Briefing Note

Low-carbon in the High North: Achieving Carbon Neutrality in the Nordic Arctic

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Introduction

The pace of temperature and environmental change in the Arctic, and the implications for the stability of the global climate system, are driving a growing urgency to decarbonise every aspect of our lives. While it is often repeated that the Arctic is ground zero for the impacts of the climate crisis, it does not abdicate the region from taking the necessary action to tackle the root of the problem: the carbon economy.

Achieving carbon neutrality, or net-zero emissions, is increasingly becoming the ultimate climate goal being adopted by an ever-growing number of public and private actors to end their contributions to global climate change. The Nordic region stands out in this regard, having committed in the Helsinki Declaration of January 2019 to the goal of becoming a carbon neutral region, in line with their vision to become the most sustainable region in the world by 2030 (Nordic Council of Ministers, 2019). This aim ties together national legislation and policy positions that mandate carbon neutrality by between 2030 and 2050.

While the Nordics' national governments have busied themselves in assessing the implications of carbon neutrality on different sectors of the economy, little consideration has been given to how to achieve carbon neutrality specifically in the Nordic Arctic region, where a unique geography, demography, and economy means that the challenges of decarbonising look markedly different from elsewhere.

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This briefing note aims to give an overview to the unique characteristics of the Nordic Arctic that may set it apart when designing policies to deliver carbon neutrality. It will discuss some key challenges and opportunities in reaching this goal in the region, identifying areas of potential conflict with other policy goals. This note does not claim to hold all the answers, but aims to begin a conversation on where sweeping national policies are less appropriate and a more nuanced Arctic approach is needed, pointing to some areas where policy development, innovation and further research are needed.

Carbon neutrality - definitions and targets

Carbon neutrality, or *climate* neutrality, is a widely used, though not always clearly defined term (Murray & Dey, 2009; Tozer & Klenk, 2018). According to IPCC (2018: 545), *climate neutrality* refers to a concept of a state in which human activities result in no net effect on the climate system. Achieving such a state would require balancing of residual emissions with carbon dioxide removal, as well as accounting for regional or local biogeophysical effects of human activities, for example, that affect surface albedo or local climate. *Carbon neutrality* (also referred to as *net zero CO_2 emissions*) is achieved when anthropogenic CO_2 emissions are balanced globally by anthropogenic CO_2 removals over a specified period (IPCC, 2018: 555). In order to achieve carbon neutrality, there needs to be a balance between emitting carbon and absorbing carbon from the atmosphere in carbon sinks (European Parliament, 2019). The above terms are often used interchangeably, so carbon or climate neutrality should always be defined in the used context to avoid misunderstanding.

This briefing note is based on climate neutrality defined as achieving net zero emissions through reduction and compensation. As a target to commit to, it dictates that some carbon emissions can still take place, if they are offset through compensation and other flexible mechanisms. A lack of a common definition, especially around compensation, means that when agreeing to a target it is not known with absolute clarity what is being committed to. This is also particularly problematic when it comes to production versus consumption based carbon accounting, which can allow the passing of responsibility for emissions (Franzen & Mader, 2018).

Furthermore, there is a growing consensus that offsets must not be used as a get-out-of-jail-free-card, and there are significant questions around their effectiveness and verifiability (UNEP, 2019). It is therefore important to approach achieving carbon neutrality by focusing on reducing emissions as much as possible, and compensating *only* as a final resort.

The Helsinki Declaration only loosely commits the five Nordic states[1] to "working towards carbon neutrality" (Nordic Council of Ministers, 2019: 1), without any further expansion on the technicalities of doing so. However, as shown in table 1, this ties together targets already set (mostly into law) at a national level.

