Chapter 2

Policies supporting a sustainable, competitive economy in the NORA region

Reinforcing economic competitiveness and a sustainable development process in the NORA region will largely depend on its capacity to overcome different challenges related to the remote location of the region, its vulnerability to climate change, and its narrow productive base. The chapter is divided into four sections. Section 1 provides recommendations for improving accessibility and for coping with the peripherality and demographic challenges of the region. Section 2 focuses on the future productivity and sustainability of the fishing industry, as one of NORA's main economic sectors. The third section identifies the opportunities for diversifying the economic base, and the crucial role that innovation plays in the region. The fourth section considers the challenges of climate change for the main economic activities of the region and the crucial role of adaptation measures to confront the effects of climate change.

Introduction

As observed in Chapter 1, the NORA territories are small and peripheral economies, heavily reliant on a narrow range of primary products (fisheries, mining, oil). The NORA territories are currently focused, to varying degrees, on expanding their economies. Chapter 1 identified four main challenges or bottlenecks to the development of the NORA region. This chapter seek to emphasise a number of actions that can contribute to better understanding these challenges, and to responding and adapting to them, so as to strengthen the international competitiveness and sustainability of the NORA region. The chapter has four main sections.

i. Section 2.1 examines the challenge of improving accessibility. The peripherality of the NORA region remains an obstacle to its economic development. The focus is on four crucial areas: demographic challenges; improving the delivery of public services; coping with economic vulnerability; and restructuring transport networks.

ii. Section 2.2 looks at the future of the fishing industry. Its fortunes in the NORA region have fluctuated over time, but it remains an important part of the NORA economies and its development is therefore a key concern. Bigger and more modern and efficient fishing vessels are faced with shrinking and highly variable fish stocks. In the future, combining enhanced productivity with the sustainability of the fishing will be a crucial issue. It will require combining the resources and approaches of the different territories and reaching agreements regarding the management of marine resources.

iii. Section 2.3 studies the opportunities for enlarging the economic base, as well as the important role of innovation in the NORA region. New developments, research and the implementation of new techniques can support the future competitiveness and sustainability of traditional natural-resource-based industries. At the same time, in the context of increasing efforts to sustain and diversify regional economies, innovation could help to support the development of emerging or new niches and sectors. However, this will require improving education and training and encouraging entrepreneurship and competition.

iv. Section 2.4 considers the challenges of climate change. Its effects will be larger and more rapid in the North Atlantic, and NORA's natural-resource-based economies will be particularly vulnerable. However the economic effects of climate change are expected to be

mixed: climate change will create certain challenges but it will also create some new economic opportunities.

2.1. Addressing the peripherality challenge

The NORA region suffers from a series of disadvantages related to its remoteness from Europe and from the major international trade routes, its higher infrastructure costs and its harsh climatic conditions. In addition, the region is characterised by a dispersed settlement pattern, migration from smaller to bigger locations and population ageing. This represents a challenge for the provision of public services and for the sustainability of smaller settlements (see section 1.2). Finally, each of the four NORA territories is small in terms of population and GDP and lacks the critical mass to achieve scale economies in most economic sectors. Weaknesses in the transport infrastructure amplify these challenges, but lack of critical mass makes it difficult to develop the transport network. Challenges of peripherality are common in predominantly rural OECD regions (Box 2.1), but the example of NORA is certainly one of the most extreme cases of geographic peripherality.

Box 2.1. **Development challenges in predominantly rural OECD regions**

A consistent theme in the various OECD reviews of rural policy has been the challenge of development in territories characterised by long distances, low densities and small numbers (of people, firms, organisations). The magnitude of this problem, of course, differs from country to country. For example, it is a greater issue in Finland than in the Netherlands, and a bigger challenge for Scotland than England, even though they are both part of the United Kingdom. But within every OECD country it is possible to see that development is more difficult in more remote areas. The crucial problems are:

- higher transport costs, both to and from and within the region, which make both local goods and imports from outside the region more expensive and increase the cost of exports;
- an inability to take advantage of the scale economies associated with Marshallian agglomeration effects, which can enhance opportunities for innovation and reduce unit production costs; and
- small truncated economies, because there are few people and firms to act as a home market and participate in the local labour market, which can in turn result in missed development opportunities, either because of missing skills or labour shortages on the one hand, or high unemployment due to small numbers of firms on the other.

Demographic adjustment

Outmigration overwhelms the natural increase in population of the NORA region

Chapter 1 shows that unlike much of the OECD, where fertility rates have fallen below natural replacement rates, birth rates in three of the four NORA territories (the Faroes, Greenland and Iceland) still allow relatively rapid natural population growth. In addition, death rates continue to decline in all NORA regions, as the average lifespan of citizens increases over time. However, because the population of the NORA territories is very small (especially the Faroes and Greenland), even small changes in net migration rates can overwhelm the natural increase in population. For example, between 1998 and 2008, net international migration in Greenland almost completely offset the high natural increase in population; total population was almost constant.

In general, the region has stable and relatively high population outflows, as young people leave to continue their education or to obtain better employment. This outflow has two consequences. First, an offsetting influx of people would be required to prevent population decline, and second, there are potential longer-term implications for future birth rates if, as is currently the case in the NORA region, the outflow includes a disproportionately large number of young women and the inflow a smaller proportion of females.[1] International immigration is largely driven by current employment opportunities. When the NORA region has better employment opportunities than immigrants' home countries, flows are higher. Conversely, periods of slow growth and weak job creation reduce the incentive to move to the NORA region. In addition, while the NORA members allow citizens of any Nordic country full freedom of entry, some have tended to restrict immigration during periods of high unemployment (see Chapter 1).

Restrictions on immigration should be released

When restrictions on immigration during periods of weak job creation are coupled with higher rates of emigration, the likely outcome is a period of net outflow of people. Given the small absolute numbers associated with the natural increase in population, it is easy to have intervals where population declines significantly even if fertility remains high. Conversely, when economic conditions are good, a strong inflow of foreigners can add considerably to population growth. For example, during 1998-2008 the population of Iceland grew by 1.5% a year. Roughly half of this was due to

natural increase and the other half to net immigration. Some OECD countries facing similar demographic challenges, such as Canada, have adopted policies to attract immigrants (Box 2.2). As pointed out in Chapter 1, there are strict regulations on immigration in the Faroe Islands and Greenland when a vacancy is to be filled by a non-Nordic citizen. As the unemployed are mostly unskilled workers, this creates serious difficulties for companies seeking to hire highly skilled international workers. Non-Scandinavian immigration would probably be limited in any case, given climatic conditions that are not especially attractive to migrants who lack a Scandinavian heritage, relatively small labour markets and the high cost of travel to the NORA region. Nevertheless, even small fluctuations in immigration can have important impacts on the demographic situation and on labour markets.

Box 2.2. **Atlantic Population Table**

Atlantic Canada is affected by an ageing population, outmigration and relatively low immigration. This undermines the region's capacity to support economic growth, innovation and productivity. The 2001 Census showed that three of the four provinces in Atlantic Canada had lost population since 1996, while most of Canada was still expanding. In addition, Atlantic Canada attracted only 1.2% of the total permanent immigrants coming to Canada in 2002, far short of the region's share of the national population. Addressing these demographic challenges became even more urgent as a resources boom in western Canada siphoned off workers, mostly young people, from Atlantic Canada. The Atlantic Population Table (APT) was set up in 2005, when senior federal and provincial officials began discussions to identify themes and issues for which common, collaborative, region-wide approaches could be considered.

At its early meetings, the APT realized that there were four areas in which joint action was needed: attracting and promoting Atlantic Canada as a destination; raising the awareness of Atlantic Canadians of the benefits that immigrants bring when they settle in the region; promoting smoother integration of immigrants into labour markets; and sponsoring research into population-related matters. The four Atlantic provinces joined the Atlantic Canada Opportunities Agency (ACOA) and the Department of Citizenship and Immigration Canada (CIC) in developing an Atlantic Population Initiative that embraced these four streams. The Department of Human Resources and Skills Development Canada (HRSDC) was also an active participant in discussions at the APT. The Memorandum of Understanding (MOU) that provides the framework was signed by ministers at the end of 2008. Under the guidance of the APT, several initiatives have been identified and are being implemented on an Atlantic-wide basis. The APT meets quarterly, and at these meetings directly pursues consultation and co-ordination activities with a range of stakeholders.

Box 2.2. **Atlantic Population Table** (*cont.*)

There has been progress as the decade has advanced. The Atlantic Canada region now attracts close to 3% of all permanent immigrants coming to Canada, as the four provinces have aggressively used their Provincial Nominee Programmes (special programmes that allow provinces to nominate individuals who wish to immigrate to Canada and who are interested in settling in a particular province) to recruit skilled workers. Retention rates have improved. Research has shown that labour market outcomes for immigrants in Atlantic Canada are rather better than for Canada as a whole.

Much remains to be done. Although the region's population decline has been arrested and reversed since 2001, rates of increase are still low. Projections suggest that by 2012 100% of net growth in the Canadian workforce will be due to immigration. Immigrants as a proportion of the Canadian labour force stand at 21%, while in Atlantic Canada they are less than 5%. Increasing immigration alone will not bring the population and workforce into balance. Increasing the productivity of Atlantic Canada firms and improving the employment outcomes for youth and under-represented pools of labour are also important.

Source: Atlantic Canada Opportunities Agency.

It will also be important to encourage the return of migrants

A striking feature of the migration pattern is the phenomenon of return flows. If there are employment opportunities, individuals who have left their home country for education or employment when they were younger often return. Typically, this happens after they have children. The demographic impact of this return flow can be considerable, particularly when migrants return with spouses from elsewhere. Moreover, the migrants return with skills and resources acquired elsewhere which add to the territory's human capital. The important implications for policy are:[2]

- Those who previously lived in the region are those most likely to be attracted to it.
- It is not necessary to encourage all previous emigrants to return; the focus can be on those who have children and are looking for a better quality of life and environment in which to raise them or on recent graduates in degrees close to the needs and potentialities of the NORA region.
- Individuals who return come back with potentially important skills.

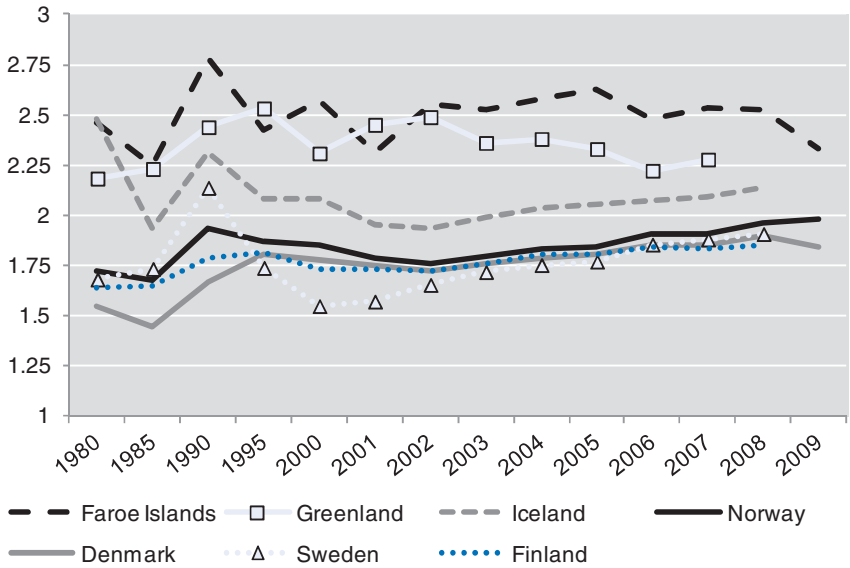
- It is important to manage the economy so that there are visible opportunities for potential returning families.
- It is also important to ensure that the existence of these economic opportunities is widely disseminated in expatriate communities and to create facilities for the immigrants wishing to return.

Current high fertility rates cannot be counted on in the future.

Fertility rates are currently high enough in parts of the NORA region to result in a slowly growing population, assuming no external migration effects. Fertility is highest in the Faroe Islands and Greenland and somewhat lower in Iceland and Norway, which are near, or below, levels that would result in zero natural population growth (Figure 2.1). Even so, the rates in all four territories are higher than those of Denmark, Sweden or Finland. Yet during the last ten years, fertility rates in the Faroe Islands and Greenland have tended to fall, while they have increased regularly in the rest of the Nordic countries. If the Faroes and Greenland evolve along the same path, a significant drop in fertility rates will lead to further population challenges. The main exception to this phenomenon could be the Inuit population of Greenland, which maintains a birth rate in excess of that required to maintain a stable population, but, even among the Inuit, birth rates have fallen in recent decades after peaking in the 1950s–1970s (Marquardt, 2002). Canada and the United States, OECD countries with significant indigenous populations, are seeing important demographic shifts in some regions in which the indigenous population is a major share of the total population and there are different fertility rates among various ethnic groups.

Low fertility rates become a more important issue when viewed alongside high rates of female outmigration, especially among younger women who do well in school. Many OECD regions are experiencing high rates of female outmigration as young women leave rural areas for better opportunities in cities. As the ratio of females to males declines, higher fertility rates are required to maintain the population. Should domestic fertility rates drop to a level associated with zero population increase, the role of international migration becomes even more crucial. Net immigration is usually strongly associated with a growing economy and ample job creation. For the NORA region to maintain current population levels, or increase them, there will have to be strong economic growth.

Figure 2.1. **Fertility rates in the NORA region and Nordic countries**



Sources: Nordic Statistics and *OECD Regional Database*.

A deteriorating demographic structure and increasing ageing of the population will place heavy demands on public budgets

Another consequence of falling birth rates and considerable youth outmigration is an increasingly unbalanced population structure. Initially, the effect of low fertility on the demographic structure is masked because the younger cohort is a small share of the population. Over time, however, as these smaller cohorts of females reach reproductive age, their low share of the population results in further population decline, because fewer women give birth. The process leads to an accelerating drop in population, as each generation produces a smaller number of replacements for those who die.

As shown in Chapter 1, NORA territories, like most OECD countries, will experience significant ageing in the next decades, especially in smaller settlements, which tend to have a higher share of elderly people. As the population ages, the share of people in the workforce declines and the growing burden of supporting old age pensions and public services falls upon a smaller number of workers. In addition, there is increased demand for social services for the elderly, and this often requires significant new investments in health care, senior housing and public transport. This is an

important challenge, not only with social impacts but also with a bearing on the future functioning of municipalities, which deliver a considerable share of public services in the NORA territories.

The dispersed settlement pattern of the NORA region presents several challenges

The settlement pattern of the NORA region was largely shaped by the historic role of communities in the fishery industry. Communities were established to exploit site-specific natural resources. Traditional fishery was highly localised: each community fished a specific territory and fish processing took place in small plants that relied on local labour. These small communities had limited public services and obtained most of their goods and services from nearby trade centres. More recently, the technology employed in fishing and in fish processing has reduced the number of boats and the number of people involved in both fishing and in fish processing. As a result many of the smallest communities in the NORA region no longer have an obvious economic function. Small rural communities specialised in the production of a limited number of goods require sufficient export revenue from sales outside the community to survive (Box 2.3).

Box 2.3. **Export base models**

While export base or economic base models are often criticised, they remain an important tool for regional economics. In particular, they can play an important role when thinking about the nature of local economies in rural areas and identifying strategies for economic development. The fundamental assumption of export base models is that there are two types of economic activity in a community. Some part of the local economy is oriented to creating goods or services that are sold to other regions, while other parts of the local economy are oriented to providing goods and services to be consumed within the region. While both types of activity are important, the distinction is central to the logic of the model.

Few economies are able to produce locally all the goods and services that residents want or firms need as inputs. These have to be purchased from external sources. The basic sector of the local economy is the part that sells its output externally and generates the revenue for the community to buy imports. The idea is particularly powerful in rural communities because they tend to be small and specialised in the production of a limited number of goods and services, so that much of what resident firms and families consume has to be imported. Unless the community receives ongoing income transfers, it has to generate enough "export" revenue (from sales outside the community – not necessarily from sales

Box 2.3. **Export base models** (*cont.*)

abroad) to pay for its imports. In urban areas, by contrast, a far higher share of final demand can be met from local sources, so the internal dynamics of the economy are more complex and more dominant.

The second part of export base theory deals with the role of the non-basic, or local, component. Production sold for local demand is important because it may be an intermediate input in the production of an export good, or because it is consumed by workers in an export activity. Thus, a firm producing lumber that is sold to another firm that produces chairs for sale overseas is a key part of the production process. It is important to emphasise that export base theory differentiates the two functions – a distinction that goes beyond the usual categorisation of 'tradable' and 'non-tradable' activities. Wood and chairs are both tradable goods, but their functions in the local economy differ. If there was no demand for chairs there would be no demand for lumber. Conversely, it may be possible for the chair manufacturer to import wood. Most importantly, if chair sales increase or decrease, there is a direct effect on the sales of the lumber firm. If the chair manufacturer fails, the lumber producer may be able to export its output, perhaps quite profitably, to furniture makers elsewhere, but the impact on the local economy as a whole may nevertheless be negative.

The share of basic and non-basic activity can be determined in a number of ways. Some sectors such as tourism are inherently basic, because tourism by definition involves customers from somewhere else who buy a tourism experience locally. Some services are effectively non-tradables and are thus by definition non-basic. Other sectors may be harder to classify. Retail establishments may sell some of their goods locally while some are exported. By segmenting economic activity on the basis of sales or employment into these two categories, it is possible to determine the share of non-basic and basic activities. The ratio of non-basic to basic activity provides a simple multiplier. If exports increase by some amount then total economic activity will increase by the multiplier times the increase in exports. A simple development strategy for a rural community consists in the first place in increasing exports and in the second place in ensuring that there is adequate capacity in the non-basic sector to support the economic base. The logic of the model suggests that some sectors/firms are more important than others, because they are, in a sense, the locomotives that power the local economy.

Consolidation of the fishing industry has allowed a small number of places in each territory to expand the number of jobs in fishing and fish processing, even though total employment in the sector has declined, but the number of settlements that have benefitted from consolidation is far smaller than the number that have seen reductions in employment. In addition, there has been a trend in public service delivery to offer services in larger-scale facilities that serve bigger populations. This has led to regional centres

which take the place of a more spatially dispersed service delivery system. The result has been pressure for settlement consolidation that has been enhanced by population ageing and migration from smaller settlements to bigger towns. A similar pattern exists in regions that historically relied upon agriculture. In the OECD, many rural communities dependent upon farming are confronting economic decline and loss of population. New production and transport technologies have resulted in fewer, but larger, farms and these larger farms no longer rely on local merchants for inputs or to purchase their crops. As a result, a few communities grow and they become the new regional service centres, while other nearby communities see firms close and people leave.

The concentration of population in fewer viable settlements may offer some benefits…

There is an open debate in some NORA territories, especially in Greenland[3] over the potential for encouraging the further concentration of population in a smaller number of more viable settlements. Demographic trends, combined with the existing sparse settlement patterns, are raising questions about the benefits of settlement consolidation. As the resource sector moves towards more capital-intensive methods and larger-scale production, the economic rationale for many smaller settlements is disappearing. In Greenland, some argue for concentrating population and workers where emerging activities linked to the mining industry and the new aluminium smelter plants are located. Concentration of population and workers is expected to have at least four effects in the long term:

- It will allow for a supply of labour in the places where new job opportunities are appearing and can thus enable diversification from traditional activities (mainly fishing and hunting) to new emerging activities.
- It will make it easier, and cheaper, to provide key public services such as education or health, because economies of scale can be achieved.
- It will reduce the pressure on public expenditures and allow a greater concentration of public investment on infrastructure, because less transport and electricity will be needed in small remote places.
- It will give the population the possibility of receiving better public services.

To help overcome the distance barrier, the government of Greenland has introduced a mobility act which allows municipalities to apply for relocation support for workers and their families wishing to take advantage of job

opportunities. If granted, recipients' transport and relocation costs are covered by the government.

…but forced consolidation has social as well as economic costs, and the benefits are not always clear

For settlement consolidation to result in significant savings in service delivery, resettlement on a significant scale is needed and some places have to be abandoned. This usually involves a greater degree of compulsion than most democratically elected governments choose to impose, especially since older residents of small villages often maintain strong attachments to their communities and resist relocation efforts. Typically, governments are unable to deny services to people who refuse to leave a community. Compensation can motivate some people to move, but this may have the effect of raising the unit cost of providing services to those who remain.

In Greenland's experience the long-term social consequences of relocating rural populations to larger settlements are often not good for the older generation and unskilled workers. If people have artisanal skills that are useful in their original community, they may be able to be reasonably self-sustaining with limited transfer payments. If they are relocated to an urban context and lack the skills needed for wage employment, or if employment opportunities are limited, they typically become completely dependent upon transfer payments and further interventions may be needed to deal with health problems or problems of social maladjustment arising from the relocation, such as alcoholism, drug abuse and violence. Another problem is the housing costs connected with relocation, not only for the individuals moving to more expensive dwellings in the larger towns but also for the public economy. In Greenland the government ensures public housing and has responsibility for the housing infrastructure and housing facilities. In cases of relocation this means increased public costs and greater pressure (and longer waiting lists) on the public housing facilities. At the same time, most isolated or sparsely populated villages now have an older work force that is rapidly approaching retirement age. As older unskilled workers have few prospects for employment in new activities, relocation schemes would effectively put part of the current workforce into a dependency situation. This means that savings in public service delivery associated with community consolidation may be offset to a greater or lesser extent by higher outlays on income maintenance. In this regard, any resettlement measure should be clearly planned from a social and labour-market perspective. Moreover, the experience of Newfoundland and Labrador in Canada (Box 2.4) suggests that it may be better to allow people to remain in their traditional environment where only supplemental support is needed.

Box 2.4. **Resettlement in Newfoundland and Labrador (Canada)**

From 1954 to 1965 the government of Newfoundland and Labrador tried to resettle residents of the smallest fishing communities in the province in larger centres. Many of the fishing ports had fewer than 300 residents and lacked a local government or any public services, such as education or medical care. Most were inaccessible except by boat and were facing economic decline as the fishery modernised. Financial aid was provided to each family, but only if the entire population agreed to move. In 1965 a joint federal-provincial programme was introduced that provided more money per family and reduced the share of the population that had to agree to move from 100% to 90%. This share was further reduced to 80% by 1972 when the programme was ended.

Although over 300 communities and 30 000 people were resettled, the programme was highly controversial. Families felt pressured to move in order to allow their neighbours to move. More importantly the promise of a better life did not always materialise. Traditional family and community relationships were destroyed and while those who relocated had access to public services they often found it difficult to find jobs and become part of their new community.

While there is no formal resettlement programme in Newfoundland and Labrador today, the same issues remain. The closure of the cod fishery in 1992 eliminated most of the inshore fishery the small communities depended on. While new fish species, particularly shrimp and crab, have replaced the cod revenue, the new fishery relies upon a small number of boats that operate far away from their home port and land their catch at central processing facilities. Newfoundland and Labrador still faces the problem of delivering expensive public services to small remote places where the population is ageing and shrinking. Now however there is a growing sense that the best solution is managed decline.

Source: Heritage Newfoundland and Labrador, *www.heritage.nf.ca/law/resprogram.html*.

As governments struggle to reduce unit service costs, the twin pressures of consolidation of traditional businesses and consolidation of public services in most peripheral communities mean that their survival hinges upon identifying a new economic function (Box 2.5). Certain emerging sectors, such as renewable energy, which is for the most part rural, could offer rural regions some opportunities. Tourism represents a significant alternative for some locations (see section 2.3). Some places with good natural amenities are able to attract tourists who become part of a new export base activity. But tourism hinges upon good natural amenities and good connections to the outside world. This suggests that if governments want to revitalise rural areas as tourist destinations, they will have to

improve the transport infrastructure. Improved transport is a two-edged sword. It lets people out as well as in. Many places have found that with better roads or other means of transport more firms and residents leave, because the cost of exit has been lowered. In this regard, co-ordination between transport infrastructure and other economic development policies will be crucial to improve the conditions, capacities and competitiveness of peripheral locations.[4] The potential prosperity of a location will therefore be determined by drivers such as human capital, entrepreneurship, access to innovation and technology, good infrastructure, and access to business and financial services.

