council. The trip, by a five-person Orkney Island Council delegation, was the first of its kind in ten years. Each year a similar group from Norway travels to Orkney to join in with the Norwegian Constitution Day events held in Orkney.

Russian Arctic Convoy Project – The Russian Arctic Convoys transported four million tons of supplies and munitions to Russia between 1941 and 1945 during the Second World War. Loch Ewe in Wester Ross in the Highlands was a gathering point for many of the convoys. There are often frequent remembrance events held

with British and Russian veterans as well as a newly rehoused Arctic Convoy exhibition in Aultbea 30 km west of Ullapool run by the Russian Arctic Convoy Project.

There are also links with Orkney and in May 2015 a delegation from Russia visited Orkney where they paid tribute and respects to those who served in the Arctic Convoys. Around 70 people took part in a special wreath laying ceremony and service at the Arctic Convoys memorial in Lyness, to mark 70 years since the Second World War ended in Europe. Andrey Pritsepov, Consul General of the Russian Federation in Edinburgh, accompanied by Vice-Consul Timofey Kunitskiy travelled to Orkney for a two day visit to the islands.

The John Rae Society – John Rae was a Scottish surgeon and explorer from Orkney. He is famous for exploring parts of northern Canada, finding the final stretch of the Northwest Passage (Rae Strait) and reporting the fate of Franklin's lost expedition. There is a permanent exhibition to John Rae in Stromness museum as well as the John Rae Society who run conferences and other projects related to John Rae. The society maintains links with Canada and Arctic expeditions.

Hudson Bay Company - Orkney had strong links with Hudson's Bay Trading Company. By the late eighteenth century - three-quarters of the Hudson's Bay Company workforce in Canada were Orcadians. With support from the Hudson Bay Company Historical Foundation, a Homecoming took place in 1999. Some 300 people of Orcadian ancestry, most of them Canadian, returned to their ancestral homeland of Orkney.

Up Helly Aa – The Up Helly Aa is a fire festival held in Lerwick on the last Tuesday of January. It has its traditional roots in Scandinavian and Celtic fire festivals and the modern accretions such as the burning of a Viking model ship, guizers and tableaux (Graham, 1979). The name comes from the Old Norse word *uppi* which is still used in the Faroese and Icelandic languages and *helly* which refers to a holy day or festival.

Civil Society and Community Based Links

Nordic Horizons - Nordic Horizons is a Scottish based think tank and community of interest which explores 'the Nordic model' in all aspects of social life and policy. Nordic Horizons frequently run events in Edinburgh exploring these issues (Nordic Horizons, n.d.).

Northern Periphery and Atlantic (NPA) Funded Projects

The Northern Periphery and Arctic 2014-2020 Programme forms a cooperation between 9 programme partner countries; the Member States of Finland, Ireland, Sweden and the United Kingdom (Scotland and Northern Ireland) in cooperation with the Faroe Islands, Iceland, Greenland and Norway. This means that the programme area encompasses the Euro-Arctic zone, parts of the Atlantic zone and parts of the Barents region, neighbouring on Canada in the West and Russia in the East. Despite geographical differences, the large programme area shares a number of common features, such as low population density, low accessibility, low economic diversity, abundant natural resources, and high impact of climate change. This unique combination of features results in joint challenges and joint opportunities that can best be overcome and realised by transnational cooperation.

To date, 44 main projects and 46 preparatory projects have been approved, representing approximately 85% of the programme funding. The future of the programme is currently in doubt with the United Kingdom's exit from the European Union. Some examples of the projects funded are given below.

Shape – The Shape project aims to enable authorities, businesses and communities to develop innovative approaches for ecotourism initiatives which preserve, manage and create economic value from local cultural and natural heritage assets in the 'Cool North'. The project is a partnership between Scotland, Finland, Greenland, Norway, and Iceland.

Adapt Northern Heritage – Adapt Northern Heritage is a project supporting communities and local authorities to adapt northern cultural heritage to the environmental impacts of climate change and associated natural

hazards through community engagement and informed conservation planning. Partners include Iceland, Ireland, Norway, Russia, Scotland and Sweden.

Drifting Apart - Drifting apart aims to unearth and strengthen an understanding, appreciation and enjoyment of the fascinating and interconnected geological heritage of the Northern Periphery and Arctic region, and its many links to natural, built and cultural heritage. Partners on this project are from Northern Ireland, Scotland, Norway, Iceland, Canada and Russia.

App4Sea – App4Sea aims to strengthen the preparedness of environmental authorities and the awareness of the general public in the coastal areas of the NPA region regarding oil spill response. The project provides communities with an open access knowledge bank as well as decision making tools for oil spill response. Partners on this project are from Scotland, Finland, Norway, and Iceland.

REGINA - the REGINA project was a partnership of research institutions, municipalities, and associate partners found in Norway, Finland, Sweden, Greenland, and Scotland. The project developed a series of tools and an overall analytical framework to reduce the vulnerability and increase the preparedness of small communities in remote areas of the Nordic Arctic and Scotland facing the development or closing-down of large-scale, resource-based industries.

Projects funded by the European Union Horizon 2020

The Social Innovation in Marginalised Rural Areas (SIMRA) is a project funded by the European Union's Horizon 2020 research and innovation programme. SIMRA's overarching objective is to fill the significant knowledge gap in understanding and enhancing social innovation in marginalised rural areas by advancing the state-of-the-art in social innovation and connected governance mechanisms in agriculture and forestry sectors and in rural development in general. The network of partners working on this are Perth College UHI, James Hutton Institute, European Forest Institute Finland, University of Oulu Finland, Eastern Norway Research Institute (SIMRA, n.d.).

The BRIDGES - Territories with Geographical Specificities project looks at key policy questions arising from territorial challenges and opportunities of geographically specific areas. The policy questions include addressing, how can place-based, smart and integrated approaches support the challenges encountered by territories with geographic specificities? And where and how is public intervention required? The partners working on this project include Perth College UHI, Swedish University of Agricultural Sciences, Nordregio and the University of Akureyri in Iceland (ESPON, n.d.).

Case Study of Rural Communities

Funded through the Northern Periphery and Arctic Programme 2014-2020 the REGINA project was a partnership of research institutions, municipalities, and associate partners found in Norway, Finland, Sweden, Greenland, and Scotland.

The REGINA project developed a series of tools and an overall analytic framework to reduce the vulnerability and increase the preparedness of small communities in remote areas of the Nordic Arctic and Scotland facing the development – or closing-down – of large-scale, resource-based industries.

The project developed the REGINA Local Smart Specialisation (LS3) framework inspired by the six-step cycle of the European Smart Specialisation Strategy. The project offered local communities facing unique development challenges posed by large-scale industrial developments a framework for developing their own local development strategy.

The six-step framework emphasizes place-based policy through its focus on providing a strong evidence base, utilising participatory planning and dealing with practical challenges faced by local communities. At the heart of the LS3 framework are three planning tools developed within the project: the Demographic Foresight Model (DFM), the Social Impact Management Plan (SIMP) and the Local Benefit Analysis Toolbox (LBAT).



As a research partner the Environmental Research Institute, part of North Highland College UHI, helped to develop the LBAT utilising their knowledge built up from identifying local benefit from the marine renewable industry and Highlands and Islands Enterprise offered support as an associate partner. The project identified a direct link where Scottish expertise could be utilised in capturing economic benefit for local communities as new Arctic resources are exploited.

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Annex III – Overview of Economic Links

Oil and gas links

As global average temperatures rise, and Arctic summers grow longer, the energy industry has been increasingly interested in the prospect of finding oil and gas reserves under the retreating Arctic ice. One of the first oil and gas companies to begin exploratory operations was Scottish firm Cairn Energy PLC, based in Edinburgh. In 2008, Cairn Energy was granted licences to explore and drill for fossil fuel reserves off the west coast of Greenland (Baskin 2008). They were responsible for the largest exploratory effort in the region between 2010 and 2011, after drilling 7 wells and spending approximately £800,000 (Pfeiffer 2011). Although, their exploratory efforts in Greenland were unsuccessful, they have continued to explore the Arctic region having secured licences and planned 10 wells on the Norwegian Continental Shelf (Cairn Energy, 2018). In 2017, Cairn Energy employed 196 people in the UK as employees, contractors and other workers.

Another notable Scotland-based company is Faroe Petroleum PLC, based in Aberdeen. In 2014, the company had 60 exploration and production operations in the North Sea, Barents Sea, Celtic Sea, Faroe, Shetland and Norwegian waters (Faroe Petroleum 2014). Between the Shetland and Faroe islands, known as the Atlantic Margin, the company could boast in 2011 as being the largest acreage holder of exploratory licenced areas competing with the likes of energy giants Statoil (Norway) and DONG (Denmark) (Business Monitor International 2011). In 2017, the company produced approximately 14,000 barrels of oil equivalent and reported revenues of £152.9 million (Faroe Petroleum 2018).

Both companies have taken an interest in the Norwegian economic zones for oil and gas exploration. Norway is the largest oil and gas producer in Western Europe – and currently has a tax system in place which reimburses companies the cost of their oil and gas exploration operations. Companies are allowed to deduct 78% of the exploration costs from taxable income, and so far, Norway has reimbursed \$12.54 billion/£9.49 billion (Reuters 2018). Political and civil societal opposition has limited some areas where exploration and drilling may occur (Milne 2017). However, since oil production peaked in the Norwegian Sea in the mid-1990s, the purpose of tax system has been to encourage oil and gas exploration in the Norwegian Continental Shelf, and in particular, the Barents Sea. Norway's oil industry expects investment into exploration and production (E&P) to grow until 2020, although revenue growth may be slowed by “challenging market environments in asset-heavy sub-segments such as rig and offshore supply companies” (EY 2018). However, in well services, consultants, construction yards, developments in Norwegian offshore technology and weakening of Norwegian krone are expected to benefit Norwegian oil and gas companies in new projects.

