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Under the Ice: Exploring the Arctic's Energy Resources, 1898–1985

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Introduction

One of the most striking aspects of media's reporting on the retreating and thinning Arctic sea ice has been the insistence that an increasingly ice-free Arctic Ocean creates vast new opportunities for the world's energy supply. The absence of sea ice in summertime is presumed to offer new possibilities for extracting oil and gas reserves, estimated to contain 25 percent of the not yet discovered deposits of those resources, according to the US geological survey (Gautier et al., 2009; AMAP, 2007). Opinions differ as to the consequences: some argue that it offers a welcome relief in the context of global energy scarcity. Others believe it will contribute to delaying a necessary transition to renewable energy sources, while fueling geopolitical tensions in the Arctic region and beyond. The impression is that – real and imagined – energy resources in the Arctic Ocean have stimulated the overall Arctic discourse, boosting the awareness from the side of both governments and the general public of the changing Arctic and, more generally, of the long-term geophysical processes under debate in the context of climate change.

Conversely, the attention paid to the changing sea ice has made the discussion about prospective Arctic energy resources more vivid. Yet this intensifying interest in the Arctic as a promising energy region is not simply an effect of the climate debate. When the 2007 sea-ice minimum aroused worldwide interest, the hunt for coal, oil and gas – as well as a variety of other natural resources that will not be discussed here – had already been going on for more than a century. In fact, as we argue in this chapter, Arctic energy exploration in the early twenty-first century was in a phase of dynamic expansion that would have continued even if global warming had not occurred. To show this, we set out to explore

Arctic energy activities of the past, with a particular emphasis on the ways in which energy actors have dealt with Arctic sea ice – in both practical and rhetorical terms. We argue that the ice – and the harsh northern environment in general – has not only been regarded as a problem, but also as an opportunity. We believe that today's quest for Arctic oil and gas, in the context of climate change, cannot be properly understood without taking these and other historical experiences into account.

The chapter is divided into three main parts: first, we outline the most important long-term trends in Arctic energy exploration; second, we investigate Arctic energy explorers' encounters with sea ice during the era of coal; and, third, in the age of oil and gas. A concluding section discusses these historical experiences in relation to the present-day Arctic energy debate.

Arctic energy in historical perspective

The idea of the Arctic as a region for extracting energy resources is not new. In the opening decades of the twentieth century, several regions in the Arctic caught the interest of actors from the south because they contained coal, the primary energy resource of that time. Coal was the energy provider that fueled the industrialization of Europe and North America. It was used for heating the steam engines, steam turbines and heating processes of factories and works, for the boilers in the locomotives pulling trains on expanding railway systems and steamships of trading fleets, for heating the apartment buildings of growing cities, as well as household stoves. There was a never-ending market for coal. Therefore new finds of this vital energy resource, even in remote regions such as the Arctic, caught the interest of mining industrialists if profitable extraction was feasible (Avango, 2005a).

In some areas of the Arctic, coal mines were opened to cater for local energy needs, while in other areas companies constructed large-scale coal-mining settlements aimed at exports to the industrial centers in the south. One such area was the archipelago of Spitsbergen (Svalbard in Norwegian), located in the European Arctic. Spitsbergen was subject to an intensive rush for coal in the opening decades of the twentieth century, involving mining companies from several nations in Europe and North America – the United States, Norway, Russia, Sweden, the Netherlands, Germany and Great Britain (Avango et al., 2010).

The history of this industry can be divided into three different phases. During an opening phase starting in 1898, entrepreneurs from Germany, Norway and Britain started prospecting companies that opened up small-sized mining camps, operated only during the summer months. During a second phase, from 1905, these companies sold off their coal fields to actors with enough resources (economic, knowledge, networks) to start up large-scale mining operations. The first ones were British (Advent City, 1905) and American (Longyear City, 1906) and as the world-market prices for coal ran high during World War I, mining companies from several countries in the Western world established large-scale mining operations for year-round production – Sveagruvan (Swedish), Barentsburg (Dutch), Brandal City (Norwegian) and Grumant City (Russian) to name a few. This period can be called a coal rush, but it was short. In the mid- and late-1920s it came to an end because of the worldwide economic crisis. The prices of coal dropped rapidly and as a consequence most of the mining companies went bankrupt and closed down their mines. The third mining phase started in the late 1920s and continues to the present. Companies from only two nations have been involved in mining for energy resources on Spitsbergen during this period – Norway and the Soviet Union/Russia. These companies operated several large-scale coal mines each, some of which are still in production (Hacquebord and Avango, 2009).