Box 2.5. **Rural communities, youth migration and economic decline**

Outmigration has been a common phenomenon in small rural communities of OECD countries for a long time. In fact, much of the growth of cities in OECD countries in the 19th and early 20th centuries came from rural migrants. Ambitious rural youth left for better jobs in urban areas. However, at that time the population of rural communities remained constant or grew slightly, because families had many children and only some left. Enough children stayed to allow outmigration but also maintain community size. What changed in the latter part of the 20th century was a decline in rural birth rates and reduced demand for labour in traditional rural industries, such as agriculture, fishing and forestry. The combination of small families and fewer local employment opportunities has made it difficult to maintain community viability. While the number of children leaving has not changed very much, they now account for a larger share of all children. Although many rural communities are actively discussing how to attract new migrants, there will be little chance of increasing the local population without an increase in the demand for labour. In the NORA region, where there has been growth in some localities, either because of mine openings, oil and gas production, new aluminium smelters or the harvest of a new fish stock, settlements have seen population growth. Settlement viability is mainly driven by having an economic function.

Challenges for public service delivery

All OECD countries face the challenge of providing basic public services in small settlements. Over time, the public's expectations about the level of services that should be made available to all citizens have increased, and changes in technology have led to larger minimum scales for delivering specific services. For example, a one-room school is no longer seen as a viable approach to education. Additionally, a community must now have a

broad set of high-quality public services if it is to attract new migrants and new firms.

In the NORA region the issue of public service delivery is particularly challenging for three reasons.

- The NORA economies are individually so small that, especially in the most peripheral locations like the Faroe Islands and Greenland, it is difficult to provide some public services (*e.g.* higher education or specialised health services).
- The region relies on air and sea links for a much greater share of transport than the OECD average, and this increases the difficulty of service delivery to small or isolated locations. Air travel is quick but very expensive and the volume and weight of goods that can be shipped are limited. Sea transport is slow and expensive for small quantities. Moreover, both airports and ports are expensive to build and require specific geographic conditions.
- A considerable, albeit declining, share of the population is located in very small isolated communities. This makes it hard to provide services jointly to these places and raises the unit cost of service delivery. Yet because much of the population is older there is high demand for public services.

In many remote rural OECD areas there have been significant advances in delivering public services. The crucial step has been to focus on service outcomes, rather than on the specific means of delivery, and to engage the local population in identifying which services are most important and the ways to provide them in a cost-effective manner that meets local needs (OECD, 2010a). Many of these approaches rely on the mobility of the service provider or the service user to achieve minimum efficient scale. In much of the NORA region these approaches are less likely to be useful because of the high cost of moving people between isolated communities. The situation is particularly difficult for Greenland owing to the reliance on air travel and the problem of weather-imposed breaks in air service. In the Faroe Islands the completion of the system of tunnels and bridges that links most of the larger islands has created road connections which have greatly increased opportunities for the mobility both of service providers and service users.

Information and communication technologies (ICTs) can play an important role in service delivery

ICTs are both a service that has great value of itself and a vehicle for delivering other services. The Internet offers a means of delivering public services such as health care and education in remote areas. E-health is being used in OECD countries as a way to provide better and more cost-efficient health services in sparsely populated and remote areas. Rural hospitals are using the Internet to allow specialists in large hospitals in urban centres to provide diagnoses and advice on treatment. The result is greatly improved medical outcomes (Box 2.6). Similarly, distance learning and e-books provide small rural schools with classes and resources that cannot be provided locally. The Internet also allows firms in small and remote places to tap national and global markets for both sales and inputs. This makes the presence of high-speed broadband an important public service in communities of all sizes. As shown in Chapter 1, Internet coverage in the NORA region is good, but better and more efficient coverage in rural areas and peripheral localities is needed. Greenland needs to broaden the coverage, and the price of Internet services is high in the Faroe Islands.[5] OECD countries implement different measures to ensure Internet availability in remote areas. The EU's Northern Periphery programme has also developed specific programmes to reduce the digital divide in remote and rural areas (Box 2.7).

The Internet can also promote good business opportunities

The Internet has also become an effective tool for rural firms seeking to penetrate distant markets in urban areas. The availability of extensive and efficient ICT connections, accompanied by well-developed ICT utilisation skills among the general and business population, is a necessary condition for the development of new activities. Internet technologies are a relatively cheap way to market a firm and a way for firms from remote locations to acquire information about new techniques and new suppliers. Prior to the general availability of the Internet, firms in remote areas were largely restricted to local markets which may have been too small to allow them to grow or even to be viable in the longer run. Now a firm in a remote place can potentially produce a specialised product that can be sold around the world. At the same time, however, such firms may face tougher competition at home, since the Internet also provides rural households and firms with the opportunity to source many more things from remote providers.

Box 2.6. **E-health in Norrbotten county, Sweden**

Norrbotten county in Sweden offers a practical example of how e-health can provide more efficient and less costly health services. Access to health services in remote, large and sparsely populated regions like Norrbotten creates challenges for the patients and the county: long distances to get medical attention and high costs per patient, as well as a large share of elderly in the population, which means both low per capita tax revenue and high spending needs. In this regard, Norrbotten has been a pioneer in implementing and getting results from e-health services. Videoconferencing is used in several services: neonatal care, psychiatry, pathology, haematology, physiotherapy and transmission of real-time ultrasonograph examinations. This allows, *inter alia*, daily videoconferences between hospital and local psychiatric units, planning of care activities and exchange of information on patients needing specialist in-patient treatment. Nurses taking care of the elderly can perform basic exams, send the results via the Internet and discuss them with a doctor who is far away. In this way, the care provided by nurses is much more efficient and the patient is moved to a hospital only when there is a true need. In addition a remote-controlled "robot" has been developed for examining patients suffering from a heart condition. This robot makes it possible to examine at a distance, through the use of video, ultrasound images or a remote-controlled stethoscope. Doctors 200 km away can partly monitor patients. Finally e-health services have led to trans-border co-operation between peripheral counties and municipalities. For example, health care providers of Norrbotten and North Finland co-operate to bring health services to the Torne Valley. All have reported several benefits for the county: better access to health services; fewer visits to the doctor and fewer stays in hospital (providing more at-home attention) with a consequent saving of time, private and public resources; access to specialists beyond county borders and throughout the county; and reduction of pollution due to less travelling.

Source: OECD (2010), *OECD Territorial Reviews: Sweden*, OECD Publishing, Paris.

Box 2.7. **Spreading the use of ICTs in rural areas**

OECD countries have introduced different strategies to ensure increased use of technology for learning and delivering care in rural areas. In Spain, the strategic project on the Information Society of Extremadura, based on the fundamental principles of connectivity and technological literacy, led to the development of a powerful communications network and to the provision of broadband access to Extremadura's 383 municipalities. Finland's Kainuu Broadband Strategy is a regional approach taken by the Ministry of Transport and Communications. It aims for full wireless coverage in the region through Wimax (Worldwide Interoperability for Microwave Access) technology, the most cost-effective alternative for the region. The pricing for services in rural

Box 2.7. **Spreading the use of ICTs in rural areas** (*cont.*)

areas is comparable to that for urban customers. The strategy is part of a broader Information Society Strategy for the Kainuu Region which involves not just improving the technological infrastructure but also training and support programmes, a multi-channel communication network and decentralised content production.

In Germany the government launched a pilot programme, Practical Solutions to Close Broadband Supply Gaps, in six "problem municipalities" to address the problem of broadband accessibility. A working group on nationwide broadband supply was formed under the direction of the Federal Ministry of Economics. Participants included representatives from central and local governments as well as private actors. The objective was to achieve the widest broadband coverage possible (*i.e.* coverage of more than 99% of households) through market solutions, thus limiting the use of subsidies. A broadband atlas developed by the Federal Ministry of Economics helped to identify market opportunities for enterprises and areas in need of government action. Preliminary findings revealed that: *i)* market solutions are feasible in many areas, even sparsely populated ones; *ii)* 20 to 30 local customers are enough to realise economically viable (wireless) solutions; *iii)* there are opportunities for small and medium-sized enterprises (SMEs) owing to the dearth of major suppliers in rural areas.

The objective of the DARRA project, supported under the European Union's Northern Periphery programme, is to decrease the digital divide in remote and rural areas among the partner regions (Finland, Ireland, Norway and Sweden) by boosting the use of ICT by SMEs and the public sector, and to improve the region's overall competitiveness. The digital divide is an inter- and intra-regional handicap and one indicator of a region's peripherality. Stronger regional ICT applications are intended to lead to *i)* reinforcement of exchanges with more central and developed regions; *ii)* more complete regional ICT-related applications; and *iii)* jointly developed approaches. The aim is to reduce effectively and sustainably the peripheral character of the partner regions. Levels of ICT maturity have been indicated with an e-ladder (a measurement tool developed under the auspices of the DARRA project) to identify the development needs of each participating company. Development activities are ongoing and SMEs' ICT maturity levels will be measured to assess the progress they have made.

Sources: *www.northernperiphery.eu*; Knaut, Peter (2008), Session IV, OECD Rural Development Conference, Innovative Service Delivery, Meeting the Challenges of Rural Regions, Cologne, Germany, 3-4 April, *www.oecd.org/gov/regionaldevelopment/cologne*; Karjalainen, S. (2007), "Bridging the Broadband Gap in Rural Areas", presentation to the OECD mission, Ministry of Agriculture and Forestry, including also slides from Karppinen, V. (2007), "Access to Broadband in Remote Rural Areas: Developing Information Society in Kainuu Region", Kainuun Nuotta Association, Kainuu, 4 May.

The inherent potential of ICTs must be exploited to the full if the NORA region is to achieve higher levels of economic activity and prosperity. E-health or e-education can support a more efficient and cheaper provision of services in remote locations. E-commerce can promote business opportunities, exchange of services and job creation in the more remote communities (Northern Periphery, 2006). Enhancing the take-up and effective use of ICTs by SMEs, learning institutions and communities will be central to future success.

The Internet is not a panacea for rural areas. To be an effective tool for business, there must also be good physical connections that allow goods to be shipped and customers to travel. To provide other services via the Internet requires a significant investment in training and in modifying practices so that the new delivery mechanism actually delivers useful services. In small and remote places, it is also important to consider private firms and local non-profit and community organisations as providers of services that might be provided by government in larger locations. Non-traditional providers can often integrate the service into their primary activity and achieve an acceptable outcome in a different way at significantly less cost. For example, in England the government has used village pubs as local post offices. This gives the pub a secondary source of income and provides postal services in places that cannot support an autonomous post office. In Canada, local pharmacies play a similar role in housing post office facilities. In Scotland retail or central eating establishments in an area often fulfil a tourist information function.

Economic vulnerability

Economic dependency exists when the local economy is highly reliant upon external support for its well-being. An economy can be both dependent and prosperous, and the NORA region largely fits this description, given its heavy reliance on transfer payments and relatively high standard of living, but this situation leaves it vulnerable to exogenous changes in political or other circumstances. The Faroe Islands and Greenland receive annual block grants from Denmark, a considerably smaller amount in the former than in the latter,[6] while coastal Norway benefits from large fund transfers from the Norwegian government. Only Iceland, an autonomous country, does not receive transfer payments. These transfers fund a significant share of the public sector in the recipient regions, thus allowing a high level of public services and reduced need to fund these services out of local taxes. They also underlie the surprisingly low openness to trade of these economies: normally, very small economies have extremely high trade turnover-to-GDP ratios, but transfers mean that these economies are much more oriented to non-tradables than they would otherwise be.

A second source of external vulnerability is more indirect and stems from very heavy reliance on an extremely narrow range of commodity exports. Glomsrod and Aslaksen (2009) show that, compared to OECD countries, the NORA economies have an unusually high share of GDP from raw materials production and the public sector. The problem with dependency is that external political authorities often shape local economic conditions. This makes it more difficult to identify effective, locally based economic development strategies. Increased resource scarcity should increase the interest of the external world in the NORA region, and while higher rates of extraction may increase income, the volume of resources removed and the net return to the region will largely be determined by outsiders.

Distance and low density of population create barriers to economic growth…

As mentioned in Chapter 1, there are only four cities with a population of more than 100 000: three in coastal Norway – Bergen (256 000), Stavanger (121 000) and Trondheim (168 000) – and one in Iceland, Greater Reykjavik (201 000). The remaining cities are all quite small by OECD standards, especially when one considers that they play the role of either national capitals or regional centres. Typically, size is highly correlated with the range of goods and services available, with larger cities having more complex economies which offer a broader range of goods and services. In the NORA region the small size of urban places and the small populations in rural hinterlands lead to local economies that rely heavily upon imported goods and services. Thus, the development context of the NORA region closely resembles the situation in most rural regions of the OECD, where the penalties of distance, low density and lack of critical mass are significant barriers to economic growth.

Regions that have large internal populations, are well connected to other regions, and have high per capita incomes tend to have more complex economies than those that are small, remote and poorer. A large internal population allows a region to take advantage of scale economies that create a "home market" effect, which is seen as increasingly important in explaining economic growth (Krugman, 1991). A large domestic market also tends to reduce transport costs, since a large customer base is geographically close to producers. Similarly, regions that are close to other regions also have low inter-regional transport costs; this favours specialisation and increased trade. Finally, regions with high per capita incomes have greater opportunities for a broad range of goods and services and a greater ability for niche producers to survive on small sales volumes.

…but peripherality also creates some opportunities for local production

The case of NORA is different. While per capita incomes in the NORA region are high by world standards, the individual economies are small in terms of population and distance from each other as well as from global markets. Small scale leads to high unit production costs in most industries and distance means high transport costs for intra-regional and external trade. However, the NORA members' also isolated nature conveys certain advantages. Because external firms do not see the markets in the NORA region as either big enough or close enough to offer adequate returns, there is often more opportunity for local firms to prosper. High transport costs combined with high per capita incomes create a larger internal market than might be expected in places with small populations. For example, Torshavn, the capital of the Faroe Islands, has a population of 18 000, yet it is able to support a relatively sophisticated retail and restaurant sector that offers items far superior to what would be found in a city of similar size in Europe or North America. Similarly, Iceland, with a population of 300 000, has an international airline that is able to compete with airlines in much larger countries. Of course, this comes at a relatively high unit cost, but in essence local producers offer high unit production costs with low transport and distribution costs, while foreign producers offer low unit production costs with high transport and distribution costs. For consumers prices are high in either case. Because local firms often predominate, it would seem that they are in fact the low-cost providers of goods and services. Prices in the NORA region will inevitably be high relative to larger places, no matter whether the goods are produced locally or imported. However, in the first case there is an opportunity for a more complex economy which may be able to export certain high value, niche items, while in the second the economy will be weakly integrated into global supply chains, but restricted to producing a narrow set of primary products.

Shared peripherality points to the benefits of stronger links among the NORA economies

For remote territories, a crucial factor for improving economic growth is the development of synergies with neighbours. It is only by pooling limited resources that demand becomes large enough to achieve the gains from specialisation. In this regard, regional co-operation can be thought of as an effort to take advantage of a larger market, just as international trade agreements are driven by the search for increased efficiency in global production. An advantage of adopting a strategy whereby NORA members strengthen internal linkages is the possibility of creating a more diversified

and more highly skilled labour force. With a focus on a narrow comparative advantage, the NORA region will remain dependent on external markets for primary and semi-finished products, with prices set in international markets. These markets are largely driven by cost efficiencies and lead to lower wages, simplification of workforce tasks and the substitution of capital for labour. This is an economic structure that will encourage continued outmigration of skilled workers who face limited local opportunities.

Currently in the NORA region, there is only limited competition among producers of any particular good or service, because the local economy is too small to support more than one or two firms. As most firms are small, they tend to have limited employment opportunities and limited export potential. While it is unlikely that most firms in the NORA region will ever become large exporters, even modest export sales would contribute to firms' viability and perhaps increase employment. In a small community, and in a small region, modest increases in employment can have large impacts.

The crucial question is where the most promising export opportunities for small businesses beyond the traditional raw materials sectors are most likely to be found, and it may be *within* the NORA region. Another key question is how great the potential for stimulating further intra-NORA trade might be, given the distances involved. It is likely that for some products and services, trade would simply add high transport costs to the high unit costs already characteristic of the region. In other sectors, it is possible that sufficient scale economies could be realised to offset the transport costs. Trade theory now recognises that the bulk of OECD countries' trade is with other OECD countries. Traditional trade models are based upon simple comparative advantage arguments that suggest national specialisation, but modern trade theory recognises that varieties of broad product categories create opportunities for trade. Thus, countries that produce automobiles also trade automobiles with each other. However, as noted in Chapter 1, such intra-industry trade tends to increase with product sophistication and differentiation and is very limited in the case of primary products, except when seasonal or other factors make it attractive. Greater intra-industry trade among the NORA economies, which rely mainly on exports of primary products, will therefore depend to a great extent on how successfully secondary manufacturing develops.

Restructuring transport networks

For the western part of the NORA region, ship and air are the only external means of transport. At present, transport patterns are strongly oriented to Denmark. This is particularly true for air travel. As shown in Chapter 1, on most days of the year the only way to travel from one NORA

member to another (or, in the case of the Faroe Islands and Greenland, to other potential markets like Canada or the United Kingdom) is via Copenhagen.[7] In Greenland, several attempts during the last 30 years to open up alternatives to Copenhagen (Iceland, the United States and Canada) have only lasted for short periods, simply because the volume of traffic was insufficient to maintain an economically viable connection. However, a year-round route has been established between Reykjavík and Nuuk and seasonal routes have been established between East Greenland and, and Reykjavik. In the Faroe Islands, historical, institutional and economic links with Denmark and low passenger flows result in an international transport system anchored in Denmark, with few connections with much closer neighbours, such as Scotland or Iceland (Table 1.11). The exchange of goods and services exhibits a similar pattern with respect to shipping: while there is some intra-member maritime connectivity, it is limited and a large share does not involve several NORA members. This type of transport network establishes a core-periphery relationship between parts of the NORA region and Denmark and restricts internal trade or the development of regional businesses. Not only Iceland, but a full range of cities in the North American Atlantic coast are closer to Greenland than Copenhagen, which is 3 600 km from Nuuk.

Improved transport infrastructure is crucial to overcoming the challenge of remoteness

Better and geographically more diversified transport infrastructure is needed to ensure the sustainability of communities and to improve the region's competitiveness. An efficient transport network is essential to business development, as it reduces transport costs and improves market accessibility. In addition, transport infrastructure enhances labour mobility, firm relocation, and access to public and businesses services. Finally, efficient connections between the NORA territories are crucial to enhancing their social, educational and economic interactions. A key area of importance in this context is the need to improve air and sea links between the different NORA territories and the international hubs. Some studies have been made to identify improvements to existing and potential strategic transport links in the NORA region (NORA, 2010). These and further feasibility studies are necessary to obtain qualitative evidence to support and promote the strengthening of the regional transport networks.

Transport improvement is challenged by the lack of critical mass

The lack of critical mass makes it difficult to further develop and diversify the transport network, especially in territories such as Greenland

and the Faroe Islands. There are few direct transport connections among the NORA members, largely because the expected volumes are too small to justify them. This results in a typical catch-22 situation, since the absence of connections can be a major impediment to the development of trade and business. Moreover, because transport is now via Copenhagen, an effort is required to identify market opportunities in the NORA region, while it is relatively easier to identify opportunities in Denmark.

A reconfiguration of transport networks could help

Before business or trade takes place there has to be contact. While the Internet now provides an effective initial way to explore opportunities, there is still a need for face-to-face contact. If this contact is hard to manage, there is less chance that market opportunities will be acted upon. The impression of public officials in Iceland[8] is that firms in both Iceland and Nova Scotia showed considerable interest in exploring trade opportunities during the brief period when Icelandair operated direct flights between them. When the flights were suspended, the interest evaporated.

Reorganising transport routes in the NORA region may be somewhat easier than in other places. Where transport is land-based, existing road and rail networks largely dictate transport corridors. The cost of creating a new route is high, because constructing the road or rail line requires large investments. By contrast, in the NORA region, where planes and ships provide transport, no investment in spatially fixed transport infrastructure is needed when routes change. Existing ports and airports can be used for any destination.

However, if the transport network is to be reoriented it will only happen if NORA members choose to act together. Improved integration is largely a public good and private transport operators have little incentive to invest in costly route changes that primarily benefit others. Indeed, because the popular perception is that the four territories are largely competitors, public efforts may be needed to stimulate the shift in behaviour necessary to make a new route structure viable. The experience of Scotland's Route Development Fund points to the potential positive impacts of public incentives to expand and diversify international air-traffic routes to help develop a region's economy (Box 2.8).

Box 2.8. **Scotland's Route Development Fund**

The Scottish Air Route Development Fund (RDF) was established in November 2002 as a partnership involving the Scottish Government, Scottish Enterprise, Highlands and Islands Enterprise, and Visit Scotland. The objective was to improve business connectivity and inbound tourist access through the provision of incentives and public funding to initiate new direct overseas air links to Scotland. Prior to the RDF, most international traffic to Scotland was routed through hub airports such as Heathrow. The RDF contributed to a dramatic improvement in Scotland's direct international air network by concentrating on routes that helped business and in-bound tourism. A recent evaluation of the RDF carried out by Scottish Enterprise found that over its period of operation, there was a steep rise in both domestic and international air passengers. A wide range of Scottish and non-Scottish users benefited from the RDF services, and migrant workers, in particular, depended heavily upon RDF-supported flights to access jobs in Scotland. The review showed that nearly all RDF services return a positive net present value and benefit-to-cost ratio greater than 1, which suggests overall good rates of return, with some instances of very high rates of return. The RDF appears to have had an overall positive impact on business perceptions of Scotland and airline industry risk aversion. As of January 2010, 31 routes continue to operate as result of investment from the Fund. The RDF ceased in its current form at the end of May 2007. However, routes started by that date remain eligible for funding. The Scottish Government has been exploring how route development could progress further.

Source: Scottish Enterprise.

Better transport infrastructure would be facilitated by a parallel process of economic development

Improvement of the transport infrastructure system would be facilitated by a parallel enhancement of the region's competitiveness and economic activity. Promoting innovation, further economic diversification, upgrading the institutional framework for business development, education and working skills appear to be crucial (see section 2.3). Strengthened regional co-operation could result in further economic, academic and institutional interchanges. This, in turn, would contribute to economic development, more regional businesses, trade and human flows, and with this a better framework for developing and diversifying the transport infrastructure network. At the same time, joint public support for improving and diversifying air-traffic routes in the NORA region would help establish a better framework for developing businesses and improving the region's economic potential.

Beyond the opportunities for strengthened economic interactions, the similarities in framework conditions and challenges shared by the NORA regions, the small size of markets and the limited resources and capacity within each of the NORA territories argue for collaborative efforts, exchange of know-how and best practices, and co-operation to confront some of these regional challenges (see Chapter 3).

2.2. The future of the fishing industry

The Faroe Islands, Greenland, Iceland and Norway have strong maritime traditions. All of the NORA territories have long coastlines and, in comparison to their land areas, extensive ocean territories. As underlined in Chapter 1, the marine sector, and especially the fishing industry, continues to dominate the national economies of the Faroe Islands and Greenland, and it remains a key sector in Iceland and Norway. The fishing industry is also an important employer in the NORA economies, including wider employment in fish processing and products. However, the conditions of the fishing industry fluctuate, owing, in particular, to declining fish stocks, increased global competition and varying market prices. Over-exploitation of fish stocks has increased rapidly, putting the biological sustainability and the economic viability of commercial fisheries under serious pressure. The sector also faces the challenges and effects of climate change. Management of the fishing industry is further complicated by the often conflicting approaches and interests at stake. Strong national and regional interests are involved, but international, co-ordinated management of shared fish stocks is essential. Sustainable development of the sector relies on local responses, such as adaptation within fishing communities. At the same time, international action is required on issues such as over-fishing, management of fish stocks and climate change. Obviously, strong economic interests are at stake, but political, environmental and cultural concerns, such as the sustainability of traditional fishing communities, are as well.