Demand for Arctic-suitable rig designs is growing due to increased oil and gas exploration in the Arctic region and because current rig designs operate in warmer climates and lack the modifications needed to operate in colder climates. Stena Drilling, based in Aberdeen, bought a \$600 million drillship purposely designed to operate in colder climates (Baskin 2008). The lack of rigs and drill ships capable of operating in Arctic conditions has caused delay of projects, such as Hurricane Exploration PLC, based in England, who's planned operations on an oil discovery was delayed due to a cold-conditions adapted rig called 'Global Arctic III' not being delivered on schedule (Hurricane Exploration 2014). Rigs are an expensive aspect of oil and gas exploration and production, and low supply of rigs capable of reliably operating in Arctic conditions can add to already high economic cost of oil extract in colder climates like the North Sea, Canadian and Russian Arctic (The Economist 2016). In this respect, Scottish offshore engineering expertise and supply chains can offer solutions (Scottish Government 2017). An example of that engineering expertise can be found in Aberdeen-based company Tritech who supplies sensors and underwater cameras to the oil and gas sector (Petroleum Economist 2006), and these technologies are important modifications for Arctic rigs and icebreaker ships due to the threat of shifting sea ice. Another example of Scottish supply chains would be production of the 'Pipeline Bundle system' at Subsea 7's facilities in Wick, Scotland, for Norwegian company Statoil's Snorre Expansion Project in Florø, Norway.

However, while countries like Norway are still focused (and investing) on finding additional reserves of oil and gas to replace their maturing assets, Scotland has been earmarked for developing offshore deep-water decommissioning infrastructure (BBC 2018a). In 2017, the Scottish Government (2017) was reporting a forecast of £60 billion worth of decommissioning work in the UK Continental Shelf could be a reality over the coming decades as the UK's North Sea reaches its end life. However, construction of deep-water harbours involves extensive time and resources as well as developed coastal harbours and transshipment hubs – and Scotland faces the prospect of losing decommission business to Norway which has a matured policy on transport and infrastructure development (Johnstone 2012). As the Arctic sea ice retreats and traffic increases, investment in ports and transfer-freight capabilities in Northern Scotland (in particular Scapa Flow and Sullom Voe) would be increasingly important for securing future supply chains and develop the infrastructure needed for decommissioning (Harvie 2011). Aberdeen, as a hub for expertise in oil and gas sector, has also been recognised by the House of Lords (2015) as a strategic location to benefit from the opening up of transport routes in the Arctic – but prerequisites in appropriate infrastructure in ports and construction yards are required to fully realize the economic potential of ship maintenance, module construction/dismantling and decommission.

Links in Renewable Energy

In the renewable energy sector, Scotland has seen considerable interest and investment by companies based in countries of the Arctic Council. In 2016, Scottish renewable generation projects secured £910 million in investment and the sector generated £277.5 million worth of exports in goods and services (Scottish Government 2017). Yet this could be considered the tip of the iceberg. In 2009, the Crown Estate issued rights to develop 6.4 GW of offshore wind power in Scottish waters, followed by additional licences for 32 GW production across the UK in 2010. Across the UK, this was estimated to create up to 75,000 jobs and involve expenditure of between £72 and £84 billion by 2020 – with £15 to £18 billion in Scottish waters (HIE 2009).

The current and future success of the renewable energy sector in Scotland can be attributed to the local engineering expertise in renewable technologies and the contribution that our natural energy system can be effectively tapped by such technology. Scotland's offshore wind and marine energy sectors have been significantly boosted by foreign direct investment that recognise Scotland's suitability for renewable energy projects due to the shallowness of Scottish waters, favourable wind, wave and tidal resources and access to manufactory supply chains via the oil and gas industry (Young et al 2014, Perez-Collazo et al 2015). Perez-Collazo et al (2015) goes on to say the ability to develop technologies that utilize wind and marine energy resources are mainly restricted to the natural suitability of North Scottish islands, Southwest of Norway and the West coast of Denmark.

As such, international investors from Arctic Council nations have shown great interest in Scottish innovation in this sector. For example, a number of Arctic-based companies have developed and tested wave and tidal projects at the European Marine Energy Centre based in Scotland – such as Finnish wave Energy Company, Wello Oy, who raised EUR €5.5 million to build and test a prototype wave energy converter (Wello Oy 2015). Scotrenewables Tidal Power Ltd, based in Orkney, also tested a device at the Centre and attracted investment from Norway-based Fred Olsen – the company recently made news with the world's most powerful floating tidal turbine which produced 3GWh during its first year of operation (more than the 2.983GWh produced collectively by tidal and wave projects in Scotland in the year before the turbines launch) (The Independent 2018).

Investment followed in the wind sector as well with Equinor ASA (formerly Statoil ASA), an oil and gas company headquartered in Norway, investing approx. USD \$235.9 million (approx. £152 million) to construct Hywind Scotland – the first commercial off-shore wind energy project to use floating wind turbines (Statoil 2017). On a smaller scale, in 2015, a joint venture between Boralex (Canadian) and Infinergy (British) energy developers secured a commitment of approx. £6.7 million to develop 10 wind projects in Scotland (GNA 2017).

Given this background of innovation and foreign investment, partnerships have formed between Scottish and Arctic-based companies, such as Pelamis Wave Power Ltd, a renewable energy company and wave technology developer headquartered in Edinburgh, who secured a partnership with Sweden-based state energy company Vattenfall AB to construct a 20 megawatt wave project off the coast of the Shetland Islands (Pelamis Wave Power 2014). Scotland is a world leader in marine energy, both in innovation and commercialisation of the renewable technology, currently and historically but competition from France and Canada could challenge Scotland's place if progress in this sector slows (Falcao 2010, Gourley 2014, Kerr et al 2015).

In similar circumstances to the future of decommissioning in Scotland, without infrastructure development in ports and construction yards, the economic benefit of building wind and marine devices, as well as the design and maintenance of these energy systems, will be sourced outside of Scotland (HIE 2009). As such, the successful meeting of the Scottish Government's Renewables Action Plan 2009 will be necessary for developing infrastructure needed for testing and research of renewable technologies, and the commercial installation of such technology with the supply chains in place to support a project's lifetime. There has been progress on this front as supply chain links have been emerging, such as CS Wind UK, based in Campbeltown, signed a Memorandum of Understanding (MOU) with Vattenfall AB to supply an estimated 100 turbine towers for planned onshore wind farms in Scotland.

In pursuit of further innovation in renewable energy, Scotland and the Nordic neighbours are looking to each other to form 'super grids' i.e. a network of international transmission power lines (Oxford Analytica 2011). NorthConnect and IceLink are proposed sub-sea electricity interconnectors between Scotland-Norway and Scotland-Iceland, respectively. NorthConnect is a £1.75 billion, 650KM interconnector project being developed by four Norwegian and a Scottish energy company, SSE PLC, which intends to combine Norway's reliable, but geographically limited, hydroelectricity output with Scotland's strong, but intermittent, wind power generation. IceLink is another interconnector project that is currently in its feasibility stage, but could be potentially the longest subsea interconnector at 1170KM and, once operational, could supply Scotland and the UK with renewable electricity from Iceland's geothermal energy resources.

Johnstone (2012) makes the case an Arctic policy for Scotland might include investment in subsea power cables, such as NorthConnect and IceLink, as pathway for Scottish business to invest in the markets of Arctic nations, but also a pathway to attracting investment and technology exchange from the northern neighbours. The economic viability of these interconnectors has slowly improved through the years as demand for renewable and low carbon electricity increases and prices rise (Landsvirkjun 2018). However, private investment into the technology has been slow as its commercial viability is often questioned (Doorman and Froystad 2013). Yet, the interconnection systems have broader value in the capacity of the systems to provide security of supply from renewable energy sources, and this aspect of interconnections was raised by the Scottish Government (2017) as a future consideration for further expansion of such networks.

Regardless of whether these international interconnector projects go ahead, other Nordic nations are developing and delivering internal interconnections in Scotland already. Scottish Hydro Electric Transmission (2014), a subsidiary of SSE, awarded £148 million worth of contracts to Nexans Norway (Norway-based), Amec Group (now part of Wood Group based in Aberdeen) and Siemens/BAM Nuttall (subsidiaries based in the UK) to construct the Kintyre-Hunterston subsea link. Nexans Norway also received an approx. £96 million contract for upgrading a subsea cable link between Kintyre and the Southwest coast of Scotland. Whereas, MMT Sweden (Sweden-based) was awarded a contract to re-route a high-voltage direct current cable from the Shetlands to the Caithness in preparation for renewable energy projects in the Shetlands. The importance of 'super grids' to the Scottish and Nordic market is increasingly evident.

Scotland and many Arctic council nations also face similar geographical challenges in the remoteness of some of their communities from energy grids. The electricity industry is dominated by trans-national corporations and larger commercial projects tend to be more economically efficient (Birchall 2009). However, as Birchall (2009) goes to say, the Scottish experience in remote communities has shown how appropriately scaled, community energy projects can bring financial and non-financial benefits that can assist with rural development. Two examples to compare are provided by RETD (2012): the Isle of Eigg in Scotland and the Faroe islands. The Isle of Eigg in 2008 had completed the construction of a £1.6 million hybrid renewable

energy system (solar, wind, hydro and diesel backups) that gave electricity to households and business 24 hours a day and at 25-40% cost saving compared to what the community was previously paying in diesel generators. The Isle of Eigg and the Faroes share similar geographical and social characteristics, much like the Isle of Eigg previously, the Faroe island communities were reliant on diesel for energy production (95% of demand was met by fossil fuels in 2009). This represents an area where Scottish companies can build upon their previous experiences to replicate and provide professional services in developing economically viable energy projects for remote communities in Arctic regions.

Whereas, Scottish companies could benefit from knowledge exchange with Nordic nations on the rollout and production of bioenergy for residential and commercial heating. In contrast to some Nordic nations, Scotland has few district or grid heating systems that could utilize biomass for heating production on a large scale and, therefore, relies on expensive transportation of biomass to small, individual heaters (Birchal 2009). At present, in remote areas of the Scottish Highlands, there are small food fuel boilers installed and provided by biomass suppliers that utilize the vast forest resources in the Highlands, but there is limited expertise in the installation of larger boiler systems and procurement for such system, as compared to Finland (Röser et al 2011). However, there are examples of good practice, such as the Albyn Housing Society Ltd which was one of the first housing associations in Scotland to construct a district heating system using wood fuel and has created a supply chain from the Cairngorms National Park (Usewoodfuel 2017). Röser et al (2011) suggests the use of wood fuel has the potential to create its own market, once utilized could lead to further development in bioenergy technology as seen in Finland which operates small-scale farming boilers to industrial sized heat and power systems from biomass.