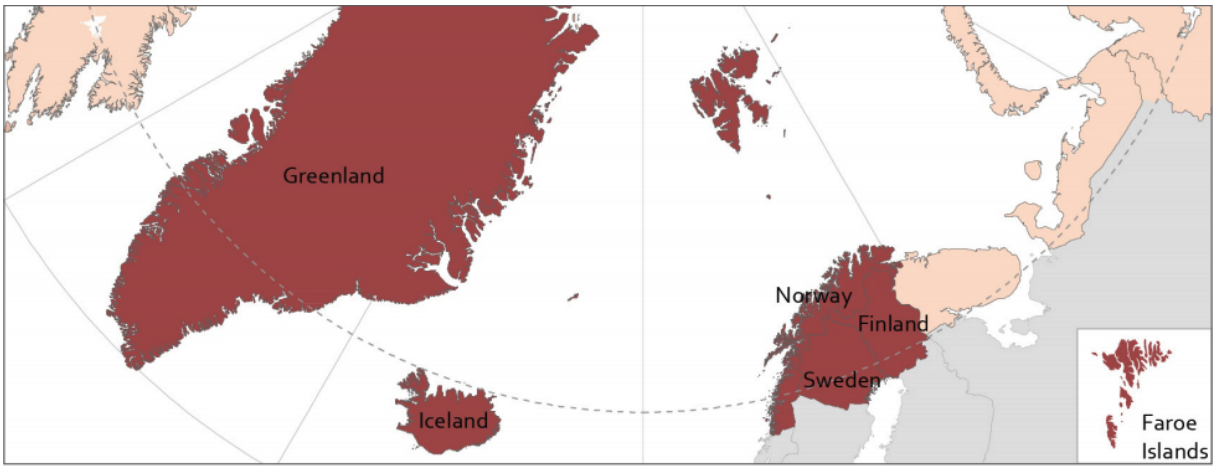
Table 1 - Carbon neutrality and other relevant targets in the Nordic countries and autonomies.

	Norway	Finland	Iceland	Sweden	Denmark	Greenland	Faroe Islands
Carbon Neutral Target Date	2030	2035	2040	2045	2050	N.A.	N.A.
Other relevant targets	Low emission society by 2050 (80-95% GHG reduction compared to 1990)	Fossil fuel free by 2035 & 80% reduction by 2050	50-75% emission reduction by 2050	Fossil fuel free by 2045	70% emission reduction by 2030 (compared to 1990)	As close to 100% as possible renewable energy by 2030	100% renewable power and electrification on land by 2030

Geography, demography and economy

The Nordic Arctic is defined here as Greenland, Iceland, the Faroe Islands, and the Northern regions of Norway, Sweden, and Finland, as shown below in Map 1. Whilst the Nordic Arctic shares many characteristics, it is also an incredibly multifaceted region, with vast disparities between its constituent parts – from the remote villages of Eastern Greenland and Norway's only coal mine in Svalbard, to the highly connected cities of Rovaniemi and Tromsø.

Importantly, the Nordic Arctic varies significantly from the wider Nordic region, in particular the capital belt of Oslo, Copenhagen, Stockholm and Helsinki, where national policymakers sit. It is therefore relevant to consider the nuances of the Nordic Arctic region when it comes to the task of translating sweeping policy aims such as carbon neutrality into meaningful policies and actions.



Map 1 - The Nordic Arctic (NordRegio, 2017)

There are several geographic characteristics that pose particular challenges in delivering the low-carbon transition in the Nordic Arctic. Firstly and perhaps most obviously, is a cold climate with wide variability in sunlight hours through the year leading to a greater energy demand, particularly for heat, but also light and transport, which also often operates less efficiently in colder conditions. Much of this energy today still comes from fossil fuels, making it one of the region's main contributions to carbon emissions. The severity of the region's climate also means that renewable solutions that are easily adopted elsewhere, such as energy storage and solar energy, are less cost-effective (although as these technologies develop, this is changing). Additionally, such conditions make low-carbon infrastructure more difficult and costly to build and more carbon intensive to operate (Marsik & Wiltse, 2019). Forest resources that can support a renewable, bio-based local economy exist in abundance in northern Norway, Sweden and Finland, but are not present elsewhere.

A second key characteristic to be considered is the large number of small, remote communities separated by significant distances. While the Nordic Arctic, particularly on the continent, is relatively well-connected and densely populated compared to the Russian and North American Arctic, it still remains a challenge. This is primarily because there lacks a compelling case for solutions that rely on economies of scale, such as connection to national power grids, which can better utilise renewable power. With such great distances to cover, many parts of the region, especially northern Norway and Greenland are reliant on aviation – a very carbon intensive method of transport – to move people and goods. The transportation of fossil fuels to remote communities that are still reliant on them for heat and power further increases the carbon footprint of these energy sources. Marsik and Wiltse (2019) find that often these factors combine to create further problems for security of supply and cost of energy, which can in turn lessen the ability to shift to zero carbon solutions.