Fisheries and the marine sector in the NORA region: major trends[9]

The economic cycles of the NORA territories have traditionally been linked to the cycles of the fishing industry. Good catches and high export prices resulted in economic growth, while poor catches and adverse fishing and market conditions have led to economic slowdown and even depression (ACIA, 2005). However, the NORA territories face different challenges related to declining fish stocks, increasing global competition and varying market prices, as well as the common challenge of climate change. A more recent challenge is the impact of the global economic crisis. Although some

areas of the industry have not been affected, there have been three main impacts on the fishing industry in the NORA territories.

- The prices of some fish species have decreased. Crucially, cod prices have been falling in Greenland, Norway and the Faroe Islands. Shrimp prices have also fallen, which poses a particular challenge for Greenland, where shrimp is the most important species. It has also affected Iceland, where the shrimp quota was not fished in 2008 owing to the low prices.[10]
- Fewer investments are made in the fishing industry because the banks are very cautious about lending money. This is the case in all four territories, but it has been especially keenly felt in Iceland. Companies, including fishing companies with loans or investments in foreign currencies, have been also negatively affected by the devaluation of the Icelandic kroná.
- High fuel prices are having a serious impact on the fishing industry, making it more expensive to run vessels and much more difficult for some vessels to remain profitable.

In general, while fishing fleets have shrunk, individual vessels have grown larger and more efficient

The commercial fishing fleets in the NORA territories vary in size, type of vessel and forms of ownership. However, there are a number of common trends in the current structure and scale of the fleets. Fishing fleets are extensive and comprise a range of vessels, long-liners, gill-netters, single and pair-trawlers, purse seiners, some ocean-going factory ships, and a large number of smaller coastal vessels. The trend for a long time now has generally been from a small-scale, labour-intensive industry to a professionalised industry based on modern vessels and gear. Vessels have increased in size and in efficiency and need fewer crew members, and the area of operation has expanded from coastal areas to the high seas. However, small-scale fisheries and small processing plants with very simple technology still exist alongside a modern, highly efficient fleet and modern processing plants.

Overall, the NORA fleets are large relative to population, but the number of vessels has been decreasing in the last ten years except in Greenland.[11] Cuts in vessel numbers are linked to a range of factors, including the increasing efficiency of modern vessels, the collapse of some key fish stocks, especially cod, fluctuations in the value of catches and the cost of running vessels. Reductions and restrictions have also been placed on the numbers of licensed vessels. For example, in Norway, an industry-

funded decommissioning scheme was launched as part of a package of capacity-management measures introduced in 2004. Several OECD countries have implemented plans for structural adjustment of fishing fleets (see Box 2.9). Another important reason for a reduction in the number of vessels is the quota management system. One purpose of individualised and transferable quotas is to explore efficiencies through concentration on more efficient vessels.

Within the fleets, a small number of vessels account for a large proportion of the catch. In Norway, pelagic trawlers and purse seiners account for approximately 40% of total landings, although they represent only 2% of vessels (FAO, 2010). In 2007, about 41% of the total catch value in Iceland was landed by trawlers, just over 1% by small undecked boats and 58% by other vessels of varying sizes and capacities (Icelandic Ministry of Fisheries and Agriculture, 2010). In Greenland, too, fisheries remain very concentrated. The trawl fleet consists of a relatively small number of shrimp vessels. Nevertheless, many small villages and settlements depend on small artisanal fisheries: small boats either have to land to central fish collection systems or the activity is for local consumption.

Employment in fisheries has been falling but remains important

There has been an important drop in employment both in fishing and fish processing in recent years. However, as shown in Chapter 1, the sector still plays a vital role in terms of employment and value creation (Table 2.1). Moreover, aggregate fishing statistics may understate the contribution of the fishing industry and ancillary activities to the economies of the NORA territories: backward linkages to activities such as shipbuilding and maintenance, fishing gear production, or fisheries research and education, and forward linkages, including the transport of fish products, fish processing or the production of animal feed, play an important role and create many jobs in the economies of these territories.

The processing sector is a key source of jobs in the NORA territories, although its size has tended to decrease over the last ten years. Processors constituted 42.5% of workers in the fishing sector in Iceland, 37.5% in Faroe Islands (both in 2008), and 34.4% in Coastal Norway (2006). In Greenland (where employment data on fish processing are not available) fish processing (mainly shrimp and Greenland halibut) is the major manufacturing industry. Advances in the sector have led to reduced running costs, less waste and the use of fish waste for processing into marketable products, such as feeds and fish oils, but it has also contributed to a reduction of employment in order to maintain competitiveness. Iceland has been at the forefront of modernisation of the fish processing industry.

Box 2.9. **Examples of structural adjustments of fishing fleets in OECD countries**

Many OECD countries are taking steps to bring production in line with resource availability. This is being achieved through a mixture of resource recovery plans, vessel decommissioning programmes, improved management measures, and the strengthening of fisheries monitoring and surveillance activities. Many OECD countries have been actively reducing the size their fleets through decommissioning programmes in order to better match fleet capacity with available resources.

- Within the European Union, strict capacity management has been established since the new Common Fisheries Policy came into force in 2002, resulting in a 10% decrease in the number of vessels and a 7% decrease in total gross registered tonnage (GRT) up to 2005. Such measures are implemented through two key requirements: any entry of capacity has to be compensated by the exit of at least an equivalent capacity, measured both in terms of tonnage and power; and capacity withdrawn (or scrapped) with public aid cannot be replaced.

- In France measures have been taken to reorganise the industry so as to enable better resource management and promotion. Until 2002, financial measures to reduce fishing had been used in order to reduce the capacity of the French fishing fleet by 3%. As from 2003, the Common Fisheries Policy imposed an additional 3% reduction of the fleet compared to the reference levels at the end of 2002. In order to achieve these objectives, a decommissioning plan was implemented over the period 2003-04 with a budget of EUR 400 million. Furthermore, fleet renewal subsidies were discontinued as of the end of 2004. In 2006, a EUR 26 million decommissioning plan was introduced. It should affect 80 vessels and result in a reduction of 23 300 kW. A plan to protect and restructure enterprises was added to the decommissioning plan for the year 2006 with a budget of EUR 26 million, to make it possible for the fleet format to adapt to the resources available and to improve, in the medium and long term, the viability of fishing enterprises. Under this protection and restructuring plan, consolidation loans are available as well as structural subsidies for replacing engines, upgrading fishing gear, etc.

- In Finland two separate decommissioning schemes (vessel scrapping with community aid) of the Finnish fleet were carried out during 1997-99 and 2004-06. The total capacity reduction with public aid in 1997-99 was 827 gross tonnes (GT) and 4 158 kW. The equivalent reduction in 2004-06 was 1 378 GT and 6 025 kW.

Source: OECD (2008), *Review of Fisheries in OECD Countries: Policies and Summary Statistics*, OECD Publishing, Paris.

Icelandic companies have contributed to increasing quality and yield by improving technology. For instance, Iceland was among the first countries to develop on-board processing equipment that could operate in extremely rough conditions. In Greenland, close to 75% of shrimp catches are processed on board the trawlers, and the remaining catch volumes are processed in factories managed by Royal Greenland in towns and settlements. Some of the plants are not profitable but have been maintained, as they play a pivotal role in the economic life of smaller towns and settlements (OECD, 2005b). How to maximise value added through better, more efficient processing and product development are key issues for the future of the sector in the NORA Region.

Table 2.1. **Share of fisheries and fish processing in total employment**[1]

Percentages

		2000	2002	2004	2006	2008
Faroe Islands	Fishing	13.34	13.49	12.38	11.23	9.6
	Processing	10.05	9.93	8.13	7.48	5.8
Greenland[2]	Fishing	4.65	5.22	4.56	4.89	
	Processing	NA	NA	NA	NA	NA
Iceland	Fishing	3.90	3.38	2.95	2.71	2.35
	Processing	4.28	4.08	3.46	2.24	1.74
Coastal Norway	Fishing	1.75	1.66	1.56	1.44	1.34
	Processing	1.17	1.13	0.94	0.75	0.70

1. Employment in fishing includes fish farming.

2. Employment only includes persons living in towns; it excludes population living in settlements.

Source: National statistical offices.

Measures to promote the long-term sustainability and prosperity of the fishing industry are as important as measures to support the communities most affected by restructuring and to promote alternative occupations. These measures will be especially relevant for smaller towns and settlements in which fishery is still the main – and, in some cases, almost the only – activity. OECD countries facing similar challenges have adopted measures ranging from financial packages to help individual fishing businesses to exit the sector to programmes aimed at training and capacity building in targeted communities (see Box 2.10)

Box 2.10. **Supporting the rationalisation of the fishing sector**

Australia's Securing our Fishing Future package, released in 2005, was designed to create a sustainable and profitable operating environment in Commonwealth-managed fisheries. The package includes an AUD 220 million structural adjustment package, a range of new fisheries management measures in Commonwealth fisheries and the declaration of Marine Protected Areas (MPAs) in the south-east marine region. The financial package included an AUD 150 million one-off, voluntary tender process to allow individual fishing businesses to rationalise or exit the industry, AUD 20 million for community assistance, AUD 30 million for onshore and related business assistance and AUD 21 million for a levy subsidy.

In Canada, the Aboriginal Fisheries Strategy (AFS) includes co-management approaches aimed at building fishing capacity, and incentives to support aboriginal communities' participation in fisheries management. The Allocation Transfer Programme is an integral component of the AFS, which facilitates the voluntary retirement of commercial licences and the issuance of licences to eligible aboriginal groups in a manner that does not add to the existing fishing effort, thereby providing communities with much needed employment and income. Other programmes and initiatives have been implemented to provide aboriginal fisheries with the capacity to manage their commercial fishing operations. Those programmes also aim at improving their participation in decision-making processes for aquatic resources and oceans management, diversification of the catch in the inshore fishery, improving overall fishing skills, as well as improving safety and vessel maintenance.

Source: OECD (2008), *Review of Fisheries in OECD Countries: Policies and Summary Statistics*, OECD Publishing, Paris.

Catches remain high by historical standards but their composition is changing

The evolution of catches in the NORA territories reveals no long-term pattern of decline. Catches in Norway and Iceland have decreased over the last ten years but remain high by historical standards, and landings continue to grow in the Faroes and Greenland (see Chapter 1). Within these broad trends, the type and volume of catches of specific species vary considerably between the NORA territories (see Table 2.2). Within a large variety of fish stocks the most important are cod, haddock, saithe, Greenland halibut, and pelagic fisheries for herring, blue-whiting and mackerel.

Table 2.2. **Key species 2008 or latest available figures (thousand tonnes)**

Species	Faroe Islands	Greenland	Iceland	Norway[1]
Flat fish	4.8	19.5	24.2	14
Codfish	361.9	12.9	507.6	1 100
Other marine fish	142.3	7.9	738.7	1 176
Crustaceans and molluscs	12.3	69.3	12.4	86
Freshwater fish	-	0.02	-	0.6
Total Fish	521.3	109.6	1 283	2 393.3
Aquaculture	38	-	5.1	846.3

1. Figures for Norway are for 2007.

Sources: National statistical offices; Norden Statistics Databank.

In terms of catches, the collapse of high-value fish stocks, especially cod, has had a dramatic impact on the sector, as cod is a high-value catch and a large part of the fishing fleets focused on this species. Greenland and Iceland experienced a peak in cod catches during the late 1980s, followed by a dramatic decline. In Iceland in 2006, cod landings were at their lowest level since 1984. In Norway, catches of cod peaked in 1997, followed by significant fall in subsequent years. This happened in a context where the resource base, not only in the NORA region but worldwide, remains under pressure. Recent data from the FAO indicate that worldwide, 25% of global fish stocks are overexploited or depleted, while 52% are fully exploited (FAO, 2007).

Yet, for some species (*e.g.* prawns, shrimp, halibut, pelagic fish), landings have generally been stable or have increased since the start of the millennium. Thus, the industry has demonstrated some areas of adaptability. For instance, in the Faroe Islands, landings of pelagic fish, which make up the majority of the overall catch, increased after 2000 and peaked in 2006, while other catches remained relatively stable. In Norway over the last ten years, catches of pelagic/industrial species have been relatively stable. In 2008, Greenland's fishery for deepwater prawns was at its highest level for almost 20 years. In Iceland herring catches have also gradually increased since 2000. Similarly, offshore shrimp catches reached their highest level since the mid-1980s in 2007/08. How to continue to respond to changes in the available fish stocks, and how to combine efficiency with sustainability, remain the sector's central concern. As will be discussed below, effective management of fish stocks is closely linked to increased co-operation and to innovation in the region.

Aquaculture is emerging as an alternative to traditional fisheries

In all NORA territories except Greenland, farming of species such as Atlantic salmon and rainbow trout is a significant and growing part of fish production. It is especially important in small coastal communities. The development of the sector is strongest in Norway and the Faroe Islands, where the geography of the coastlines' deep fjords, the clean, temperate waters and strong currents provide ideal conditions for fish farming. The volume of fish farming has more than doubled in both territories over 1998-2008 (Table 1.7). Norway in particular, is a world leader in aquaculture. In 2008, Norwegian seafood exports amounted to NOK 39.1 billion (EUR 4.8 billion), 51.7% of which consisted of farmed seafood; for the first time, exports of farmed fish exceeded those of wild capture fish (NORA/Norden, 2009). Salmon makes up close to 90% of total sales of Norwegian fish farming; preliminary figures for 2009 and early 2010 show considerable growth of farmed salmon, both in volume and value, following the collapse of the competing Chilean industry due to infectious salmon anaemia (ISA). Farming of other species, including cod (11 104 tonnes in 2007), has expanded. In the Faroe Islands, too, aquaculture represents an increasing proportion of production, though fish farming in 2008 still amounted to not much more than 9% of sea catches in live weight.

Fish farming is very vulnerable to sudden collapses because of fish diseases (see Chapter 1.2). The development of fish farming requires strict environmental controls, in order to minimise the risk of pollution, diseases and other damage to the surrounding ecosystem: sea lice, mass escapes and infectious diseases from fish farms can seriously affect surrounding wild fish; escapes can also produce interbreeding (genetic pollution). At the same time, medication, pesticides and fish-farm feed, if not controlled, can also have severe environmental effects. The recent launching of the "Strategy for an Environmentally Sustainable Norwegian Aquaculture Industry" by the Ministry of Fisheries and Coastal Affairs seems to go in the right direction. It identifies the main environmental challenges for the industry, sets goals and explains what needs to be done to achieve them. It does not include specific effect-indicators for acceptable influence (Norwegian Ministry of Fisheries and Coastal Affaires, 2009). Further work is therefore necessary on implementing the concept of sustainability in an appropriate manner. This will require further research and investment in technology (*e.g.* to develop containment systems that protect wild fish from sea lice, mass escapes and infectious diseases).

Fisheries management in the NORA region

The continued development of fisheries relies on effective and sustainable management of the resource. Fisheries management systems are crucial for protecting stocks from over-fishing and for improving the economic performance of commercial fishing industries (Pearse, 2002). Because fish stocks do not follow administrative borders, and because marine environmental challenges have a clear international component, regional co-operation is needed to promote more efficient and sustainable fisheries and aquaculture.

NORA territories apply different approaches to the management of fisheries

Fisheries management systems and approaches are the subject of considerable debate. The NORA regions apply their own, distinct approaches to the management and development of the fisheries sector over their own extensive aqua-territories. In this regard, they have retained a high degree of independence in the management of their fisheries, in comparison, for example, with EU member states. The approaches used for NORA fisheries management vary in detail, but can be divided into two main categories: output-controlled systems, based on shares of allowable catches, and effort-based fisheries management systems, based on fishing days (see Box 2.11). This diversity can be a source of strength, as it provides administrations with the opportunity to learn from each other's innovations (Norden, 2010). Yet differing approaches make greater co-ordination within the NORA region complex, especially as access to fisheries is a politically contentious issue, involving lengthy and complex negotiations and a wide range of interests. Co-operation is a key element of the response, especially for mobile fish stocks. Thus, there is a range of international agreements and arrangements covering the NORA region, *e.g.* the North-East Atlantic Fisheries Commission (NEAFC), as well as collaboration with international institutions (*e.g.* the EU and the International Council for Exploration of the Sea).

Box 2.11. **Output- and effort-based fisheries management systems**

Output-controlled systems are applied in Iceland, Greenland and Norway. They focus on how much fish can be landed. Fisheries rights are distributed in quotas, *i.e.* shares of total allowable catches (TACs). Decisions on quotas generally involve consultation with key stakeholders.

- Iceland was one of the world's first fisheries management systems to base the distribution of quotas between vessels on a system of individual transferable quota shares (ITQ system). Within Iceland's exclusive economic zone TACs for individual fisheries are set by the Ministry of Fisheries and the Parliament, based on advice from the Icelandic Marine Research Institute (Christensen *et al.*, 2009a, 2009b).[1] In particular, a harvest control rule (HCR) for the most valuable catch, cod, was introduced in 1996, which means that this TAC is a direct calculation based on advice from the Marine Research Institute.

- Fisheries management in Greenland is based on a system of licences. Different types of licences are issued, based on time and catch limitations. Each licence states where a vessel owner is allowed to fish, for which species and with what kind of vessel. The quota attached to the licence is expressed in terms of quota shares, and the owner of the licence receives an annual quota. The Greenlandic government (*Naalakkersuisut*) establishes rules on access to fisheries, sets TACs, and determines the conditions under which the fishery should be carried out. TACs are generally based on advice from the Greenland Institute of Natural Resources. The *Naalakkersuisut* also consults with the Fisheries Council, which includes representatives from the fishing industry, mainly from the bigger vessel companies.[2] Finally, regulation of shrimp fishery is based on quotas – ITQs – and licence regulations, while the TAC is based on the biological advice of the North Atlantic Fishing Organisation in order to ensure sustainable use of the resource.

- Norwegian fisheries management is based on quotas and licensing requirements. Three main types of quotas are allocated to different groups of vessels. Individual quotas are then allocated to each vessel, either through individual vessel quotas (IVQs) or through maximum quotas. In the case of IVQs, the group quota is shared among the participating vessels with a fixed portion for each vessel. The system of maximum quota sets an upper limit to the annual catch. Vessel quotas and maximum quotas allocate a fixed maximum quantity of a certain species. The authority to manage Norwegian stocks lies with the Norwegian central government and the Ministry of Fisheries. However, there is consultation with key stakeholders. For instance, the Institute of Marine Research and the International Council for Exploration of the Sea (ICES) give advice for setting TACs for specific species. TACs for Norwegian stocks are then established in consultation with experts, industry representatives and government officials, following hearings held by the Fisheries Directorate and the Management Council.

Box 2.11. **Output- and effort-based fisheries management systems** (*cont.*)

In contrast to the output-controlled approaches use in Iceland, Greenland and Norway, an effort-based system, which replaced an ITQ system in 1996, is applied in the Faroe Islands. The system is complemented by technical measures and area closures (Løkkegaard *et al*., 2004). The Faroe Island's effort-based system is based on the number of days that individual fishermen have the right to fish. The system is structured around a segmentation of the fleet, based on the size of vessel and gear type. Each year the relevant fleet groups are allocated a number of fishing days per year. These days are allocated to the individual vessel, but fishing days are tradable with certain restrictions. The idea behind the fishing-days system is that fishing capacity and the numbers of fishing days are fixed and allow fishermen to absorb and respond to fluctuations. The effort-based system was designed to take account of the fact that fishing for demersal ground fish species in Faroese waters often results in a mixed catch. Basing the management system on a multi-species approach and the ecosystem in which the fishing takes place means that the entire catch is legitimate and has an economic value, thus reducing discard of unwanted fish. TACs for the stocks of the exclusive economic zone (EEZ) are set domestically. Advisory boards consisting of key stakeholders, biologists and active fishermen advise the relevant minister and parliament (*Løgtingið*) in setting the TACs. However, for shared fish stocks, which are mainly pelagic species (herring, blue-whiting and mackerel) the TACs are set in international agreements.

1. Stakeholders play no formal role in the decision-making process. However, representatives of the fishing industry are involved in discussions on the advice of the Marine Research Institute (Christensen *et al*., 2009a, 2009b).

2. The Greenlandic government (*Naalakkersuisut*) is developing a new system. However, at the time of writing the details of this system are not publicly known, although indications are that it will be more formalised and transparent.

Management systems are complemented by a range of additional regulations. For instance, all the systems have restrictions and allowances for different gear types, minimum mesh sizes on nets to prevent catches of immature or young fish, and sorting grids to minimise unwanted by-catch. Closed areas are also used. Some areas are closed during the spawning season. Temporary closures are applied in areas in which there have been high catches of juvenile fish. In the Faroe Islands long liners are not allowed to fish within six miles of the coast. Other areas are closed for trawlers. For instance, in Greenland, trawling is banned within three nautical miles of the skerries; in these areas only passive gear types are allowed. Norway has a number of trawler-free zones, which are permanently closed.

Transferability of fishing rights could help improve the robustness of the sector

Transferability of fishing rights allows for an important element of flexibility and adaptability. The introduction of transferable rights tends to lead to greater concentration of fishing rights in fewer hands. This can increase economic efficiency. Experience in fisheries which have introduced transferable rights has shown that transferability also tends to limit overcapacity, as some commercial fishers sell their rights (CEC, 2007). This can improve the balance between fishing capacity and stocks. Transferability can also be an important platform for co-operation. Once individuals are members of a group that collectively holds exclusive rights to fish, and each has a specified share of the harvest, "the stage is set for co-operation" (Pearse, 2002). Moreover, if individual quotas are secure, long-term and transferable, they are valuable assets and their holders may develop a keen interest in protecting and enhancing them, *i.e*. in developing conservation measures.

Nevertheless, experience has demonstrated that transferability is not a panacea for problems of overfishing or activities such as high-grading (selectively harvesting fish so that only the best-quality fish are brought ashore). Additionally, transferability and potentially excessive concentration can make it more difficult for new entrants, particularly for young people who have to acquire their first fishing rights. It may also have consequences for small-scale fleets, as structural adjustment can lead to higher economic and social costs (CEC, 2007).[12] The extent to which rights can be transferred varies between the NORA territories (see Box 2.12)

Box 2.12. **Transferability of fishing rights in NORA territories**

The fishing-days system operated in the Faroe Islands allows for the transfer of fishing rights. Throughout the year, Faroese fishing vessels can trade their fishing days within a section of the fleet. Fishing days may be leased for one year or sold. In the last three months of the fishing year (from June to August), all commercial fishers can trade fishing days, but only for the remaining part of the current year. However, transferring fishing days between different kinds of vessels is more complex than transferring ITQs (individual transferable quota shares) between similar vessels. Therefore a key for transforming fishing days from one kind of vessel to another has been developed to ensure that as many of the fishing days as possible are used. Trading of fishing days is monitored by the fisheries inspection.

Box 2.12. **Transferability of fishing rights in NORA territories** (*cont.*)

Quota shares in Greenland are partially transferable. The only clear kind of transferability is that quota shares are hereditary. The rules for fishing companies owned by the government are more flexible. Licences or quota shares can be sold if, for example, a vessel is out of order for an extended period, or if ice or similar circumstances prevent the fishing company from using its quotas. However, there are still restrictions. The Greenlandic government (*Naalakkersuisut*) can reduce the quota shares that are transferred and added together. The Fisheries Act sets the maximum quota-share percentage (between 10% and 33.3%) for various fisheries in order to ensure that none of the fishing companies becomes too big. The Act stresses that transfer can only take place within the same fleet component; this means that a vessel can only fish what it is licensed to fish. Additionally, as a general rule, rented quota shares should only be fished by the company that owns the quota.

