Energy as a developmental strategy: creating knowledge-based energy sectors in Iceland, the Faroe Islands and Greenland

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INTRODUCTION

Iceland, the Faroe Islands and Greenland share a history as overseas autonomies of the Kingdom of Denmark. It is relevant to compare their constitutional, political and socio-economic trajectories, since there are processes of learning and spill-over between these three microstates. Although only Iceland is fully independent, we refer to them as ‘microstates’ in this chapter, because that term highlights a central aspect of these societies: how they face the challenge of being very small societies located on the periphery. The three societies differ in size: Iceland has a population of about 310 000; the Faroe Islands, 48 000; and Greenland, 56 000. Some Icelandic commentators object to the label of ‘microstate’ for the island, but it is precisely Iceland’s socio-economic success despite its very small population and remote location that is of interest here. Iceland is in a different position than the other Nordic countries that are typical small states.

In this chapter, we examine the role of energy as a developmental strategy for these societies: historically, today and in the future. We enquire into the role of knowledge, competences and human capital for an environmental, socially and culturally sustainable use of energy resources for development. All three societies have been working determinedly to increase their political and fiscal independence, to diversify very narrow economic bases and to ensure human development and economic growth. And, as we will see in this chapter, energy continues to play a key role in these endeavours.

These three North Atlantic societies came to be overseas territories of the Kingdom of Denmark through the early mediaeval expansion of the Kingdom of Norway for control of the Viking settlements of Iceland, the Faroe Islands and Greenland, followed by the 1397 Kalmar Union between Denmark, Norway and Sweden, and the Danish–Norwegian re-colonization of Greenland in the 1700s. This constitutional-political status defined Icelandic history, and has continued to define Faroese and Greenlandic politics and society.

Iceland progressed through home rule to, first, sovereignty and then to a republic through a political process from 1845 to 1944. In 1845, the Icelandic Viking-age assembly, Althingi, was reconstituted as an advisory assembly to the absolute Danish monarch, and remained so until 1874 (Denmark became a constitutional monarchy in 1848, but Iceland kept its separate overseas status by remaining outside the unitary state). In 1874, the Althingi gained legislative and budgetary power, although executive and judiciary power remained Danish, with the administration of Iceland led by a Danish Minister for
Iceland residing in Copenhagen. Then followed the crucial step in 1904: the appointment of an Icelandic Minister for Iceland, responsible to the Althingi, brought the government of Iceland to Reykjavik. In 1918, Iceland became a sovereign state as the Kingdom of Iceland in a personal union with a shared monarch with the Kingdom of Denmark. This union was mutually dissolvable after 25 years, and Iceland declared itself a republic in 1944. This historical process should be borne in mind for its learning effects for subsequent processes in the Faroe Islands and Greenland.

The Faroe Islands enjoy close cultural, family and economic ties with Iceland, and have been inspired by the history of Icelandic independence. When Iceland managed to remain outside the unitary Danish constitutional monarchy after 1848, the Faroe Islands became an overseas county of the Kingdom, with the local Viking-age assembly Løgting reconstituted as the county council. During the Nazi German occupation of Denmark from 1940 to 1945, the Faroe Islands were de facto politically self-governing under British military occupation. After the Second World War, a return to the previous situation was impossible, and in 1948 the Faroe Islands gained internal home rule within the Kingdom of Denmark, with the Løgting as the legislative body for matters of home rule. In 1998, an independence-minded majority of the Løgting proposed a ‘1918’ union between Denmark and the sovereign Faroe Islands closely modelled on the Danish–Icelandic union treaty of 1918, although without severing the financial ties between Denmark and the Faroe Islands as had happened in 1918, which made the agreement unacceptable to Denmark. In 2005, Denmark and the Faroe Islands agreed that the Faroe Islands could act in international affairs in domains covered by Faroese home rule and become an associate member of international organizations, under certain conditions. The Faroe Islands gained the rights to their mineral resources in 1992 – a point central to the argument here.

Greenland had also been settled by Norsemen from Iceland in the Viking age, who later accepted the sovereignty of the King of Norway. Contact with these Norse settlers in Greenland was lost in the Middle Ages, but they were not forgotten. In 1721, the Danish–Norwegian pastor Hans Egede received the permission of the king to set out for Greenland to convert the Norsemen, still believed to be Catholics, to Protestantism. Hans Egede did not find any Norsemen, but instead found the Inuit, which led to the colonization of Greenland by Denmark-Norway. Greenland remained a colony of Denmark until 1953, when it became an overseas county on a par with the rest of Denmark. The experiences of de facto self-rule by the Danish governor during the Second World War while under US military occupation and the lifting of colonial status led to a forced modernization process during the 1950s and 1960s. Inspired by indigenous land claims in North America, and learning from previous Icelandic and Faroese experiences of home rule, Greenland was granted home rule in 1979. There has been strong determination in Greenland to expand and develop this self-government and work towards full independence. In 2009, Denmark and Greenland reached an agreement on self-rule for Greenland which recognizes the Greenlanders as a people with the right to gain full independence when desired, and which awards the mineral rights of Greenlandic territory to Greenland with certain deductions of natural resource rents from the Danish financial support to Greenland.

That was the backdrop. What has defined these North Atlantic microstates and continues to define the Faroe Islands and Greenland is the search for political and economic
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independence – which leads us to enquire into energy as a developmental strategy. We will first look at the role that energy played in Iceland in its pursuit of independence and later socio-economic development, and then we will look at the role it plays in the Faroe Islands and Greenland in their pursuit of the economic development and fiscal independence that forms the basis of their dream of full independence from the Kingdom of Denmark.

In examining energy projects as drivers of economic development in the North Atlantic, it is customary to look at manual labour, investment stimulation of the economy and subsequent revenue from operations. Here we will look into the issues of knowledge, competences and human capital. We will examine the triple helix of academia, business and government and the quadruple helix of those three plus the customer as drivers of innovation, asking to what extent these helixes have created domestic, globally connected, knowledge-based sectors in these economies (Machlup 1962; Drucker 1969; Etzkowitz 2008; Carayannis and Campbell 2009; Afonso, Monteiro and Thompson 2010).

North Atlantic economies, like Arctic economies in general, are commodity-based economies, founded on energy, marine resources or minerals. The level of well-being and human development of these societies is dependent on the ability of these societies to capture the value and benefits of these raw materials. Key to this is a successful combination of natural resources and human capital. Local communities must have the human capital to explore, exploit and benefit from their natural resources. For many Arctic communities, the good, well-paid jobs in connection with raw materials, general services or government are filled by outsiders – which in turn leads to organizational instability, loss of knowledge and the outflow of rents and savings. In the meantime, the local population is often struggling with poverty and underemployment. It is clear, especially from the experience of Iceland, that a very high level of human development requires a strong and successful combination of natural resources and human capital. In turn, this human capital requires strong domestic educational opportunities combined with outside education and brain circulation.