Whilst the population is forecast to continue growing across the Nordic region, adding further pressure on efforts to achieve carbon neutrality, population growth in the Nordic Arctic is more modest (NordRegio, 2019). However, urbanisation is set to continue with more people moving into the region's larger towns and cities, shifting demand for energy, transport, construction, and other resources and services. Employment in the Nordic Arctic is lower than the region as a whole, but is well balanced across different sectors, with a slight over-representation of public administration.

Economic development and sustainable resource management are key threads of most of the Nordic states' Arctic strategies, but there is little acknowledgement of how this may be in conflict to goals of carbon neutrality. The economy of the Nordic Arctic is varied, but heavily focused on natural resources, much of which (mining, hydrocarbon extraction, tourism etc.) is highly emitting in its nature (Duhaime & Caron, 2006). A lack of economic diversity in parts of the region is a major underlying factor when considering how to transition to a zero carbon economy. As the Nordic Arctic has every right to develop in the same way that the rest of the Nordics has, it is important to open more dialogue on the responsibilities and expectations when it comes to reducing carbon emissions.

The road to zero in the Nordic Arctic

Despite some of the factors discussed that make the Nordic Arctic a difficult place to achieve carbon neutrality, there has already been some excellent progress in the region. This has mostly been within power and heat, where efficiency gains, electrification and renewable power are rapidly reducing demand for fossil fuels (Rud et al., 2018). High standards of building insulation, even if driven mostly by economic and practical factors, means that the region is home to some of the most heat efficient buildings in the world. Renewable power is also taking hold in the region at a strong pace, with hydropower playing a critical role, even in areas of permafrost, although Svalbard is yet to make this transition as it still relies heavily on Norway's only coal-fired power station (Verkis, 2018; Rud et al., 2018).

As renewable power sources increase, electrification of the heating sector through mature, cost-effective solutions such as electric boilers, district heating and heat pumps have the potential to greatly reduce the carbon intensity of heating in the region. In Greenland, for example, 67% of heat and power is renewable, while in Iceland that number is 99% (Nukissiorfiit, 2020; Craig, 2016).

Notwithstanding a small number of remote communities where fossil fuels still dominate for heat and power, it is foreseeable that renewables and electrification will be able to reduce the Nordic Arctic's carbon emissions in this sector to a negligible amount in time. The Faroe Islands have set the goal of all such energy being supplied through renewable electricity by 2030, and it seems plausible that it will be achieved given the current trajectory of investments and policies, a pattern that is also reflected more widely in the region (Nolsøe, 2016).

It should be noted that bioenergy produced in the Nordic Arctic (typically forest-based) is used widely for both heat and power, and is often seen as a renewable solution. However, bioenergy still releases greenhouse gases (notably including black carbon as further discussed below) into the atmosphere, which is only recaptured when the biomass regrows. As such, the true carbon footprint of forest-based biomass is reliant on ongoing improvements to sustainable forest management, which should be accounted for when considering the contribution of bioenergy to carbon neutrality goals (Koponen et al, 2018; Soimakallio et al, 2016).