The core of the Icelandic system is the transferability of quota. All commercial fish species in Icelandic waters are subject to the ITQ system. Quotas can easily be transferred (either on a yearly rental basis or by selling them) between vessels. This is carried out via an online system, which is regularly updated and provides the fishers (and fisheries inspection) with a real-time picture of who over-fished his quota and who still has quota left. As part of this system, a vessel can transfer some of its quota between fishing years, but the quota is lost if the vessel catches less than 50% of its total quota in two subsequent years. There is also a requirement that, within the year, the net transfer of quota from any vessel must not exceed 50%. The quotas are based on so-called cod equivalents, whereby cod is assigned a value of 1 and cod equivalents are calculated as the proportion of the value of individual species compared to the value of gutted cod. The Directorate of Fisheries publishes cod equivalent tables annually. The cod equivalents fluctuate considerably from year to year, mostly owing to changes in market prices. This system was tailored to ensure maximum economic gain from fisheries. The system of cod equivalence also contributes to biological robustness for cod because fishers can catch all other species without owning the quota or having to lease it as the catches are deducted from their cod quota. The aim is to make the system flexible and help to prevent discard.

In Norway, quotas are not directly transferable. Some vessels have a common pool quota; this group of vessels can fish as long as quota is left in the common pool. Other vessels are under a system of individual vessel quotas (IVQs). This is a management mechanism to distribute the Norwegian TAC among different segments of the fishing fleet. The fleet is divided into several groups according to size and fishing technique (trawlers, purse seine, etc.). Each vessel group is then allocated a group quota which is shared among the participating vessels in fixed and (more or less) guaranteed portions. Trade in quota is not allowed, although an informal market has existed. In addition, different quota-transfer systems have been developed to meet the challenge of increasing overcapacity due to technical development in vessels, gear and equipment (OECD, 2008b).

The extensive debates that have taken place over the relative merits of these management systems are beyond the scope of this study. However, when addressing the common challenges and opportunities for co-operation in the NORA region, it is important to recognise the potential contribution of three main features to sustaining the sector:

- In light of climate change, ocean pollution, overfishing and technological advances, there is a need to maintain a flexible and responsive approach to the design, implementation and application of management systems in order to reflect changing social and biological conditions in particular fisheries. At the same time, for the industry to develop, there needs to be some stability in the overall approach to allow forward, strategic planning.

- As mentioned, the ability to transfer rights to others in the sector can help improve the sector's adaptability and robustness. The introduction of transferable rights can lead to increased economic efficiency, help limit overcapacity and provide an important platform for co-operation. Yet safeguards are normally adopted to limit negative economic and social consequences. Most countries that have introduced transferable rights schemes have safeguards, *e.g.* to limit transfers of rights to geographically defined communities or to reserve a share of rights for young people (CEC, 2007).

- Stakeholder consultation in the decision making process is key to securing success in implementing management approaches (OECD, 2008a). Such involvement helps to ensure that the best information is used in the decision-making process and stakeholder buy-in for changes. Any uncertainty in scientific assessments should be clearly expressed to stakeholders, given that many decisions will be made based on less than perfect information (OECD, 2008a). Additionally, in the face of increasing uncertainties about the long-term future of stocks, obtaining agreements on a set of pre-established harvest control rules as the status of the stock changes is of particular importance. This can serve to limit calls for rapidly increasing quotas or for removing restrictions when there are signs of improvement.

Co-operation in the management of fish stocks

The management of fish stocks requires co-operation

Fish stocks migrate and in many cases are shared between two or more countries. For example, in Norway, 90% of the catch comes from stocks that are shared, including with the Russian Federation, the European Union, Iceland, the Faroe Islands and Greenland (OECD, 2008b). This makes co-operation among states on fisheries management and conservation especially crucial. At the same time, there is a need to address imbalances between fish resources and harvesting capacity, as it is widely acknowledged that overcapacity in the world's fishing fleet is the primary cause of over-fishing and depleted fish stocks. This has led to a range of international agreements, such as the UN Fish Stocks Agreement, which establish a precautionary approach in fisheries, strengthen the basis for regional co-operation, provide for more effective enforcement of rules and introduce mandatory dispute resolution for straddling and highly migratory fish stocks (FAO, 2002).

Management systems for shared fish stocks are based on total allowable catches set by international agreements. Regional fisheries management organizations (RFMOs) have a key role, both in promoting regional co-operation and in setting TACs for shared fish stocks. Setting of TACs for shared stocks normally takes place in collaboration with RFMOs such as the North East Atlantic Fisheries Commission (NEAFC) (for pelagic and deepwater stocks in the North Atlantic), the Northwest Atlantic Fisheries Organisation (NAFO) and the North Atlantic Salmon Conservation Organisation (NASCO) (see Box 2.13). The proportion of shares allocated are based on a range of factors including fishing history, the extent to which stocks exist and can be fished commercially in national waters, the level of dependency on fisheries, as well as the contribution to scientific research on the stock. RFMOs are generally established under a convention on multilateral co-operation, which aims to promote the conservation and optimal utilisation of fishery resources and encourage international co-operation and consultation with respect to these resources. RFMOs have been under increasing pressure to better manage the fisheries resources under their control. Some changes to strengthen these international organisations have been under way with varying degrees of success (and some significant success stories) in terms of ensuring stable co-operative agreements and improved management of the fisheries resources under their control (OECD, 2009a).

Box 2.13. **Key regional fisheries management organisations in the NORA region**

The North East Atlantic Fisheries Commission is a regional fisheries management organisation for pelagic and deep sea fish stocks in the Northeast Atlantic. NEAFC aims to "promote the conservation and optimum utilisation of the fishery resources of the North-East Atlantic area and aims to encourage international co-operation and consultation with respect to resources" (*www.neafc.org*).

The Northwest Atlantic Fisheries Organisation is a regional fisheries management organisation on fisheries for fish and shrimp stocks in the North West Atlantic. NAFO's general objective is to contribute through consultation and co-operation to optimal utilisation, rational management and conservation of the fishery resources of the Convention Area (*www.nafo.int*).

The North Atlantic Salmon Conservation Organisation focuses on international co-operation for the conservation, restoration, enhancement and rational management of migratory salmon stocks in the North Atlantic.

Bilateral and multilateral agreements are also important. In the NORA region, there is extensive co-operation regarding shared fish stocks, not only among the four NORA territories, but also with neighbouring states, as many of the most important fish stocks migrate between domestic and foreign waters or into the high seas. For instance, the Faroe Islands has reciprocal fisheries agreements with neighbouring economies in the North Atlantic region, including Iceland, Norway and Greenland. These involve the exchange of fishing opportunities, which give foreign vessels quotas and access to the Faroese zone in exchange for equal fishing opportunities for the Faroese fleet in their zones. These agreements provide Faroese fishing vessels with the scope and flexibility to pursue a variety of fisheries in the best seasons (Ministry of Fisheries and Natural Resources, 2008). Similarly, in Norway, bilateral negotiations take place on shared stocks. Russia and Norway have established the so-called Mixed Norwegian–Russian Fisheries Commission for shared stocks in the Barents Sea. Norway and the EU negotiate on North Sea stocks. Many Norwegian TACs are set in these negotiations. Iceland as well has bilateral fisheries agreements with the EU, Greenland and the Russian Federation (in addition to those mentioned with Norway and the Faroe Islands).

Another important actor is the EU. None of the NORA regions is an EU member (although Iceland applied for membership in July 2009). A desire to retain independence in fisheries and opposition to the EU's Common Fisheries Policy (CFP) are widely recognised as key reasons why the other

NORA territories have not sought to join the EU. The self-governing status of the Faroe Islands and Greenland allows them to legislate regarding fisheries independently. Nevertheless, the EU's CFP, which sets overall standards for fisheries management (such as TACs, minimum landing sizes, number of days at sea, etc.) in the member states, has an impact on the management of international fish stocks. For instance, Norway holds two annual meetings with the EU every autumn – one in Bergen and one in Brussels – to set TACs and other regulations and management plans concerning the shared stocks. Norway and the EU have developed management strategies for several joint stocks (*e.g.* long-term management plans for cod, haddock, saithe and herring). The Fisheries Partnership Agreement (FPA) between Greenland and the EU, for a duration of six years from 1 January 2007, allows Community vessels mainly from Germany, Denmark, the United Kingdom, Spain and Portugal to fish in Greenland waters. In exchange, the Community pays an annual financial contribution to the Greenland authorities to be used for research undertaken by the Greenland Institute of Natural Resources and for training of fisheries officials, as well as for cod management plan studies (EU, 2006).

Co-operation on shared fish stocks is complex but pays off

Co-operation on management of shared fish stocks is crucial, though complex and sometimes contentious. There are many examples of successful co-operation and co-ordination in the management of shared fish stocks, though securing and applying these agreements are the result of lengthy, complex and, at times, challenging negotiations (see Box 2.14). Negotiations regularly break down (*e.g.* between Scotland and Norway on shared stocks and quotas in 2010) and in some cases agreements are simply not reached (*e.g.* NEAFC countries have sometimes been unable to agree a quota regime for blue whiting on the high seas).

Co-operation is also crucial for maintaining and sustaining the maritime environment

Environmental protection is a crucial element of the management of fish stocks and it, too, requires co-operation. Through their legislative arrangements and participation in international fisheries management organisations, the NORA territories actively engage in co-ordination on a range of marine conservation measures. More generally, marine environmental protection in the region is regulated by international conventions, such as the MARPOL Convention for the Prevention of Pollution from Ships and the OSPAR Convention for the Protection of the Marine Environment in the North Atlantic, which is concerned with the

Box 2.14. **Co-operation on shared stocks**

In some cases co-operation agreements have been critical for sustainably managing stocks and sharing resources. An interesting example of direct co-operation in the management of a fish stock is the management of Norwegian spring spawning herring. Herring stocks were seriously depleted in the late 1960s. Subsequent rebuilding of stocks over more than two decades led to substantial growth in stocks by the early 1990s. The migratory range of the herring then expanded beyond the Norway's territorial waters, which changed the stock's status from an exclusive to a shared (straddling) fish stock. In the absence of an international management regime for this new stock in international waters, in theory it could be fished by vessels from other countries. In 1996, talks among the coastal economies in the region resulted in an agreement whereby Norway, Russia, the Faroe Islands and Iceland agreed to a TAC for the fishery and its distribution (Churchill, 2001). A small share of the TAC was defined as the high seas component of the stock and it was left to NEAFC to decide on its distribution. The following year the European Union was included in the agreement. The allocation arrangement for herring took a scientific report on its distribution as its point of departure (Norwegian Ministry of Fisheries, Department of Marine Resources and Research, 1995). The scientific assessment concluded that in terms of its distribution the "zonal attachment" of the stock was overwhelmingly Norwegian (89.2%). Yet, the quotas awarded did not reflect this and were also driven by power relationships between the territories involved. Historic fishing patterns, as well as dependency upon fishing were brought forward as arguments in the talks. While it is not possible to quantify relative influence, power relationships played a major role in the quota agreed (Ramstad, 2001). Norway is the major coastal state involved, but had accepted a much smaller share of the allowable catch, while Iceland and the EU obtained sizeable quotas. With the larger share of the stock in its waters, Norway stood to lose most in the case of non-agreement, as anyone could have fished herring in international waters. However, multilateral agreements are not easy to reach and owing to disagreement over the relative shares in the quota arrangement, the parties were unable to reach an agreement on TAC and quota shares in 2004 and 2005, with the result that each party set unilateral quotas.

Source: Hoel, A. H., and I. Kvalvik (2006), "The Allocation of Scarce Natural Resources: The Case of Fisheries", *Marine Policy*, Vol. 30, pp. 347-356.

prevention and elimination of pollution from land-based and off-shore sources and assessment of the quality of the marine environment. Such co-operation is vital to maintaining and sustaining wild fisheries. OECD countries participate in different regional co-operative efforts for sustainable management of marine resources. For example, Korea organised the first APEC Ocean-related Ministerial Meeting in April 2002. At the meeting, the

APEC countries adopted the "Seoul Ocean Declaration", a milestone for co-operation in the region on the sustainable management of marine and coastal resources. Following this conference, the second APEC Ocean-related Ministerial Meeting was held in Bali, Indonesia, in September 2005. At that meeting, member countries, including Korea, adopted the "Bali Plan of Action" aimed at healthy oceans and coasts for the sustainable growth and prosperity of the Asia-Pacific community (OECD, 2008a).

Co-operation also plays an important role in fish farming. For example, veterinary regulations are based on an agreement with the EU. The health of stocks is monitored at various stages of production from broodstock, egg, fry, smolt and ready-to-harvest fish. Farming areas are inspected regularly. At the same time, the Faroe Islands has adopted an inspection system based on those operated in Norway and Scotland, which monitor the seabed in farming areas. Systems of licences are used to regulate the industry. Additionally, facilities are developed to minimise the risk of introducing or spreading disease to native stocks.

In relation to the marine environment, another area of co-operation by the NORA territories, and a notable difference between the NORA region and many neighbouring states, is their stance on managing marine mammals. The Faroe Islands, Greenland, Iceland and Norway are all members of the North Atlantic Marine Mammal Commission (NAMMCO). NAMMCO focuses on conservation, management and study of marine mammals in the North Atlantic. The NAMMCO Council meets annually to review advice from its Scientific Committee, to co-ordinate recommendations for further scientific research and to review hunting methods for marine mammals in member countries. In terms of co-operation within the region, common ground on issues such as hunting marine mammals is a regional link and a source of exchange, although there is also opposition to the stance taken on hunting some species from some interest groups in the NORA territories. More generally, the formal position taken by the national authorities on issues such as whaling has been a source of some tension.

Exchange of technical information and data is essential

A key to managing sustainable international stocks is exchange and collaboration on developing and utilising high-quality data and research. The success of fisheries management systems and management of the marine environment relies heavily on the quality of the scientific assessments and advice on the status and management of stocks and marine eco-systems. The NORA territories all have institutions to inform their decisions on fisheries management. National stock assessment is based on a

range of investigations such as bottom trawl, surveys carried out by research vessels, commercial catch and effort-data from log-books, and the sampling of commercial catches for age and length. National organisations are also involved in the International Council for the Exploration of the Sea (ICES)[13] which provides scientific advice on the marine ecosystem to governments and international regulatory bodies that manage the North Atlantic Ocean and adjacent seas. Finally, the NORA territories also maintain their own links and systems of co-operation. For instance, the Nordic Fisheries Co-operation (AG-Fish) has a long tradition, though a limited budget.[14]

Climate change introduces challenges and uncertainties

Among the most important concerns for the future are the productivity and changing patterns of fish stocks as a consequence of climate change. The impacts of climate change on marine ecosystems and fisheries are not yet fully understood (see section 2.4). However, research indicates a close relationship between changing weather patterns and the productivity of marine ecosystems. The Fourth Assessment Report of the International Panel on Climate Change (IPCC) notes that changes in salinity, circulation and ice coverage, which have already happened and may be expected to continue, are affecting primary production, fish growth and fish migration. Climate change is likely to contribute to a change in the composition of species (due to migration). While in some cases the resulting direction of the growth and migrations of certain stocks seems relatively clear, the speed and magnitude of these changes and how they may affect particular regions are much less clear. Finally, a parallel challenge for the fish industry is related to the increase in alternative activities (*e.g.* transport, access to mineral resources or offshore oil extraction) which compete with and have an impact on the fish industry (including increased pollution) (Molenaar, 2009).

Policy makers and key stakeholders have to be aware of the need to respond to and anticipate and incorporate climate-related changes (OECD, 2008a). Changes in productivity and the availability and migration of key fish stocks as a result of climate change suggest the importance of: *i)* research into ways to mitigate and adapt to climate change and its specific impacts on the marine environment and industries; *ii)* adaptation in fleet types and technologies; and *iii)* responsive fisheries management and governance systems. In addition, given uncertainty about the precise effect of global warming on fisheries, regional co-operation and co-ordination are needed to further improve the basis for adaptation strategies (see section 2.4).

Innovation is crucial for the long-term competitiveness of the marine sector

Innovation is crucial for sustaining and improving the competitiveness of the sector, for improving methods and for improving safety and sustainability. The role of research and innovation is all the more important in light of cost pressures linked to increased fuel costs, pressures on fish stocks and the marine environment, and the potential impacts of climate change. All these challenges call for new and innovative solutions. Advances in the technologies and techniques applied in the fishing industry are responsible for considerable improvements in the efficiency, effectiveness and sustainability of open sea fisheries: improvements in gears, more energy-efficient vessels, traceability and eco-labelling, among others. For aquaculture, innovation is also viewed as essential to cope with the challenges of changing demand or global competition (for example research and development for farming new species), environmental sustainability (*e.g.* developing better barriers to prevent the spread of diseases and escapes) or adaptation to climate change (see section 2.3).

The NORA territories engage in co-operation and pooling of resources to support R&D and innovation in the fishing industry. NORA partners have been involved in a number of EU-funded projects on research and innovation in the fisheries and marine sector, *e.g.* through the 2007-13 Northern Periphery Programme, Norwegian partners are working with partners in Scotland and Ireland on a project to develop the methods and technology required to rear cleaner fish for use by the cod and salmon farming industry (*www.eco-fish.org*).

Accumulated expertise on fisheries is a source of competitive advantage

The long-term sustainability of the sector also depends on a sufficient base of expertise. This can be ensured through training and educational opportunities. The NORA territories have gained an excellent international reputation in the fisheries and marine sectors, through their long experience in fisheries and as mariners and engineers in the international merchant-shipping sector. A number of institutions offer professional studies in the field of fisheries and maritime occupations.[15] This internationally recognised expertise is a source of competitive advantage over other maritime economies and potentially a source of revenue. Support for these activities is important to ensure the long-term sustainability of the sector and to continue to develop the expertise and know-how that are essential to ensure the sector's continued competitiveness and adaptability, especially during a

period of change and uncertainty. Opportunities to maintain and build on this expertise in the region are therefore crucial.

2.3. Economic diversification and innovation in the NORA region

In all OECD countries, innovation has been recognised as a key aspect of competitiveness and growth. Innovation is the creation of economic value through the exploitation of new ideas: it takes the form of new products, processes, organisational forms, marketing practices, etc. It goes far beyond R&D and development of high technology and can take place in all sectors, industries and services. Enhancing innovation is both an economic imperative and a political priority for the NORA territories as for others. Indeed, in some respects, their need for innovation is unusually great. The NORA territories all adhere to the Nordic welfare model, with its high living standards and a premium placed on balanced socio-economic development. This model, combined with the region's acute development challenges, puts huge pressure on public budgets and translates into high salary costs. This prevents an economic development strategy based purely on price competition. Hence, sustaining high levels of productivity and strong productivity growth is a necessity and a challenge for all parts of NORA.

The NORA regions have two options when trying to ensure strong productivity growth: more intensive use of natural resources or an emphasis on innovation and new business development aimed at increasing productivity and value added in all economic activities. These options are complementary, but the second is more promising, particularly because the NORA region has largely achieved high levels of efficiency in the exploitation of primary resources. Opportunities for further intensive development in this field are limited, at least in the absence of further technical innovation. To be sure, quantitative increases in sales and exports of primary resources may result from "extensive" growth: the catch of new marine fish species and the extension of fisheries to the deep sea, the opening of new fish farming sites, or the exploration and development of new hydrocarbon and mineral deposits. But the potential of these approaches is limited. Innovation in primary resources exploitation is needed to ensure these industries' competitiveness in the face of intense international competition. Innovation in resource-based economies differs from the usual pattern of innovation based on the development of high-technology industries. It is based on knowledge absorption capacity, at least as much as on knowledge creation capacity: innovation in resource-based economies is thus poorly measured by traditional R&D investment indicators. This is notably the case for the "Norwegian paradox": a wealthy

and innovative economy with strong technology adaptation capacity and relatively low private R&D investment (Fagerberg *et al*., 2009).

As noted in Chapter 1, a development strategy based mainly on exploitation of natural resources is fragile, particularly for such small economies. Worldwide fluctuations in demand and commodity prices, environmental pressures or the emergence of substitute energy sources, may have dramatic effects on the demand for the specific primary resources in which the NORA territories are specialised. This points to the need to create new niches or even new activities in non-traditional sectors.

Innovation to improve the performance of the primary sector

Natural resource-based sectors, and in particular the fishing industry, are and will remain central sources of economic activity in the NORA regions. New developments and the implementation of new techniques or new organisational methods are needed to support the future competitiveness and sustainability of the natural resources-based industries.

Innovation could improve the efficiency, safety and sustainability of the fishing sector

The NORA region's fishing industry is one of the most efficient in the world. Nevertheless, continued improvements in productivity in fishing, fish processing, and fish farming and management are still required to maintain a leading edge. Innovation is also needed to address problems related to overexploitation of marine resources and climate change. Domestic development of new techniques and implementation of further organisational changes as well as access to worldwide knowledge and technologies can help. Technological change and innovation have in the past been geared towards improving productivity. Today, they are increasingly oriented towards addressing environmental challenges, improving energy efficiency and ensuring the sustainability of the fishing industry (Boxes 2.15 and 2.16).The development of user-driven initiatives, such as eco-labelling and product traceability, has also accelerated. Finally, better technology and research will be crucial to adapt to climate change (see section 2.4).

Box 2.15. **Energy management solutions: Marorka**

Reykjavik-based Marorka is a leading provider of energy management solutions for the international shipping industry. Marorka's products and services enable vessel operators to optimise fuel consumption by maximising the energy efficiency of their vessel or fleet. This reduces both emissions and costs. Marorka started out as a NORA project. In 2002, NORA supported a collaborative project which led to the development of an IT solution for the optimisation of ships' energy requirements. This solution – Maren – is a comprehensive system developed for onboard energy management equipped with operational optimisation, simulation-based decision support and extensive energy-analysis tools.

Sources: NORA and *www.marorka.com.*

Innovation will also be needed to cope with challenges of changing demand, global competition and environmental protection in aquaculture. The rapid growth of Norwegian aquaculture is largely due to scientific and technological advances, such as vaccines, improved cages and developments in feed (NORA/Norden, 2009). Measures to minimise the impact of rearing and production methods on local coastal environments and stringent regimes for veterinary monitoring have been major factors in the success of the industry in the region. Other developments could focus on the management of effluent from the industry, disease control and feeding efficiency. For the environment, closed recirculation systems technology is especially important to reduce water use, to separate farmed fish from wild fish and thus to prevent the spread of diseases and parasites and eliminate escapes and discharges of waste into the ocean. The possible farming of new fish species is also being explored (Box 2.17). In this regard, the example of Arctic charr shows how exchange of know-how and information can be a source of regional co-operation.

The energy sector also needs technological advances to ensure its sustainability

The most prominent example within NORA is Norway's oil and gas industry. It is a very competitive industry, responsible for a high share of Norwegian gross value added (mining, oil and gas together accounted for 30% of Norwegian value added in 2008; see Chapter 1), and the country leads the world in technologies and systems for oil and gas exploration and exploitation (see Box 2.18). To maintain its leading edge, it should continue to innovate in these technologies, including in technologies to prevent environmental damage and disasters. In addition, the development of

Box 2.16. **Development of new technologies with applications in the fishing industry**

Advances in technologies and techniques applied in the fishing industry are responsible for considerable improvements in the efficiency, effectiveness and sustainability of open sea fisheries:

- Lighter and more selective fishing gear has helped to reduce the impact of fishing on the marine environment, *e.g.* trawl undersides with rollers to minimise the damage to the seabed.
- New sorting grids and other technical adaptations have been developed, such as the flexi-grid for use in pelagic trawling, such as blue-whiting fishery, and have been shown to significantly reduce by-catch of cod. Technical advances have also helped to evolve towards the capture of non-traditional species.
- New developments have produced more energy-efficient vessels and fishing practices. This is of particular relevance as it cuts greenhouse emissions and reduces fuel costs.
- Improvements in fish processing have led to a more cost-efficient industry, with less waste, higher-quality products, and greater use of waste products.

Traceability and eco-labelling are among the key recent innovations in the sector. Eco-labelling of fish is increasingly used and can increase the price of catches. Pressure for the eco-labelling of fish has been driven by processors and especially supermarkets which demand labelling of fish in line with other products. The most widely used form of eco-labelling is that of the Marine Stewardship Council (MSC). In Norway different fisheries have recently obtained the MSC certification (*e.g.* Norway's offshore Northeast Arctic [NEA] cod and haddock fisheries). The Faroese Pelagic Organisation (FPO) Atlanto-Scandic Herring, obtained the MSC environmental standard for sustainable and well-managed fisheries in March 2010.