Besides the importance of knowledge and human capital for benefiting from natural resources, the cases in this chapter will also show that these North Atlantic microstates may create human capital and knowledge bases which can be exported, for high returns. We discuss and analyse how triple or quadruple helixes around energy in these societies can create domestic, but globally connected, knowledge-based economic sectors. However, such economic results are not without environmental costs, so issues of sustainability and trade-offs between economic gain and environmental, cultural and social costs must be kept in mind throughout.

ICELAND: POLITICAL INDEPENDENCE WITHOUT ENERGY MEGA-PROJECTS, BUT LATER ECONOMIC DEVELOPMENT ASSISTED BY ENERGY

When Iceland was pursuing political independence from Denmark in the late 1800s and early 1900s it was one of the poorest Western European societies. Old Icelanders can tell stories of growing up in households marked by self-sufficiency, living off the land and the
sea, with terrible losses of life to tuberculosis, infectious diseases and the sea. Iceland was predominantly an agricultural society based on sheep-herding which had changed little for centuries, traditionally supplemented by small-scale fisheries. Around 1900, Iceland was slowly industrializing and mechanizing, with the mechanization of the fishing fleet and the arrival of the first trawlers. These emerging industrial fisheries came to form the basis of the growth of urbanization and the creation of centres of population along the coast.

In this political and economic atmosphere, Icelanders were looking for opportunities that could propel their country politically, economically, technologically and internationally. In addition to the traditional sectors of agriculture and fisheries, that opportunity was energy. Iceland was well aware of technological and economic advances in the outside world through, for instance, reporting from world expositions. In the late 1800s and early 1900s, hydropower was advancing rapidly in countries like Switzerland and Norway, powering the advanced energy-intensive industry of the time: the manufacture of nitrogen-based fertilizer through hydropowered electrolysis. Using hydro-electric power in Iceland for fertilizer manufacturing became the central political, economic, technological and conservation question of the early 1900s, introducing the issue of using energy resources and foreign capital and technology to pursue political and economic independence (Ragnarsson 1975, 1976, 1977; Ármannsson 2005; Jónsson 2005; Hálfdanarson and Karlsdóttir 2005; Kristinsson 2005; Karlsdóttir 2010) – which resonates to this date in the Faroe Islands and Greenland.

And yet, Iceland did progress to sovereignty in 1918, declaring itself a republic in 1944, without energy mega-projects, on the narrow economic basis of agriculture and fisheries. What made it possible to take those steps back then, which now seem much more difficult today for the Faroe Islands and Greenland? An important reason is probably the ensuing development of the Nordic welfare state and the growing importance of the public economy for the national economy. When Iceland was an overseas territory of the Kingdom of Denmark, the public sector played a minor role in the national economy, and subsidies from Copenhagen were a small part of that. Thus, when Iceland severed its fiscal ties to the Kingdom of Denmark in 1918, the loss of the Danish grants was tolerable for the Icelandic economy. The Nordic welfare state in Iceland and the other Nordic countries came later, and the Icelandic welfare state developed in an independent Icelandic economy. By contrast, in the Faroe Islands and Greenland the welfare state developed in tandem with the welfare state of Denmark, and based on the Danish economy. The Faroe Islands and especially Greenland developed into welfare states with public sectors that ensured high levels of human well-being but that could not be sustained by the local economies. This fiscal dependence on Denmark to sustain levels of well-being has forced these societies to find significant alternative sources of income in order to pursue independence.

**Icelandic Hydropower, a Quadruple Helix from the Local Farmer to British Households**

Without mega-projects, Iceland electrified rapidly through a bottom-up process with local hydropower electrification of towns, villages and even individual farms. This bottom-up electrification was driven by local authorities and local consumers (Kristjánsson 1997; Þórdarson 2004; Ísleifsson 2007), pointing to the quadruple helix for innovation. Here we will focus on the larger-scale projects (Kristjánsson 1997; Sigurðsson 2002; Þórdarson...
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Large-scale hydro-projects to power the emerging population centre of the southwest corner of Iceland around Reykjavik started in the 1930s with the Sogsvirkjun project, completed in the 1950s with loans associated with the Marshall Aid to Iceland. These early large-scale hydro-projects powered Iceland’s first energy-intensive industry, the national fertilizer factory (1954) and the national cement factory (1958), which sowed the seeds of later foreign-owned power-intensive industry (Kristjánsson 1997; Sigurðsson 2002; Pálsdóttir 2005; Ísleifsson 2007).

After the Second World War, British and US aluminium companies had toyed with the idea of Iceland and its hydro-electrical resources, but without results. Iceland had responded to the Great Depression by creating one of the most heavily-managed economies of Europe with an intricate – and increasingly unmanageable – system of import restrictions and export subsidies. This economy and the political forces behind it could not and would not accept large foreign investments in natural resources, which points back to the controversies half a century before (Jónsson 2005; Pálsdóttir 2005; Karlsdóttir 2010).

The British and US occupation of Iceland during the Second World War pulled Iceland out of the Depression through large-scale hiring and investment in infrastructure projects and the like. After the War, Iceland found itself facing the challenge of maintaining this level of economic growth and development, which was first attempted through a regulation economy. This policy gradually broke down, and in 1959 the ‘Viðreisnarstjórn’ or ‘Restoration Government’ consisting of the Conservatives and Social Democrats took office with an agenda of deregulating and internationalizing the country’s economy. Iceland negotiated the construction of an aluminium smelter with Swiss Alusuisse, powered by the Búrfellsvirkjun power station (first energy mega-project in Iceland), funded by the World Bank and operated by the new national power company Landsvirkjun, which was established for this purpose in 1965. Here we should note that this first mega-project was based on scientific surveys carried out since the late 1940s by Icelandic scientists, often educated abroad, working with foreign colleagues and institutions with support from the Icelandic Government and the United Nations Special Fund. The Búrfellsvirkjun power station was designed by the US firm Harza Engineering, but the construction was carried out by Icelandic workers and subcontractors (Jónsson 2005; Pálsdóttir 2005; Karlsdóttir 2010).

The ‘Restoration Government’ fell in 1971 and was replaced by a left-wing government sceptical to foreign-owned large-scale energy-intensive industry. A hiatus then ensued. Then, in the late 1970s, a Conservative government resumed the policy of attracting foreign power-intensive industry and succeeded in attracting the Norwegian company Elkem to build a ferrosilicon factory in Grundatangi in western Iceland in 1979. The 1970s and 1980s saw the development of the Icelandic knowledge sector around hydropower. There was a long lull in energy-intensive industry projects until the Columbia Ventures aluminium smelter in Hvalfjörður in western Iceland in 1998. In the meantime, the Straumsvík smelter doubled its energy consumption and domestic consumption grew by leaps and bounds, driving the expansion of hydropower and, to a lesser extent, geothermal electrical power (Pálsdóttir 2005; Jónsson 2005).