Coal energy resources were also available in Alaska, known by indigenous peoples of the region for a long time. From the second half of the eighteenth century, actors from Russia and Britain started to explore them during expeditions in the area. The first coal-mining operation in Alaska started already in 1855 by the Russian-American Company, followed by several small-scale mining operations. Most of these mines were opened in southern and central Alaska, but coal mines were also opened in the Arctic parts of the province by whalers and other skippers who used them for the fuel needs of their ships and whaling operations. However, coal mining on a larger-scale did not take place until after the construction of the Alaskan railway in 1917, again in southern and central Alaska. In Arctic Alaska, large-scale coal mining came even later, in the early 1940s after the US Department of Defense had issued orders for opening larger-scale coal mining in that area. These coal mines, located along the coast, only supplied a local market and were short-lived (Armstrong et al., 1978, pp. 130–1; Merrit, 1986).

Greenland was also targeted for its energy resources by actors coming from the south. Again, however, the coal was only used for local needs. The first coal mine was opened in 1780 at Disko Bay, western Greenland, and was operated until 1833. In the mid-1920s a Danish coal-mining firm opened a new coal mine at Disko, which remained in operation until 1972 (Armstrong et al., 1978; Bach and Taagholt, 1976).

A more substantial move for Arctic coal energy resources took place in the Soviet Union starting in the 1930s. Already in the late nineteenth century the Russian government had taken initiatives to prospect for coal in the Russian Northwest and on Novaja Zemlja. These prospecting campaigns did not result in any mining operations, but in the 1910s Russian explorers, backed by private capital and the government, found and claimed coal resources on Spitsbergen. As a result, Russian companies opened coal mines at Green Harbor and the Grumant Valley on Spitsbergen (Avango 2005b; Lajus 2004). In the early 1930s, the Soviet authorities opened large-scale mining operations also on the mainland of Arctic Russia, in Vorkuta, as a part of the establishment of the Gulag labor camp system.

In the postwar period, the primary interest in Arctic energy resources shifted from coal to oil and natural gas, whereby Arctic energy explorers pushed towards the north from four different directions: Alaska, Canada, Russia and Norway.

The Alaskan oil industry had been started on a small scale already in the late nineteenth century, but it was the postwar oil surge and the recognition that the United States, from 1949, had become a net importer of oil that stimulated the search to take off in earnest. There was also considerable interest in Alaskan oil from resource-poor Japan. At first activities were concentrated on Alaska's Pacific coast. In the more challenging environment of the North Slope, facing the Arctic Ocean, first drillings took the form of military ventures, but from 1963 activities expanded on a commercial basis. An enormously rich field – North America's largest, as it would turn out – was found at Prudhoe Bay in 1968. The find stimulated further exploration to quickly expand towards both east and west along the Arctic coast.

Prudhoe Bay oil started flowing in 1977. As a result of the dramatic transfigurations on the global oil scene during the 1970s, and steeply rising oil prices, the interest in Alaskan oil from the side of several actor groups continued to increase. The oil hunt thereby also expanded out onto the continental shelf in the Beaufort Sea. A number of fields believed to have commercial potential were found both on- and offshore, but as of the mid-1980s oil companies felt disappointed by the development, as no other giant field had been found. They had expected more. In 1985 Sohio and Exxon became the first companies to decide on the actual exploitation of an Alaskan offshore field – Endicott – but it was not expected to generate much profit. In the oil industry parlor, Endicott was a 'marginal' field. The purpose of developing it was mainly to prevent further exploration from dying off altogether (Curtis and Huxley, 1985).

The neighboring Canadian oil industry traced its origins to the early twentieth century, when oil was found at Norman Wells on the Mackenzie River. Logistical problems made it impossible to distribute the oil in an economically viable way, although it, similar to its Alaskan counterpart, was used for military purposes during and after World War II. Commercial oil and gas exploration in the Canadian Arctic started in the early 1960s and was concentrated on two fronts: the Arctic islands and, further west, the Mackenzie delta. Disappointingly, the actual oil finds were not at all as rewarding as those made in the neighboring US state, and until 1985 the only oil that actually flowed from the Canadian Arctic was from the historical Norman Wells field. That year production from a field on Cameron Island in the High Arctic commenced on a small scale, enabling crude oil for the first time to be shipped through the Northwest Passage to Montreal for refining (*Oil and Gas Journal* [OGJ], 9 September 1985).

Apart from oil, relatively promising natural gas finds had also been made on the Arctic islands, but it was uncertain if and when this gas would ever find any use. A large number of smaller oil and gas fields were also found, but all of them were too insignificant for their exploitation to be commercially viable. The federal government offered generous support to explorers who were willing to continue the search and, in addition, state-owned companies – notably Panarctic Oils – acquired dozens of small private actors that had failed in their Arctic efforts. Precisely the many failures of onshore explorers also stimulated the Canadians, just like their Alaskan counterparts, to expand out into the Beaufort Sea, starting in 1972–1973 (OGJ, 8 March 1971), an effort that was further promoted and accelerated in response to the first oil crisis and the stagnation in US domestic gas production. By the mid-1980s, oil companies were optimistic about the possibility of commercially developing at least a few offshore fields (OGJ, 6 May 1985).