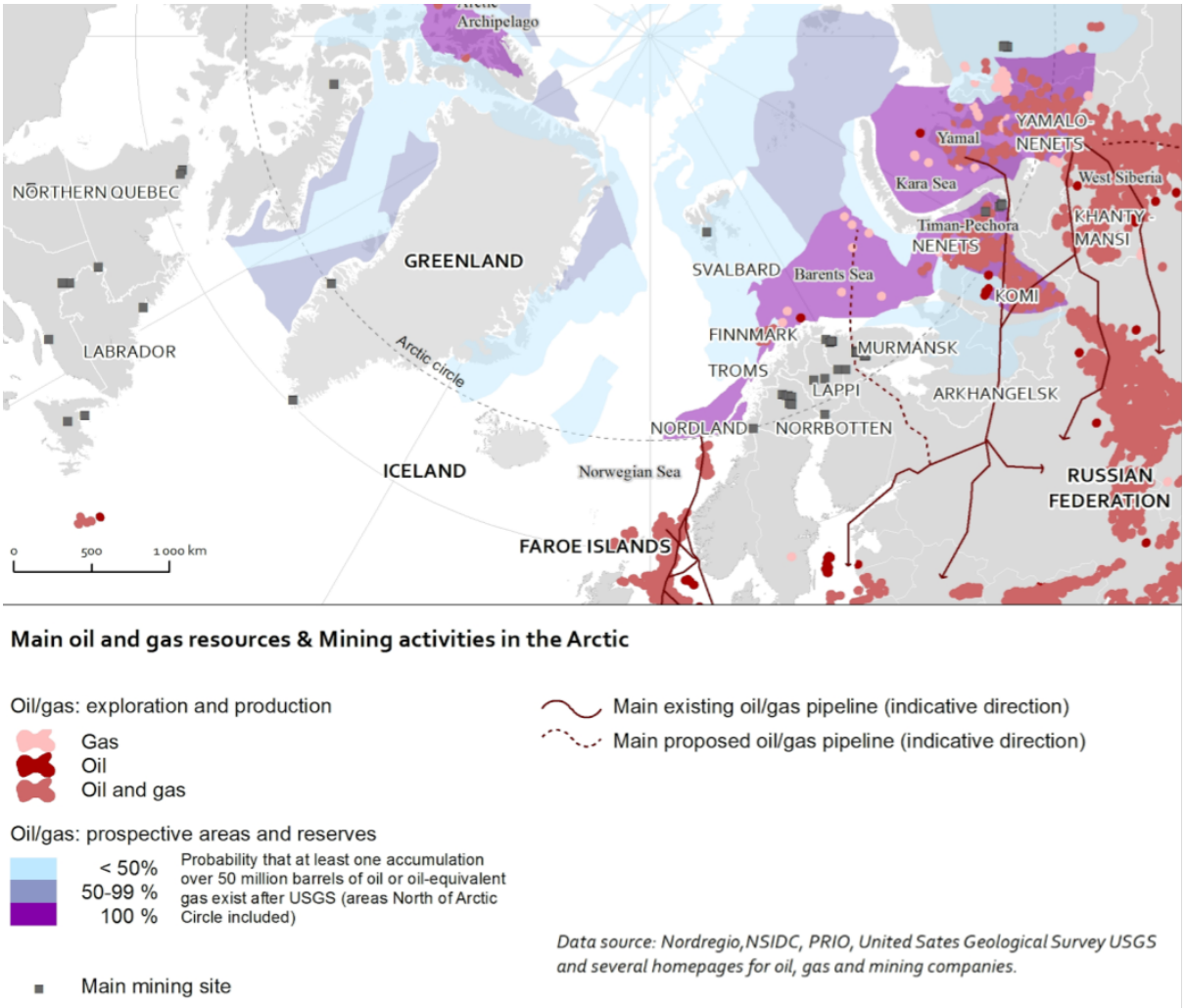
While decarbonisation of heat and power seems within reach, the primary energy supply which includes other uses such as transportation and industry is a different story, with less than 15% being sourced from renewables in Greenland, the Faroe Islands, and Svalbard (Rud et al., 2018). As discussed further below, some of these areas may prove challenging in decarbonising the Nordic Arctic.

In addition to CO_2, short-lived climate pollutants (SLCPs), such as black carbon are of particular significance in the Arctic due to the impact on local climate forcing and albedo (Ting-Feng & Cun-De, 2016). In recent years the Arctic Council has paid more attention to this area, establishing the Expert Group on Black Carbon and Methane in 2015, which finds that regulations are helping to bring down such emissions in many sectors (Arctic Council, 2019). The use of heavy fuel oil (HFO) – which causes especially high levels of black carbon pollution – by ships in the region is one area that requires international cooperation. As such, the Nordic countries are leading the advocacy efforts towards a ban on HFO use in Arctic waters within the slow-moving frameworks of the International Maritime Organisation (IMO) (Lehtomäki, 2019).

Other areas pose more significant challenges for achieving carbon neutrality in the Nordic Arctic, forming bumps on the road to net zero emissions. Below we examine some of the most important sectors for consideration, concentrating on extraction activities, transport and construction.

Hydrocarbons and minerals

Oil and gas extraction often remains the elephant in the room when it comes to the sustainable development of the Nordic Arctic, given the resource potential of the region shown in map 2. Norway's approach is of particular interest, where extensive petroleum activity takes place in the Barents and Norwegian Sea, areas that are considered Arctic by the Arctic Monitoring and Assessment Programme (AMAP, 2009). Despite being the hydrocarbon pusher of the Nordics, consumption based accounting means that Norway's 2030 carbon neutrality goal does not account for emissions from the burning of the fossil fuels it produces and exports.



Map 2 - Hydrocarbon and mineral resources in the Nordic Arctic in 2019 (Turunen, 2019).