The east coast of Iceland had been heavily affected by out-migration to the Reykjavik area throughout the 1900s, and there was strong political interest in reviving the east
coast through energy-intensive industry. Vatnajökull is the largest glacier in Europe, with several powerful glacier rivers flowing from it. In the late 1990s, the Icelandic government negotiated with Norwegian Norsk Hydro for a giant aluminium smelter project with a hydro-electric power station in the east. Norsk Hydro withdrew, but was immediately replaced with Alcoa in 2002, which led to agreement on a 360,000 ton per annum smelter to be powered by the enormous Kárahnjúkar Dam and power station, doubling the country’s electricity-generation capacity. The design and construction of Icelandic power stations had come full circle. Due to the size and complexity of the task, Kárahnjúkar was co-designed by Icelandic and foreign engineers, and constructed by Portuguese and Chinese workers. The Icelanders now had knowledge jobs, whereas the manual jobs were carried out by foreign labour – in contrast to the first large-scale project at Búrfell 40 years before (Jónsson 2005; Pálsdóttir 2005; Karlsdóttir 2010).

The severe Icelandic economic downturn since 2008 has led to strong calls for new power-intensive projects to revive the economy and create employment. There has been talk of smelter projects in the southwest at Helguvík and in the northeast at Húsavík. This debate has revived the century-old debate between the advocates of economic development through developing energy resources and the conservationists who reject such projects because of the environmental costs. To resolve this debate and create transparency and predictability for investors and others, Iceland has worked on a national master plan for developing hydro- and geothermal-power resources that gives priority to conservation and energy. The plan classifies 13 tW (terawatt, 10E12 W) as accessible, 5 tW in a grey zone and 13 tW for conservation. The Althingi has adopted the plan, but the implementation is being challenged (Rammaáætlun n.d.).

When hydropower was first being considered as a developmental strategy for Iceland around 1900, the intention was for this energy to power the energy-intensive industry of the day: fertilizer manufacturing. For decades now, the main energy-intensive industry has been aluminium smelting. Now various uses of power are being considered, among them energy-hungry server parks and a sub-sea power cable to Scotland. These considerations show how the state of technology is vital to the development of energy resources in Iceland.

The idea of a sub-sea power-line to Scotland has been considered for decades, but has not been deemed feasible yet. However, Norway – which has often been the role model for Iceland in hydropower matters – has shown the feasibility of long sub-sea power-lines to Germany, the Netherlands and Britain. These power-lines have made it feasible for Norway to sell its abundant hydropower at higher retail prices to European households, rather than to energy-intensive industrial buyers in Norway. Landsvirkjun, the national power company of Iceland, is seriously considering such a power-line to Scotland, which would open up important new opportunities. Aluminium smelters are very demanding customers, requiring totally stable power supplies – which makes them uninterested in peak hydro-electric power (caused by meteorological swings) that could be sold together with new electrical energy at retail prices to British consumers.¹

Lifting the Smog of Reykjavik, the Geothermal Revolution of Iceland

Viewing today’s Reykjavik, with its crystal-clear air and vistas of distant glaciers and mountains, it is difficult to imagine Reykjavik covered in smog from coal firing in the
This difference highlights the geothermal revolution in Iceland in the 1900s parallel to the hydroelectric revolution. Of course, Iceland has always been known for its hot water and steam from the ground. Reykjavik means ‘smoky bay’, a name given by the Viking settlers. As with hydropower, internationally-minded Icelanders were inspired by the vanguard of international technology, as when the prominent politician Valtýr Guðmundsson wrote in 1910 about early geothermal heating in Idaho in the USA (Guðmundsson 1910). However, it was not until the 1930s that Icelanders started using geothermal resources on a large scale to heat their houses and water.

What is relevant from the geothermal revolution in Iceland for our argument here is twofold: heating through geothermal resources rather than coal and oil has saved Iceland considerable foreign currency – a central point for a highly import-dependent country. What is especially pertinent for our argument about energy as a developmental strategy has been the creation of a domestic, but globally connected, knowledge-based sector in geothermal energy. Here a globally connected quadruple helix has been at work, involving Icelandic academia, business, government and customers with overseas participants.

We find a similar pattern in geothermal developments and with an even stronger Icelandic element. Icelandic scientists who had studied abroad, working in partnership with foreign scientists and universities, explored the geology of geothermal resources. Icelandic engineering firms for local Icelandic heating utilities conducted the exploration and exploitation of geothermal resources. Geothermal electricity generation started with the pioneering power stations at Krafla in northern Iceland in 1978 and Svartsengi in the southwest in 1979, today famed for its ‘Blue Lagoon’ of warm water from the power station.

Geothermal energy has created transnational relations for Iceland with other countries with geothermal potential, many of them developing countries. Icelandic engineering companies are working globally, exporting Icelandic know-how in this field. The Icelandic government uses geothermal energy for promoting Iceland in, for instance, Japan. A particularly clear example is the United Nations University Geothermal Training Programme (UNU-GTP) at the Icelandic National Energy Authority. The UNU-GTP has been in operation since 1979, offering six-month training programmes to scientists and engineers from developing or transition countries. By 2012 the programme had trained 525 fellows from 53 countries, becoming a significant part of Icelandic development assistance, later followed by the UNU Fisheries and Land Restoration training programmes.

As with hydropower, Iceland’s geothermal revolution rests on human capital. It is predicated on the country’s strong human capital in science, engineering and surrounding services like law, finance and planning – the product of strong domestic education coupled with the brain circulation entailed in going abroad to leading international universities and then returning to Iceland (Friðleifsson, Svanbjörnsson and Thorsteinsson 1984).

Iceland’s Search for Hydrocarbons: a New and Greater Knowledge Challenge

Iceland is currently moving into hydrocarbon search in its exclusive economic zone (EEZ), which makes a pertinent case for comparison with the two other areas of energy. Hydrocarbon search is highly knowledge- and capital-demanding for a microstate with
little experience in the field. It will be very interesting to see whether Iceland can manage to create a domestic knowledge-based sector in hydrocarbon exploration and exploitation. An important difference from the Faroe Islands is Iceland’s membership in the European Economic Area (EEA), whereby Iceland must adopt European Union (EU) legislation and Internal Market rights and responsibilities. This means that Iceland cannot set the requirements as to contributions to local business activity and research and education successfully imposed by the Faroe Islands, a non-member of both the EU and the EEA.

The area of relevance for hydrocarbon search is the Drekasvæði or ‘Dragon Area’ in the northeast corner of Iceland’s EEZ bordering the Norwegian EEZ around Jan Mayen. Norway established a presence there through a weather station in the 1920s and annexed the island in 1929. The development of the law of the sea in the 1970s led to the need to establish the limits of the EEZs of Iceland and Norway – and Denmark/Greenland – which led to the Icelandic–Norwegian Jan Mayen Accord of 1981. Concerning potential hydrocarbon finds in the region, the agreement includes provisions for sharing these resources: each party is entitled to a 25 per cent share in a sector on the other side of the demarcation line.