In Europe the interest in Arctic oil and gas built on the tradition already established in Spitsbergen during the coal era. Norwegian, American and Soviet actors arrived in the archipelago during the 1960s with drilling equipment, though the outcome was disappointing from an economic perspective (Barr, 2001). In parallel, stimulated by the huge natural gas finds in the northern Netherlands in 1959, seismic surveys and drilling expanded from continental Europe into the North Sea. The breakthrough for North Sea oil came in 1966. Both British and Norwegian North Sea oil attained special significance in the face of new turmoil on the global oil scene from the late 1960s. The Norwegian strikes were even referred to as Western Europe's 'own North Slope' (OGJ, 18 May 1970 and 25 May 1970). Following the second oil crisis in 1979, the Norwegian government opted to open up waters further north for explorers (OGJ, 15 October 1979 and 23 April 1984). Large oil finds were made in the Norwegian Sea, and in October 1984 Statoil announced its discovery of the Snøhvit oil and gas field in the Barents Sea (OGJ, 4 March 1985).

In Russia, geologists had pointed at the promising prospects for oil in the country's far north already during Imperial times. Lenin sent a hopeful expedition to the Komi Republic in the early 1920s, but it took until the late 1950s before the development took off in earnest. The breakthrough for Arctic oil and gas in the Soviet Union came in the first half of the 1960s through a series of major discoveries in and around the Ob delta and on the Yamal peninsula. The 'Third Baku', as this region was nicknamed, was enormously much richer in both oil and gas than Alaska and the Canadian Arctic. A consequence of this richness was that the Soviets did not feel the same hurry to expand out onto their continental shelf, which thus remained unexplored for much longer than the Beaufort Sea. When *Izvestiya* published a map in March 1966 showing how rich the Arctic Ocean – and especially its Soviet section – was believed to be in terms of oil and gas, it was at the same time emphasized that the first oil and gas from the Arctic offshore would most probably not start flowing before 20 to 30 years, that is, around 1990.

Serious interest in surveys of the Soviet Union's offshore Arctic areas gained momentum only in the late 1970s as Siberian oil – but not Siberian gas – faced the threat of stagnation following over-exploitation of several oil fields. To get a better idea of the geology below the Barents Sea, the Soviets drilled a hole on Kolguyev Island in 1972 and another on an island in the Franz Josef Land archipelago in 1977. From a geological perspective, the Kara Sea was deemed the most promising, but the Barents Sea was more accessible and most early efforts were thus concentrated there. Actual offshore drilling in the Barents Sea was launched in 1982 (OGJ, 22 February 1982). As of 1985 no oil had yet been found, but petroleum geologists were extremely optimistic about coming Soviet offshore finds in the Barents, not least because the Norwegians had made significant finds in their part of the same sea (OGJ, 11 February 1985).

To sum up this section, the present quest for energy resources in the Arctic is not a new development. Over the last 150 years, deposits of coal, oil and gas in the Arctic parts of North America, Europe and Asia have all been interpreted as energy resources and partly also been utilized as such. The motives have been both economic and political. The present efforts to utilize oil and gas resources is merely the latest stage in a more or less continuous development, in which state actors and energy companies have pushed their operations to areas increasingly remote from main centers of energy use.

Encountering sea ice in the era of coal

Industrial companies interested in extracting energy resources in the Arctic have always had to consider the geographical and environmental circumstances of this region when developing their projects. We argue that they have done so in two different ways: by developing technology and through rhetoric.

The coal-mining industry at Spitsbergen in the first half of the twentieth century provides several instructive examples. The mining companies involved were all eager to make maximum use of the opportunities for profits that had opened after the turn of the century. In addition to the general demand for coal described in the above, states tended to support the idea of utilizing Arctic energy in order to secure the needs of their nations, particularly for the railways which were not only an infrastructural backbone in the industrial economy but also had a military function. This issue was particularly problematic in the Scandinavian countries, which lacked satisfactory domestic coal resources. Dependence on imports was not only a security issue but also an unfavorable competitive situation for industry at a time when the free-trade ideas of the mid-nineteenth century had given way to protectionist policies. In addition, there were strong foreign policy interests fueling the Spitsbergen coal rush. Spitsbergen was regarded as a no man's land, therefore the energy resources were available to all, without any state demands to apply for concession or to pay taxes. However, in the opening decade of the twentieth century, Norway challenged the *terra nullius* status with the aim of achieving sovereignty. The Swedish and Russian governments were strongly opposed to these initiatives, which resulted in an international conflict which was not resolved until the competing nations signed the Spitsbergen Treaty in 1920. The states involved in the conflict supported 'their' mining companies and even took initiatives to start new ones, all for the sake of having a strong national presence on Spitsbergen and thereby also a stronger position in the negotiations (Avango, 2005a; Avango et al., 2010). In other words, there was a general economic and political context in Europe which worked in favor of actors who wanted to utilize the coal resources available at Spitsbergen; profits could be made and national needs for energy and political influence could be catered to.