A report from the Norwegian Petroleum Directorate (2019: 5) states that over half of the undiscovered petroleum resources are located in the Barents Sea, and that therefore, these northern areas can play an important role when it comes to maintaining the Norwegian petroleum production in the long term. While efforts are underway to reduce emissions from the operations of hydrocarbon extraction in Norway, for example through electrification of platforms, this has

so far had limited success, fails to address the underlying problem, and may be seen as oil companies trying to gain social licence to continue with business as usual (Elset, 2018).

Although there will be a continuing need for hydrocarbon extraction in a carbon neutral economy for non-combustion uses such as in producing petrochemicals and plastics, this will be modest and should not require further development of resources in the Nordic Arctic. Whilst it can be argued that the wealth accumulated from hydrocarbon development in Norway has funded their ability to grow a world-leading low-carbon economy in many respects, it is ultimately incompatible with the goal of carbon neutrality, and should be phased out in an economically responsible way over the coming years.

Mineral extraction on the other hand – currently also a highly carbon intensive industry – will certainly be needed to provide critical resources in a carbon neutral economy. Greenland's desire to expand mining operations is often cited as a reason why their emissions are forecast to increase over the coming decades. The mining sector has been slow to adopt any serious initiatives to reduce emissions, despite the fact that the readiness of the technology is at such a level where many operations could vastly reduce on-site emissions through electrification (Azadi et al., 2020). A greater level of external pressure, likely through regulation, will be needed for the sector to not become problematic in the region's goals of carbon neutrality.

Transport

Decarbonising road transport – primarily through electrification – is a well covered policy area, with bans in place on the sale of combustion engine cars on the horizon in Iceland, Sweden and Norway, and the technology developing at the required pace to meet such targets (Rud et al., 2018). As noted however, distance and lack of access in the Nordic Arctic means a heavy reliance on aviation for transport of goods and people. These are often lifeline services which should be supported, but airport expansion to meet goals of economic development through tourism and trade should also be levelled against climate priorities, until we have commercially available zero emission aircraft. While the aviation sector has to date shown only incremental signs of decarbonisation, for example through small additions of biofuels, there are promising developments for electric planes for short-haul routes in small aircraft. Indeed, the Norwegian carrier Widerøe is aiming to shift their entire fleet of Dash 8s to electric planes by 2030 (Widerøe, 2020). If the sector proves difficult to decarbonise within the required timeframe, emissions may have to be offset in other ways, but it does not mean that one should not question the necessity of the scale of planned aviation expansion in the region.

As well as aviation, the region relies heavily on maritime transport, where traffic is increasing due to a growth in trade and tourism, however, this is a sector that is also proving difficult to reduce emissions in. Norway has led the way in investing in low-carbon solutions for near-shore shipping, shifting ferry and feeder routes to electric and hybrid solutions, but meaningful scale is still some way off (DNV GL, 2018). Globally, the shipping industry is incrementally setting targets (such as the IMO's rather unambitious 2050 50% emission reduction target) and implementing new low-carbon initiatives, but greater commitment from the large shipping firms operating in the Nordic Arctic is needed. Pressure from the legislator may be needed to achieve this, although the shipping sector is especially complicated due to its international nature.

Aside from important steps such as the aforementioned HFO ban in the Arctic, hydrogen fuel cells are also a potential solution in the shipping sector where electrification is unfeasible. However, as Rud et al. (2018) note, there remains uncertainty and disagreement on the future of hydrogen, and the region currently lacks the requisite infrastructure to support the technology. If successful however, such developments will also help the fishing industry – of huge economic importance in the Nordic Arctic – to reduce its reliance on fossil fuels. Efficiency offers good potential here, too, such as in Iceland where the sector has managed to almost halve its carbon emissions since 1990 (Fisheries Iceland, 2017).

Construction

Energy efficiency of buildings in the Nordic Arctic is some of the highest in the world, but less attention has been paid to the embedded carbon emissions of the buildings themselves (Rud et al, 2018). Conventional concrete and steel production is associated with high emissions, and such materials must often be transported into the Nordic Arctic, furthering their carbon footprint. At a national level in the Nordics, regulation is forthcoming to better measure and eventually limit the full lifecycle emissions of buildings, and the Nordic Arctic too must be ready for this.