The seabed immediately around Iceland is too young to yield hydrocarbons, but the continental crust in the area between Iceland and Jan Mayen has similarities to the Norwegian hydrocarbon fields. Therefore, in the 1960s and 1970s, geologists from Iceland, Norway and the USA, as well as from France, Germany and other nations, started exploring the area between Jan Mayen and Iceland with seismic tests and sediment samples. Here we can note the same pattern as in the development of hydropower and geothermal: the initial scientific work was conducted by Icelandic scientists often educated abroad, working together with foreign colleagues and universities.

In parallel, the Icelandic Continental Shelf committee (Landgrunnssnefnd) started preparing Icelandic legislation, similar to the multi-faceted knowledge basis for hydrocarbon exploration. With the Icelandic–Norwegian Accord in place in 1981, Iceland and Norway could turn to exploration, and seismic testing was conducted in 1985. However, in 1989 it was concluded that the area was not commercially viable. In the late 1990s, Iceland prepared its law 13/2001 on search permits. This legal work was inspired by Norwegian but also Faroese experiences. And in 2001, permission to explore was awarded to an Icelandic–Norwegian consortium (Geysir Petroleum/Saga).

In interviews with one of the authors, key Icelandic civil servants responsible for developing hydrocarbon legislation and policy emphasize the importance of learning from Norway and brain circulation with the Nordic countries. Norway, as a fellow Nordic country with similar offshore conditions and vast offshore oil and gas experience, has served as a very useful role-model. The study and work experience of many Icelanders in Norway and other Scandinavian countries is deemed highly important. Familiarity with the Scandinavian language, plus work experience, has greatly facilitated communication with the Norwegian authorities. As was the case with hydropower and geothermal energy, also here we see the importance of the successful Icelandic combination of domestic and international education for human capital and absorptive capacity.

The Icelandic legal framework has recently been reconsidered, and more seismic studies have been conducted in the Drekasvæði. Moreover, in 2012, Iceland submitted
an application for extension of its continental shelf to the United Nations Commission on the Limits of the Continental Shelf. In 2009, Iceland adopted legislation on the taxation of hydrocarbons, but this was poorly received by the industry. Revised hydrocarbon legislation was adopted in 2011 and a call for exploration permit applications was issued. This call resulted in three applications, two issued first and one after expansion of the consortium. The two first issued are the consortia between Faroe Petroleum Norge (FO) (operator) (67.5 per cent), Íslensk kolvetni (IS) (7.5 per cent) and Petoro (NO) (25 per cent), and secondly Valiant Petroleum (owned by Canadian Ithaca Energy, Inc.) (operator) (56.25 per cent), Kolvetni (IS) (18.75 per cent) and Petoro (NO) (25 per cent). Petoro is the Norwegian Government oil company that represents the Norwegian interest in accordance with the 1981 Jan Mayen agreement. The third application was from the Icelandic company, Eykon, which was instructed to seek foreign partnerships. Eykon subsequently partnered with the China National Offshore Oil Corporation and of course Petoro representing the Norwegian share.

The two Icelandic companies Íslensk kolvetni and Kolvetni have been established by two of Iceland’s main engineering consultancies, Mannvit and Verkís, which shows how Icelandic business is building up knowledge and capacity in this field. Icelanders with relevant foreign education and experience, not infrequently from Norway, play a central role in this capacity-building. Hydrocarbon exploration is a highly knowledge-and capital-intensive activity, and it is clear that international experts, crews and equipment will conduct the actual exploration. The Icelandic approach seems to focus on creating business opportunities in the support and infrastructure required by specialized foreign operators. However, high-level Icelandic informants also believe that the building of knowledge and capacity by Icelandic business concerning the Drekasvæði is directed at the enormous Norwegian market and opportunities in Greenland. Such thinking is in line with the Faroese experience of the – as yet – futile search for hydrocarbons, which has created a substantial Faroese hydrocarbon exploration support sector.

The hydrocarbon case is the latest step in Iceland’s use of energy potentials as a developmental strategy. This time, the requirement as to knowledge and capital is greater. There is far greater risk and uncertainty in this search – so perhaps the best strategy is to build Icelandic knowledge for export, as in the Faroese experience. The focus on energy as a developmental strategy has moved from energy as the resource to knowledge as the resource.

EVOLUTION OF THE FAROESE OIL INDUSTRIAL CLUSTER

The Faroese government took over the rights to sub-sea resources in 1992 (Harhoff 1993). Since then, approximately 2.5 billion kroner (335 million Euro) have been spent on oil exploration, but no oil in commercially viable quantities has yet been found (Eliasen 2013). Instead of oil discoveries, what has emerged in the Faroe Islands is an internationally competitive oil industrial cluster, based not on actual Faroese oil resources but entirely on the export of know-how to the oil industry worldwide. The institutional framework for this development was made possible by three critical political decisions:
1. the Faroese competence development fund;
2. all physical transit to oilrigs in Faroese waters must pass through a Faroese harbour or airport;
3. guaranteed equal opportunity for Faroese businesses.

The Competence Development Fund

As a part of the granting of exploration licenses, oil companies have had to commit 117 million kroner (15.7 million Euro) to a general competence development fund for the Faroes. Of this, 110 million kroner (14.7 million Euro) had been spent as of April 2013, leaving a further 7 million (0.94 million Euro) still to be used (Eliasen 2013). Funds are to be spent on any activity that could increase knowledge and competence relevant for the Faroese business sector (Oljumálastýrð 2001). Therefore, from the outset, the funding was not limited just to the oil industry and related businesses, but aimed at the wider business community. Thus far, the fund has financed a wide range of projects, including PhD scholarships, alternative energy projects, leadership courses at the business school (in conjunction with Robert Gordon University in Scotland), and even golf course management.

The Faroe Islands have their own language, but in the 1990s, when the prospects of an oil industry appeared on the horizon, no Faroese words existed for the many technical aspects of the industry. The Faroese were therefore ill-equipped to communicate with each other in their own language about the new and emerging sector. One of the early projects funded by the competence development fund was to invent new Faroese words and develop an English/Faroese ‘oil dictionary’ (Poulsen). The project was carried out by linguists at the University of the Faroe Islands. Here are a few randomly selected words that were invented, all based on existing Faroese roots:

- blowout preventer = útblástrarforði;
- drilling company = borifelag;
- sea-floor housekeeping = botnrøkt;
- whipstock = sveigstokkur;
- damaging to the environment = umhvørvisskaðiligur.