Fisheries and Fishing links

The economic importance of fisheries and fishing activities to Scotland is significant. It is estimated that fisheries contribute £400 million to the Scottish economy and 68% of the UK's total catch is harvested in Scottish waters – with fishing ports of Peterhead and Scrabster being particularly important to Scottish, Faroese and Icelandic boats (Johnstone 2012). However, the most matured economic link in this sector between Scotland and the Arctic region is found in the salmon industry.

Salmon is the largest food export of Scotland with £600 million worth of exports in 2017 (Scottish Government 2018a). The largest salmon fishing companies in Scotland are Scottish Salmon Company Ltd, headquartered in Edinburgh, and Norway-based Marine Harvest ASA. Scottish Salmon Company Ltd revenue reached £151 million in 2018. The EU and USA imported 35,000 and 26,000 tonnes of Scottish salmon, respectively, in 2017 (BBC 2017). The industry recently recovered from previous years where sea lice and infections damaged salmon farmers across Scotland. Sea lice being a persistent issue that salmon farmers are hoping research can find a solution to better protect fishing stock (Powell et al 2017). While the salmon companies themselves invest in research and development, this presents Scottish research institutions an opportunity to offer research and development (R&D) services in Scotland and beyond as the issue of sea lice threatens stock in the Arctic region as well.

Norwegian companies in particular have invested in the Scottish salmon industry. Marine Harvest (based in Norway) and Scottish Sea Farms (a subsidiary of Norwegian companies SalMar and Leroy Seafood Group) are the two most prominent Norwegian companies with Scottish operations (and R&D spending). Even Scottish Salmon Company Ltd, headquartered in Edinburgh, feels Norway's reach with 8 out of the 20 largest shareholders being Norwegian companies (Scottish Salmon Company 2017). Investment is a large part of the Norwegian company's global strategy, with many Scottish salmon operations under Norwegian ownership and utilizing technologies in aquaculture developed in Norway (Shepherd et al 2017). Marine Harvest is currently building £93 million feed plant on Isle of Skye to provide feed for its Scottish, Irish and Faroese operations (FFE 2017). Norway dominates the global salmon trade, but nonetheless, the growth of salmon farming in Scotland and Norway (arguably in conjunction due to Norway's influence) has created a high value export product and provided employment, particularly in remote areas (Shepherd et al 2017).

A sign of the close economic ties between Scotland and Norway in the salmon industry is further demonstrated by the signing of Memorandum of Understanding (MOU) on cooperation and best practice in aquaculture (Manning and Hubley 2015). However, the Scottish operations differs to the Norwegian operations in that Scotland does not compete with the volume of salmon sold by Norwegian companies but offers a range of specialised salmon products and diversity of feeds to achieve higher omega-3 levels. Manning and Hubley (2015) makes the point that there is evidence that consumers strongly take into consideration omega-3 levels of salmon (and other nutritional aspects) when choosing their salmon product – and, therefore, this is a niche the Scottish salmon industry can benefit from, and should protect the feed stocks which support this corner of the salmon market.

Cooperation with Arctic council nations concerning fishing and quotas for sustainable catches has historically been tense and under negotiation. In 2012, tensions came to a head during a period being referenced to as the ‘mackerel war’ due to disagreement on quotas for catching mackerel, which had migrated north, between two blocks: Scotland, Norway and the EU, against Faroe Islands and Iceland. Faroe Islands and Iceland landed approx. 300,000 tonnes of mackerel versus the EU’s 349,230 tonnes, surpassing the estimated sustainable catch limits (Dickie 2013). Faroe Islands and Iceland claimed the mackerel were migrating into their waters as a result of climate change, whereas the coastal nations which have traditionally fished mackerel contested this claim (Spijkers and Boonstra 2017). Scottish fishermen are responsible for landing three quarters of the UK’s mackerel quota (The Economist 2010), and the processing of mackerel is estimated to contribute £324 million to the Scottish economy as well as support 2260 jobs (PDMFN 2014). Scottish fishermen have complained that Faroe Islands and Iceland have limited experience of catching mackerel (Dickie 2013), and even if Faroese and Icelandic fishing boats were inclined to bring their catch for processing in Scotland, the high taxation outside their own ports means many choose to process their catchments in their own nation (PDMFN 2014). Scotland can learn from the Norwegian experience of investing in Scottish salmon operations. By investment and development of best practice with rival fisheries, Scottish companies can champion mutually beneficial arrangements rather than confrontation.

Tourism Links

The tourist industry is an area that Scotland and many of the Arctic Council nations want to cultivate and grow. Tourism in Scotland supported 217,000 jobs in 2015 and has resulted in £12 billion of wealth being generated by the wider Scottish supply chains linked to tourism (Scottish Government 2018b). One of the major markets targeted by Scottish tourist companies are the USA and Canada due to high levels of Scottish diaspora i.e. foreign nationals of Scottish heritage. For example, approximately 5 million out of a total population of 34.8 million Canadian citizens claim to have a Scottish ancestor (Northrop 2014). In 2009, VisitScotland and EventScotland organised an event called “Homecoming Scotland” which aimed to engage Scottish diaspora and bring tourists to Scotland. The event was a success with 72,000 additional visitors from outside Scotland (23,000 of whom cited the “Homecoming” as their primary motivation for traveling) and generated £53.7 million in expenditure (Scottish Government 2010).

While Scottish diaspora is found in the Arctic Council nation of Canada, there are few potential diaspora tourists found in other Arctic nations. However, historical ties, such as Norway’s with Dumfries during War World II, when displaced Norwegian soldiers were stationed there, is annually celebrated with a wreath-laying ceremony and inspired a trail with various activities called “Our Norwegian Story” that was attended by 100 people (BBC 2010, Lateral North 2017).

Beyond historical links, an attitudes survey conducted by Gudlaugsson and Gunnar (2012) found Scotland has a place in people’s mind as a country of entertainment and nightlife, with similar attitudes found with Finland. Scotland can also look towards Denmark when it comes to green tourism; Denmark hosts tourists in hotels and campsites alongside wind farms (Katalin et al 2017), and a survey by Scotland MORI (2002) found 80% of tourists would consider a wind farm with a visitor centre to be a serious attraction.

Scotland's cruise and ferry industry have a well-established tourist link between Scotland and many of the Arctic nations. The Scottish commercial cruise sector is worth approx. £100 million annually to the economy with 761 vessels (carrying 680,000 passengers) visiting Scottish ports in 2017 (Insider 2018). Cruise Scotland (2016), a Scottish marketing organisation, listed over 40 cruise operators that called at Scottish ports in 2016 with most travelling between Scotland and Arctic Council nations (and some operators offering 'Arctic themed' cruises). Kirkwall in the Orkney Island was the most visited UK port by cruise ships in 2010 (BBC 2015). One of the more innovative developments in Scotland's cruise and ferry industry would be Ferguson Marine Engineering Limited, a Glasgow-based ship building company, that was awarded €9.3 million (of a €12.6 million project) in June 2018 to construct the world's first hydrogen-powered car and passenger ferry (Scottish Enterprise 2018). The Scottish Government (2017) is keen to promote Hydrogen/Fuel Cells technology in transportation, and a world's first in hydrogen-powered ferry marks Scotland as both an innovator in renewable technologies and a promoter of green tourism as well.

However, one of the maturing economic links between Scotland and the Arctic region is the cooperation between the respective nations' tourist agencies. In 2016, VisitScotland and Icelandic Tourist Board signed a Memorandum of Understanding (MOE) to cooperate on best practice and knowledge exchange in areas such as sustainable tourism, regulatory framework, research, and others (VisitScotland 2016). VisitScotland is also developing relationships with the West Sweden Tourist Board, Innovation Norway, VisitDenmark, Visit Faroe Islands and Finnair. Collaboration with other tourist agencies is earmarked by VisitScotland as a means to raising the profile of Scotland as a tourist destination and showcase the agencies services in key fields of tourism development, quality assurance, digital marketing, among others. Ultimately, the goal of these exchanges is to develop links with the Arctic region and Scotland's tourism economy. Notable developments in promoting this are for example, air route expansions. This includes Finnish company Finnair's Edinburgh-Helsinki flight route (BBC 2018b) and the Faroese company Atlantic Airways Edinburgh-Vágar flight route (RouteOnline 2014).

Fostering local economic development – Highlands and Islands Enterprise

Highlands and Islands Enterprise is an organisation with a remit from the Scottish government to foster economic and social development in the Highlands and Islands – a region covering more than half of Scotland's landmass which is home to 450,000 people (Highlands and Islands Enterprise, n.d.). The organisation's four priorities include accelerating business growth, strengthening communities, supporting growth sectors, and developing regional attractiveness, with the vision to make the Highlands and Islands a region where an increasing number of people choose to live, work, study and invest. The organisation was created recognising the particular development challenges of this sparsely populated region which also boasts almost 100 inhabited islands. There issues are similar to those faced by similar regions in Arctic states, such as Norway, Russia, and Canada. Thus, there is much potential for further fostering cross-regional cooperation between HIE and its Arctic counterparts in this context.

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Annex IV – Overview of Environment and Climate Change Links

Introduction

Throughout the literature, on project websites/ funding calls and in personal communication, there is one recurring issue which underpins recent interest in the area and provides impetus for future Scottish connection to the region- **the impacts of climate change**. The increasing change in physical, biological and chemical parameters within the Arctic environment has implications not only for the inhabitants of the Arctic region but for all of us. The scale of change is best highlighted by the following statements:

‘The Arctic is the most rapidly changing environment on the planet supporting diverse yet still poorly understood ecosystems. The Arctic Ocean, whilst small in size, has extensive shelf regions and contributes 5-14% to the global balance of CO₂ sinks and sources. The Arctic is also intrinsically tied to global processes, whether they are climatic, environmental or socio-economic. Consequently, the Arctic is responding in unknown ways to profound changes in the physical environment as well as to multiple natural and anthropogenic stressors. The scale of these challenges facing the Arctic is immense and is further compounded by the rate of change.’ (NERC 2015)

‘Environmental conditions in the Arctic are currently changing at an unprecedented rate. Most prominently, temperature rise leads to a decrease in sea ice cover and thickness, resulting in a fundamental increase in the amount of light in the water. This has far-reaching implications for Arctic marine ecosystems.’ (FAABulous project 2015).