Therefore the coal-mining companies had strong incentives for finding ways to cope with the Arctic environment. First, they did so by developing technology fit for withstanding the demands of this environment. One of the most serious of these challenges was, no doubt, the sea ice. It covered the bays of the archipelago and it appeared as pack ice in the surrounding seas for parts of the year, in particular the summertime. In general the only sites where the mining companies could mine the coal resources in a technologically and economically viable way were at the inner parts of bays, which were ice-covered from late October until the beginning of July. Therefore there was only limited time available for shipping and all coal produced from October to July had to be stored at the mine. For this reason the mining companies could only establish their coal mines at places where there was enough space for storing the entire mass of coal produced at the mines in the winter months – a significant problem in an archipelago characterized by steep coastlines with only limited space available for building industrial works. In addition, the companies had to construct highly effective loading systems in order to be able to load one year's produce of coal onto ships within the narrow window of three ice-free months. Such systems required not

Figure 7.1 Coal-storage area at the Svea mine, Spitsbergen, in the early 1920s
Source: B Walldén photo archive.

Figure 7.2 Pier and loading facilities at Longyear City, Spitsbergen, early 1910s
Source: Longyear Spitsbergen Collection, MTU archives, Michigan.

only space but also substantial investments (Avango, 2005a; Avango et al., 2008a; Avango et al., 2008b).

The sea ice also created other obstacles. The core of the loading systems for coal was the jetties, often equipped with multiple loading systems such as conveyers, railway and aerial ropeways. These complex and expensive loading systems were vulnerable to the movements of the ice. If the ice carried the jetty away while the mine was isolated in the winter, the company would not be able to export their mountain of coal when the summer arrived – a scenario which would lead to bankruptcy. Therefore the companies had permanent work groups whose primary task was to maintain and re-enforce the jetties (Avango, 2005b; Hartnell, 2009).

When sunlight returned to Spitsbergen during the months of spring, the mining companies would often include the sea ice into the technological systems of their mining operations. In general the edge of the Arctic Ocean sea ice was located just off the western coastline of Spitsbergen, some 30 to 50 kilometers away from the mines. The companies utilized the ice edge for anchoring supply ships in order to offload equipment

and food to the mines, facilitate the arrival of new employees, and for allowing personnel who wanted to leave an opportunity to do so (or indeed to expel union activists). The supplies were pulled by dog sleds and later bandwagons across the frozen bays to the mines and along the route the companies built intermediary stations for storage and shelter (Avango, 2005a; Avango, 2008a).

Another challenge was the complete absence of vegetation, which meant that mining companies had to import and store massive amounts of wood from the south. Coal mining required a lot of wood, not only to construct buildings for lodgment, services, storage and recreation but also for the production and transport systems. Of crucial importance were wooden pit props, used in huge numbers for supporting the roof of areas in the mine where the coal had been extracted, and most importantly to secure the roof of the main tunnels. The Arctic climate also meant that nothing could be cultivated and that cattle could only be kept with great difficulty. The resources needed to keep a permanent population of hundreds if not thousands of mine-workers alive (and happy), had to be imported. The companies handled this problem by establishing substantial storage facilities and in cases by running greenhouses and keeping live pigs, hens and cows as a living reserve of fresh meat (Avango, 2005a; Avango et al., 2008b).

Another challenge posed by the Arctic environment was the snow. Although there is not much precipitation at Spitsbergen, the open character of the landscape allows winds to carry snow from vast expanses of landscape and deposit it in depressions, behind ridges and at mountainsides. For this reason, coal-mining companies ran the risk of having their buildings and railway systems buried under vast amounts of snow for much of the year. Most companies handled this problem by placing buildings in elevated places, with gabled walls towards the prevailing wind direction, allowing the snow to blow clear from the buildings. They also opted for aerial ropeway transport systems which could carry the energy resources from the mines to the storage areas unhindered by the snow cover. Companies using railways covered them with wooden or concrete tunnels. From the snowfall followed avalanches which posed a particularly serious threat during the early summer thaw. Therefore mining companies usually placed buildings and production systems in naturally protected places and if necessary erected avalanche barriers (Avango, 2004; Avango et al., 2008b; Avango et al., 2009).