In addition to the more general competence development fund, another fund, Sindri, was established, endowed with 80 million kroner (10.7 million Euro) with the sole purpose of funding geological research and activities specifically in the Faroe Islands. However, this funding is not reserved for Faroese researchers. Several projects have involved foreign universities and research institutions (Eliasen 2013).

Together, these two funds have channelled 197 million kroner (26.4 million Euro) into knowledge and competence development and research. It is hard to estimate the total effect, as no complete overview exists of all the projects that have been financed. However, it is clear that the competence and development fund sparked a society-wide exploration and experimentation of a diverse set of activities which otherwise would not have occurred. An explorative activity which in some cases led to tangible results, e.g. PhDs, research findings, linguistics, management education, alternative energy – and investments in the golf business.
All Physical Transit to Oilrigs Pass through a Faroese Harbour or Airport

A much-debated clause has been the §11 in the oil legislation, which requires that the transport of all personnel, goods and services to oilrigs operating in Faroese waters must go through a Faroese harbour or airport. In many cases this could be impractical for the oil companies – for instance, if they operate in areas near the UK border, which might be closer to Shetland than to the Faroes. However, the intention was to create as much economic activity and jobs in the Faroe Islands as possible. Directing all traffic through the Faroes was seen as one way to do this, while also increasing security. The oil industry has argued that the clause is impractical and raises the cost of exploration (Vinnumálaráðið 2004).

However, the clause remains in force and has played a critical role in the development of oil-related activity on land. One example is the creation of the Atlantic Supply Base at Runavík, established by a consortium of several private Faroese businesses and the local municipality. The harbour has serviced offshore boats and other ships that go through Faroese waters. This clause has also meant more business for the Faroese airline, Atlantic Airways, which has transported personnel to the oilrigs during exploration work.

The petroleum administration may grant exemptions from this clause, but only in exceptional circumstances, for example in case of sudden death or other emergencies. In one case where the administration granted an exemption from this rule, it also wrote that the oil company should not expect this ruling to serve as a precedent in the future (Oljumálastýrið 2001). The clause was to be enforced – also in the future.

Guaranteed Equal Opportunity for Faroese Businesses

To ensure Faroese businesses have the opportunity to benefit from the oil exploration, the oil companies have to guarantee that they will give Faroese businesses an equal chance to compete with other foreign companies for the goods and services needed by these companies. There is, however, no requirement as to minimum/maximum Faroese participation.

Since the oil business is highly regulated and, for insurance reasons, cannot compromise on safety standards, requirements to suppliers are extremely high. In the first exploration rounds, very few Faroese companies qualified to participate at all. However, the same sets of demands have served to push and motivate Faroese businesses to continuously develop and upgrade their competencies in terms of international training and certification.

The Oil Industrial Cluster

Though the ‘black gold’ rush has eluded the Faroe Islands, a remarkable development has nevertheless taken place since the Faroese government took over the rights to sub-sea resources and institutionalized its oil legislation. Expectations of a major oil bonanza, combined with the three above-mentioned conditions set by the government, have sparked the development of entirely new businesses and brought a considerable diversification of the economy. Today a range of businesses, organizations and government
agencies are engaged in oil-related activity. The oil-industrial cluster that has emerged in the Faroe Islands includes:

1. oil companies (Atlantic Petroleum, Kolvetni/Faroe Petroleum);
2. offshore supply ships (Skansi, Thor, Jacobsen);
3. shipyard (MEST);
4. offshore supply services (Faroe Offshore Supply Services);
5. IT (Simprentis, Føroya Tele);
6. harbour (Atlantic Supply Base);
7. Petroleum Administration (Jarðfeingi);
8. University of the Faroe Islands (Fróðskaparsetur Føroya);
9. Maritime College (Vinnuháskúlin);
10. news portal (www.oljan.fo).

1. Both Atlantic Petroleum and Kolvetni/Faroe Petroleum are engaged in the exploration and production of oil in Faroese waters, the North Sea, Norway and the Netherlands. Atlantic Petroleum is headquartered in Tórshavn, the capital of the Faroe Islands. While Kolvetni is a subsidiary of Faroe Petroleum and was established as a Faroese company, it changed its base to the UK in order to raise sufficient capital for its further development. Of these two companies, only Atlantic Petroleum can still be considered a fully Faroese company. However, the original founders of Kolvetni became owners of the now Faroe Petroleum. Recently, Dana Petroleum, owned by the Korean National Oil Corporation, KNOC, bought 22 per cent of the shares in Faroe Petroleum (Dana Petroleum 2012; Faroe Petroleum 2013). In 2012, Atlantic Petroleum produced 928,000 barrels of oil equivalent (BOE) from their oil fields in the North Sea and had revenues of DKK596.7 million (79.9 million Euro) (Atlantic Petroleum 2012).

2. There are currently two operating oil-supply ship companies, Thor and Skansi; a third company was established in 2012 (Krúnborg Offshore 2012) and has just commissioned a new supply ship. All three companies have historical roots in the fishing sector, but have now diversified into the offshore sector. Together these companies have assets of over DKK1 billion (134 million Euro). Both Thor and Skansi are operating in oil exploration in Faroese waters, but they also both operate worldwide. For example, Thor has supply ships servicing oil production in Africa and the Gulf of Mexico, while Skansi is operating for Statoil in Mozambique, and Tanzania, and for BP in Norway (Skansi Offshore 2013a, 2013b; Thor Offshore and Fisheries 2013).

3. The local shipyard, MEST, has a special department for oil supply (PAM) which provides skilled personnel for oil platforms (Mest 2013).

4. The Offshore Supply Service company specializes in hiring out skilled labour to the oil industry worldwide. It has had people working mainly in the North Sea and Norway, but also in destinations as distant as the Falkland Islands (Faroe Offshore Service 2011).

5. Simprentis develops and provides IT solutions for training purposes. The company has developed an oil exploration simulation game that is used worldwide (Simprentis 2011). Simprentis currently has offices in Tórshavn, Aberdeen, Bergen,
Houston, Rio de Janeiro and Calgary. Føroya Tele, the Faroese telecommunication company, has won contracts to provide telecommunication services to oilrigs operating in UK waters near the Faroese border.

6. Atlantic Supply Base is a harbour facility in Runavík that specializes in servicing all activity related to oil exploration. Besides servicing the ships that must transfer all goods through Faroese ports, the facility also mixes the mud for oil exploration (Atlantic Supply Base 2011).

7. Apart from administering the Oil Act for the Faroese Government, the Petroleum Administration is involved in research activity and is engaged in international projects (Jarðfeingi 2008).

8. The University of the Faroe Islands offers a BA programme in energy and environmental engineering and conducts related research – for example, in seismic data interpretation (Fróðskaparsetur Føroya 2012).

9. The Maritime College trains officers in the maritime sector. Many graduates find work within the oil and gas sector (Vinnuháskúlin 2013).