‘The interconnected nature of the environment, wildlife, and human health in the Arctic has long been recognized, but perhaps never so clearly as it is today in face of global climate change. Warming temperatures and other environmental changes are expected to promote the emergence of new pathogens and the northward spread of insects and other vectors of disease into the Arctic. Fish and wildlife, already compromised by chemical contaminants and other changing ecosystem dynamics, may be at heightened risk for infection and contribute to the spread of zoonotic diseases through the Arctic environment and to its human inhabitants’ (AMAP 2018b).

Scotland has well- established connections with the Arctic and surrounding countries, through collaborative research and participation in environmental monitoring and assessment programs. There are numerous examples of international cooperation and coordinated research activity, much of which has been going on for over 25 years. Scientific collaboration occurs through a number of programs including the EU H2020 Arctic Cluster (EU-PolarNet 2016), UN conventions and scientific associations.

However, with confirmation that ice extent across the Arctic Ocean is continuing to decline in October, we are effectively entering uncharted waters. Further, recent investigation by Arctic Monitoring and Assessment Program (AMAP 2018a) has highlighted the increasing threat to Arctic communities and wildlife posed by pollutants –a consequence of a rapidly changing environment.

In terms of understanding how change in the physical environment (ice and ocean) will affect the large-scale ecosystem structure and biogeochemical functioning of the Arctic Ocean the five year, £16 million ‘Changing Arctic Oceans’ Program funded by Natural Environment Research Council (NERC/UKRI) and German Federal Ministry of Education and Research aims to develop a fundamental and quantified understanding (Changing Arctic Ocean 2018). This Program is coordinated through the University of Edinburgh allowing institutes from across the UK to work with partners in the Arctic states. The ultimate goal is to generate a better understanding of the Arctic so models can more accurately predict future change to the environment. There are four main projects with more than 80 scientists combined, from 18 UK research institutes.

Other environmental links have been facilitated through Scottish Funding Council pooling activities – Scottish Alliance for Geoscience Environment and Society (SAGES 2018), a partnership between Scottish Universities

which hosts Europe's largest glaciology research group, SURGE. This coordinated international network for advances in glaciology has a particular focus on the Greenland Ice Sheet and glaciers of Svalbard.

Sub theme: Technical Innovation

Technical innovation in the form of robotic and autonomous marine observation systems (University of St Andrews and SAMS (Scottish Marine Robotics Facility)) have facilitated monitoring of the Arctic Ocean during winter/ extreme conditions. Autonomous vehicles (e.g. AUV Remus 600) have collected oceanographic data from the Arctic Ocean. SAMS, working with Norwegian partners (NUTU and The Arctic University of Norway, Tromsø) and funded through Norwegian Research Council, developed Ice tethered Platform cluster (ICE-POPEs). SAMS have also commercialized their Sea Ice Mass Balance buoy (SIMBA) which can be monitored through iridium satellite connection (Berge 2016).

Using new generation Argos tags fitted to marine mammals, SMRU (University of St Andrews) has collected oceanographic data from the Arctic seas. Animal borne data loggers relay information via satellite and allow investigation of at- sea ecology as well as collecting oceanographic data from hostile marine environments (Boehme 2009). The portal for ocean data (MEOP-CTD) collected by marine mammals has over 300,000 oceanographic observations.

Research into use of micro satellites (University of Strathclyde/ KTH Sweden) for remote sensing has been ongoing since 2003. Bathymetric data collected via Satellites is available through the transnational portal (EMODnet) with Digital Terrain Models (DTM) available for the following areas:

- The Atlantic Ocean (Channel, Celtic Seas, Western Approaches)
- The North Sea and Kattegat
- Norwegian - Icelandic Seas
- European arctic region + Barents Sea

In terms of business links, Clyde Space –supplier of CubeSats and other small satellite systems - recently merged with AAC Microtec, a spin out of the Angstrom Space Technology Centre at the University Uppsala, Sweden. These companies develop nanosatellites for commercial, military and scientific use and are currently working to deploy nanosatellites to improve communication in areas where global connectivity is poor due to frequency band width, network technology and remoteness. Such innovation could provide vital safety links for remote communities which become isolated due to sea ice melt. It will also allow high data volumes to be transported from remote, environmental monitoring stations within the Arctic.

The limited availability of consistent, longitudinal data for marine traffic in Arctic Canada presents significant challenges (Dawson 2018). As ship traffic increases, these areas are becoming ever more important to the global economy. However, there are significant barriers that continue to hinder economic expansion. Among these is the absence of good telecommunications solutions available to vessel operators, researchers allowing accurate weather forecasting and sea ice tracking.

Sub theme: Climate change

According to the United Nations, climate change is now affecting every country on every continent. It is disrupting national economies and affecting lives. Weather patterns are changing, sea levels are rising, and weather events are becoming more extreme. The poorest and most vulnerable people are being affected the most. **Given the scale and pace of climate change in the Arctic, collaborative activity and research which contributes towards Sustainable Development Goal 13 –Climate Change is highly relevant.**

1. Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters
2. Integrate climate change measures into national policies, strategies and planning
3. Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning

This call to arms is echoed in the key findings of Conservation for Arctic Flora and Fauna's Arctic Biodiversity Assessment (CAFF 2015):

Key Finding 2: Climate change is by far the most serious threat to Arctic biodiversity and exacerbates all other threats.

IPCC (2018) recently reported that action is needed now. Oceans have warmed, the amounts of snow and ice have diminished and sea level has risen. From 1901 to 2010, the global average sea level rose by 19 cm as oceans expanded due to warming and ice melt. The Arctic's sea ice extent has shrunk in every successive decade since 1979, with 1.07 million km² of ice loss every decade. Implications for Scotland include increased storm surge and loss of coastal habitat. This would include threats to sand dunes which provide valuable sea defence for low lying communities and to machair - important for crofting and as breeding grounds for a range of protected wildlife species.



Figure 1. Melting sea ice @ Malin Johansson

Satellite-derived estimates of sea-ice thickness and age have shown a fundamental shift from thick multi-year to thinner first year ice and some climate models have predicted an ice-free summer Arctic Ocean within a few decades. Arctic marine ecosystems are responding to changes in ice, water and light availability, nutrient cycling, pollutants, and acidification. Collectively, these multiple stressors are acting on the distribution of organisms, and the structure and functioning of food webs, and biogeochemical processes (NERC 2015).

A good example of current, coordinated Scottish/ Arctic research activity on climate change is that funded through NERC program 'Changing Arctic Ocean: implications for marine biology and biogeochemistry' –detail provided in case study.

The Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC) is a key international flagship initiative under the auspices of the International Arctic Science Committee (IASC 2016). The aim of MOSAiC is to improve our understanding of the functioning of the Arctic coupled system with a complex interplay between processes in the atmosphere, ocean, sea ice, and ecosystem coupled through biogeochemical interactions. A number of Scottish organisations contribute to this.

Scottish Association of Marine Science (SAMS) are also involved in long term monitoring activity. The Faroe-Shetland Channel (FSC) is one of three regions where exchange between the Atlantic Ocean and Norwegian Seas occurs across the Greenland-Scotland Ridge (GSR). This region therefore is a key location for the transfer of warm and saline Atlantic water towards the Nordic Seas and Arctic Ocean, and for cold, dense overflow waters to return southwards into the Atlantic Ocean. The variability of heat and salt supplied by the Atlantic inflow is significant for the regional climate of Scotland and it is an important component of the larger scale Atlantic circulation (Walicka 2016).

As above, the Marine Climate Change Impacts Partnership (MCCIP -UK) includes contribution from a number of Scottish institutes. Regular report cards highlight impacts on coastal and marine interests and have highlighted that changes in Arctic will influence storm events and coastal flooding in Scotland.

Other projects such as CoastADAPT (Northern Periphery Programme 2007-2013) brought partners together from Iceland, Scotland (ERI/UHI), Norway and Ireland to investigate the impacts of changing climate on coastal communities. The final report highlighted a need for consistent/ universal data collection. As an example, adaptation is already required in Hammerfest, northern Norway with less snow and more ice/ rainfall putting pressure on road systems as well as increasing the threat of landslip and avalanche. Increased waves and storms in the Barents Sea have led to isolation of island communities and problems for the fishing fleet (McClatchey 2014).

Sub theme: Biodiversity

The Arctic contains some of the most iconic and beloved species in the world: polar bear, walrus, narwhal, caribou/reindeer, Arctic char Arctic fox, snowy owl, and more. But the Arctic also contains thousands of lesser-known species, often having remarkable adaptations to survive in extreme cold and highly variable climatic conditions. In all, the Arctic is home to more than 21,000 known species of highly cold-adapted mammals, birds, fish, invertebrates, plants and fungi, and microbe species.

The Arctic also contains a wondrous diversity of marine, freshwater and terrestrial habitats, such as vast expanses of lowland tundra, wetlands, mountains, extensive ocean shelves, millennia-old ice shelves, pack ice and huge seabird coastal cliffs.

Arctic biodiversity provides innumerable value to its people. Among those who live in the Arctic are dozens of distinct indigenous peoples. Their ways of life demonstrate the vitality of language and traditional knowledge, key aspects of the human relationship with biodiversity. Biodiversity and a healthy natural environment remain integral to the wellbeing of Arctic inhabitants. They provide not only food, but the everyday context and basis for social identity, cultural survival and spiritual life.

‘Large tracts of the Arctic remain relatively undisturbed providing an opportunity for proactive action that can minimize or even prevent future problems that would be costly, or impossible, to reverse. The key findings of the Actions for Arctic Biodiversity (CAFF 2015) are interrelated and responding to them would benefit from a holistic approach. When taken together, three cross-cutting themes are evident:

- significance of climate change as the most serious underlying driver of overall change in biodiversity;
- necessity of taking an ecosystem-based approach to management; and
- importance of mainstreaming biodiversity by making it integral to other policy fields, for instance by ensuring biodiversity objectives are considered in development standards, plans and operations’.