Source: Adapted from NORA/Norden (2009), *Innovation in the Nordic Marine Sector*, S. Margeírsson and T. Edvardsen (eds.), Nordic Council of Ministers and NORA, June.

technologies linked to off-shore drilling can be exploited in other energy sectors. Drilling and technology developed in the context of oil and gas industries should for example provide the foundation for knowledge needed for future research into renewable sources such as geothermal energy.

Box 2.17. **Opportunities for farming new fish species**

The possibility of farming cod, in particular, is being explored in the Faroe Islands. Cod found in the Faroese bank have especially rapid growth rates, and natural conditions in the Faroese fjords are considered to be well suited for farming. In Greenland the focus has been on the potential for wolffish farming and seaweed harvesting. In Norway, efforts are under way to farm new species, such as cod, halibut, wolffish and shellfish. Cod production from aquaculture in Norway exceeded 11 000 tonnes in 2007 (up from 300 tonnes in 1997), which demonstrates the potential for farming high-value species.

The project Sustainable Aquaculture of Arctic Charr is a collaboration between partners in Norway, Iceland and Sweden funded by NORA and the EU's 2007-13 Northern Periphery Programme which aims to develop commercial farming of Arctic Charr. The partners aim to increase the production of farmed Arctic Charr in the northern periphery by identifying production potential and bottlenecks in different regions and with different technologies. The project also aims to develop and implement solutions to problems in farming and to initiate triple-helix structures in order to provide stakeholders with tools and a contact network that will facilitate development.

Sources: National Statistical Office of Norway, *www.ssb.no/en*; *www.northcharr.eu.*

Box 2.18. **Competences in energy research in coastal Norway**

The development of the Ormen Lange field in the Norwegian Sea is one of the largest and most demanding industrial projects ever carried out in Norway. Hydro, a Norwegian petroleum company, is the operator. The field is situated in an area of the Norwegian Sea with climatic and oceanographic conditions that make this one of the world's most challenging development projects. Norwegian research and industrial centres of expertise have been engaged to find solutions to a set of challenges that had not previously arisen for oil and gas development on the Norwegian continental shelf. Together with several partners in the Ormen Lange field, Hydro is implementing a major pilot programme to test the viability of a sub-sea compressor off the Norwegian coast. This highly innovative project would eliminate the need for a conventional platform, saving billions of NOK and halving operating costs.

Several Norwegian universities are also conducting advanced energy-related research. The Norwegian University of Science and Technology (NTNU), in Trondheim, is Norway's primary institution for educating the nation's future engineers and scientists. Energy is one of six thematic strategic areas established by NTNU in 2000. The objective is to organise multidisciplinary research and education to handle complex social problems and challenges that can only be solved by multidisciplinary teamwork.

Box 2.18. **Competences in energy research in coastal Norway** (*cont.*)

The SINTEF Group, located in Norway, is the largest independent research organisation in Scandinavia. Every year, SINTEF supports the development of some 2 000 Norwegian and other companies via its research and development activity. The "Petroleum and Energy" area of expertise at SINTEF offers R&D and advanced technical services to improve the development of Norwegian and international petroleum resources by means of safe, environmentally friendly techniques. It focuses on: exploration technology for petroleum resources; reservoir and well technology, well-stream technology, energy systems, thermal energy processes and electric power. By the application of the "teamwork strategy" NTNU and SINTEF have been able to increase energy-related research activity substantially since its start-up in 2000. Today more than 1 200 people in NTNU-SINTEF are working to bring new knowledge, new technology and new solutions to in the energy sector.

Finally, the Northern Research Institute (Norut) is a national research group located in Tromsø, Narvik and Alta in northern Norway. Norut has research activities in technology, innovation, natural and environmental science, and social science, with a special focus on the High North. Norut Narvik has a special research group on renewable energy and especially solar electricity. The main work of the group concerns development of silicon-based solar cells. The research is performed in co-operation with national and international companies, and a centre of competence has been built in Narvik for the development of new methods of production of solar cells and PVPT (photovoltaic production technology). The institute is majority-owned by the University of Tromsø.

Sources: OECD (2008), *OECD Reviews of Innovation Policy: Norway*, OECD Publishing, Paris; *www.ntnu.edu*; *www.sintef.no*.

Hydroelectric power (in the Faroe Islands, Greenland, Iceland and Norway) and geothermal energy (in Iceland) are two resource-based sectors in which NORA territories have developed leading positions. Using its cheap energy sources (geothermal and hydropower) to produce electricity, Iceland has set itself the goal to become the first country to break its dependency on fossil fuel: it built the world's first commercial hydrogen refuelling station in 2003 and the first hydrogen-powered rental cars in 2007. The country conducts research and experimentation on hydrogen-powered vehicles and aims to convert all its transport fleet to hydrogen by 2050. The NORA project EL-mobility seeks to broaden awareness of electric cars in the Faroes, Greenland and Iceland. The project aims to test and evaluate battery-powered cars in different landscapes of the North Atlantic (including measuring potential complications due to the harsh climatic conditions). The project seeks to assess the potential for

increasing the use of renewable energy sources in future transport systems. These developments contribute to the goal of ensuring greater sustainability and energy efficiency.

The future of energy in NORA territories is dependent not only on the presence of abundant resources, but also on a continually improving capacity to exploit them. Despite the diversity of energy sources throughout the NORA territories, opportunities for co-operation in energy research exist. However, the NORA regions also compete in a number of respects, most crucially for the location of aluminium companies attracted by cheap hydro-electricity: this creates a barrier for co-operative research that is close to exploitation of such energy resources. Other renewable energy sources, such as wind, tidal and wave energy, are also potential sources of environmentally friendly energy, thanks to the NORA territories' favourable natural conditions. However, given the region's limited research and technological development capacities, co-operation and exchange of ideas on these new energy sources could be particularly fruitful, and should extend beyond NORA to countries with acknowledged expertise.

Small-scale renewable energy may offer opportunities for remote locations

The development of renewable energy in small settlements is an emerging opportunity that would be valuable for the NORA region. Small settlements in the NORA region are largely dependent on oil and gas. Some small-scale renewable energy facilities exist, but developing renewable solutions for peripheral communities will require addressing problems related to the small size and isolation of these locations and to their harsh weather and geographic conditions. Renewable energy production in peripheral areas can have a triple benefit: it increases the amount of clean energy, it can contribute to cost savings in places that currently use generators powered by imported diesel, and it may create employment opportunities in regions with high unemployment. However, large-scale solutions and mainstream technologies are often not appropriate for remote locations, because the production facilities required are not cost-effective and create overcapacity, because local connections to common backbone systems are limited, or because these places present weather-related limitations (lack of sun, very strong wind, ice conditions).

The crucial issues for developing renewable energies in remote locations are: identifying the source of energy best adapted to local assets and local restrictions and reliability in terms of availability and of resilience to harsh environmental conditions. With small-scale power systems there are few standard technologies, but the experience of early adopters can be very

useful for subsequent initiatives. Communities are likely to face similar challenges for designing and installing power systems. Shared study of strategies that have succeeded and failed in the NORA regions could thus facilitate the development of renewable energy systems in other places. Efforts are being made by NORA governments to research and invest in renewable energies. Since 2006, the government of Greenland has earmarked funds for research and development of renewable energy. As a result, the first hydrogen plant for renewable energy storage was inaugurated in Nuuk in March 2010 (Box 2.19). In addition, educational institutions and innovation centres have over the last decade become increasingly open to participating in research and development and providing training facilities for more diverse technologies. A Centre for Energy Technologies has been created in Sisimiut, Greenland, and an Institute of Energy Research at the University of Akureyri in Iceland. At the same time, the Nordic Task Force for Renewable Energy in Sparsely Populated Areas[16] has as its main focus finding suitable common solutions for a decentralised energy supply that could contribute to a reduction in fossil fuel usage.

Box 2.19. **Hydrogen plant for storage of renewable energy in Greenland**

The hydrogen plant for renewable energy storage is a test system to provide suggestions for how hydrogen can be used for future renewable energy storage in Greenland. The hydrogen plant is owned and operated by the national energy company Nukissiorfiit. Its purpose is to gain experience with production, distribution and use of hydrogen as an energy carrier and thus investigate opportunities for increasing the share of renewable energy in energy production. Currently close to 60% of the energy produced in Greenland comes from hydropower. The rest is produced by the use of expensive and polluting diesel, especially in small settlements. The plant includes a compression and distribution system that enables storing of hydrogen under pressure in distributable bulk containers. The hydrogen can then be distributed to other cities and settlements in Greenland and used for local energy production. The plant is also prepared for a future upgrade with a hydrogen refuelling station to enable the use of hydrogen as fuel for transport. The next phases of the project are being planned. One idea is to distribute hydrogen from the plant to a nearby settlement or to move the entire plant, as it has been designed to be moveable.

Source: *www.h2logic.com.*

Developing the mining sector will require advanced technologies and judicious macroeconomic policies

Mining today accounts for a minor share of the NORA territories' GDP and employment, but significant opportunities exist for increased exploitation of mineral resources in Greenland and northern Norway. In these territories, the exploitation of minerals is seen as an activity that can make an important contribution to regional development and provide jobs in areas lacking other location-specific advantages. New mining developments are at the core of Greenland's development strategy. Given worldwide competition for the production of these raw materials, it is obvious that the latest technologies should be used and further developed if mining is to be economically and environmentally sustainable. In addition, since hard minerals and hydrocarbons are depletable, their exploitation may be temporary. The policy challenge is thus to stabilise growth via judicious macroeconomic policies, as well as to maintain competitiveness in non-mineral sectors through fiscal discipline and assertive structural policy reforms (OECD, 2005a). The Government Pension Fund in Norway and the stabilisation funds of Chile are good examples of how some OECD countries combine the development of raw material sectors with stabilisation measures to ensure balanced development through benefits derived from the oil and copper sectors, respectively (Box 2.20). These funds could serve as a reference for the development of the mining industry in Greenland, and for both Greenland and the Faroe Islands if oil production takes off in the future.

Box 2.20. **Stabilisation funds in Chile and Norway**

Chile

Chile's fiscal finances are heavily dependent on the volatile price of copper, Chile's leading export. In the past, the volatility of the price of copper had a very negative impact on fiscal finances. In 1987, the Copper Stabilisation Fund was established. It was designed to partially isolate the available fiscal revenues from cyclical fluctuations in the price of copper. When the price of copper goes above a certain target, the extra revenue is deposited in the Fund and is not available to the budget. Similarly, when the price of copper falls below a certain target, the revenue shortfall in the budget is compensated for through withdrawals from the Fund. Since 2006, surplus earnings are assigned to the Economic and Social Stabilisation Fund, and the Pensions Reserve Fund, which replace the previous Copper Stabilisation Fund. At the end of 2008, the two funds had savings amounting to USD 21.5 billion (12% of GDP) thanks to the rise in copper prices

Box 2.20. **Stabilisation funds in Chile and Norway** (*cont.*)

between 2006 and 2008. Sound macroeconomic management has enabled the Chilean government to run counter-cyclical fiscal policies. It adopted in 2001 a structural fiscal rule which forces the government to maintain a structural surplus equivalent to 1% of GDP (relaxed in 2008 to a structural surplus of 0.5% of GDP). As in other countries, the overall Chilean economic outlook shifted drastically with the world economic crisis during the last quarter of 2008. Nevertheless, the structural surplus and the stabilisation funds accumulated during the "prosperous" years were used to launch a fiscal stimulus package in January 2009 which boosted public investment programmes and transfers. This stimulus package included, among others, investments in infrastructure, small enterprise development, and subsidies to low income households.

Norway

The Government Petroleum Fund was established in Norway in 1990 to build up financial reserves in order to preserve an equitable share of present petroleum revenues for future generations and decades, and to prevent short-term fluctuations in the oil price from influencing spending in the current and following year's budget. The Fund is fully integrated into the state budget and net allocations reflect the total budget surplus (including petroleum revenues). It remained empty until 1996, as a result of the recession of the early 1990s, but has seen a rapid build-up in assets in recent years. The government decided in 2005 to establish the Government Pension Fund, which encompasses the former Petroleum Fund (renamed the Government Pension Fund – Global) and the National Insurance Scheme Fund (renamed the Government Pension Fund – Norway). Its real return can be seen to provide a partial pre-funding of future pension liabilities. This fund mainly transforms depleting oil and gas resources into financial assets. As this wealth belongs in theory to present and future Norwegian generations, the capital stock should be preserved, and only the returns consumed, to allow future generations to make their own choices in allocating these earnings. For 1997-2006, the average annual real return was 4.6% after deducting management costs. In 2004, new ethical guidelines were adopted for the allocation of the fund's international investments. In April 2007, the government announced plans to increase the equity allocation to 60%.

Sources: OECD (2004), "Budgeting in Chile", *OECD Journal on Budgeting*, Vol. 4, No. 2, OECD Publishing, Paris; OECD (2005), *OECD Economic Surveys: Norway*, OECD Publishing, Paris; IEA (International Energy Agency) (2009), *Energy Policy Review Chile 2009*, International Energy Agency, OECD/IEA, OECD Publishing, Paris.

Innovation in emerging sectors and further economic diversification

Developing new activities will offer further opportunities for economic development

Alongside the further development of traditional raw-material-based sectors, the creation of new niches or entirely new sectors is a complementary development path for the NORA territories. Further economic diversification would help to reduce the risks attendant on NORA's current high dependence on natural resources (Chapter 1). It could also help address the problem of outmigration of qualified and young people by offering new and more attractive jobs to highly skilled workers. The development of new products and new activities is particularly important for economies heavily dependent on fisheries – especially the Faroe Islands and Greenland – where structural adjustment in fishing fleets (concentration of vessels, increased efficiency of fishing techniques) implies a continuous reduction in fisheries employment (see section 2.2).

Acquired knowledge in fisheries could provide a good basis for the creation of new niches

The NORA region could capitalise on the strong knowledge base acquired through traditional fishing and fish-processing activities by developing value-added food and non-food products from the marine sector: *e.g.* new nutrients, bio-medicines and pharmaceutical products, among others (Box 2.21). Many opportunities linked to the better use of by-products, biotechnology and marine resources have not yet been seized and could be an opportunity for NORA territories. The blue biotechnology[17] area is a growing sector worldwide with the search for new biological principles and organisms that have not been exploited so far. Nordic collaboration could result in a combined effort to screen material obtained in the oceans and in by-products from the seafood processing industry (NORA/Norden, 2009).

Box 2.21. **Innovative use of marine products: Acadian Seaplants Limited**

There is a growing demand for marine-based biochemical products to meet new and growing customer demand. Marine-based biochemicals, such as omega-3 fatty acids, have expanded their market share. Traditional compounds such as proteins, oils, fatty acids, sugars and polysaccharides also present good market opportunities. Novel compounds, *e.g.* secondary metabolites and compounds processed from traditional compounds, are under development by innovators active in health-related products. Health benefits of long-chain omega-3 fatty acids are well documented and there is growing evidence of the multiple benefits of fish-based peptides. In terms of fish raw materials used to process food, less than 50% is utilised directly as food in some cases. The rest contains components that are in great international demand (*e.g.* for supplements, pharmaceuticals, cosmetics and energy sources). Seaweeds are another source of important biochemicals: they are an economically feasible source of special polysaccharides for industrial applications. Macro-algae also contain a great variety of other complex and "unusual" polysaccharides of great potential for diverse non-food applications. Algal polysaccharides and derived bio-compounds have, for example, emerged as an important class of bioactive natural products with interesting medicinal properties: blood anticoagulant, anti-tumour, anti-mutagenic and anti-inflammatory.

The case of Acadian Seaplants Limited (ASL) in Atlantic Canada is a good example. Headquartered in Dartmouth, Nova Scotia, in Atlantic Canada, with five manufacturing plants in three of the four Atlantic provinces, ASL has elevated the harvesting and cultivation of select wild seaweeds into a thriving business which markets its high-quality specialty products and ingredients to more than 70 countries around the world. The once rural company has grown. It now has more than 500 employees and has become the largest independent manufacturer of seaweed specialty products in the world, exporting close to 95% of its annual production. Its success is closely aligned to its on-going commitment to research and development. ASL has its own R&D Centre for Innovation, with eight PhD-level researchers on staff. After close to 30 years of operation, the company continues to take a common, often ignored natural resource and turn it into a wide variety of products. Its competitive advantage relies on innovation and being first to market with new, difficult-to-duplicate products. As a result ASL is now a highly diversified technology-based manufacturer of natural specialty fertilisers, feed, food ingredients, health and beauty ingredients and brewery supplies. With funding from the Canadian government through the Atlantic Canada Opportunities Agency (ACOA), ASL – in collaboration with the National Research Council and the Nova Scotia Agricultural College – has begun to develop and eventually expects to market two new seaweed food products "with functional properties", that is, food with health-promoting or disease-preventing properties. These new products will be targeted to the Asian market, especially Japan.

Source: Atlantic Canada Opportunities Agency.

Specialisation in maritime activities also offers favourable conditions for the emergence of world leaders in niche products and in equipment linked to the food processing industry. Iceland's Marel, for example, is a leading global provider of advanced equipment and systems for the food processing industry. Innovation started in Marel in the 1980s, when the company harnessed computer technology to develop intelligent graders and scales specially adapted to the fish processing industry. Since then it has grown into an industry leader by developing an extensive mix of high-technology processing equipment to fit current, emerging and projected needs of the broader food industry. Finally, given the small size of each of the NORA territories, research linked to the fishing industry is a potential area for co-operation to achieve critical mass and exploit complementarities in research resources.

Exploitation of natural Arctic products could be further developed

Arctic food is another niche in which NORA regions may develop competitive advantages. Some Icelandic and Norwegian companies have already become leading producers and suppliers of ready-to-eat meals, fine seafood and premium Nordic food products. Further expansion of secondary fish processing to other NORA territories, especially Greenland, is constrained by long distances; production/packaging facilities for secondary processing normally need to be close to the market. There have been recent efforts to develop Greenlandic Arctic water and ice industries. High transport costs for a relatively low–value product could be a problem. Yet Greenland water will be targeted as a luxury value-added product for which limited volumes could offer significant profit (Box 2.22). One key to unlocking new opportunities in this sector lies in the development of strong marketing efforts, exploiting the clean and natural image of the NORA environment, and building the infrastructure and capacity to respond to international demand.[18] Opportunities for co-operation within the NORA territories would more easily be developed at a pre-competitive stage, such as shared branding of green/pure products and research into wider consumer trends for North Atlantic products. Opportunities for joint ventures in innovative businesses could be explored and facilitated by intermediaries diffusing information on technology transfer opportunities.

Box 2.22. **Spring water from Greenland**

In 2009 Greenland Springwater ApS, received the green light from the government of Greenland for processing and bottling mineral water from the island of Disko. Greenland Springwater ApS's production and storage facilities (including PET production and filling systems) are located in Qeqertarsuaq, in the south of the Disko island. Greenland Springwater plans to market the high-quality mineral water as a luxury product "from an untouched natural landscape" to countries such as Korea, the United Arab Emirates, Germany, Switzerland, France, Belgium and Israel. The bottled water is called 938, named for the water's pH level of 9.38 which is considered an ideal level of alkalinity for mineral water. Initially, the company will target upscale hotels, high-end boutique shops and restaurants. The second phase of marketing will target the fitness and beauty industry in participating countries.

Source: www.938.ch; *www.icenews.is*.

The rich ecosystems of NORA present opportunities for expanding tourism

As pointed out in Chapter 1, there is a lot of potential still to be developed in the tourism sector. In order for this activity to be economically and environmentally sustainable, tourist products with high value added should be promoted. The type of tourism that can be developed in the region would need to differentiate itself from mass and low-cost tourism: the high-quality, high-price segment of the industry remains the most promising for the NORA region. High prices and the limited supply of tourist amenities prevent the development of a tourist offer based on quantity. But high-quality tourism with limited numbers can make a significant economic contribution. Moreover, value-added ecological tourism is "environmentally friendly", an important factor in an environmentally fragile region. Ecological tourism, adventure tourism, high-class events for both businesses and individual tourists are interesting niches that could be further developed. For instance, Norway (through Innovation Norway) has been involved in developing value-added tourism. There are also untapped opportunities for involving the local population in the development of innovative tourist products, based on local culture and traditions, which can constitute good sources of ideas and a supply of differentiated tourist products. Efforts should be directed to improve co-ordination and co-operation between local entrepreneurs, and to offer consistent, high-quality services. This would require better organisation and training of local operators. The Gros Morne Institute for Sustainable Tourism in Atlantic Canada offers training programmes to help local entrepreneurs to learn ways to market and develop

the expanding adventure/ecological tourism sector (Box 2.23). The goal is to enhance the quality of services and to develop a low-impact economic activity, respectful of both environmental and socio-cultural sustainability.

Box 2.23. **Gros Morne Institute for Sustainable Tourism**

There is a shift in how visitors want to experience their tourist destinations. They want to understand and experience the local culture and traditions in low-impact and sustainable ways. The challenge that operators and service providers face is to create visitor experiences that allow for an intimate connection without harming what people want to see and experience. The Gros Morne Institute for Sustainable Tourism (GMIST) seeks to enhance the quality and sustainability of operators' and service providers' outdoor/nature-based offers throughout the four Atlantic Canada provinces. The Institute, founded in 2003 as a not-for-profit organisation, develops and provides training programmes that respect sustainable tourism practices, experiential tourism services and eco-adventure tourism. GMIST is funded by the Canadian government through the Atlantic Canada Opportunities Agency (ACOA), Parks Canada, the Canadian Tourism Commission, and by the four Atlantic provinces (New Brunswick, Newfoundland and Labrador, Nova Scotia and Prince Edward Island).

The Institute's Edge of the Wedge Experiential Travel programme offers full immersion and hands-on experience to help participants develop new skills in sustainable experiential product development, cutting-edge marketing techniques and partnership development. The two-day Beacons of Effective Sustainable Tourism programme guides tourism business owners and managers through a series of checklists and resources as they build their own "sustainability action plan". Participants consider and examine the three pillars of sustainability – economic, environmental and socio-cultural – to provide a balanced and holistic approach to achieving and improving sustainability. Throughout the programme, participants learn from local operators how sustainable practices have changed their businesses for the better – higher margins, lower costs, and new markets – while caring for tourism resources. They also learn how to calculate and measure the impact of changes on both the world around them and their bottom line, explore a wealth of resources to implement the sustainability action plan customised by them for their operation, and get exclusive access to post-course materials and support.

Source: Atlantic Canada Opportunities Agency.

There are opportunities for regional co-operation in tourism. NORA territories are competing among themselves and selling similar destinations. However joint efforts, such as common branding of the North Atlantic as a "last frontier" destination, could help address the challenge of lack of brand

recognition noted in Chapter 1. Joint training initiatives for tourist entrepreneurs may also be an opportunity for collaboration. Beyond that, the expansion of the cruise ship industry is a prime example of a tourism sector that would benefit from co-operative efforts.

Further development of the cruise industry could be promoted

Cruise ships are especially attractive in the NORA context because they avoid the expense of constructing large accommodations for seasonal demand. Currently the region's cruise-ship-based tourism is modest but expanding (see Chapter 1). Ships do not stay long and the local tourism sector is often not organised to take advantage of the visitors. If cruise ship passengers could be retained in port for several days, they would provide a captive audience for a range of off-ship activities. However, this implies a wide range of activities that are easily accessible from the dock and attractive to ship clientele. It suggests the need for further research on the types of activities that would be most attractive to cruise ship patrons and identification of ways to structure local tourism resources to provide these or similar services. While all the NORA members offer the same basic tourism opportunities, there are important differences among the various locales that would allow synergies to be exploited. It should therefore be possible to put together multi-stop itineraries that would offer passengers a richer and fuller experience. It would also increase the economic return to the various firms involved. However, putting together this type of package would require collaboration among NORA members and close work with cruise ship firms. At the same time, it should be kept in mind that the presence of cruise ships in small or remote localities also involves a number of challenges in terms of infrastructure, safety and rescue equipment, as well as impact on the environment.