Another way of dealing with the environmental conditions of the Arctic was by rhetoric. It is clear that the prevailing discourse about the Arctic in the early twentieth century worked in favor of the Spitsbergen mining companies. They could profit from a contemporary mythology about polar research and exploration as cutting-edge science and as heroism, when rallying political support, investments or when recruiting employees. On the other hand, the same mythology contained stories about encounters with pack ice, isolation and blizzards and these stories were less useful as tools for enrolling investors. Therefore, while using the tropes of Arctic exploration, the mining entrepreneurs and their supporters also tended to downplay the challenges of the Arctic in order to build support for their projects. This became visible in company prospectuses, in correspondence, in professional journals and in the media.

In their rhetoric, mining companies and their supporters tended to emphasize how accessible Spitsbergen was, despite its location in the Arctic. Typically they would refer to the warming effect of the North Atlantic current which rendered the west part of the archipelago free from sea ice for much of the year. Problems with belts of pack ice in the summertime was recognized but downplayed. The Arctic summer would always allow for at least three months of shipping, making it possible to export the annual production of coal from the mines and provide the mining communities with the necessary supplies. The ice cover in the bays, they claimed, could easily be handled by icebreakers, while late-autumn darkness could be countered with a system of lighthouses (Andersson, 1917, pp. 239–48; Brown, 1915, pp. 19–20; Enström, 1923a, pp. 4, 14–16; Hemming, 1921; Högbom, 1914, pp. 199–203).

The 1,000 kilometers distance between the Spitsbergen west coast and the coal market in north Scandinavian ports such as Narvik was recognized, but was described as short in comparison to the closest source of coal to the south: Scania in southern Sweden (Högbom, 1914, pp. 208–10). Spitsbergen was also close to Britain, 'only fifty hours steaming by a fast cruiser from our shores' (Brown, 1915, p. 19). On maps in their coal-mining prospectuses, the mining companies pictured Spitsbergen as located just off the north coast of northern Norway, with shipping routes connecting it with the railway infrastructures of Scandinavia, creating an image of an easily accessible resource at a minor distance from north European markets (Andersson, 1917, p. 248; Enström, 1923a, p. 4; Enström, 1923b; Johnsson, 1916).

In 1919, Scottish geologist and geographer Henry Cadell, a stern supporter of British coal mining on Spitsbergen and board member of the coal-mining firm The Scottish Spitsbergen Syndicate, took this argumentation even further. He predicted that in the future Spitsbergen would suffer even less from the problems of ice. Based on his observations of retreating glaciers and the disappearance of permanent fjord ice

Figure 7.3 Map on the front page of a Swedish coal-mining prospectus from 1916, presenting the Spitsbergen energy resources as easily accessible, ready to plug into the larger infrasystems of Scandinavia. Similar maps are published by scientists and engineers supporting the Swedish mining of coal resources on Spitsbergen
Source: Johnsson, 1916.

in Alaska, he envisioned: 'that the time may come when Norway will see more of the ground free from the grip of glaciers, and the area of the more habitable parts of Spitsbergen considerably extended' (Cadell, 1920).

In cases, mining companies and their supporters presented the Arctic environmental conditions as great assets. The absence of any vegetation made the geological layers readable in the mountainsides, which made it easy for prospecting engineers to map out the extent and character of the coal seams and to identify fault zones. In addition the permafrost kept groundwater from seeping into the mines, which made it unnecessary to invest in expensive drainage pumping systems. Moreover, the low temperatures would make underground mine work comfortable compared to the hot and sweaty character of coal mining in more southern latitudes. Potential problems of wintering over in permanent darkness and complete isolation was recognized, but presented as easily handled by electric light, good housing and sound spare-time activities such as skiing and reading. Indeed, the Arctic climate did nothing but good to those who dared to encounter it: the climate was known to be sound and hardening, even suitable for locating sanatoriums because of a presumed complete absence of any airborne bacteria (Andersson, 1917, pp. 230–4; Brown, 1915, pp. 18-20; De Geer, 1912, p. 372; Högbom, 1914, pp. 204, 206).

In newspaper media, journalists often combined the two narratives. On one hand, their stories romanticized Spitsbergen as an Arctic wilderness, with calving glaciers, polar bears and a landscape beautiful and frightening at the same time. This part of their stories aligned with the wider genre of polar exploration literature at the time and thereby conveyed some of the glow surrounding polar exploration to the Arctic mining industry. On the other hand, the same media stories emphasized the success of the mining companies to handle the Arctic conditions through state-of-the-art engineering. By adapting the latest innovations in transport and mining technologies, the challenges of the Arctic environment – including the sea ice – could easily be overcome. The same was said to be true for the working conditions in Arctic mining settlements. The frustration over isolation and months of winter darkness was supposedly easy to counter through social engineering – decent housing and food, high salaries, libraries, outdoor activities and choirs (Avango and Houltz, 2012).