As well as innovative developments in the concrete industry, increasing the share of bio-based building materials should be seen as an attractive way in which to reduce carbon emissions from construction. Given the high availability of sustainably managed forest resources in the region, mass timber is a solution that can not only boost local rural economies, but also lock carbon away into buildings, and reduce transport emissions thanks to its light weight. Local strategies, such as in Skellefteå in Sweden, have proven an excellent lever in reducing lifecycle emissions from construction (Vestergaard Jensen & Craig, 2019). Additionally, circular principals should be better embraced to better utilise waste streams and ensure that resources remain in the value chain for longer.

Negative Nordic

Achieving carbon neutrality in the Nordic Arctic, as discussed, is not without its challenges. However it is also worth considering where the region can contribute to compensations, as well as taking opportunities to help other areas with reductions. While carbon capture and storage technologies and initiatives could prove to be of support, it would require substantial progress within the next few years in order to be of real use in achieving reduction targets. Further research and innovation is necessary and important, but should not be relied upon as the sole solution. Thus, the Nordic Arctic should focus on initiatives and legislation that can reduce emissions and transition to a zero emission economy.

Natural solutions also have a key role to play, as the greening of the Nordic Arctic means that the region can potentially lock more carbon into vegetation and soil stores. In Northern Finland, peat restoration projects are sequestering and locking in carbon, and work is underway to find a mechanism that can register this as verifiable offsets (Gatehouse, 2020). On the other hand, warmer temperatures can also lead to the release of already stored carbon from the thawing permafrost, as well as an increase in wildfire occurrence.

Where there is an abundance of renewable energy, the Nordic Arctic is also well positioned to help support growing green industries, from zero emission data centres – where the cold climate also can come in handy – and aluminium smelting in Iceland to battery production for electric vehicles

in Northern Sweden. This represents just a small snapshot of some of the opportunities that can be taken in the region to positively contribute to the decarbonisation of the wider economy.

Conclusion and recommendations

If the Nordic region is to achieve carbon neutrality in the coming decades, a more nuanced approach that accounts for the particular circumstances in the Nordic Arctic must be adopted. The Nordic Arctic's extreme climate, small and remote settlements, and fast-developing economy are characteristics that present unique challenges in decarbonisation efforts. The choice to pursue economic development in the region through the extraction of natural resources and tourism is hard to level with carbon neutrality targets, and more open dialogue should be had on this trade-off in policy aims.

Some sectors such as heat and power sectors are making significant progress in cutting carbon emissions, and recent attention from the Arctic Council on short-lived climate pollutants has resulted in reductions in hard-to-abate areas. However, the three sectors discussed in this paper – hydrocarbon & mineral extraction, transport, and construction – form bumps on the road to net zero emissions in the Nordic Arctic. Plans to be fossil fuel free across much of the Nordics are at odds with being a hydrocarbon producing region, and as such greater commitment is needed to phase out the industry in an economically responsible way over the coming years – without leaving people behind and ensuring that livelihoods are supported throughout the carbon-neutral transition. Greater pressure from the legislator, combined with commitment from larger shipping firms is needed to tackle emissions in the maritime transport and fisheries sector, while the necessity of the scale of planned aviation expansion in the region should also be brought into question. As urbanisation in the region continues, emissions from construction materials present a growing issue, which can be tackled through for instance improved strategies to utilise local bio-based resources and make better use of waste streams in the circular economy.

In addition to the key challenges described in this briefing note, there are also many ways in which the Nordic Arctic can positively contribute and even lead in the transition to a zero carbon economy through green industries, carbon capture and storage and the harnessing of natural solutions to carbon sequestration. Furthermore, this has the potential for a double dividend of new economic and employment opportunities in the North. At a Nordic level, there is a need to develop a common understanding of the precise definitions and accounting methods of carbon neutrality in order to better integrate efforts across national boundaries.

Despite some of the challenges laid out in this note, the Nordic Arctic remains well placed to achieve the goal of becoming carbon neutral. It is a realisable goal, but it will not be reached without a more nuanced Arctic approach being taken at a national and Nordic level. Moreover, greater ownership of the carbon neutral aim is needed locally from policymakers and corporations to maximise the benefits from building a zero carbon economy in the Nordic Arctic.

Notes

1. The Helsinki Declaration is signed by the five Nordic States of Norway, Finland, Iceland, Sweden and Denmark. However the Nordic cooperation also includes the three autonomies Greenland, Faroe Islands and the Åland Islands (the latter of which has been omitted from table 1 as it is not geographically in the Arctic). While Greenland and the Faroe Islands are a part of the Kingdom of Denmark, they have autonomy on climate policy.

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