There is potential for developing ICT applications and creative industries

The NORA territories have some specific potential for developing innovative ICT applications, such as Internet-based customised services or "cloud computing" applications (see Boxes 2.24 and 2.25). In general, knowledge-based activities are still a small part of economic activities in the NORA territories. Iceland demonstrates, however, that knowledge-based companies (*e.g.* in medical equipment or ICT applications) can be developed, despite a small economic base and a traditional orientation towards exploitation of natural resources. Long distances to the main world centres of trade and business have been an incentive to develop a good ICT infrastructure (except in Greenland) and early ICT applications, with a

population that is generally more receptive than in more densely populated areas. Their geographical and cultural context generally favours openness to innovative ICT applications, and their small size and isolation can be an advantage for the development and testing of demonstration projects.

Box 2.24. **ICT applications can take advantage of the climate of the Far North**

A new Icelandic start-up, Greenqloud, will open the world's first environmentally friendly public compute cloud later this year. It will only use renewable energy sources. Greenqloud offers hardware stored in data centres and leased to clients on a self-serve basis. The client pays only for the time of use. The company's hardware and software will only be run in data centres with guaranteed access to renewable energy sources. In addition, Greenqloud takes advantage of Iceland's cold climate, which reduces the need for energy to cool the equipment.

Source: www.greenqloud.com.

Box 2.25. **The Bitland initiative in the Faroe Islands**

Private businesses in the Faroe Islands have launched the Bitland initiative which aims to detect and support innovative projects based on ICT exploitation in the islands, and stimulate the interest of large multinational companies in adopting the area as a test bed for new ICT developments. Bitland offers office facilities to entrepreneurs and companies; project management and co-ordination; advice on development and processes in relation to innovation; advice on innovative projects for investors and financial providers. Examples of the projects in which Bitland has been involved are: development of a nation-wide plan to enable digital transfer of all traceability data in the Faroese fishing industry between various links in the value chain; development of a conceptual scheme for personal safety at sea in relation to new telecommunication opportunities. Bitland participates in an EU FP7 project, with a focus on the potential for using location and identification technologies such as RFID, barcodes, mobile data capture and natural feature identification to optimise the use of feed and other resources and to improve yield factors, animal health and welfare. However, it has proven difficult to run the company profitably, and the question of the minimum critical size for conducting such an activity efficiently has been raised.

Source: www.thebitland.com.

Finally, creative industries are less dependent on scale than many others. Design activities and artistic creation may thrive if supported by appropriate marketing efforts and some public support for internationalisation at an early stage of development. A recent Green Paper on the creative economy for the Nordic region highlights the many assets of Nordic countries in this area (Norden, 2007). It advocates the development of a pan-Nordic strategy for the creative sector, arguing that this would increase the potential for sharing resources and exploiting complementarities and enlarge the market. The lack of entrepreneurship has been identified as an important barrier for the development of this sector: creative ideas and projects are often not transformed into commercial ventures. The development of a creative sector in the NORA territories and in a Nordic context could engage with a segment of the tourism sector oriented towards the discovery of the specific culture and heritage of the Arctic and northernmost regions.

The NORA region could become a knowledge hub in niche areas

Each NORA territory is a small entity with limited critical mass in research, but it is also part of a larger network of countries and regions, with the potential to play a specific role in research networks in areas of specific interest. In research and technology development activities, the question of critical mass is important and it is important to take an international perspective. While it would be unrealistic to view each of the NORA territories as a self-sufficient knowledge hub, each has assets that could be exploited in a more distributed model of knowledge creation. Many examples encountered during this review point to the potential role of NORA territories on the applied and experimental R&D spectrum through exploitation of their specific conditions and their long-standing expertise in traditional resource-based sectors. Areas in which the NORA region can provide expertise either as experimental fields for research or as contributors to new applied or fundamental knowledge include:

- Climate change research relies heavily on new data (see section 2.4), and the Arctic area provides a unique environment to collect these data and conduct experiments. Physical and biological processes in the Arctic play a key role in understanding global climate dynamics. Climate change is expected to be more significant and to take place more rapidly there than in many other parts of the world. This offers opportunities for positioning the region as a key location for climate change research, with opportunities for further strengthening local institutions, promoting local research and further developing local facilities for climate and environmental research, among others. The Kangerlussuaq International Science

Support (KISS) and the Arctic Station in Greenland are examples of facilities which provide the opportunity for scientists from all over the world to develop research projects in the Arctic environment. The challenge is to ensure that the NORA region contributes to R&D activities and is not confined to a role of supplier of experimental fields and basic services. In this respect, the University Centre in Svalbard (UNIS) is a good example of research facilities combined with applied research and high-quality teaching (Box 2.26).

Box 2.26. **The University Centre in Svalbard (UNIS)**

The University Centre in Svalbard (UNIS) was established in 1993 to provide university education in Arctic studies, to carry out high-quality research and to contribute to the development of Svalbard as an international research platform. UNIS' geographical position gives it a unique advantage by enabling students and faculty to use nature as a laboratory and arena for observation and for data collection. UNIS is a share-holding company, owned by the Norwegian Ministry of Education and Research. The four traditional Norwegian universities – Oslo, Bergen, Trondheim and Tromsø – are represented on the Board of Directors. The centre offers courses in Arctic Biology, Arctic Geology, Arctic Geophysics and Arctic Technology Science, including high-quality research on climate change. About 350 students from all over the world take one or more courses every year at UNIS. The student body is 50% Norwegian and 50% international students and English is the official language (*www.unis.no*).

Source: www.unis.no.

- Research in fishing and fish-farming would build on traditional specialisations of the NORA research communities, which have recently turned to blue biotechnology as a new area for which the NORA territories have important assets, thanks to their knowledge of the marine environment. The Marine Research Institute in Iceland, the Faroese Marine Research Institute and the Norwegian Institute of Fisheries and Aquaculture Research are important research hubs in this field, which are well linked to Nordic and other institutes.
- Research on building technologies can benefit from studying the specific climatic conditions in the North Atlantic area, in order to develop applied research activities targeted at such environments. The Icelandic Innovation Centre and its Building Research Division,

Narvik University College in Norway, and Artek, the Arctic Technology Centre in Greenland, are three examples of institutes conducting applied research in this field.

- Small-scale (renewable) energy exploitation systems especially adapted to remote and rural areas have been mentioned as a specific area in which new research and applications are needed and seem particularly well suited to conditions prevailing in the NORA territories.

Exploiting the potential of the region would require overcoming certain barriers

NORA territories can develop comparative advantages linked to their location in the clean Arctic environment and exploit traditional or more recent knowledge linked to this environment. This could lead either to the development of new niches in sectors already present in some NORA territories, or to the development of new sectors. However, exploiting this potential will require overcoming certain barriers:

- **Distance.** An important condition for the development of new activities in the NORA region and for overcoming the challenge of distance is the availability of extensive and efficient ICT connections, accompanied by well-developed ICT skills. In this regard, the potential of ICT must be exploited to the full (by improving coverage in rural areas and in Greenland) if the area is to achieve further economic development (see section 2.1).
- **Size.** As observed, the lack of economies of scale makes developing new niches and activities more difficult. For potentially small organisations in remote regions, regional co-operation would offer opportunities to undertake activities, develop ideas or initiate processes jointly (see Chapter 3).
- **Education and skills.** Developing new sectors will require specific education and skills. Addressing the brain drain and attracting qualified workers will therefore be crucial priorities.
- **Entrepreneurship.** Conditions for entrepreneurship and start-ups need to be improved, especially in the Faroe Islands and Greenland.
- **Natural resource dependency.** Traditional resource-based activities might tend to crowd out the development of new activities. The orientation of education and research systems, the availability of funding sources, and the priorities of public support systems tend

to favour existing branches of activity, leaving little room for new activities. Innovation and economic development policies to support the development of new niches and new sectors will be required.

The last three points will be addressed below.

Improving the conditions for innovation and diversification

A more diversified economy will require more diversified skills

Until recently, the evolution of the NORA economies has been mainly influenced by the economic value of natural resources, mainly fish, but also oil and gas in Norway. These industries formerly required large numbers of relatively low-skilled workers. As they evolved, they required more and more skilled technicians, engineers and other specialists, such as biologists. The educational systems in the NORA territories have been shaped by the changing needs of these industries. Given the region's peripherality and the small number of students, a large part of the higher education supply is outside the NORA region, mainly Denmark for the Faroe Islands and Greenland and other countries for Iceland (see Chapter 1). In Norway, there is less outwards mobility, since students from coastal Norway have access to the well-developed and diversified domestic Norwegian education system.

Further economic diversification and the development of new economic activities or sectors generate the need for an even larger and more diversified supply of higher education. This is unlikely to be met within the NORA higher education systems, which are specialised in the disciplines most relevant to the existing economic specialisations of the NORA economies. In particular, the breeding of creativity is becoming a crucial component of higher education in all disciplines. It is very difficult to "teach" creativity, but mobility and exposure to different environments is a good way for students to develop new and more innovative skills. The small scale of education systems in the NORA territories and the resulting need for outwards mobility can be turned to advantage if further developed into an internationally open system, and if brain drain can be turned into brain gain by attracting the return of internationally qualified students.

There is a need to address brain drain

A crucial issue for the NORA territories is to attract new university graduates to the region to improve the skill base of the workforce. Limited opportunities to improve skills and limited current employment opportunities for those with more formal education contribute to youth

outmigration. Strengthening local universities is one option and has already proved successful in larger locations like Tromsø, Bergen or Reykjavik (see Chapter 1). Yet, even in these places, it will not be possible to develop a fully fledged offer for higher education. In smaller locations, local universities will never be able to provide the range or depth of education available in larger places. Student mobility can constitute a "brain gain" if enough of those who leave for study abroad return home with higher education and international experience.

Increasing the number of students who return after completing their studies abroad could be a key to the diversification and strengthening of the economies of Faroe Islands and Greenland in particular. Such students bring international experience and an international outlook. Higher education in Iceland, for example, has always had a strong international dimension, encouraged by the government, which sees this as an opportunity for brain gain more than brain drain. Prior to the crisis, at least, the impression of public officials (there are no statistics) was that most students who studied abroad returned home. Twice a year, the government and enterprises from Greenland organise a mission to Denmark to persuade students to return home. A comparable biannual event is organised by the Municipality of Tórshavn in combination with public and private institutions. Yet it is still a challenge to persuade young, highly skilled Greenlanders (and to a certain degree also Faroese) to move back home, especially to highly isolated and remote areas. Norway also makes efforts, such as tax reductions and reduced payments on student loans, to get students and workers to return to – or move to – remote or very remote areas such as North Troms and Finnmark. A recent Australian study suggests that it is possible to attract university graduates to remote and very remote locations but that this requires a premium of some kind (see Box 2.27). However, ultimately, the rate of return of students finalising studies abroad will be closely related to the offer of competitive job opportunities in the home country. Even if there is a case for targeted subsidies to encourage return, these cannot compensate for a lack of economic development opportunities.

Box 2.27. **Return of students to remote areas in Australia**

Australia has both a highly urbanised population which is concentrated in a small portion of its territory in large core cities and a vast area with small and dispersed population centres remote from the core. "Australia's sparsely populated regions have the lowest levels of accessibility to urban amenities and services in the OECD." (Corcoran, Faggian and McCann, 2010) A crucial feature of rural and remote Australia is a high rate of youth outmigration for higher education. Return flows after completion of higher education are limited. This brain drain is seen as limiting future economic growth and weakening human capital. Stemming the loss of more highly motivated youth is seen as a necessary condition for any rural development strategy, but little is known about the specific motivation of those who leave and then return to rural Australia. Survey data of recent university graduates from 2006 have been used to provide important information on individual motivations. The data show that of the 54 698 students surveyed, among those coming from a university located in a major city, some 7 665 relocated outside a major city and of these 1 010 relocated to a remote or very remote region. The latter number represents only 1.9% of all graduates from major city universities, but it is a number that is equal to 72% of all graduates from universities located in a remote or very remote area. The high percentage mainly reflects limited opportunities to attend universities outside major cities in Australia. But it also points out the importance of even modest return flows from city universities. Those who moved to remote or very remote regions can be characterised in the following ways:

- graduates from programmes where there is a government incentive to stimulate employment in rural areas (*e.g.* education, health care) are more likely to relocate;
- native-born are more likely to relocate than foreign-born;
- full-time work opportunity increases the odds of relocation over part-time employment;
- higher wages increase the odds of relocation.

The Australian data suggest that it is possible to attract university graduates to remote and very remote locations but a premium of some kind is required. This is not surprising because simple inertia suggests that relocation only takes place if the move significantly increases a person's well-being.

Source: Corcoran, J., A. Faggian and P. McCann (2010), "Human Capital in Remote and Rural Australia: The Role of Graduate Migration", *Growth and Change*, Vol. 41, No. 2, pp. 192-220.

Nationals living abroad could be also a source of know-how

Diaspora populations abroad could also be a particularly important source of know-how and international links. A number of countries with large numbers of highly skilled people living and working abroad view this expatriate population as an important development resource and a source of valuable linkages and know-how to be accessed, *e.g.* through initiatives such as GlobalScot (Box 2.28).

Box 2.28. **The Globalscot Network**

The GlobalScot network is a fully funded service, designed and provided by Scottish Enterprise, the Scottish Government Economic Development Agency for Lowland Scotland. Working in partnership with Scottish Development International, the Scottish government and other agencies both in Scotland and around the world, GlobalScot aims to expand and diversify Scotland's business culture by: developing new markets overseas; attracting new businesses to Scotland; and mentoring Scottish businesses at home and abroad. More specifically, GlobalScot seeks to develop and expand Scotland's standing in the global business community by utilising the talents of leading Scots around the world, and of people with an affinity for Scotland, to establish a worldwide network of individuals who are outstanding in their field. Scottish companies are able to draw on this network for brokering deals, leveraging finance, receiving advice, and developing contacts, assistance and support.

Sources: Scottish Enterprise; *www.globalscot.com.*

Interchange programmes could be further promoted

Encouraging interchange programmes and joint Nordic degrees would also help, particularly in conjunction with steps to attract more graduates to return home. As noted in Chapter 1, the participation of Faroese and particularly Greenlandic students in these programmes is currently very limited. An increased presence of Greenlandic and Faroese students in regional universities would represent an opportunity to acquire education and research in areas of special relevance for the far North (environment and natural resources, marine science, renewable energy or earth sciences, etc.). Beyond that, sharing resources and developing joint academic programmes, training and research activities on the basis of excellence and relevance of education and research, is a must for the small NORA higher education sector.

Changes in primary and secondary education are also needed

While tertiary education needs priority attention, there is also a need to improve primary and secondary education in rural areas in general and in Greenland in particular. It is in primary and secondary schools that the creative skills needed for an innovative economy can be fostered. In addition, development of the spirit of entrepreneurship can be bred at secondary level through specific schemes such as "student enterprises", as developed in various OECD countries. Improving language skills (especially English) is a particular priority for Greenland. The government is aware of this need and since 2006 has been implementing the Greenland Education Programme (Box 2.29). Given the small basis for recruiting teachers, international exchange programmes for teachers would need further support.

Box 2.29. **The Greenland Education Programme**

Parliament adopted the Greenland Education Programme (GEP) in 2005 in recognition of the territory's low educational level, which is viewed as an impediment to economic development and improvement of living conditions. GEP's overall purpose is to ensure that two-thirds of the work force has an education providing them with academic qualifications or vocational skills in 2020. In its first phase (2006-12) the GEP focuses on lower secondary school leavers who drop out of the education system after graduation and on unskilled workers under 50 who are unemployed, in threatened trades and/or breadwinners for a family. In the second phase (2013-20) the focus will be on higher education. Implementation of the GEP is supervised by the Executive Steering Committee, which has members from several ministries and from the Association of the Municipalities in Greenland.

Source: Government of Greenland.

Openness of the labour market should be further promoted

The lack of critical mass for further developing business is critical in the Faroe Islands and Greenland, and it also affects the sparsely populated areas outside the capital in Iceland, and outside the main cities in coastal Norway (see Chapter 1 and section 2.1). NORA territories can mobilise their work forces through various initiatives: *i)* promoting better accessibility to the markets (see section 2.1); *ii)* aiding the transition of youth into the workforce through training programmes and adequate links between the private sector and educational institutions; *iii)* reducing school dropout rates; and *iv)* promoting adult training programmes and entry into the workforce.

Improving and broadening the offer of vocational training programmes would help diversify local economies. Diversification in vocational education is also required to meet the changing needs of the economy: the development of sectors such as mining or tourism will require training and an upgrading of the skills of the local population. Increasing employment in the construction sector will also require an intensified training effort. A better-educated work force can augment productivity and reduce mismatch problems in the labour market. To overcome the limitations of small critical mass, international mobility and distance learning can help establish a good-quality supply and encourage interactions among students from different origins and locations. Promoting better connections between vocational training schools and the private sector is one way to enhance the availability of a workforce for existing and new activities. At the same time, a stronger focus on technical education can help counteract the outmigration of youth to the cities or to foreign countries. Vocational programmes at upper secondary level, professional degrees at university level, in-company and labour market training and adult education are all options that might reduce incentives to leave.

The development of flexible lifelong learning opportunities, including distance learning components, is another need, especially for Greenland. Further education and training initiatives could be extended to other partners from the NORA region and beyond, either in the form of networked institutes, or through the establishment of joint bodies. The further education sector is particularly well suited to the development of distance learning systems, since its student population is composed of adults with professional and family responsibilities and thus faces higher barriers to mobility than younger students.

Entrepreneurship should be encouraged

Impediments to expanded entrepreneurial activity in the NORA area are significant. They include: the remoteness of the NORA region as a business location; a limited local market that is unable to support additional producers of many goods and services; little entrepreneurial tradition in local societies; and strong traditions of working in traditional resource industries or for government. However, the various NORA territories differ quite a lot with respect to entrepreneurship. Iceland has a strong inclination and good environment for individual entrepreneurs (and the crisis further exacerbated this potential); the Faroe Islands, and especially Greenland, at the other extreme, face strong barriers to entrepreneurship, owing in large part to the dominance of public-sector employment and traditional industries linked to natural resources, the lack of entrepreneurial tradition in traditional communities, and a weak skills base. The small size of local markets is a

problem throughout NORA, especially in the most remote settlements. However, high living standards offer opportunities to develop new businesses to capture expressed or latent demand on local markets, and a strong outward orientation is favourable for the creation of new innovative ventures.

An important factor for the development of new products or new activities is the presence of favourable conditions for entrepreneurship. In most OECD countries entrepreneurs are recognised as key drivers of economic growth. This is especially true in rural and remote areas where opportunities for large-scale manufacturing are unlikely. The sharing of experience between business support agencies which support start-ups and new entrepreneurs could help increase the efficiency of their services (see Box 2.30). In Greenland, new regional innovation centres have recently been established in the four newly merged municipalities, and these would benefit from the experience of other intermediaries within NORA or in other sparsely populated environments. Finally, encouragement of women entrepreneurs should receive particular attention, given the specific problem of gender-biased emigration (see Chapter 1). Scotland's "Women into Business" initiative provides a range of targeted services to encourage and enable more women to start a business (Box 2.31).

Box 2.30. **Supporting entrepreneurship: IMPRA**

IMPRA at Innovation Centre Iceland assists entrepreneurs with the start-up, growth and management of SMEs. IMPRA operates an Incubator Centre which offers support and facilities to start-up companies working on innovative business ideas. IMPRA offers extensive Internet information services, workshops and courses for SMEs and the general public and publishes books and manuals on management, marketing and more. IMPRA also runs an Enterprise Europe Network office (EEN) to encourage co-operation between Icelandic and European companies. IMPRA has also set up a network of delegates in small knowledge hubs disseminated throughout the country, to help support existing and potential entrepreneurs in remote rural areas.

Source: www.nmi.is.

Box 2.31. **Women into Business Scotland**

In Scotland, research commissioned by Scottish Enterprise and Highlands and Islands Enterprise in 2003 indicated that 67 000 women run businesses, of which 26% is self-employment, up from 20% in 1984. However, women account for only 10% of high-growth businesses in Scotland. Despite women's entrepreneurial interest a relatively low level of women-owned businesses pursue growth strategies. In terms of new starts, women are now thought to constitute around one-third of the total. Over the last few years Scottish Enterprise (SE) has increased its effort to encourage more new business creation and development by women. The programme "Business Gateway" has targeted services and initiatives to encourage and enable more women to start a business:

- Women into Business Networking: a sustained programme of business seminars and networking opportunities for pre-start customers that provides links to advisers, business people and informal mentors offering information, advice and firsthand experience on setting up a business.
- Mentoring Support for Female Entrepreneurs: the Business Mentoring service is a partnership between Scottish Enterprise and the Scottish Chambers of Commerce. Businesses are carefully matched with experienced business mentors, all of whom have a track record of success in business.
- *scottishbusinesswomen.com*: this website was created to communicate and promote the range of targeted initiatives available from Business Gateway to encourage more women in Scotland to start a business. It is a key communication channel to reach and inform women and to promote the range of activities and services. The website provides customers with access to information, advice and online registration to targeted programmes, training and services. It highlights other partners' events and services and provides a wide range of case studies on women in business.
- Women into Business Conference: these events, organised by Business Gateway, aim to inspire, encourage and enable more women to start a business. The events provide a series of workshops on personal and business development subjects. The speakers are women who have an excellent track record in business and who can share with attendees their formula for success, demonstrate how they have developed their business and also highlight how they have found their way through adversity in business.

Source: Scottish Enterprise.

There is a need to develop an efficient public sector that does not crowd out private sector activities.

As mentioned earlier and illustrated in Chapter 1, the public sector plays a key role in the NORA economies, especially in Greenland and the Faroe Islands, where it is very involved in business activities through ownership of key companies and enterprises. This is due to the specific accessibility and scale challenges of these regions, which create a situation in which certain economic activities (such as air transport) are not profitable for private firms. However, in such economies a big public sector represents a challenge for private-sector competitiveness (especially for SMEs) including a risk of crowding out private activities (see Box 2.32). These challenges should however be set against the role the public sector plays in maintaining the welfare system of these economies. Although the fundamentals of the situation cannot be changed, there are opportunities to open the economy further to foreign investors, improve the housing market situation in Greenland (see OECD, 1999) and, as mentioned above, promote entrepreneurship.

Box 2.32. **The dominant role of the public sector and private sector challenges in the Faroe Islands and Greenland**

The size of the public sector in the NORA economies, particularly Greenland and the Faroe Islands, reflects in part the requirements of the Scandinavian welfare model. It is reinforced by the peripherality of these territories, their dispersed settlement patterns and their harsh climatic and geographic conditions. Basic services for communication with the outside world such as aviation, shipping or telecommunications are publicly assured by the government for the different settlements. It would be extremely difficult to create well-functioning competitive markets in many activities, but there are opportunities to improve the conditions for expansion of the private sector.

A big public sector and a lack of entrepreneurial culture imply a risk of crowding out private activities, including enterprise start-ups, and a great risk of unfair competition, as publicly owned enterprises may face softer budget constraints. Weak competitive pressures may also result in the inefficient use of resources. When national economies are small, the dominance of the public sector reinforces the diseconomies of scale in the private sector. The role of the private sector becomes limited and may become too small to reach the "critical mass" necessary for longer-term expansion. A further problem is the lack of a support network for SMEs, which face particular challenges in an environment dominated by the public sector and by a small number of large companies in fisheries and other resource sectors. The formation of clusters is challenged by

Box 2.32. **The dominant role of the public sector and private sector challenges in the Faroe Islands and Greenland** (*cont.*)

the island structure of the settlements and their small size. In addition, an important challenge in the Faroe Islands and especially Greenland is the lack of a local entrepreneurial culture and traditions for establishing new enterprises. In Greenland, new industrial enterprises have been established for decades either by Danish residents in Greenland or by the government, and only to a limited extent by Greenlanders. This pattern is changing, but it will be some time before a business culture emphasising local entrepreneurship emerges.