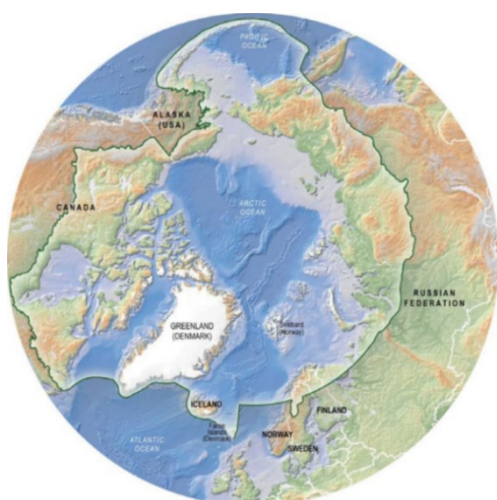


Figure 2. CAFF 2013 Designated Area

Scottish researchers contribute to Arctic Council working groups- primarily Arctic Monitoring and Assessment Programme (AMAP) and Conservation of Arctic Flora and Fauna (CAFF). Several key findings from CAFF (2015) are of relevance to Scotland – either because of established research collaboration and expertise (climate change / invasive species/ pollutants / migratory species / sustainable heritage management) or because they present future opportunities for collaboration, knowledge exchange and research.

The interdependence of many species in the Arctic (including indigenous populations) on the marine ecosystem highlights their vulnerability to natural and anthropogenic stressors –the significance of which are often poorly understood. There is an increasing ‘global’ market for wildlife tourism in the Arctic

(Greenland) which, if managed sustainably, could help support local communities and wildlife populations.

In terms of Scottish links - researchers are involved in international collaborations (e.g. University of Stirling and SAMS –DIAPOD project (NERC 2015)). Universities have strong educational links - doctoral studies on a range of environmental topics that have Nordic/ Arctic co supervisors (e.g. ERI PhD / Norwegian Institute for Nature Research) provide opportunities for students to gain Arctic experience.

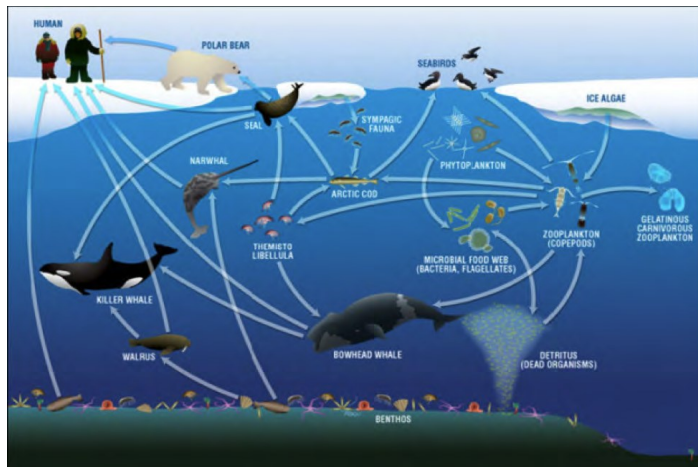


Figure 3. Example of co- dependency within the arctic marine food web (adapted from Darnis 2012)

Scotland provides important overwintering locations for migratory species including several protected goose species and Icelandic whooper swans. Species experts contribute to international census and the development of Single Species Action Plans i.e. Greenland white-fronted goose. Large flocks of overwintering species attract visitors (WWT Caerlaverock) and contribute to winter tourism (Islay Blog 2018). SNH, RSPB, WWT and JNCC are all involved in species monitoring and tracking schemes (Fox 2017).

Sea Mammal Research Unit (SMRU consulting) provides a state of the art marine mammal consulting service including survey, population assessment and contribution to Environmental Impact

Assessment. SMRU has developed novel technologies for tracking and contributes to mammal research across the region (Greenland harbour porpoise (Wilson 2018)).

In addition, staff from Joint Nature Conservation Committee (JNCC) in Aberdeen contribute to the Arctic Council’s Circumpolar Biodiversity Monitoring Program –CBird (Irons 2015).

Various transnational projects which involve staff from the University of Highlands and Islands (e.g. Governance for Sustainable Heritage Areas (SHAPE 2018) share best practice on land use and the importance of local biodiversity to community culture. At the recent Arctic Circle (Reykjavik 2018) community delegates emphasized the importance of co –production of knowledge to ensure local resilience (Arctic Resilience Action Framework).

By integrating local knowledge of biodiversity and land use with science and monitoring, communities should be better able to respond to external development pressures and climate change impacts.

Sub theme: Protected areas/ safeguarding

NordMAB (2018) aims to strengthen cooperation across Nordic Biosphere Reserves and create models of management recognized within UNESCO and the World Network of Biosphere Reserves. Set up to facilitate Nordic cooperation, NordMAB is recognized by the Man and the Biosphere (MAB) program. Two Scottish Biosphere Reserves are members –Wester Ross Biosphere (which will host the 2019 international meeting) and Galloway and Southern Ayrshire. Partners aim to promote regional sustainable development by focusing on migration of young people, tourism, education and industrial projects. All are highly relevant to the more sparsely populated areas in Scotland.

For its size, Scotland has the most varied geology and landforms of any country in the world. Our three Geoparks cover about 10% of our land area. Shetland and Wester Ross Geoparks participated in Drifting Apart (2017) funded through the NPA Programme. The project supported the development of new parks and built a

strong network of geoheritage destinations across the region. Partners came from Northern Ireland, Scotland, Norway, Iceland, Canada and Russia.

The reduction in sea ice is contributing to the increased accessibility of the Arctic for industrial activities, including shipping, oil and gas development activities, mining, commercial fishing and tourism. These activities can impact the quality of marine habitats and the species that depend on them, as well as the rich cultural heritage of the Arctic region. Acute accidental events, marine and coastal habitat alteration and additional pollution loads (some land-based) add to the incremental and cumulative pressures on the Arctic marine environment (Arctic Council 2015).

Protecting and conserving the Arctic marine environment and biodiversity is an important Arctic Council priority, due to the role of Arctic waters in moderating the global climate, protecting marine biodiversity, and providing food security, income and cultural identity for Arctic peoples and communities. The proposal is to develop a pan-Arctic network of marine protected areas (MPAs) that sets out a common vision for regional cooperation in network development and management, based on international best practices. Whilst these areas will be located within the national jurisdiction of Arctic States (Exclusive Economic Zones (EEZ)), the framework recognizes linkages to inland and the high seas, since activities in either location may impact the health of EEZ, and coastal habitats and biodiversity

Closely aligned with the ecological benefits listed above are the cultural and socio-economic values and benefits stemming from Arctic MPA networks. Protecting marine biodiversity and ecosystem processes is important for maintaining the range of benefits people receive from nature, which include:

- Direct economic values (commercial, and employment benefits for communities)
- Cultural and heritage values (connections to the sea and the way of life in coastal communities/ historical important sites)

The Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR 2018) of which the UK is a signatory, is a regional seas convention which includes part of the Arctic. It is a legal instrument supporting international cooperation and can be instrumental in the establishment of MPAs. OSPAR has established several sites in areas beyond national jurisdiction (of the A8) which together with national MPAs, form the OSPAR network of Marine Protected Areas.

Marine Scotland Science (MSS), scientific Division of Marine Scotland has provided data that is used in national and international assessments conducted by inter-governmental organisations such as OSPAR and the International Council for the Exploration of the Sea (ICES). The scientists, engineers and socio-economists at MSS collaborate extensively across the UK and contribute to marine spatial planning.

Marine spatial planning is designed partly to implement the ecosystem –based approach to the management of marine resources worldwide. Scotland has developed methodology for transferring the National Marine Plan to local planning (Smith 2018). This experience could help to support near Arctic neighbours as they develop and implement a framework for MPA.

Sub theme: Fisheries

Multiple stressor impacts have been identified for northern fish populations which traditionally support the seafood industry / fish processing in Scotland. Although no specific Scottish/Arctic links were documented from temperature and climate change research on fish and seafood species within Arctic waters, Marine Scotland Science and other institutes make mention in strategic documents.

Fisheries for arctic freshwater and diadromous fish (Atlantic salmon) contribute significantly to northern economies. Climatic vulnerability and extreme weather will have an impact on these fisheries and it is documented that increases in sea temperature are leading to increased parasites and disease.

Specifically, the ‘Seafood Strategic Outlook’ (Garret 2016) highlights various climate change impacts on Arctic and North Atlantic fish populations that have commercial value to UK/Scotland as well as adverse effects on marine ecosystems (lower pH/ rising temperature affecting fish habitat and recruitment). This position paper

by Seafish (Edinburgh) and MCCIP considers the major industry impacts arising from key climate change drivers.

Taking a precautionary approach to fisheries management in the region, the European Union (EC 2018) recently signed agreement with Canada, China, the Kingdom of Denmark (Faroe Islands/ Greenland), Iceland, Japan, the Republic of Korea, Norway, the Russian Federation and the United States of America to prevent unregulated high seas fisheries in the Central Arctic Ocean, an area that is roughly 2.8 million square kilometres in size. Commercial fishing is not known to occur in this area but rapidly changing environmental conditions make it prudent to adopt this approach.

The Agreement will support a Joint program of scientific research and monitoring to improve understanding of the ecosystem(s) in the central Arctic Ocean, and to determine whether fish stocks might exist that could be harvested on a sustainable basis.

Scottish organisations including SAMS; Marine Scotland Science and University of Strathclyde have interests. This theme review has not explored the economic impact of climate change on northern fisheries but there are undoubtedly implications for fish processors and the Scottish fishing fleet.

Sub theme: Pollution including plastics and noise

Scottish Universities are involved in collaborative research which seeks to understand the impact of pollutants on Arctic wildlife, fish and people. Specifically, research into the impact of marine plastics on marine species (ERI & SAMS) and the analysis of the impact of emerging chemicals in marine mammals (SMRU) indicate an increasing need for additional research, especially given the potential for bioaccumulation and cultural links to wildlife across the Arctic region.

‘The Arctic and its inhabitants harbours elevated levels of environmental pollutants, most of which originate from the industrialized centres and agricultural regions of lower latitudes. Chemical pollutants transported via the atmosphere, oceans and rivers are deposited in Arctic ecosystems, where they bio accumulate in organisms and magnify through food webs. Many of the chemicals found at elevated levels in the Arctic have also been associated with effects on animal and human health (AMAP 2018a).