This rhetoric often had a nationalist content. Through the media, Swedish mining companies and their supporters described the mining industry at Spitsbergen as a result and continuation of a much longer history of Swedish science and exploration in the Arctic. Swedish scientists had played a prominent role in the arena of scientific research in the European Arctic since the 1850s and much of this research had taken place at Spitsbergen. When the geographer Gerard de Geer summarized

these efforts in 1912, he counted 24 expeditions, 376 publications and 60 maps (De Geer, 1912, p. 367). Swedish geographers and geologists had not only mapped the features of the Spitsbergen landscape and the depths of its bays, but also the geology, including the coal. Building on this track record, supporters of Swedish coal mining on Spitsbergen portrayed the Spitsbergen coal-mining industry as a result of the efforts of Swedish polar science, highlighting renowned scientists such as A. E. Nordenskjöld, A. G. Nathorst and Gerard De Geer: 'without exaggeration it can be said that what Spitsbergen really is, is what Swedish researchers have made it to be' (De Geer, 1919; Lundström, 1920; von Holstein, 1920). By statements such as these in the media, the mining industry was presented as being built on a solid platform of scientific knowledge, a claim that harmonized well with widespread ideas on the relationship between scientific research and industrial development at the time.

Moreover, the coal industry was built on Swedish knowledge, greater than that of other nations because of supposedly superior standards in science and engineering and an inherent ability of Swedes to cope with the Arctic environment. This attitude was conveyed in newspaper articles and in literature comparing the Swedish Svea mine to other mining towns on Spitsbergen, in which the Swedish Svea mine stood out as the most solid and productive mining town on the archipelago. If anyone, Swedes were able to successfully colonize and utilize the Arctic, as expressed by royal family member and explorer Prince Wilhelm, in a newspaper aimed at Swedish youth in the early twentieth century:

> Some talented engineers and supervisors direct the work, which is exclusively performed by a Swedish workforce. There are medical doctors at the site, and the wireless telegraph system mediates communication with the outside world. In any weather, in rain and snow, in biting cold and arctic darkness, they work the whole year through. It's a constant struggle for survival and keeping the vile climatic conditions at bay. Honor to the men, who thereby establish the northernmost outpost of the Swedish spirit of enterprise; fame to their deeds, which show that where enduring power and purposeful organization is put to work, a Swede will never need to be ashamed of his countrymen, even if the task is to colonize the North Pole! (Wilhelm, 1919, pp. 35–6)

These narratives of Swedish abilities to utilize the energy resources of the Arctic should be understood as tools for attracting investors to Swedish coal mining on Spitsbergen, and to strengthen the Swedish position in the ongoing negotiations regarding the future legal status of Spitsbergen. Similar objectives lay behind much of the rhetoric of other actors within coal mining on Spitsbergen (see for example Cadell, 1920).

However, rhetoric and technology did not always solve the problem of successfully extracting energy resources in the Arctic. There are many examples of mining companies failing to cope with the environmental conditions at Spitsbergen. Often the sea ice was the source of the problem. Mining companies failed to supply their mining communities with the necessities for the wintertime isolation, because sea ice blocked the ships carrying the supplies. Coal ships were forced to turn back to the European mainland in the middle of the summer after meeting solid pack ice instead of an open sea and ice-free bays (Avango, 2005b; Dole, 1922a, pp. 298, 309, 355–6). One of the most extraordinary cases from the coal boom on Spitsbergen in the early 1900s was the summer of 1915, when pack ice blocked the coastline of Spitsbergen during the entire summer. The ships of the mining companies were unable to reach the mines or were crushed in the ice (Dole, 1922b, pp. 372–5). These ice conditions certainly affected the enthusiasm for Spitsbergen as a provider of energy resources. At the time a US firm, the Arctic Coal Company, was trying to sell its coal mine Longyear City – by far the largest coal mine at Spitsbergen – to a Russian syndicate, which sent an engineer to inspect the facilities. His ship got stuck in the ice and two months after leaving Tromsø, it was finally crushed by the ice and his team was forced to walk across the pack ice off the west coast of Spitsbergen, looking for help. Naturally the Russian investors pulled out of the affair and instead the Arctic Coal Company entered negotiations with the Norwegian investors who eventually bought the mining settlement, which today is the provincial capital of Norwegian Svalbard – Longyearbyen (Dole, 1922b, pp. 412–14). Others, however, were not discouraged. The ships of the Swedish mining company spent two months travelling up and down the edge of the pack ice, unable to reach the site where they were constructing their mine (AB Isfjorden-Belsund, 1915). The company board remained silent about this event however. It was not communicated to the shareholders in the company in the annual report and, despite the severity of this setback, the company leadership proceeded to establish what became one of the most significant mining towns on Spitsbergen – the Svea mine. Thus the mining companies tended to exclude narratives about the ice which were not beneficial to them.