10. Finally, there is the news portal, www.oljan.fo, which is owned by the Faroese Oil Industry Group (FOIB), an association of oil companies that have been granted licence to explore for oil in the Faroe Islands (FOIB 2014). The purpose of the association is to create a single point of contact regarding common issues shared by all licence holders, and to lobby for oil industry interests in government. The news portal has one full-time journalist, writing regular columns on the latest developments in the oil industry in the Faroe Islands and the Arctic.

As mentioned above, no oil has yet been found in the Faroe Islands in large enough quantities to warrant commercial exploitation. Thus the Faroese oil industrial cluster is driven by expectations of future oil discoveries – and, most importantly, by the successful integration of Faroese business and its labour market into oil exploration and production in the surrounding waters (Norway and EU), and even in further markets like Africa and in the Gulf of Mexico.

The main source of the competitiveness of the oil industrial cluster lies not in the abundance of domestic natural oil resources (since none has been discovered yet), but in its knowledge and competence, at levels that enable it to participate and compete in the oil industry globally. The Faroe Islands have thus escaped what has become known as the ‘resource curse’, which often plagues regions with abundant natural resources.

How can a small Faroese oil company like Atlantic Petroleum or Faroe Petroleum compete on the international market with giants like Shell, Statoil or BP? The answer lies precisely in its small size. The oil wells that Atlantic Petroleum has bought into are too small to be commercially interesting for the oil giants – but they are attractive for a small company.

Seen from a longer historical perspective, the development of the Faroese oil industrial cluster is an astonishing achievement, one that breaks with the traditional pattern whereby economic and social development is limited to the utilization of domestic natural resources. In the former agrarian society, wool from Faroese sheep was the main source of export earnings. In the fishery society that emerged around 1873 and continues today, fish remain the main export. However, with the emergence of the oil industrial cluster in the twenty-first century, and its successful integration into the global oil business, the
‘export’ earnings from this sector are not tied to Faroese natural resources: they depend entirely on the knowledge and competence of Faroese businesses and the Faroese labour force. Thus a remarkable shift has taken place, a shift from an economy based entirely on the export of natural resources, to an emerging knowledge export economy as well.

Implications

The significance of the expansion to an emerging knowledge economy is threefold.

First, it proves that the economic strategy of knowledge export is possible for a remote microstate like the Faroe Islands. It proves it beyond doubt, because this is already happening.

Second, it underscores the critical importance of political institutions for economic development. The irreversible transfer of rights to the sub-sea resources to the Faroese Government was a precondition for the focus of effort and commitment of capital to oil exploration in Faroese waters. Furthermore, the way in which the Faroese Oil Act was crafted, specifically three clauses (the competence and knowledge development fund; all physical transit to oilrigs to pass through Faroese harbours or airports; guaranteed equal participation for Faroese businesses), proved instrumental for the development of the Faroese oil industrial cluster.

Here we should note that the legislation was elaborated before any oil exploration began. If the process had been reversed, with a major oil discovery first and then the development of the oil legislation, then both the commission that did the preparatory work and the parliament that enacted the legislation would have had to negotiate with lobbyists from the oil industry during the process. It is likely that the oil industry would have opposed the three clauses, or seen it as their duty to their shareholders to minimize their expenses and thus argue for removal of these clauses. In that case, it is unlikely that any oil industrial cluster would have emerged.

Third, and finally, the reality of the oil industrial cluster in the Faroe Islands indicates that the time may have come for the Faroese to re-evaluate their identity as a fisheries nation. Though fisheries still play a crucial role in the economy, this sector is no longer the sole ‘bread-winner’. Instead of seeing the Faroe Islands as an exclusively fish-exporting nation, it should more accurately be recognized as an emerging sophisticated knowledge-export economy.

GREENLAND – AN ARCTIC MICROSTATE

Greenland is the largest island in the world, and home to the world’s second-largest icecap – but, with a population of only 56,000, it is one of the smallest states (Nielsen 2001). In the eighteenth century Greenland became a colony of Denmark; this lasted until 1953, when the status was changed into a county of Denmark. In 1979 Greenland gained home rule, extended to self-rule in 2009. The self-rule agreement transferred the authority over underground and sub-sea areas, including minerals and other natural resources, from the Danish state to the Greenlandic government. Only a few policy domains – foreign affairs, security and defence – are still shared between the two countries. However, Greenland has remained financially dependent on Denmark, and receives...
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a fixed block grant annually. Achieving financial independence from Denmark is a long-term goal, regularly expressed by the Greenlandic government (Pfeifer and Thompson 2011). This will require additional sources of income, and diversification of the economy.

Today, the Greenlandic economy relies mainly on four economic sectors, besides the Danish annual block grants: fisheries and hunting, tourism, raw materials and land-based industries (Nielsen 2001). Fisheries is the largest economic activity at present, but has limited future growth potential, as stocks are threatened and the sector is heavily regulated by quotas that might decline in the future. Therefore the Greenlandic government has been looking into other opportunities, and sees greatest potential in developing its non-living natural resources. Onshore mineral deposits and potential offshore oil and/or gas reserves are seen as a ticket to greater social welfare, development and eventual (financial) independence.

The existence of onshore mineral resources in Greenland is already proven. The surface where mineral deposits can be found is steadily growing, as the melting icecap exposes ‘new’ land. Deposits throughout the country are currently being explored by small-scale, junior mining companies (Bureau of Minerals and Petroleum 2009c). The first few projects have now applied for a construction license, more are expected in the next coming years.

With the publication of the US Geological Survey in 2008 (United States Geological Survey 2008a, 2008b), Greenland’s potential for oil and gas resources became better-known to the rest of the world. It was estimated that 31 billion BOE could be found in the northeastern waters and 17 billion BOE in the northwestern part of the seas around Greenland. Moreover, oil and gas are likely to remain part of the energy mix for the foreseeable future (European Commission 2009). With the world’s more readily recoverable reserves running out, unconventional resources and new geographical locations are becoming interesting. Within a context of progressing technologies, decreasing sea ice and high oil prices, Greenland has been receiving considerable attention from large international oil companies. Although 14 exploration wells have been drilled since the 1970s in Greenlandic waters, no reserves have yet been found (www.bmp.gl). However, expectations are high enough to stimulate the development of an oil and gas industry in Greenland. Oil and gas, together with other mineral resources, will become increasingly important for the economy.

Large-scale Energy Projects: Risks and Challenges

Large-scale projects related to oil, gas and minerals have become a topic of public debate in Greenland. Such projects entail special risks and challenges as well as potential benefits that are new to Greenland. The balance between risks and benefits is the crucial point here: people are asking ‘What’s in it for us?’ Maximizing the benefits for the local society is the main challenge, and here there are lessons to learn from Iceland and the Faroe Islands. In both places, the presence of (potential) energy resources has been central to economic development, with knowledge as a key element in maximizing benefits locally. How does Greenland envisage maximizing local benefits? And what could be the role of a knowledge-based economy?