In order to trade and conduct business in Greenland, a trading licence must be obtained from the public administration. The Greenland Trade Act (2001) states that a person wishing to obtain a trading licence must possess Danish citizenship or have a work permit for Greenland and be a resident of Greenland, unless an international agreement valid for Greenland states otherwise or the government grants a waiver. Citizens of Nordic countries do not need work permits or residence permits. Companies and branch offices can obtain trading licences if they are registered in Greenland and if the management resides in Greenland. For public and private limited companies, half of the company's actual management must reside in Greenland. These requirements could be substantially relaxed, as such overt protectionism represents an impediment to business formation (OECD, 1999).

Public finances both in Greenland and in the Faroe Islands are under pressure, and this pressure will increase in the coming years, owing to population ageing and the need for substantial investments in education and infrastructure. In addition, the block grant from Denmark is calculated in fixed (nominal) prices: in order to avoid structural imbalances and to ensure sound public finances, there will be a need for lower public expenditure and/or more private commercial activity to create higher tax revenues.

Sources: OECD (1999), "Greenland's Economy: Building a Strategy for the Future", OECD, Paris; Faroese Governmental Bank (2009), *Economic Assessment, Economic Outlook 2009 and 2010*, Landsbanki Føroya, 30 October; Bank of Greenland (2009), *The Bank of Greenland Annual Report 2009*; Ministry of Industry, Labour and Mineral Resources of Greenland (2010), *Setting-up a Business in Greenland: Guide for Investors*, NIRAS Greenland A/S, Nuuk.

Innovation and economic development policies could support further expansion of the economy

It would be important for innovation policy and economic development policies to support potential new developments, notably by giving a voice to entrepreneurs and the private sector in policy design. A number of policy instruments are available to support innovation in NORA territories. They

are either developed and managed at national level, such as national funds for research or technology and technology centres, or owned by the national government and implemented in partnership with the regions, such as Innovation Norway or IMPRA in Iceland. The Icelandic Regional Development Institute (*Byggdastofnun*) supports eight industrial regional development agencies formed by municipalities, federations of municipalities, trade unions or private institutions. Byggdastofnun provides added financial support to projects concerned with regional development and innovation conducted under the auspices of these agencies. A few genuinely regional instruments exist as well, such as Greenland Venture or the Faroese Research Council. The orientation and intensity of these policies influence the NORA innovation potential and provide a pool of experiences for sharing knowledge and practice in support of innovation, adapted to the region's specific situation.

The most relevant policy instruments for the NORA region will be those that tackle the key bottlenecks for economic development and diversification: internationalisation, entrepreneurship, new firm creation and venture capital provision. One key policy instrument that is present or under development in the NORA territories is the establishment of local or regional innovation agencies and of intermediaries to support innovation in existing or new businesses. Such intermediaries are found in many OECD regions. A recent OECD study has identified success factors for these agencies (Table 2.3). These conclusions, coming from a comparative survey of several models of OECD regional innovation agencies, could be taken on board in exchanges of experiences between NORA actors involved in this type of support.

Given the small size and limited market in the sparsely populated areas of NORA, a promising co-operation activity would be exchanges between regional offices of Innovation Norway, IMPRA and regional knowledge centres in rural Iceland, Danish Regional Growth Forums, Greenland Venture and the regional agencies recently established in the newly merged municipalities in Greenland. Those exchanges, focusing on innovation promotion in remote and sparsely populated peripheral areas, would bring food for thought throughout the NORA region. Policy learning from other regions facing similar development challenges should also be taken into consideration (*e.g.* rural Scotland, Box 2.33).

Table 2.3. **Strengths, weaknesses, threats, opportunities, and success factors for regional innovation agencies (RIAs)**

Category	Key issues
Strengths	• Knowledge of specific situation of local companies • Proximity with local public and private actors in charge of innovation promotion • Central position to enhance regional partnerships and social capital, facilitator role • Well placed to achieve horizontal co-ordination of portfolio of services
Weaknesses	• Unclear mandate • Lack of impact evaluation of activities • Difficulty to find and retain qualified staff (owing to unstable funding) • Inward-looking perspective constrained by administrative boundaries – lack of vertical co-ordination
Threats	• Unfair competition with private services • Unfocused activities owing to a shortage of financial resources • Public status and absence of competition induce lack of performance incentives • Inward-looking strategies – unnecessary competition with other regions
Opportunities	• Co-ordination and synergy of regional innovation support (to avoid fragmentation) • Acquiring legitimacy through the demonstration of goals achieved – need for strategic evaluations • Development of tools and professional support for own governance and to fuel strategic policy intelligence • RIAs as agents of change in the regional innovation system, "one step ahead"" • Overcome administrative boundaries to obtain effective innovation promotion
Success criteria	• Institutional recognition as a legitimate regional policy instrument • Complementarity of services, either internally or externally, in either one or another of two models: integrated or networked • Flexibility in the definition of the services portfolio (adaptability to new needs) • Strategic management capacities • Goal-oriented approach and (partly) performance-based funding • Quality of human resources (professionalism, specialisation) • Suitability of structural funding sources (not too high, not too low)

Source: OECD (2011 forthcoming), *Regions and Innovation Policy*, OECD Publishing, Paris.

Box 2.33. The South of Scotland Innovation System Initiative

In September 2008, Scottish Enterprise launched a three-year project, the South of Scotland Innovation System Initiative, to address some weaknesses in the rural south of Scotland: a high proportion of small businesses and self-employment; industries with low levels of knowledge-intensive employment; dispersion of businesses; limited size of local markets and competition; few regionally produced research and graduates. Ultimately, such a situation results in lower levels of innovation within the region and a relatively weak innovation infrastructure. The project has two major components:

- Linking Entrepreneurs programme to facilitate business-to-business exchanges of ideas and experience and to support businesses to innovate through peer networking and collaboration; and

- Knowledge Links programme to facilitate business-to-academia linkages and support businesses to access relevant research academics and students.

This initiative has helped to fill gaps and create linkages in the region's innovation system. Where the project has provided direct support to businesses, there have been clear, measurable benefits. The project has also seen some success in connecting extra-regional innovation support to businesses within the region. This has largely been achieved by encouraging innovation support providers to host events and promote services in the region and by raising awareness of support available through regional businesses development intermediaries.

Source: Scottish Enterprise.

2.4. Meeting the climate change challenge

For the NORA territories, climate change will raise challenges, but opportunities to expand some economic sectors are also envisaged. The main economic sectors and activities of the region (fisheries, mining, energy, transport) will be affected, either positively or negatively, by climate change. Adaptation measures will be required to address the forthcoming challenges and to take advantage of the economic opportunities in a sustainable manner.

Climate change in the NORA region

Today's climate varies considerably across the territories in the NORA region, from Arctic regions in parts of Norway and Iceland and the great ice sheet in Greenland to the oceanic climate of the Faroe Islands. Yet, projections of climate change suggest that by the end of this century, temperatures will increase in the NORA territories, and in the Arctic regions in particular, more strongly and earlier than in the rest of the world. However, before examining the possible impact of climate change, it is important to note that there is much uncertainty surrounding the issue.

There are different assumptions about climate change. Some studies refer to specific emissions scenarios, with detailed information about changes in several climatic parameters. Some take potential adaptation measures, such as reduced CO_2 emissions, into account, while others do not. Potential impacts are analysed in different social and economic contexts. Some analyses limit themselves to considering the impacts of an increase in global mean temperature. Others focus on the specific effects of climatic changes in single areas. It is also important to note that, as well as climate change linked to increased greenhouse gas emissions, other processes can also affect climate patterns, introducing additional uncertainties into the projections. For instance, the North Atlantic Oscillation (NAO) is a climatic phenomenon in the North Atlantic Ocean, which involves fluctuations in atmospheric pressure at sea level between the Icelandic low and the Azores high. The NAO is linked to marked shifts in weather conditions: fluctuations in ocean and land temperatures, rainfall and surface pressure, and impacts on the marine and terrestrial ecosystems (Hurrell, 1995; Visbeck *et al*., 2000; Thostrup and Rasmussen, 2009). At the same time, the thermo-haline conveyor belt is part of the large-scale ocean circulation and changes in the conveyor patterns and the circulation of cold and warm waters in the ocean have had dramatic impacts on climate, *e.g*. severe winters in the north and drought in other areas (Gagoslan, 2003; Thostrup and Rasmussen, 2009). These phenomena mean uncertainties about attributing specific changes to a single cause.

While taking into account the different scenarios and uncertainties about the precise effects of climate change for the purposes of short-, medium- and long-term planning in the region, it is still important to consider key projections and the likely indicators of change.

Temperatures are expected to rise by more than the global mean

Projections on the exact extent and rate of change differ. Crucially, estimates vary according to the emissions scenarios applied (Hanssen-Bauer, 2009). Some of the most widely used projections are set

out in the IPCC Special Report on Emissions Scenarios (Table 2.4). Geographic differences and specificities must also be taken into account.

Table 2.4. **IPCC emissions scenarios**

Scenario	Characteristics	Global average surface warming (by 2090-99 relative to 1980-99)
A1B	Rapid economic growth based on technological change and balanced use of fossil and non-fossil energy sources, and a world population that peaks in 2050.	↑2.8°C
A2	A more heterogeneous world with slower economic growth and technological development and a continuously growing world population.	↑3.4 °C
B2	Slower population growth than A2 and focus on environmental protection at the local and regional level.	↑2.4 °C
B1	Population peaks mid-century and CO_2 emissions are reduced through the introduction of new technologies and global solutions.	↑1.8 °C

Source: IPCC (2007), *Climate Change 2007: Synthesis Report: An Assessment of the Intergovernmental Panel on Climate Change*, AR4, IPCC.

Projections based on the disaggregation of global climate models suggest that the North Atlantic region will experience a more humid climate and warmer temperatures by the end of the century. Developing accurate projections for the NORA territories is difficult because of the influence of ocean currents on local climates, especially in Iceland and the Faroe Islands (Heide-Jørgensen and Johnsen, 1998; NVF, 2006). Nevertheless, specific projections have been attempted for the region and for the NORA territories individually, the results of which are summarised in Table 2.5.

Table 2.5. **Summary of the projected temperature increases in NORA territories 2071-2100 relative to 1961-90**

Indicator	Norway	Iceland	Faroe Islands	Greenland
Mean winter temperature change	4.3-6°C	2-3°C	Mean change up to 3°C	Uncertain: About 2° C in the south and 6-10° C in the north in winter (with only small increases in summer)
Mean summer temperature change	2.4-3.5°C	2.5-3.5°C		

Source: Various, see text.

Temperature increases are expected to be greater than the global mean in this region, with the largest increases in winter, yet because the NORA region covers a large and diverse area, territories will face different challenges, and even internally, especially in Greenland and Norway, potential impacts will vary over the territory:

- In the Faroe Islands, global climate models (May, 1999; Stendel *et al*., 2000) project an increase in the mean annual temperature of approximately 3°C for 2071-2100 compared to 1961-90, with only small differences in temperature rise between winter and summer (Cappelen and Hesselbjerg Christensen, 2005). Heide-Jørgensen and Johnsen (1998) project an increase of up to 1-2°C warming up to 2100 with a slightly greater increase in winter.

- For Greenland, projections vary in their estimates of the extent of change. Estimates of global and regional climate models (May, 1999; Stendel *et al*., 2000; Kiilsholm *et al*., 2003) show a general trend of an increase of around 2°C (a little more in winter than in summer). In northern Greenland there would be temperature increases of 6-10°C in winter, and minor increases in the summer (B2 emission scenario). The Danish Meteorological Institute projects a 7-8°C increase by 2080, under a scenario of rapid economic growth (A1B emission scenario) (Danish Meteorological Institute, 2009). The Arctic Climate Impact Assessment projects a 3°C mean warming of eastern Greenland by 2070-90 (ACIA, 2004). Heide-Jørgensen and Johnson (1998) suggest that projections for southern Greenland are more uncertain as the area has experienced a period of cooling that may counteract the effect of global warming in the medium term.

- In Iceland, a temperature increase of 2-3°C is projected, slightly smaller than the projected increase in Scandinavia (NVF, 2006).

- In Norway the mean temperature is expected to increase by 2.3-4.6°C by 2071-2100 relative to 1961-90, with the largest temperature increase taking place in winter in the north and the smallest increase taking place in the west. Changes for Svalbard are expected to be similar to those in mainland Norway, but with an even larger temperature increase during winter and an overall increase in precipitation across seasons (Hanssen-Bauer, 2009).

Projections point to increased precipitation, less snow and reduced icebergs

Precipitation levels in the region are generally expected to increase. For example, for the Faroe Islands a small increase in precipitation of around 4% is projected (Heide-Jørgensen and Johnsen, 1998). In Greenland, an overall increase in precipitation is expected. In the medium term, the combination of increased precipitation and temperature could result in increased melt rates at the margins of Greenland's ice sheet, but increased accumulation rates in the interior due to greater snowfalls. In the longer term, the increased melt rate is expected to be the dominant trend (Heide-Jørgensen and Johnson, 1998; Anisimov *et al*., 2007). The projected scenarios for Iceland vary. Based on an assumption of slower economic and population growth (A2 and B2 emissions scenarios), increased precipitation is projected for northeast Iceland, especially in winter. For the southwest, precipitation may decrease during winter, spring and summer, but increase by as much as 30% during autumn (NVF, 2006). Additionally, the size and quantity of Icelandic glaciers are expected to decrease drastically over the century. Finally, a general increase in precipitation is expected in Norway, with an expected 18.3% increase in annual mean precipitation. The largest increase in precipitation is expected in the regions of the west coast where autumn, winter and spring precipitation changes are expected to be largest.

In all of the NORA territories, as a result of temperature changes, snow seasons are likely to become shorter, especially at low altitudes. For instance, by the end of the century in Norway, the snow season is expected to be reduced by as much as 2-3 months at low altitudes; this could lead to winters without snow in some areas. Snow depth is also expected to decrease across the country by the end of the century, but may increase in the northernmost areas and at high altitudes in the medium term owing to increased precipitation (Hanssen-Bauer, 2009). In Norway, as in Iceland and Greenland, the size and quantity of glaciers are expected to decrease drastically over the century. For instance, Nesje *et al*. (2006) project that 98% of the Norwegian glaciers may disappear, and the area covered by glaciers could be reduced by 30-40% by 2100.

Upper layer sea temperatures are likely to increase…

As with land temperature changes, projections for changes in sea temperatures vary, owing to uncertainties about changes in sea-ice coverage. However, a number of estimates have been put forward. Sea temperatures will remain unchanged in areas covered by ice. However, ACIA (2005) suggest that upper layer sea temperatures are likely to increase by the same amount as air temperatures in areas without sea-ice coverage. Such changes

would mean increased variability in surface water temperatures, increased exposure to wind and, related to this, changes in water circulation with implications for ocean temperatures.

…while sea-ice coverage will contract

A greater area of sea is expected to be without ice coverage. The extent of sea-ice cover in the Arctic during the summer has already decreased by 15-20% over the past 30 years and is expected to further decrease by over 50% by the end of the century (ACIA, 2004). Hanssen-Bauer (2009) suggests that summer sea ice could disappear by the middle of the century, the mean surface temperature of the North Sea could increase by 1.4°C over the century, and a 1°C increase in the temperature of the Barents Sea could occur in the period 1995-2059.

Changes in sea levels are also highly uncertain, owing to questions about the melt rates of the Greenland ice sheet and Antarctic land ice, for example.[19] ACIA (2005) project a 5 cm increase in sea level by 2020, 15 cm by 2050 and a 25 cm rise in sea level by the end of the century, but with a range of 10-90 cm due to uncertainties about the rate and extent of change. Land geography also affects patterns of sea level rise. For instance, for Norway, the projected rise in sea level by 2100 are a 70 cm increase along the coast of southern and western Norway, 60 cm along the northern coast and 40 cm in the largest fjords. However, it is also suggested that the exact level of change may be up to 35 cm higher or 20 cm lower (Hanssen-Bauer, 2009).

Change in wind climate is also an important indicator of climate change. Few clear conclusions can be drawn concerning changes in wind patterns in the North Atlantic (Hanssen-Bauer, 2009). However, climate change has been linked to a possible increase in regional storm intensity and a probable northward shift in storm tracks (ACIA, 2005). For instance, for Norway, small changes in daily maximum wind strength are expected, but the number of days with winds exceeding 15 metres per second could increase by four days a year by the end of the century (Iversen *et al.,* 2005).

Impacts, responses and adaptation

Climate change will affect a broad range of human activities and welfare in different ways and to different extents. A distinctive characteristic of the effects of climate change in the NORA region is that they will probably be mixed: some effects will be negative, creating new challenges for the development of the regional economies. Yet, climate change is also seen as a potential source of new opportunities. Action can be taken to adapt to and

to mitigate climate change. Mitigation measures[20] are beyond the scope of this review, which focuses on the specific impacts of climate change on the main economic sectors of the region and on potential adaptation measures. The long-term economic development of the NORA territories will depend on timely adaptation and reasonable management of the region's environment and natural resources. This section considers the impacts of climate change and points out some responses in terms of adaptation in the following areas: fisheries and aquaculture; agriculture, forestry and hunting; energy and mineral resources; transport and accessibility; and tourism. It will also point to the potential effects on settlements and traditional communities.

There will be changes in the migratory trends, stocks and fertility of fisheries

Fisheries in the NORA territories are large in a European context, and constitute the most important economic sector in the Faroe Islands and Greenland (see section 2.2). The dominance of this sector makes the impact of climate change on fisheries especially important to understand and, where possible, plan for. Many coastal and marine ecosystems are already under pressure from various human activities that result in pollution, overfishing and damage and loss of habitats (OSPAR, 2009). The potential effects of climate change, along with other pressures, render marine ecosystems particularly vulnerable.

While it is difficult to anticipate the precise effects of climate change on fisheries and aquaculture across the region,[21] the projections set out above and the analysis of the characteristics of the region's fisheries (see section 2.2) make it possible to highlight a number of potential effects. First, sea temperature changes and changes in salinity are expected to affect migration patterns and the distribution of key fish stocks. Possible changes include a northward shift in fish stocks in response to warming, but also the appearance of new fish stocks from the south (ACIA, 2004) (see Box 2.34). Second, sea temperatures are linked to growth rates and the fertility patterns of key stocks, which have implications for catch quotas and fisheries management. Research suggests that cod may become fertile one year earlier if water temperature increases by 2°C (Drinkwater and Sundby, 2006). Third, climate change is expected to lead to loss of habitat for key species. Ocean acidification, coastal erosion and changes in sea temperatures all have damaging effects on the fragile marine environments that sustain key stocks. Associated impacts are the possible invasion and establishment of non-indigenous species, changes in the distribution, abundance and seasonality of plankton and fish, increased chemical

pollution and eutrophication (an increase in the concentration of chemical nutrients in an ecosystem), which can lead to severe reductions in water quality.

Box 2.34. **Changes in fish migration**

ACIA (2004) describes possible impacts on the distribution of important fish stocks in the Arctic region at an increase in ocean temperature of 1-2°C. However, there may be some variation in the rates at which stocks react to change. For instance, pelagic fish living in the open water column are highly mobile and responsive to change, while demersal fish, living at or near the bottom of the sea, tend to be slower to respond to variations. Particular attention has focused on the impact of cod stocks, which are already subject to high pressures from commercial fisheries. Key cod stocks are predicted to respond to temperature increases by moving north of Iceland and into the Barents Sea (Stenevik and Sundby, 2007; ACIA, 2004). Stocks are also expected to move to deeper waters. Seasonal migration patterns may also change substantially, *e.g.* migration may increase if coastal sea ice disappears altogether (Drinkwater, 2005). Warming due to climate change could lead to the establishment of a new Greenlandic cod stock, but is also likely to lead to a decrease in the stock of shrimp (ACIA, 2004). Stocks of herring and mackerel may move from the North Sea into the North Atlantic and total stocks may also increase. Anchovy, sardines and tuna are possible new species in the North Atlantic. Productivity in the Arctic Ocean may increase, and, crucially, accessibility to fish stocks could improve with the melting of sea ice.

Climate change also has important implications for aquaculture, a key sector for the NORA territories. In many areas, current sea temperatures are favourable for cultivating key species, such as Atlantic salmon and sea trout. In Greenland, reduced sea-ice coverage may also provide opportunities not currently available. However, increased water temperatures will make some areas that currently rely heavily on aquaculture too warm and increase the risk of disease and algae bloom. For instance, in the south of Norway, an increase in water temperature of 2–3°C will negatively affect the cultivation of salmon (Lorentzen and Hannesson, 2005). This could encourage southern industries to move to the north of the country, thereby contributing to an increase in fish farming density and thus to increasing risks of spreading diseases (see section 2.2). In addition, any increase in extreme weather events will also affect the viability of aquaculture, as fish pens can be damaged in stormy conditions.

Better technology can enable adaptation

Uncertainties about the precise nature and impacts of climate change make it difficult to propose detailed and specific responses. However, it is worth noting that in the past commercial fishing has regularly had to adapt to changes in the availability of key fish stocks. Such changes can be negative or positive and can be a challenge for industry adaptation, *e.g.* decommissioning of vessels, substantial job losses and the high costs of adapting vessels and machinery to fishing new species.

There are opportunities to develop new technologies to exploit and adapt to change, especially in the already technologically advanced NORA fleets. However, this requires investment and support. Many traditional fishing communities lack means of developing alternative economic activities and would require support. For instance, in Greenland, a shift from shrimp fisheries to cod fishing would require investment in new equipment and could negatively affect communities that are highly dependent on shrimp fishing. The impact on Greenlandic communities will depend on the ability to adapt and the costs of adaptation.

For the aquaculture industries, options include the farming of new species (see section 2.3), shifts in location and means of preventing or fighting diseases. Research and development is under way on new types of fish cages for use in more open waters that would dramatically open up the scope for fish farming. At the same time, research into more effective vaccines continues. However, the side effects of medical treatment are controversial, and may not be acceptable in the long run.[22] A recent OECD Workshop on the Economics of Adapting Fisheries to Climate Change (held in Busan, Korea, in June 2010) suggested that aquaculture may be part of the adaptation to climate change. As a production system aquaculture can more easily be adapted to climate change through technological developments and by growing species that better resist such change (temperature, salinity, etc.).

Flexible, responsive fisheries management is required

In the meantime fisheries management needs to be flexible and to provide an incentive structure that preserves fish stocks. In particular, a number of studies have highlighted the pressures that could result from migration from one economic zone to another (*e.g.* Hannesson, 2007). In this respect, the period during which the stock does not belong to one country is critical: the shorter it is, the more likely the stock is to survive. However, the strong national interests involved mean it may take time for the parties to agree on a new arrangement for the distribution of quotas. As

shown in section 2.2, the difficulty of monitoring the movements of stocks and the conflicting interests of stakeholders and countries make adapting fisheries management systems a particularly challenging task. However, in the past it has been possible to develop systems and bilateral and multilateral agreements for the management of shared and straddling stocks. For instance, as herring stocks recovered and returned to international waters, an international management regime was agreed for the stock, based on an agreement between Norway, Russia, the Faroe Islands and Iceland (Churchill, 2001; Hoel and Kvalvik, 2006). Similarly, systems would have to be developed to cover newly accessible stocks, *e.g.* in the Arctic, and new species.

Climate change could create opportunities for some sectors, while threatening others

Owing to their harsh weather conditions, agriculture and forestry play a modest role in the NORA territories. However, a warmer climate, increased precipitation and an extended growing season will mean increased productivity with longer crop seasons or the harvesting of new ones. The effects are already being felt. In Greenland, sheep farming is already increasing in importance, as is agriculture in the south, given a longer crop season and the introduction of new vegetables. Agriculture and farming activities are thus making an important contribution to the local economy of southern Greenland (Thostrup and Rasmussen, 2009). In the north of Norway, climate change is expected to increase grass yields and offer scope to farm new crops. Studies indicate that the northern limit for growing wheat may move 160 to 180 km per 1°C increase in mean temperature (Kuusisto, 2004). In Iceland, higher temperatures and better pastures could improve conditions for livestock and crops for human consumption. Additionally, afforestation and revegetation are being considered as a means of carbon sequestration (Clement, 2006).