In conclusion, the early twentieth century quest for Arctic energy resources did not take place within the context of a debate on global warming and melting sea ice. However, accessibility was an issue in the debate regarding the potential of Spitsbergen as a mining region. The mining companies handled this problem by developing technologies that in most cases were sufficient to withstand the Arctic environment. Equally important, they managed to convincingly construct a narrative about the Arctic conditions in general and the sea ice in particular, in which they were able to successfully domesticate the Arctic conditions through scientific research and modern industrial technology. The ice was turned into a challenge showing their ability.

Oil, gas and ice

In the postwar era, as we have seen, oil rather than coal was the focus. The Arctic energy challenge now became even more daunting. On land, glaciers and permafrost covered many promising oil regions, and when explorers moved offshore they had to deal, depending on the season, with both landfast ice along the coasts and floating sea ice. In both West and East, however, actors believed technology could be developed that would allow exploitation of both onshore and offshore Arctic energy resources. Offshore activities were regarded as the most difficult, but if there was a perceived need to be patient about the realization of this possibility, it was not because actors hoped that global warming – the possibility of which was not widely discussed before the late 1980s – would help to make conditions less harsh, but because scientific and technological progress needed time.

The first challenge was not so much to enable exploration as such, but to overcome logistical barriers for shipments of oil and gas from onshore wells across Arctic waters to worldwide markets, and to bring in machinery and equipment to offshore drilling and production sites. Prudhoe Bay, Alaska's (and North America's) largest oil field, remained unproductive for nearly a decade in the absence of acceptable solutions regarding distribution of its abundant oil. Two main options were considered: to pump the oil through a pipeline overland to US markets, or develop an Arctic tanker route (OGJ, 8 June 1970). Since sea ice made tanker transport difficult, risky or, as some believed, simply impossible during much of the year, stakeholders eventually opted for the pipeline solution, which for its part became one of the most environmentally controversial projects in American history (Coates, 1993). But the sea route was still used for shipping a variety of heavy machinery and equipment to the drill sites. The Alaskan 'sealift' became an annual, almost festive, event for the oil companies involved. From a winter base near Seattle, a convoy of several dozen large barges, loaded with a hundred thousand tons or so of heavy equipment and even housing modules, embarked every year in June or July on their 6,000 kilometer voyage. Having passed through the Bering Strait, the vessels waited at Point Barrow for the Arctic sea ice to break up (this usually happened in August) before continuing to the Prudhoe Bay area. The sealift was an expensive and risky venture. In 1975, many of the barges were 'forced to turn back because of heavy ice', and others were forced to remain through the winter at Prudhoe Bay. The following year the companies managed to hire the service of US Coast Guard icebreakers to prevent this debacle from being repeated (OGJ, 5 July 1976).

The development in the Soviet Union largely paralleled the American one, although the focus here was more on natural gas than on oil. The Soviets took into operation their first long-distance pipelines from onshore Arctic gas fields already a few years before the Trans-Alaska Pipeline was inaugurated. The huge costs of the system, however, were subject to intense internal debate that was played out not only behind the locked doors of the totalitarian regime, but openly in official media. *Pravda*, for example, published a variety of articles that criticized the Arctic pipelines on both economic and environmental grounds (Slavkina, 2002; Gustafson, 1989).

A possible alternative to an Arctic pipeline system, the critics argued, would be to locate major industrial gas users to the Soviet Arctic, as this would eliminate the need for long-distance transport of gas. Another proposal was to move the gas to Arctic harbors for liquefaction and tanker transport abroad. This was an attractive idea in view of the enormous difficulties, delays and breakdowns that the Soviet Union experienced when trying to sell natural gas to foreign customers by pipeline (Högselius, 2012). It seemed to fit well with ideas discussed at the time concerning Soviet gas exports to the United States. Several US gas companies approached Moscow in the early 1970s regarding the possible establishment of a Soviet–American trade in liquid natural gas (LNG), identifying such a trade as a possible solution to America's looming gas shortage. When leading Soviet newspapers in 1976 proudly reported that the Soviet Union was about to make use of nuclear-powered icebreakers to open up 'a year-round shipping route from Murmansk through the Barents and Kara Seas', the Western oil industry was enthused. However, their analysts suspected that the Pechora and Kara Seas were much too shallow for large LNG supertankers to operate safely. Instead, if the United States wanted access to Soviet gas, pipelines would first have to be laid from the Siberian gas fields to a harbor further west, on the Barents coast (OGJ, 29 May 1972 and 22 October 1973).[1]

The vision of Soviet LNG exports faded away as geopolitical tensions increased in the late 1970s. From an internal Soviet perspective, however, the opening up of the northern seaway was still of great importance for the country's oil and gas industry. This was because it facilitated a Siberian sealift, similar to the Alaskan one, of heavy equipment, machinery and housing modules to the main energy sites, located as they were in otherwise highly inaccessible regions. Starting in the second half of the 1970s, pressed by the looming scarcity of oil, the Soviets started transporting massive equipment by barge to Cape Kharasavei on the Yamal peninsula's southwestern coast, and from there by specially designed vehicles on the Kara Sea ice pack to promising drill sites on the peninsula's northern tip, several hundred kilometers away (OGJ, 27 June 1977).