As reported in the Arctic Monitoring and Assessment Programme ‘Assessment of Chemicals of Emerging Arctic Concern (AMAP 2017b), chemicals previously undetected in the Arctic are now being found in circumpolar wildlife and fish and may contribute to adverse effects in these organisms. Although levels of these so-called ‘chemicals of emerging concern (CECs)’ are currently low in comparison to other known toxins (persistent organic pollutants (POP)) and mercury levels, lack of information on their effects precludes an evaluation of their potential for health and population impacts. Future research focused on the biological effects of CECs would improve the ability to estimate risks to Arctic biota.

Many indigenous communities of the Arctic rely on locally harvested fish, seabirds, and marine mammals as part of their traditional diets. The observation that some populations of these Arctic species contain levels of polychlorinated biphenyls (PCBs) and mercury sufficient to place them at a higher risk of biological effects serve as a reminder that there may be a coincident human health risk to consider as well (AMAP 2018b).

As apex predators of the Arctic, polar bears continue to exhibit levels of mercury that put them at a high to severe risk for reproductive and other adverse health effects. Having a reduced capacity to detoxify organohalogenated compounds (OHCs), killer whales are among the most highly polychlorinated biphenyls (PCB) - contaminated species on Earth. The potential impact of exposure on the health and survival of cetaceans continues to be an issue for conservation and management (Hall et al., 2018).

As part of the International Whaling Commission’s Pollution 2020 initiative, SMRU (St Andrews) developed a framework for assessing the effects of pollutants on cetacean populations.

Most plastics are extremely durable and persist in the marine environment for a considerable period. However, plastics also fragment in the environment as a consequence of exposure to sunlight (photo-

degradation) in addition to physical and chemical deterioration. This breakdown results in numerous tiny plastic fragments –secondary micro plastics. Others are categorised as primary micro plastics due to the fact that they are produced either for direct use, such as for industrial abrasives/ cosmetics or for indirect use such as pre-production pellets or nurdles (OSPAR 2018).

Various studies by Scottish researchers highlight the extent of plastic pollution in the Arctic environment. Marine creatures living in the deepest parts of the ocean have been feeding on micro plastic particles for at least four decades (Courtene-Jones 2019). Using archived samples from the Rockall Trough researchers at SAMS identified the historical extent of micro plastic ingestion in the stomachs of bottom-dwelling starfish and brittle stars.

Traces of eight different plastics, including polyester and nylon, were found in specimens that lived more than 2,000 meters below the ocean surface between 1976 and 2015 – and the levels of ingestion were similar throughout that period. When ingested by sea creatures, micro plastics may be retained in their bodies and passed up the food chain.

We know that marine plastic pollution is an increasing, and global, environmental issue. Numerous marine species are affected by plastic debris through entanglement, nest incorporation, and ingestion, which can lead to lethal and sub-lethal impacts. Research conducted through Circular Ocean (INTERREG NPA) by the Environmental Research Institute, collected information from the north-eastern Atlantic Ocean to better understand how marine plastic affects seabird species (O Hanlon 2017).

In addition, OSPAR recently set out its 'Regional Action Plan for Prevention and Management of Marine Litter in the North-East Atlantic' (OSPAR 2018). This sets out OSPAR's work on marine litter and describes the various actions that members will take on over the coming years.



Figure 4. Spatial distribution of seabird interactions with marine plastic in the north-eastern Atlantic. Source: O'Hanlon et al., 2017.

Anthropogenic underwater noise is also recognized as a world-wide problem, and recent studies have shown a broad range of negative effects. Underwater noise from shipping is increasingly recognized as a significant and pervasive pollutant with the potential to impact marine ecosystems on a global scale (Williams 2015). As the sea ice melts in the Arctic Ocean there is increasing concern that cetaceans and other sea mammals will be adversely effected. SMRU and the School of Life, Sport & Social Sciences at Edinburgh Napier have been involved in recent studies.

The treatment of municipal wastewater in the Arctic is challenging due to a variety of financial, operational, climatic and technical issues. Studies have been carried out to better understand the

efficacy of wastewater treatment and the hazard posed to receiving waters by nutrients and contaminants (i.e., pharmaceuticals, antibiotic resistance genes) (Chavez-Barquero 2016).

The increased interest in new shipping routes and from oil and gas exploration in the region has raised concern about the potential devastating effects of oil pollution (Pelaudeix 2016). ERI/UHI is involved in a NPA funded project APP4Sea to enable forward planning and improve oil spill response across the Northern Periphery region.

Other collaboration in the region take place through 'Health without Harm' which includes contribution from ERI/UHI and Glasgow Caledonian University. Given the increasing incidence of pollution in the region, and international expertise which already exists within Scottish institutes, this is an area where Scotland may be able to help address issues of concern.

Sub theme: Tourism and the environment

The concept of ecotourism – visitor experiences building on natural and cultural assets, conserving the environment and sustaining the well-being of the local people – has been around for a long time. For rural and sparsely populated areas it is seen as a key factor in sustainable development, providing employment and income, whilst conserving the fundamental qualities of traditional life.

Led by Perth College/UHI, SHAPE project focuses on a set of sustainable heritage areas (SHAs) with diverse experiences of sustainability and regional cooperation involving heritage management, tourism, and governance. In these SHAs (including the 2 biosphere reserves in Scotland and in Greenland, Iceland, Finland and Norway), the partners work with local stakeholders to incorporate their activities into regional strategies for sustainable development.

The strength of ecotourism, the strong, local involvement, is also its weakness (SHAPE 2018). The players and their organisations are small and often lack both resources and knowledge. The aim of SHAPE is to enable authorities, businesses and communities to develop innovative approaches which manage and create economic value from local assets. SHAPE aims to gather these experiences and make them available to communities struggling with similar challenges across the NPA region.

In 2016, Visit Scotland and the Icelandic Government signed a memorandum of understanding on Tourism to explore opportunity for collaboration and economic development.

Case Studies

From the mapping exercise we have identified numerous examples of long-established research collaboration between Scotland and Arctic institutions which are seeking to answer contemporary environmental issues. There are also a number of inspirational, transnational projects which involve local communities and stakeholders in developing joint solutions to environmental problems. This section presents two examples which show how organisations have built on initial Arctic collaboration to embed learning and develop wider benefits for their region.

Climate Change – Adaptation/ community collaboration

Climate change is occurring at a faster rate and with more severe impacts in the Arctic than in the rest of the world. According to the Arctic Council's Snow, Water, Ice and Permafrost (SWIPA) report, the Arctic region is being forced to shift into a new state (AMAP 2017a).

Changes in the Arctic are also global: they affect weather in mid-latitudes, influence the Southeast Asian monsoon, cause acidification of oceans and increase the rate of global sea-level rise, to mention a few examples. What happens in the Arctic is critical for the rest of the world. (Arctic Yearbook 2017)

Whilst the Paris Agreement within the United Nations Framework Convention on Climate Change seeks to limit global warming, communities across the region are already having to anticipate the effects of climate change and taking appropriate action to minimise damage and/ or respond to opportunities that may arise. Adaptation strategies are therefore needed at all levels of administration- local, regional and national.

Clim-ATIC Climate Change: Adapting to the impacts by Communities in Northern Peripheral Regions

Between 2008 and 2011, Perth College, UHI was lead partner for Clim-ATIC, a 2.4 Euro million project (INTERREG - Northern Periphery Program). This involved community stakeholders working with public sector and academic institutions from Scotland, Sweden, Norway, Greenland and Finland, to explore the potential for different sectors to develop climate change capacity and deliver adaptations that provided local economic and social advantages.

Clim-ATIC's overall objective was to establish a service that provided information, training and advice to communities, SME and local administrations across the region, to significantly increase capacity to adapt to the impacts of climate change. The project undertook a range of activities with 10 communities (from each of the five regions), and their appropriate community stakeholders.

A key outcome was the development of an online training resource on how to address the impacts of climate change and incorporate adaptation measures into the development cycle. In 2011, Clim-ATIC hosted an international 'train the trainers' climate change adaptation workshop in Norway. The intention was that the resource would provide a step towards bridging the communication gap between research, policy, and the wider public. The resource was developed, in conjunction with partners, by Western Norway Research Institute (WRNI)/Vestlandsforskning.

Following the success of this resource, the Western Norway University of Applied Sciences has gone on to launch a Masters in Climate Change Management (2018). Promotional material indicates that climate change has created a demand for candidates with up-to-date climate and planning competence. Taught in English the course aims to build capacity in:



Figure 5. Storm Damage 2011, Sogn og Fjordane. Source: Harald Vartdal/Fjordingen – Dagbladet.

- Developing strategies and measures for the reduction of greenhouse gas emissions.
- Developing areal planning for roads, railroads, and residences to avoid damaging effects of floods and avalanches.
- Gaps –Higher education

Perth College also runs an online Masters in Sustainable Mountain Studies which attracts international students from the Yukon and other arctic locations - providing opportunities for delivery of higher education in remote communities. However, to ensure sufficient course numbers consideration needs to be given to the inclusion of funding for travel to allow cohorts to meet annually.

The significance of support for collaborative activity which allows remote communities to share best practice to develop local solutions to emerging environmental problems has already been highlighted. The cost of travel to/from remote areas is often prohibitive, leading to isolation and duplication of effort. However, online resources and toolkits can be used to offset isolation. Clim-ATIC is just one example of Scottish involvement in Arctic projects, others are mentioned in the relevant sub theme sections. All require funding and resource to allow knowledge to be shared. Initiatives such as the Nordic-Scottish Agreement and subsequent INTERREG funded Northern Periphery programs provide a useful model for collaboration and show how problems can be addressed locally using shared knowledge.

In addition, Perth College, UHI see a number of opportunities to build on educational links within the region to provide new courses to address emerging problems in remote communities. Educational opportunities have been highlighted by a number of stakeholders as well as by University of Arctic President –Lars Kullerud during Arctic Circle Assembly2018.

Climate change – environmental research

Climate change is having obvious and severe impacts in the Polar Regions. The Arctic is currently warming at more than double the rate of other parts of the globe, causing unprecedented change to the region's ocean environment. The Arctic Ocean's ecosystem is especially sensitive to warming because of its reliance on sea ice, from the algae that grow on its underside to polar bears that hunt and live on its surface. The accelerated

melting of sea ice threatens the existence of the animals, plants, microbes (and the communities) that rely on it.