To facilitate the development of its mineral, oil and gas potential Greenland chose a one-stop-shop approach when it achieved self-government in 2009. The Bureau of
Minerals and Petroleum (BMP) was established to deal with all aspects of oil, gas and mining development: granting licences, enforcing (environmental) standards and collecting the royalties (Greenland Parliament 2009). The basic intention was to create one government institution with which the industry would have to deal; further, to centralize all governmental expertise and experience in one organization, to prevent fragmentation of the already limited knowledge and expertise available. The BMP used to have a staff of 30 people and worked closely with various Danish research institutes on environmental issues (Bureau of Minerals and Petroleum 2012). Although this approach seemed to function well for the BMP, it was subject to criticism.

Criticisms of the BMP relate to a challenge often faced by microstates. With only 30 people in charge of all aspects related to oil and gas development centralized in one organization, the question of their integrity arises (Aaen 2012). There are fears that staff are wearing several ‘hats’ at the same time, and the risk of compromises when it comes to enforcing environmental standards is of particular concern (personal communication). This worry has recently been addressed by the division of the BMP into two organizations: the Mineral License and Safety Authority (MLSA: Råstofstyrelsen) and the Environmental Agency for the Mineral Resources Area (EAMRA: Miljøstyrelsen for Råstofområdet). The MLSA still falls under the authority of the Ministry of Industry and Mineral Resources, while the Ministry of Environment and Nature has the responsibility for the EAMRA.

Another point of criticism relates to the sizable role that Danish research institutes play in the environmental domain of oil and gas development. Specialized knowledge on environmental and geological issues is to be provided by several selected Danish research Institutes (Parliament of Denmark 2009). With only limited expertise on this subject available in Greenland, the Danes and not the Greenlanders are seen as taking the decisions. Transferring knowledge from Denmark to Greenland on these issues is a slow but ongoing process.

The BMP used to be perceived as a closed power house with limited transparency (Aaen 2012). Even the parliament did not have full insight into the details of individual licenses agreed on by the BMP with individual oil companies. Increasingly, people were asking whether the BMP is capable of maximizing the benefits for Greenlandic society. Is the BMP not overwhelmed by the world’s largest oil companies and their demands? Companies like Shell, BP and Exxon have a significantly greater financial and human capital than the entire government of Greenland, let alone the BMP. And if oil and gas development is to be turned into a success, institutional strength is required (Mehlum, Moene and Torvik 2011). These worries and the limited transparency of the former BMP might have been partly reduced by the creation of a separate environmental entity. However, even with this new institutional structure the questions related to the limited capacity are still valid.

Creating a Knowledge-based Economy

Greenland is trying to benefit as much as possible from the current spur of interest in its oil, gas and mineral resources – not only by collecting taxes and royalties, but also by demanding participation, jobs and education for the population. It is acknowledged that by participating in the industry, society will benefit in a more long-term, sustainable way.
However, in order for the people of Greenland to work in the industry they need to have the right education, qualifications and skills. Government participation in the industry is ensured by the national oil company NunaOil, which has a 12.5 per cent share in each licence (Bureau of Minerals and Petroleum 2009b).

Education is one of the major challenges Greenland faces today. Finishing secondary school is not always a matter of course: many pupils drop out at an early stage. To obtain qualifications for work in one of the extractive industries, one can study at the Mineral Resources School in Sisimiut, opened in 2010 (Bureau of Minerals and Petroleum 2011). The establishment of this school has resulted in a new international network for Greenland. Since 2010, cooperation with, for example, Norway has been further developed to enhance the school’s capacity and ensure placements for students to gain practical experience in the petroleum industry (Hoegh-Dam 2011). As the University of Greenland focuses on language, history and social sciences, higher technical education at a university in Greenland is not yet possible. Denmark is a popular study destination because of the close historical ties and familiarity with the language. However, not all who go to study in Denmark return to Greenland afterwards. It is a challenge to attract talented, highly-skilled individuals to live and work in Greenland.

That is also a difficulty faced by the government itself. At present, most politicians are Greenlandic, whereas most civil servants are Danish. Turnover of civil servants within the government is high, and the average length of service is approximately two years, resulting in low levels of consistency (personal communication). Furthermore, it is mainly young, less-experienced Danes who go to Greenland to work for a few years and then return to Denmark. This might affect the experience of the overall Greenlandic administration and its institutional capacity. Moreover, it is argued that because of the many Danish civil servants, there remains a considerable post-colonial Danish influence on Greenland (Nielsen 2001).

Even though Greenland is still only on the threshold of creating a knowledge-based economy, the future looks positive. When the relevant legislation was formulated in 2009, lessons from other countries were incorporated as much as possible. For example, oil companies are required to enter an Impact Benefit Agreement (IBA) when starting to perform exploration and/or exploitation activities (Bureau of Minerals and Petroleum 2009a). This IBA comes in addition to taxes and royalties, and focuses on community benefits such as supporting education for oil and gas sector jobs in Greenland and giving preference to Greenlandic workers with the requisite skills. This IBA is signed not only by the oil company and the national government but also includes the involvement of the local municipality in question (Bureau of Minerals and Petroleum 2009a). The agreement is valid for one year, after which a new agreement must be made. This allows Greenland to learn from previous years, and to tailor the agreements appropriately. During its 2010/2011 drilling seasons, Cairn Energy supported the Mineral Resources School in Sisimiut, not only financially but also with placements on its drilling rigs.

If Greenland is to maximize its benefits from oil and gas development, even if no (viable) oil and/or gas resources are found in the future, it must increase its share in highly skilled jobs and expertise. The development of this highly skilled knowledge can relate to exploration activities as such, but also to Arctic infrastructure development and other related fields. Specializing in Arctic technologies and environmental and social issues related to oil and gas development could become a unique selling point for use
in the future. Even if this knowledge might perhaps not be applied in Greenland itself, it could be highly valued in Russia, other Arctic countries, or countries with similar climatic conditions. Developing this type of industry may be more easily said than done, but there are lessons to be learned from the successes of Iceland and the Faroe Islands. Greenland has already started educating and training as many Greenlanders as possible (European Commission 2007) so that they will possess the right skills to participate in the oil and gas industry and related fields of knowledge. This forms the start of a local knowledge-based economy, which can be further expanded in years to come. Simply the sustained expectation of oil and gas resources could prove sufficient for developing a knowledge-based economy. If, however, due to other global processes, interest declines prematurely, Greenland might not be ready in time to export its highly skilled knowledge. However, there is another possibility. Since Greenland’s onshore mineral resources are already proven and worldwide interest has been demonstrated, this sector could form the basis for the development of a local knowledge-based economy as well. That specific issue falls outside the scope of this chapter, but should be kept in mind when thinking about Greenland and the development of a local knowledge-based economy.