But warmer weather also create challenges, especially for traditional communities

However, milder winters and a damper climate could lead to the invasion of non-native species, an increase in the risk of diseases, pests,[23] fungus and insect attacks, all of which can cause extensive damage to crops and habitats, as well as to more flooding, run-off and erosion. The impact of climate change on more traditional hunting and herding activities in the NORA regions can also be important. For instance, a long tradition of reindeer herding is still an important part of the indigenous culture and economy in the northern regions of Norway. Warmer weather and irregular winter seasons will affect traditional reindeer migration routes, will reduce

reindeer's access to food, and will affect the way of life and main economic activity of traditional reindeer herding communities (see Box 2.35). In Greenland, hunting sea mammals is important, especially for some settlements of the North, where traditional hunting and fishing are the main economic activity and the main source of food. As ice and weather conditions become less predictable, major changes are likely in the distribution of mammals, as many species rely on stable sea-ice conditions for feeding and new species may appear (Hovelsrud and McKenna, 2006). Finally, warmer weather makes the ice cap thinner. This will affect dog sledge routes and higher risk of breaks in the ice will make traditional hunting and fishing much more dangerous. The effect on the local economies of traditional herding and hunting communities in Norway and Greenland is potentially very large.

Box 2.35. **Climate change and reindeer herding**

Reindeer herding exists in Norway, Finland, Sweden, Russia, Greenland, Alaska, Mongolia, China and Canada. A small herd is also maintained in Scotland. There are about 100 000 herders and 2.5 million semi-domesticated reindeers in the world (United Nations, 2010). Approximately 6 500 Sami work as reindeer herders in the Sami area: Norway, Sweden, Finland and Russia (Kola Peninsula). In Norway, as of 2006/07, there were a total of 556 Siida units (or groups of reindeer owners) with a total of 2 936 people. Of these, 403 Siida units and 2 200 persons are in the county of Finnmark, numerically the most significant region for reindeer husbandry in Norway. The total number of reindeer in Norway fluctuates but is normally around 200 000. Since reindeer herding takes place in nature and is very dependent on the conditions that nature provides, changes that occur have an impact on reindeer husbandry. Frozen ground underlies most of the region and if warming degrades the permafrost, traditional reindeer migration routes are likely to be disrupted. Moreover, according to the ACIA (2005), irregular winter seasons, with periods of rain and freezing create an ice layer on the ground that reduces reindeers' access to the underlying lichen of the pastures. Such conditions represent a major change from the norm, and in some years, have resulted in extensive losses of reindeer. Future changes in the extent and condition of snow could have major adverse consequences for reindeer herding and the associated physical, social and cultural livelihood of the herders. But it is still not clear how and how much reindeer herding will be affected by increased climate change.

Sources: International Centre for Reindeer Husbandry, *http://icr.arcticportal.org*; United Nations (2010), "Study on the Impact of Climate Change Adaptation and Mitigation Measures on Reindeer Herding", Economic and Social Council, Permanent Forum on Indigenous Issues, Ninth Session, E/C.19/2010/15, 8 February, New York.

The expansion of new and existing activities needs to be governed within a sustainable framework

Agricultural activities are already increasing in many parts of the NORA region and could be developed further. The changing natural environment offers an array of opportunities for more agricultural or forestry-based economic activities in local communities (as in southern Greenland). Yet, efforts to exploit new opportunities arising from climate change should go hand in hand with preservation and conservation of the region's unique and extremely valuable habitats and environments. Some environments can help mitigate climate change. For example, wetlands, in particular peat bogs, are very effective carbon sinks. Restoration and conservation of such areas could be a means of addressing climate change and preserving important natural habitats in the NORA region, as the Nordic countries, and especially Iceland, have recognised (Thostrup and Rasmussen, 2009); Scotland is also exploring this (Edwards, 2010). Finally, research is needed to address potential negative effects on agriculture and forestry (*e.g.* an increase in pests, fungus or insect attacks).

Adaptation of traditional communities will require support

In Greenland, traditional hunting methods are based on detailed knowledge of sea-ice conditions and have been developed over thousands of years. Although these methods have adapted to past climate variations, dramatic changes in sea-ice cover could be beyond the adaptive capacity of hunting-based communities.[24] In addition, scope for adaptation depends on a range of complex processes and factors. For instance, institutional constraints, loss of habitat, animals of prey, as well as federal regulations and restrictions all limit reindeer herders' ability to adapt (Tyler *et al.*, 2007).

Energy and mineral resource sectors will also be affected

Climate change can affect energy supply and energy demand. For instance, severe weather, a rise in sea levels, coastal erosion, increased precipitation and runoff could all affect energy production and potentially damage existing sites. But climate change could also have positive effects on the production of energy. Most electricity production in Norway and a substantial part in Greenland, Iceland and the Faroe Islands is based on hydropower. Increased precipitation and a substantial increase in runoff during winter in large parts of the hydropower production areas could yield higher potential for hydropower production (Beldring *et al.*, 2006). At the same time, it is assumed that higher temperatures will reduce the demand for heating, while the demand for cooling/air-conditioning is low and is not

expected to increase with increased temperature. In a study of the Nordic electricity market, Gabrielsen and Bye (2005) assume that the inflow to hydropower plants will increase by 13% in 2040 and that electricity demand will decrease with increasing temperature. Both effects could contribute to a reduction in electricity prices. It may, however, be costly to utilise this potential as long as the main increase in runoff comes at a time of the year when the magazines are filled. To what extent utilisation of this potential will require new magazine capacity is uncertain, but an increase is clearly expected.

A warmer climate could increase access to a range of opportunities for mineral and oil exploitation, particularly in Greenland, where exploration for mineral resources previously hidden by ice sheets has already begun. In addition, climate change could increase accessibility to the expected considerable reserves of petroleum off the coasts of Greenland and facilitate its transport. Oil and gas fields in the north of the Arctic Circle currently account for a small share of the world's hydrocarbon production. However, the share could rise significantly in coming decades as sea ice recedes and as technical challenges are addressed and costs decrease.

The ability to drill wells in ice-covered seas will be critical to the efficient development of Arctic resources. Existing drilling units in ice-covered waters generally have a limited operational window, although the receding ice cap will increase this window. Fit-for-purpose Arctic drillships are being developed in Norway for water depths of more than 80 metres. New technologies such as subsea and sub-ice drilling are being considered. A majority of offshore fields will most likely be developed using subsea technology and well-stream transport to land. For easing oil flow at the surface, effective solutions are still to be developed, including fluid conditioning, pressure-boosting and well intervention technologies (OECD/IEA, 2008). Moreover, the Arctic presents many of the high-profile challenges associated with deepwater operating conditions: remoteness, personnel safety, environmental footprint and high costs. An extreme climate and hazards from ice and icebergs add to these difficulties. As mentioned in Chapter 1, the recent tragedy of the Deepwater Horizon oil spill in the Gulf of Mexico, the economic dependence of the NORA region on maritime resources, and the fragility of its rich ecosystems, make it particularly crucial to carry out any further development of the oil industry under the strictest environmental regulation and control.

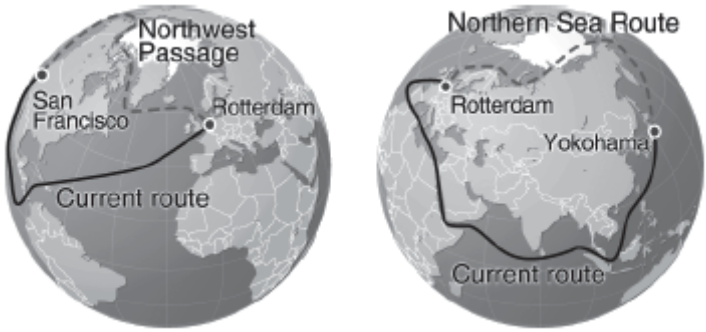
More can be done to develop renewable energy resources and energy efficiency

With energy-related emissions of carbon dioxide accounting for 61% of global greenhouse-gas emissions, the energy sector is at the heart of efforts to cut emissions (OECD/IEA, 2008). Improved energy efficiency, energy savings and increased use of renewable energy are pillars of the international response to climate change and are also reflected in NORA approaches to the issue. For instance, efforts are being made in Greenland to improve household insulation and to expand hydropower energy. As noted in section 2.3, the NORA territories are in a favourable position to capitalise upon and further develop their physical resources and technical expertise in energy efficiency and renewable energy. Increasingly integrated plans are being developed to consider how best to approach these issues, although in some cases these have not been implemented. Plans must consider the need to invest in and expand new technologies and develop the skills to work in new sectors. There is scope to further develop co-operation and collaboration within the region on these issues. In this regard, the Nordic Council of Ministers has established a working group to promote co-operation between the Nordic countries on energy efficiency. Nordic Energy Co-operation aims at the development of technologies and means to oversee the creation of a sustainable energy system across the Nordic regions.

The potential impact of climate change on sea transport is a major issue

Accessibility and transport are key challenges for the NORA region's development (see section 2.1). As a result, the impact of climate change on accessibility is a key concern. In particular, any reduction in the amount of sea ice has important implications for maritime access. Some projections suggest that the Arctic Ocean could be free of ice during part of the summer by the middle of the century (ACIA, 2004). As a result, the length of the navigation season in the Arctic could increase by 20-30 days by 2040 and 90-100 days by 2080 (ACIA, 2004). Faster shipping routes, especially between the North Atlantic and North Pacific, could offer easier access to markets and resources for the NORA territories; it could even give them a more central place in global shipping routes (see Figure 2.2). Additionally, as the scope to develop further economic activities in the Arctic increases, demand for marine transport will increase. Climate change over the last decade has already led to increased shipping activity in the Arctic (Valsson, 2009). Greater use of the northwest route is attractive, as it shortens transport distances between the Far East and European ports by 40%, allowing savings in journey times, fuel and carbon emissions).

Figure 2.2. **Current and future sea routes around the Arctic basin**



Source: UNEP (2007), *Global Outlook for Ice and Snow*, Geneva.

However, at the same time, changes linked to global warming could have more negative local impacts. More severe weather and storms could affect the reliability of local ferry and transport services, especially to remote coastal communities. It could also make routes across sea ice less stable for hunters and indigenous populations. Additionally, increased shipping activity raises energy consumption and pollution and creates the risk of environmental damage from intentional or accidental spillages and discharges that can damage sensitive ecosystems, such as those in the Arctic. Concerns are also raised about the potential for invasive species to be transported to new marine environments via new sea routes. For instance, as new sea routes open, it is expected that ships coming from warmer oceans will be carrying organisms that could become established in the Arctic Ocean (ACIA, 2005).

Direct and indirect effects will also be felt on road and air transport. Despite the high proportion of sea transport in the region, road transport is still vital, especially as rail networks are not well developed.[25] A warmer climate and reduced snow and ice coverage could improve road accessibility. However, increased levels of precipitation could lead to a greater risk of flooding, subsidence, landslides and heavier snowfalls (Nordiska Vägtekniska Förbundet, 2006). In addition to floods and severe weather, extreme high tides are also a threat to infrastructure in low-lying areas. Finally, an aspect of transport in the region that is less directly affected by climate change, but is linked to increased carbon dioxide emissions, is air travel. The NORA territories rely heavily on air transport for internal and external connectivity, especially in extremely remote areas. The increased cost of air travel and concerns about its environmental impact

could have a negative impact on accessibility and transport options for remote communities, *e.g.* as oil prices increase, there could be further pressures for reducing some routes.

Further sea-transport infrastructure and appropriate regulations and standards would be required

Climate change could have both positive and negative implications for regional and local transport, and these should be planned for. Increased maritime activities and new global transport routes may require new harbours; for example, transhipment harbours could be developed to service large cargo vessels and feeder ships that distribute goods to local harbours. Several possible locations for a transhipment harbour in Iceland have been considered (Valsson, 2009). Also, new areas may become accessible and offer new development opportunities, which would increase demand for infrastructure to open up areas and connect communities and resources.

The design, construction and operational standards of future Arctic marine activities, including international maritime law, will require adaptation. For instance, despite thinning and retreating Arctic ice, reinforced ships will still be needed in Arctic waters. In some cases, icebreakers and surveillance will be necessary to maintain routes, *e.g.* by providing cargo vessels with support from icebreakers. However, future ice conditions, especially ice thickness, are very uncertain, and high-resolution regional sea-ice models will be needed. In addition, infrastructure developments will have to be sensitive to the surrounding fragile environments and harsh climatic conditions. In view of changing transport patterns and shipping movements, OECD countries recognise the importance of monitoring fleets and the effects of their movements on ecosystems (OECD, 2008d).

The impact on settlement patterns is likely to be high

Negative effects on traditional sectors and changes in the surrounding environment could place considerable pressures on fragile communities and particularly on indigenous populations, leading to outmigration and social pressures. As mentioned, changes in the distribution of Arctic mammals or fish stocks and negative impacts on reindeer herding, would directly affect Inuit and Sami populations since these are their main source of food and income. Beyond the direct economic impacts of climate change, the potential impact on the living conditions and quality of life of people in the region is crucial to the viability and vitality of this sparsely populated region and would require special attention. The relative "marginality" of the NORA

region and its strong reliance on natural resources mean that its populations have faced and responded to considerable change in the past (Thostrup and Rasmussen, 2009). However, future climate change may be outside the range of past climate variation and raise particular challenges for some of the most isolated or specialised settlements.

Sectors such as tourism could be encouraged

Improved accessibility and new economic opportunities may bring people to the region and build populations in some areas. In Greenland for instance, the development of new mining opportunities will open up new employment opportunities, attracting workers and families to the areas around the new mining sites. Tourism is a growth sector, and climate change is expected to affect opportunities for its development. A warmer climate may change tourism in NORA territories by increasing access to areas that previously were inaccessible, because of sea ice for instance. Increased awareness of the vulnerability of the Arctic to climate change may also increase the popularity of NORA territories as a tourist destination. The number of travellers to Greenland is already increasing, having more than doubled from 1999 to 2008 (Round, 2009). More generally, "green tourism" is a growth area which the region could capitalise upon. In the longer term, some local tourist attractions based on wildlife may be affected by changes in features such as glaciers and certain plants, animals or opportunities for recreational fishing. For winter tourism, less predictable snowfalls could be a problem in some areas. However, the effects of climate change in other winter resorts, *e.g.* in the Alps, could be even greater and thus lead to an increase in tourist numbers to more northerly destinations.

Training and support for adaptation in communities will be critical

Communities facing the impacts of climate change may require support. In some cases this will be necessary to mitigate the negative impacts of change, *e.g.* to help fishing communities diversify, tackle structural or environmental damage, and stem outmigration. In other cases, support is necessary to allow communities to respond to new opportunities and adapt in a proactive manner, *e.g.* in order for new jobs in emerging sectors such as mining or green tourism to benefit local inhabitants, training and educational opportunities will have to be provided to develop the skills and capacity these sectors require. Otherwise, local populations could miss out on new job opportunities, owing to the lack of appropriate skills and training.

There is a need for adaptive development strategies

Adaptive strategies need to span a range of activities and time scales. For instance, short-term coping mechanisms in response to situations that threaten livelihoods should be considered to support communities through "abnormal" or extreme seasons or years. However, longer-term adaptive strategies that help individuals, households and communities change their productive activities and modify local rules and institutions to secure livelihoods also have to be planned (Berkes and Jolly, 2001). It is essential to work with local communities in developing such strategies because of their superior knowledge of and links to their area. For instance, in the development of Arctic oil and gas resources in Russia and commercial and tourism industries in the Scandinavian north, local knowledge is increasingly recognised as vital. Knowing where it is safe to build, how to site the foundations for a new road, airstrip or pipeline, what terrain to avoid, and how to do so responsibly while protecting biological diversity will all be increasingly important (Tisdall, 2010).

It is important to integrate adaptation to climate change in overall strategic planning (coherent planning and implementation of adaptation efforts at strategic, regulatory, budgetary and operational levels). Coherent *ex ante* adaptation plans could help reduce vulnerability to many effects of climate change. In contrast, "development as usual" may increase vulnerability. This points to the need to assess climate risks and vulnerabilities systematically and to include potential adaptation measures in development policies, plans and projects (OECD, 2009c). There have been some advances in this respect. For instance, Iceland has adopted a Climate Change Strategy that includes research on the likely impacts of climate change on Iceland, taking into account a possible rise in sea level in designs of communities and constructions on shore, and assessing opportunities and threats related to increased maritime activity. The strategy also sets out plans for carbon sequestration, emissions reductions, research and innovation in fields related to climate change, and climate change adaptation measures (Ministry for the Environment of Iceland, 2007). Yet, in general, development policies, plans and projects in NORA territories, as in many OECD countries, are just starting to integrate the impact of climate change and need to go further in building comprehensive adaptation plans.

Moreover, integrating environmental factors in sectoral and economic policies will be crucial. As mentioned in Chapter 1, the unique environments of the NORA region, and the high degree of economic dependence on natural resources, make environmental preservation especially crucial. Integration of environmental factors in sectoral and economic policies is still limited. The Faroe Islands and Greenland do not have a clear sustainable development strategy. They integrate environmental criteria in the

development of individual economic activities (*e.g.* Greenland pays considerable attention to physical and ecological environmental factors during all stages of mineral resource activities). However, the relatively larger potential effect of climate change on vulnerable ecosystems (*e.g.* increasing pressure from transport, oil, mining or tourism activities; uncertainties regarding the effects of climate change on fisheries) calls for going a step further and giving high priority to the development of comprehensive national strategies for sustainable development. Norway has long been a key promoter of environmental and social sustainability as well as sustainable economic growth as essential objectives of economic policy (OECD, 2010c). Its experience could serve as a benchmark for the development of sustainable development strategies in the Faroe Islands and Greenland.

Conclusions

This chapter has reviewed four key challenges for the NORA region: how to improve accessibility and to try to overcome the challenges raised by its peripheral location; how to improve both the competitiveness and sustainability of one of the main economic activities of the region, fisheries; how to use innovation, research and technology to improve the efficiency of traditional sectors and to further expand economic activities in emerging or new niches and sectors, and finally, how adaptive responses could help to deal with climate change and to take advantage of potential economic benefits of global warming.

Co-operation to address the main regional challenges is already a fruitful area of interaction across the NORA region and more widely. The characteristics shared by the NORA territories indicate that regional co-operation can be an important vehicle for addressing these challenges. Similar and shared approaches and systems are used and international links and agreements are also in place. At the same time, the NORA territories have specialised expertise which could be a basis for complementarities and productive exchanges of technical know-how. For small territories like those of the NORA region, joining efforts, resources and complementarities may result in a clear advantage in areas such as exchange of research, development of new technologies, shared branding or the development of regional tourism. Yet, co-operation also presents challenges. NORA territories compete directly for resources, agreements are sometimes difficult to reach, and the benefits of co-operation are not tangible in the short term. The following chapter will focus on the rationale, opportunities and challenges for co-operation in the NORA region.

Notes

1. As noted in Chapter 1, with the exception of Norway where recent surveys show that male mobility in peripheral municipalities has increased relative to female mobility, resulting in only minor differences.

2. It is important to note that in Norway peripheral regions have high population turnover, with high immigration from abroad as well as outmigration. In this case policy measures for sparsely populated areas should be based not only on attracting migrants but also on encouraging people to remain there.

3. In the 1950s, Norway had active relocation policies which met with resistance. The issue is not currently on the agenda.

4. Investment in infrastructure can facilitate development and help to diminish local disadvantages. However, parallel measures (promoting innovation, investment incentives, or the improvement of education and working skills) will also be needed to ensure that a remote or peripheral location can take full advantage of the opportunities that improved infrastructure creates (Vickerman, 1991, 1995).

5. Recent media coverage in the Faroes has shown that the price of Internet access is five times higher than in Denmark (Dimmalætting, 2010).

6. The amounts received in each of the territories are very different. The block grant from Denmark accounts for 57% of government revenue in Greenland (2009) and 12% of public revenue in the Faroe Islands.

7. An illustrative example could be flying from Torshavn to Reykjavik (800 km) from Tuesday to Thursday (days without a direct flight). This would mean going first to Copenhagen (1 310 km in the opposite direction) to get a direct flight to Iceland (2 100 km flying over the Faroe Islands). The waste of time and money is obviously considerable.

8. Interviews conducted during missions to the country.

9. The statistical information available varies from country to country, *e.g.* with regard to years available and/or measurement used. Hence, the tables are not directly comparable, but they show the tendencies in each of the countries and these tendencies can be compared.

10. However, the devaluation of the Icelandic *kroná* means that the sale of exported fish in foreign currencies has absorbed the consequences of decreasing fish prices on the market. Today Icelandic shrimp fisheries have started again because devaluation has made it profitable.

11. In Norway, the fleet was composed of 6 789 vessels in 2008, less than half of the size of the fleet ten years earlier (13 248 vessels). In Iceland fleet numbers peaked in 2001 (2 012 vessels) and decreased by 25% in 2008 (1 529 vessels) (Nordic Statistics).

12. Conversely, there have been major fleet concentrations in countries where no "official" market in rights exist and may be due to the fact that fishing rights are traded in a largely uncontrolled and non-transparent manner.

13. ICES is a network of more than 1 600 scientists from 200 institutions; it gathers data, disseminates knowledge, provides scientific advice and promotes marine research on oceanography, the marine environment, the marine ecosystem, and on living marine resources in the North Atlantic.

14. The organisation has a budget of only NOK 6 million. Co-operation has traditionally focused on research and policy making, yet increased attention is given to innovation and co-operation. A committee of senior policy officials functions as a think tank and advisory body to identify issues of common interest and opportunities for co-operation (NORA/Norden, 2009).

15. For instance, in the Faroe Islands, the Fisheries College offers a three-year course of secondary education designed to train students for the Faroese fish processing and aquaculture industries. The country's marine school provides students with a five-month course that prepares them for work on board fishing or merchant vessels. The Centre for Marine Studies and Engineering offers courses on the international standards for maritime training and provides internationally recognised maritime qualifications (Ministry of Fisheries and Natural Resources). In Norway, the University of Bergen has a Fisheries Ecology and Aquaculture Research Group and offers several master's programmes in areas such as fisheries biology and management or aquaculture biology.

16. Based on the Nordic Committee of Senior Officials under the Nordic Council of Ministers for Energy.

17. The application of biotechnology to marine biology.

18. Past attempts to develop small-scale, high-quality products in Greenland usually encountered problems for ensuring deliveries.

19. In the North Atlantic Region, land rise is also an important factor determining relative sea level rises (Hanssen-Bauer, 2009). Globally, the sea level may increase by 18-59 cm by 2100 compared to the end of the last century, depending on the emissions scenario. However, these estimates exclude uncertainties in climate-carbon cycle feedbacks as well as uncertainties concerning the full effect of changes in ice sheets. The upper value of the estimated rise in sea level should therefore not be considered as an upper limit (IPCC, 2007).

20. Mitigation refers to actions to address anthropogenic causes of climate change. It aims to slow down changes by reducing emissions and enhancing "sinks" of CO_2 and other greenhouse gases. Recent OECD analysis shows that beyond the effects of the economic crisis, ambitious policy action to address climate change makes economic sense, and that delaying action could be costly (OECD, 2009b).

21. Oceans' ecological systems are extremely complex and there are major uncertainties about oceanographic responses to an increase in air temperatures and in acidification due to higher levels of CO_2. Additionally, patterns of change will vary greatly across the area. For instance, owing to increased freshwater runoff, coastal areas may be more vulnerable to changes in salinity and in ecosystems.

22. For instance, overuse of antibiotic pharmaceuticals may lead to the development of resistant bacteria, as has already been noted in Norwegian fish farming. Resistant bacteria in fish farms also imply an increasing threat to natural fisheries because of the escape of farmed fish to open seas.

23. Among vector-borne diseases, the likelihood of increased frequency of ticks has attracted most attention in the NORA territories. Ticks transfer serious diseases that in some cases paralyse the body or have other serious long-term effects.

24. Historically, mobility was high – when the climate changed most hunters moved, following the prey and the conditions they were used to. But with the sedentary settlement pattern that has increasingly characterised the Arctic – and definitely Greenland – during the last century, this is no longer an option. Traditional hunting communities have therefore become more vulnerable to changes in climate and resources.

25. With the exception of some tracks that link western and northern Norway to the European railway network.

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