Any reduction in sea ice habitat will affect the entire food chain, including some of the most productive commercial fishing grounds in the world. Scientists don't yet understand how these impacts are going to unfold. They need more data and improved computer models to predict the consequences.

Changing Arctic Ocean started in February 2017 with four large projects funded by Natural Environment Research Council (NERC 2015). These projects cover different aspects of the Programs goals: how change in the Arctic is affecting the food chain, from small organisms at the bottom to large predators at the top (ARISE); how warming influences the single main food source at the bottom of the food chain (DIAPOD); the effect of retreating and thinning sea ice on nutrients and sea life in the surface ocean (Arctic PRIZE) and on the ecosystem at the seafloor (ChAOS). The Programme is coordinated by University of Edinburgh.

A further 12 projects joined the program in July 2018, co-funded by NERC and the German Federal Ministry of Education and Research. Each one investigates different aspects of the Changing Arctic Ocean and require a joint investigatory approach. Combined, the projects involve 32 research institutions and organisations in the UK and Germany, and more than 180 scientists.

An essential component of successful work in the Arctic is international collaboration. Scientists are working closely with Arctic teams in 15 other countries. The outcomes will contribute to improving predictions of change in the Arctic of benefit to decision making at levels ranging from indigenous populations to international policy.

Specifically, in terms of Scottish contribution, Arctic Productivity in the Seasonal Ice Zone (Arctic PRIZE) led by Scottish Association of Marine Science (SAMS) is a £1.5 million project which seeks to understand and predict how change in sea ice and ocean properties will affect the large-scale ecosystem structure of the Arctic Ocean. The project is embedded within international Arctic networks based in Norway and Canada and coordinated with ongoing US projects in the Pacific Arctic. A key objective of Arctic PRIZE is to forge lasting engagement with the international Arctic research community. SAMS is working closely with the partner institutes within the Nansen Legacy – a leading Norwegian initiative focused on the Barents Sea.

Arctic PRIZE is committed to the development of the next generation of Arctic researchers: An important objective for SAMS is to be able to provide high quality education and training through association with the University Centre in Svalbard (UNIS) and with the institutions of project partners.

The breadth of partnership within this project - SAMS (lead); University of Edinburgh; University of Oxford; University of St Andrews; University of Strathclyde; National Oceanography Centre; UiT, The Arctic University of Norway, Tromsø; University Centre in Svalbard; Akvaplan-Niva (Norway); Norwegian Polar Institute; Institute of Marine Research (Norway); University of Trondheim; SINTEF (Norway); University of Hamburg (Germany); Arctic Net (Canada); University of Washington (USA); University of Rhode Island (USA) shows the wider benefit of collaborative funding calls.



Figure 6. The Scottish Marine Robotic Facility –AUV Remus 600

These projects facilitate technical innovation in the form of development of robotic and autonomous marine observation systems (Scottish Marine Robotics Facility 2018) which allow monitoring of the Arctic Ocean during winter/ extreme conditions.

SAMS has been at the forefront of UK research into the arctic marine environment for over twenty years. Since 2002 they have led 4 major research expeditions to this region and they participate in field expeditions each year across the arctic. Networks established through Scottish Funding Council Pooling initiatives (SAGES; SURGE; MASTS) provide a strong collaborative research community, allowing participation in international

activity. For example, Professor Finlo Cottier (SAMS/UHI) is a UK representative on the International Arctic Science Committee Marine Working Group. Four other Scottish research institutes are represented on other working groups.

SAMS, in conjunction with the University of the Highlands and Islands also provides training in arctic science - BSc Marine Science with Arctic Studies which sees students spend part of their third year at Norway's University Centre in Svalbard (UNIS). Teaching staff also make regular contribution within Arctic institutes – primarily UNIS.

There is scope for further engagement through the link that UHI has to the University of the Arctic - Professor Finlo Cottier holds an Adjunct Professorship and part of this role is to provide teaching and guidance at postgraduate level to students. In addition, SAMS has a business arm called SRSL which produces an autonomous device to measure the thickness of sea ice and snow cover. The “Sea Ice Mass Balance Array” SIMBA is sold to organisations within Arctic nations. There is scope for this device to be developed and the market broadened.

This case study highlights the wider benefits for Scottish institutes of being involved in multidisciplinary, international research projects in the Arctic.

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Annex V – Overview of Academic Links

Scottish research and the Arctic

Scottish universities and research centres have a long tradition of conducting world-class research on the Arctic. The geographical and cultural proximity of Scotland to the Far North and the fact that environmental change in the Arctic has direct impacts on the Scottish environment, particularly in the Highlands and Islands, has driven the interest of Scottish academics and researchers in the region for decades. For instance, Scotland's strategic location in the North Atlantic has resulted in the world's longest data-series on ocean circulation. Today, Scotland-based researchers offer expertise in fields as diverse as hydrology, glaciology, geology, marine and environmental sciences, engineering, renewable energy, geography, anthropology, resource economics, health sciences, archaeology, linguistics, and arts, among others. A number of Scottish universities host Arctic research programmes, including the Universities of Aberdeen, the Highland and Islands, St. Andrews, Edinburgh, Glasgow, Dundee, Stirling, Strathclyde and Heriot-Watt University. The Scottish Association of Marine Science (SAMS) is also a major player in Scottish research on the Arctic, and specializes in ocean systems, changing coasts and the blue economy (SAMS, n.d.).

From the literature review and subsequent stakeholder workshops, we have identified that most of the Scottish Universities have links to the Arctic either through participation in research programs or as partners in transnational collaboration projects. There are numerous examples of international cooperation and coordinated research activity, much of which has been going on for over 25 years. Scientific collaboration occurs through a number of programs including EU funded H2020 (Blue Action), UN conventions and scientific associations (EU-PolarNet, n.d.). Scottish scholars also provide evidence to international and national bodies on Arctic matters, including OSPAR and the UK Government.

Likewise, there are many examples of collaborative activity being used to address community and environmental issues (e.g. health in remote communities; resilience planning for industrial development; management of tourism in heritage areas; adaptation to climate change). Organisations across the Highlands and Islands have participated in EU funded programs (INTERREG Northern Periphery; Northern Periphery and Arctic [NPA]) to share knowledge and best practice and collectively develop innovative solutions to common challenges.

For instance, cooperation in the Highland Region commenced in 1994 with high level policy engagements taking place in north of Scotland, Finland and Sweden. This led to provision of funding through the Nordic-Scottish Cooperation Agreement which, in turn, developed into the Northern Periphery Programme (NPP, n.d.). The significance of support for collaborative activity which allows remote communities to share best practice and knowledge to specifically develop local solutions to emerging environmental problems should not be underestimated.

All of these examples, regardless of how they have been funded, have provided opportunities within Scotland to link with Arctic countries for development of multidisciplinary research groups, technical innovation, expanded education programs and business growth. Moreover, these activities contribute to the National Outcomes within Scotland's National Performance Framework (Scottish Government, 2011). For example:

- We are better educated, more skilled and more successful, renowned for our research and innovation
- We have strong, resilient and supportive communities people take responsibility for their own actions and how they affect others.

Examples of Scottish academic excellence

University of Aberdeen's Arctic Domus

This interdisciplinary, six-year (2012-2018), €2.5 million project funded by the European Research Council and housed at the University of Aberdeen investigated how people and animals today, and in the past, build sustainable communities around the circumpolar Arctic (University of Aberdeen, n.d.). The focus of the project, which involved over 30 scholars from Scotland, Canada, Russia, and Norway, was domestication. The initiative combined expertise in ethnography and anthropology, history of science, environmental archaeology, osteology and animal genetics, which was applied to seven field sites in the Russian Federation, Fennoscandia and Canada. The research brought Arctic field examples to the theoretical debates in animal domestication, human/animal co-evolution, and commensalism, and provided insights into our theoretical understanding of society-nature relations in the circumpolar North. It also sought to facilitate the professional development of young scholars in a highly interdisciplinary environment. The project provides an excellent example of how Scottish academic expertise in social and natural sciences can be combined to better understand and support remote communities and economies in the Far North.

University of the Highlands and Islands

The University of the Highlands and Islands (UHI) is an integrated Scottish university encompassing both further and higher education. Based in the Highlands and Islands of Scotland, the distinctive partnership of 13 independent colleges and research institutions, with more than 50 learning centres, covers a large geographic and sparsely populated area. UHI's expertise in distance learning provision is of very high relevance for the Arctic. The learning centres are locally based and rooted in communities, but with national and international reach, as part of a regional university structure. UHI provides an innovative approach to learning with distinctive research and curriculum – all enriched by the people, natural environment, economy, culture and heritage of the Highlands and Islands and its communities. UHI utilise a variety of online learning tools which include video conferencing, virtual learning environments, 24-hour helpdesk services, and online learning communities. Online teaching and support has been pioneered to allow for the provision of a wide curriculum of courses across a large geographic area. The curriculum portfolio across both further and higher education is designed to meet current and future local and regional needs and to attract other students to study in the Highlands and Islands. UHI has engaged with European programmes and funding to develop higher education provision in remote, sparsely populated areas and has looked to share these lessons with other countries looking to develop provision in geographically similar regions.

Scottish education and the Arctic

Over the years, strong educational links between Scotland and Arctic have been established. Two Scottish higher education institutions – the University of Aberdeen and UHI – have a particular relationship with the Arctic and the region's academic institutions as members of the University of Arctic (UArctic). UArctic is a cooperative networks of research bodies that has as its goal the promotion of education, research and outreach on the North to enhance local human capacity, promote sustainable economies and forge global partnerships (University of the Arctic, n.d.). In 2017, the University of Aberdeen hosted the UArctic Rectors Forum (Shared Voices 2018) and recently signed a Memorandum of Understanding with Northern (Arctic) Federal University in Russia. SAMS, in conjunction with UHI, also provides training in Arctic science - BSc Marine Science with Arctic Studies which includes a period of study at University Centre in Svalbard (UNIS). Researchers also regularly participate in field study through INTERACT – International Network for Terrestrial Research and Monitoring in the Arctic (INTERACT, 2017).