Arctic Energy Resources in International Geopolitics

Greenland uses its potential energy resources also in the Arctic and international political arena. A unique feature of politics in Greenland is that one politician can serve as a direct bridge between the very local politics and the highest level of geopolitics. Greenland has been attracting the attention of superpowers like China mainly because of its mineral resources and their limited availability in the rest of the world. China needs these minerals to fuel its own economic development (Erickson and Collins 2012) and Greenland uses this position to get a seat at the table in global politics. However, oil and gas resources have not been used in this way by Greenland, simply because there are no proven reserves yet.

For its international activities, Greenland remains largely dependent on Denmark and its extensive network of connections and embassies. However, Denmark has given Greenland considerable freedom to position itself internationally in recent years (Kleist 2012). One example is the Arctic Council, where it is officially Denmark that is the member, with a seat at the table. But since it is Greenland that makes Denmark an ‘Arctic’ state, the two work closely together, and Denmark generally follows the line advocated by Greenland. With the Arctic becoming more and more a theatre of high-level politics due to the high stakes associated with (energy) resources and shipping activities, it remains to be seen whether Greenland will be able to maintain its current position and role. Restrictions would not necessarily have to come from Denmark: other Arctic states with regions seeking greater autonomy might want to see the independent role of Greenland curbed.

Conclusions: Greenland and the Hydrocarbon Sector

In Greenland, developing an oil and gas sector is seen as crucial for achieving greater social welfare, creating jobs and in the long run becoming (financially) independent from Denmark. To maximize the local benefits, it is important for Greenlanders to
have the right skills for participating in the oil and gas sector. Education is central, now that Greenland finds itself at the starting point of developing a local knowledge-based economy associated with the developing oil and gas activities. Education and training take time, however, and if no oil and gas are found in the reasonably near future it remains to be seen if high levels of interest will continue long enough for the development of a local knowledge-based economy that Greenland could export elsewhere. Greenland could learn from the experiences of Iceland and the Faroe Islands. Further it could be worthwhile to look at lessons learned in Alaska (offshore oil and gas) and Canada (mineral resources) as well, because of the strong cultural links with these areas.

The Greenlandic government also uses its potential oil and gas resources to attract international attention. Major powers like the USA and China are interested in Greenland, and delegations visit Nuuk often. Strategic interests in the Arctic region and potential energy resources are driving forces.

The potential energy resources can bring many opportunities for Greenland – not only domestically in creating jobs, diversifying the economy and increasing social welfare, but also internationally by attracting the attention of other countries and investors. New connections are being made, thanks to its potential energy resources.

CONCLUSIONS

This chapter has examined three cases: Iceland, the Faroe Islands and Greenland. What conclusions can now be drawn?

We have seen that Iceland has created vibrant, domestic, but globally connected, knowledge-based sectors around hydropower and geothermal power, thereby creating considerable value for Icelandic society – although the trade-off with environmental values must be kept in mind. Further, Iceland may develop a knowledge-based sector in hydrocarbons, which will probably be more export-oriented than with hydro- and geothermal power. The Icelandic case highlights the central importance of domestic human capital. This human capital has been based on a successful combination of high-quality domestic primary, secondary and sometimes undergraduate tertiary education, often coupled with international higher education. This mix has contributed significantly to absorptive capacity: the capacity to learn and work with foreign counterparts at a high level.

The Faroe Islands have much in common with Iceland – historically, culturally and linguistically. Also, the Faroe Islands are well-equipped with human capital based on a combination of domestic and outside education and experience. However, young Faroese still go overwhelmingly to Denmark for further education, and that gives the Faroe Islands access to a much narrower range of expertise and contacts than is the case with students from Iceland, who are spread out over Europe and North America. The Faroe Islands have benefitted from being outside the EU and the EEA, as this has enabled them to set requirements as to local business, and educational and research activities in connection with hydrocarbon exploration. The human capital together with the high level of exploration activity has created a substantial Faroese knowledge-based hydrocarbon exploration sector working in the Faroe Islands and abroad.
Greenland is much more dependent on Denmark, financially and for human capital. It will need to have greater human capital if it is to capture the value of its energy (and mineral) resources. Greenland today is heavily dependent on outside human capital for hydrocarbon exploration. It is equally dependent on Denmark for the related knowledge-based work, whether through young Danish civil servants working for brief spells in Greenland or environmental analyses carried out by Danish research institutes. Greenland needs to build up its human capital in the field of energy: indeed, this applies to its society in general. Our comparison of Iceland, the Faroe Islands and Greenland gives clear indications as to what needs to be done. Greenland must continue to pursue a successful combination of high-quality domestic primary and secondary education and higher education, in some instances with further international higher education. The challenges to local primary and secondary education and the brain circulation with Denmark and other countries are well known. The case of energy as a developmental strategy highlights these educational challenges, and the importance of solving them. If they can be solved, that will have profound social, political and constitutional consequences for Greenland and for the Arctic as a whole.

Iceland, the Faroe Islands and Greenland show how energy can serve as an important developmental strategy for microstates pursuing independence and/or economic development. True, Iceland gained full independence without energy mega-projects, despite voices calling for such projects around 1900, because it had been comparatively less financially dependent on Denmark. All the same, Iceland struggled to develop from being one of the poorest Western European societies at the beginning of the twentieth century, and here energy came to play an important role. Today, the Faroe Islands and especially Greenland are heavily financially dependent on Denmark, and find themselves hard-pressed to find new sources of income in their pursuit of greater (and eventually full) independence from the Kingdom of Denmark.

Traditionally, interest in the economic effects of energy development in these societies has focused on investment activity and revenues from operations. In this chapter we have sought to highlight how an important societally-beneficial effect of energy development can be the development of domestic, but globally connected, knowledge-based sectors. Arctic societies, and not least these three North Atlantic societies, are communities based on natural resources and energy. The well-being of these societies hinges on being able to capture the value and benefits of their natural resources. Achieving these local benefits from natural resources will depend on a successful combination with human capital. The lessons of these three societies highlight the importance of local education, combined with brain circulation, if peripheral natural resource-dependent economies are to succeed in capturing the social benefits of their natural resources.

Continued climate change in the Arctic region will affect these energy-centred development strategies. Climate change will improve access to offshore oil and gas resources off Greenland, and is likely to create further opportunities in the future. For hydro-power resources, however, climate change and glacial melt will have more complex consequences. On the whole, we can conclude that climate change will bring increased complexity, and with it greater demands for human capital and knowledge, if local communities are to benefit from these resources.
NOTES

1. From the Landsvirkjun annual meeting, Reykjavík, 21 March 2013.
2. President of Iceland, Dr Ólafur Ragnar Grímsson, speaking at Harvard Business School, 4 April 2007, and Harvard University, 25 September 2007.
3. This section builds on interviews with key officials at the Icelandic National Energy Authority and the Icelandic Construction Authority, and information from the National Energy Authority oil search website www.os.is/oliuleit/.

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