There are long held links with the region through the Scottish Arctic Club – a group of enthusiasts with a common interest in the Arctic (Scottish Arctic Club, 2018). The Club was founded in 1970 to encourage expeditions to the area and many members have travelled extensively throughout the region. A library including the Waterston, Angus Erskine and Polar collections is held by the Royal Scottish Geographical Society (RSGS) and displayed in the Shackleton Room at Lord John Murray House, Perth. The Scottish Arctic Club also has an Expedition Fund from which it makes financial awards to encourage young people to explore and study in the Arctic.

The Polar Academy

A unique example of a Scottish-Arctic educational partnership is the West Lothian-based Polar Academy. The Academy specialises in organising polar expeditions to eastern Greenland for “invisible’ 14-17 years old secondary school children, crushed by a lack of self-esteem” and offers them an opportunity to redefine themselves in physical and mental terms (The Polar Academy, 2018). Participants are subjected to what is considered Europe’s toughest youth training programme. Upon their return, pupils become local and national advocates for the Arctic, including its people and their environment, and engage with thousands of peers across Scotland. The Polar Academy is also planning to invite Inuit teenagers and hunters to Scotland for educational purposes to demonstrate the similar environmental and climate change challenges faced by local communities in both Greenland and Scotland. Importantly, many of the teachers, medical staff, and those on the operations are locals, as one of the purposes of the trips is to empower the Inuit and show them they can take control of their own country with the support from ‘neutral’ visitors.

Bottlenecks and constraints

Poor coordination and weak institutional links

Because of the sovereignty of the Arctic States (A8), the Arctic Council is a key player to consider when conducting Arctic research. In 2017, members signed an agreement to enhance international Arctic scientific cooperation, including collaboration with non-Arctic states (Arctic Council, 2017). Whilst international expertise in Arctic science is dispersed across the UK and supported by the UK Arctic Office in Cambridge, there is distinctive expertise and capability within Scottish research institutes. Scottish researchers contribute data to a number of physical, chemical and biological monitoring programs as well as social science-based projects. The opportunities to contribute to scientific understanding and to build on current links are therefore considerable.

However, despite the high level of Arctic research being undertaken at Scottish universities, it appears that this activity often remains dispersed and uncoordinated. While project partnerships do take place on a regular basis, as in the case of HYDRA which involves three Scottish universities (Aberdeen, Heriot Watt and Stirling) alongside three non-Scottish partners (NERC, n.d.), coordination between different projects is lacking. Stakeholders often noted that there is no institutional centre for Arctic research in Scotland comparable to the UK’s Scott Polar Research Institute in Cambridge (although ambitions for creating a similar hub exist at the University of St. Andrews through its Arctic Research Centre or at SAMS). Similarly, student exchange between Scottish universities and their Arctic counterparts outside the Erasmus Programme appears to have been limited.

Disproportionate focus of Arctic research on natural sciences

Following stakeholder engagement workshops and literature review, it became clear that Arctic research conducted in Scotland is heavily dominated by natural sciences. Examples of these initiatives have already been mentioned in the Environment & Climate Change section of the report. Stakeholders have suggested that an overly focus on quantitative, natural science risks missing out on expertise and experience of local communities which may be of crucial importance not just from the research but also the policy standpoint. That said, it should be recognized that Scotland has a steadily growing expertise portfolio in multidisciplinary research. In terms of academic output, one study on the quantitative analysis of Arctic-related articles in the Humanities shows Scotland-based scholars have globally published the 8th most articles in social subjects (Hua et al., 2012). Arctic research has gradually expanded from the historical, archaeological, and anthropological fields to political, social, educational, and cultural sciences, international relations, music, and art. Compared to natural science, the influence of social science in Arctic study is relatively weak (Hua et al., 2012) and whilst historically research in the Arctic has focussed on the natural sciences there is now growing acceptance that social subjects will be a key focus of future research.

Examples of the growing importance of social sciences in Arctic research conducted in Scotland include the aforementioned *Arctic Domus* project at the University of Aberdeen, SAMS' work on the blue economy and the activities of the Scottish Alliance of Geoscience, Environment and Society (SAGES). The latter is an initiative by a group of Scotland-based scientists concerned with the human-induced changes in the global atmosphere and their significance for Scotland and the world (SAGES, n.d.). SAGES has a Transformations in Society and Environmental Policy theme, through which it seeks to ensure "translation between the latest scientific developments and the needs of policy makers, industry and business, and other users" (SAGES, n.d.). Finally, the establishment of the Arctic Research Centre (The Arc) at the University of St. Andrews in partnership with the Moscow State Institute of International Relations has marked another important step towards developing Scottish social scientific expertise on the Arctic (The Arc, 2015). The Arc includes academics and doctoral researchers representing a range of disciplines, including human geography, energy policy, economics, biology, mathematics, and statistics.

The scope of Arctic research has expanded to almost all areas of the humanities and social sciences. Politics, law, environment, energy development and economics have been increasingly prominent topics in recent years, and are bound to remain the research focus in the future (Hua et al., 2012). However, as indicated by stakeholders, there is a need for research donors – including public bodies (e.g. Scottish Funding Council and Scottish Enterprise) – to create more funding channels for Arctic research that includes or foregrounds social sciences. That, it is argued, would better reflect the aforementioned focus of the Arctic Council and many existing national approaches to the Arctic on local lives and livelihoods. This is particularly important given the unclear nature of funding for social development projects and the related research initiatives currently supported by European funds (e.g. NPA). In this context, stakeholders have also indicated the need for funders to support existing longitudinal studies to complement the more usual focus on 'innovative' research, citing the data produced by the Mauna Loa Observatory in Hawaii as an example of the former which is of critical importance to modern climate science.

Funding

Funding for Arctic research in Scotland comes from a number of national and international donors. At the European level, a number of projects have been financed through the 2014-2020 Northern Periphery and Arctic Programme (NPA) and earlier through the 2007-2013 Northern Periphery Programme (NPP). In the case of NPA, Scottish research institutions have so far participated in 31 projects worth over 34 million euros (NPA, 2018). The NPA is financed by European Regional Development Fund (ERDF) contributions from the Member States, ERDF equivalent funding from the non-EU partner countries, supplemented by match funding from projects.

Research activity is often corralled to address contemporary issues through specific funding calls, allowing expertise from different institutes and countries to be pooled (e.g. NERC Changing Arctic Ocean) and costs to be shared (e.g. access to research stations and ice breaker vessels). Scottish Higher Education Institutes are involved in Arctic science. In 2017, 90% of the Natural Environment Research Council's (NERC) £76.3 million funding in Scotland went to 7 institutions. Over the last 20 years, institutions in Scotland have contributed to more than 1035 published peer-reviewed articles about the Arctic. A major UK funder of Arctic research has been the NERC Arctic Research Programme (ARP), a £15 million initiative with the goal of supporting projects that seek to understand the changing nature of the Arctic environment. Five Scottish universities – Aberdeen, Dundee, Edinburgh, Heriot-Watt and Stirling – have been involved in three ARP projects to date (Landslide-Tsunami, HYDRA and CYCLOPS) (NERC, n.d.). Long established relationships have also created opportunity for researchers to act as evaluators for funding calls (Norwegian Research Council) and to contribute visiting lectures.

It is unclear what impact Brexit will have on the availability of EU funding for Arctic research. In the worst case scenario, Scottish research bodies will lose access to the likely successor of NPA, creating a funding gap in the Scottish research landscape. Moreover, Arctic research heavily depends on strong regional networks which EU funding has facilitated. It is unclear if and to what extent UK funding for Arctic research would compensate the loss of available funds in a hard-Brexit scenario.

Opportunities and Recommendations

The need for consolidation of Arctic research in Scotland

The last decade has seen a renewed interest in Arctic matters, and science and technology have been at the forefront of this new drive towards the North. Virtually all Arctic policies analysed for the purposes of this report contain a very strong scientific research component, and stress the need for increased regional cooperation in this context. As a small nation, Scotland has limited resources to, for instance, maintain its own research station in the Arctic. However, a number of other countries find themselves in a similar situation, including the Netherlands (Netherlands Organisation for Scientific Research, 2014). Others, such as Italy, actively seek to further internationalize scientific activities in the region (Government of Italy, 2016). There is therefore ample scope for international collaboration for developing both infrastructure and partnerships in the Far North. At the international governance level, active participation in regional scientific bodies, such as the International Arctic Science Committee (IASC) through the UK delegation, should be pursued by Scottish authorities.

In the same vein, a number of non-Arctic states (Germany, Italy, France, Japan) have set out to consolidate their domestic research initiatives on the Arctic, for instance by planning to establish an Arctic research consortium (as in the case of South Korea) or by launching similar research forums to facilitate knowledge exchange at the national level. In addition, the Government may consider assuming a brokering role in developing contracts and partnerships between research actors and businesses interested in pursuing economic opportunities in the Arctic (for example in the areas of transport, aerospace, shipping, energy, mineral resources, insurance, communications, health), as set out by the French Arctic policy (Government of France, 2016). In general, it is clear that Scottish research activities on and in the Arctic require consolidation and coordination, an issue that should be considered by a future Scottish Arctic policy. There is fertile institutional ground for this kind of consolidation given the existence of a number of multidisciplinary research centres and associations either with a specific focus on the Arctic or with expertise that could be mobilized for Arctic research, including SAGES, MAST, the Arc, UHI's Environmental Research Institute, and SAMS. In the UK context, the Scott Polar Research Institute in Cambridge and the UK Science and Innovation Network could provide valuable guidance in this context.

Fostering educational links

At the educational level, it appears that there is much scope for increased cooperation between universities and research centres in Scotland and its Arctic and near-Arctic partners. The Scottish government should facilitate increased cooperation in this context in order to capitalize on the already forged research, outreach, and teaching and learning partnerships, particularly by the Scottish members of the UArctic. Membership of other Scottish universities in UArctic should also be explored. Scottish academic institutions could in this way be repositioned as the gateway to the Arctic (or to Europe). The design for a revamp of the current partnership between the universities of Scotland and those in the Arctic produced during an interactive workshop with BuroHappold and the Scottish Government demonstrates how this could be achieved without an excessive level of financial investment (BuroHappold Engineering, 2018). At the pre-university level, there is scope for widening the activity of entities such as The Polar Academy, which could facilitate exchanges with young people from local communities who do not have immediate access to higher education institutions.

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Annex VI – Stakeholder Engagement Workshop Agendas and Participants