The Canadians, meanwhile, aimed to feed oil and gas from the Mackenzie delta into newly built pipelines that would link up with existing pipeline grids. As for the promising gas finds made on the remote Melville and King Christian islands, however, there was much hesitation about the economic feasibility of a piped infrastructure for bringing the fuel southward, the distance to the main consumption centers measuring about 4,000 kilometers. The Canadians had ample experience in ultra-long pipeline construction, having completed a Trans-Canada pipeline already in the 1950s, but the harsh Arctic environment made a corresponding system in a north-south direction a challenge of totally different dimensions. As in Siberia, pipes, compressor stations and other equipment would have to resist extreme temperatures and winds, but in addition the pipeline would have to be protected from potential sea-ice scour on the critical subsea crossings of several Arctic straits – the longest of which measured 122 kilometers across (between Melville and Victoria islands) (Kaustinen, 1983). Research showed that ice scour could be a problem down to depths of at least 50 meters, which meant that pipelines would have to be buried in deep trenches on the sea bottom for protection (OGJ, 3 January 1983).

Another problem, which the Russians never had to face, was an uncertainty as to whether sufficient gas would actually be available. The main stakeholders – of which Panarctic Oils and TransCanada PipeLines took leading roles – formed the Polar Gas Project consortium in 1972 to investigate the issue in depth (Kaustinen, 1983; OGJ, 2 December 1974). The main problem, in Panarctic's view, was not so much the harsh Arctic climate, physically speaking, but rather the lack of a 'suitable *political* and *economic* climate'. Optimism increased with the unprecedented rise in fuel prices, since this meant that the pipeline might pay for itself even though fairly modest volumes of gas were available. In what followed, additional drilling ventures – both domestic and foreign ones – were attracted to the Canadian Arctic. By the early 1980s this new dynamism had resulted in several new gas finds.

Gas shipments in the form of LNG from the Arctic islands were also discussed as an option. An LNG route, it was argued, would give the Canadians greater freedom and flexibility in their export activities and make them less dependent on the United States as their main customer. Envisaging gas sales to Western Europe, Panarctic in 1982 launched a cooperative venture with Germany's largest gas company, Ruhrgas. The main technical challenge when considering the LNG opportunity was to design icebreaking LNG tankers (OGJ, 3 January 1983). In November 1981, a Canadian interdepartmental committee approved a pilot LNG project, saying it trusted that 'the project can proceed safely if a number of recommendations are followed'. These included a 'year round reporting system on ice conditions' and arrangements for providing navigators with 'adequate warning of collision hazards'. There was opposition to the project, however, from the side of environmental groups. Moreover, Greenland's parliament 'voted unanimously to condemn the project and wanted to take the issue to the UN, worried about potential environmental hazards posed by heavy traffic of LNG tankers along its shoreline' (OGJ, 2 November 1981). In August 1984, then, Canada's National Energy Board officially shelved the Arctic LNG pilot project (OGJ, 20 August 1984), though apparently not so much for environmental reasons but rather because of failure to come to agreement with prospective customers.

In the Spitsbergen archipelago, onshore drillings for oil were made difficult both by lack of harbors and by the presence of landfast sea ice. In addition, the Spitsbergen Treaty stipulated that aircraft landing strips must not be built, thus further hampering logistical operations. Even so, the archipelago attracted explorers. In June 1972, for example, a Belgian–Norwegian drilling expedition arrived on Spitsbergen's Edgeøya, which had been identified as a geologically promising site but where landfast ice precluded the reliance on ships for bringing the drilling rig onshore. Instead, all parts of the rig, along with a complete camp for the oil workers, were lifted from the ship to the drilling site by helicopter – a tedious and expensive method. Nevertheless, in 1973 the venture moved on to the even less accessible Hopen Island (OGJ, 10 September 1973). A total of 12 sites were drilled in Spitsbergen during these years, but the lack of actual strikes then led most companies to abandon the contested archipelago. To the extent that an interest was retained, this was because there was 'a fund of geological data to be gathered that could be valuable in preliminary mapping of the Barents Sea' (OGJ, 4 February 1985; Barr, 2001).

In all the projects described above, oil and gas companies were forced to deal with Arctic sea ice despite the fact that drilling and production took place onshore. When the companies in a second phase moved out into the sea itself in search of oil and gas, their ice encounters were further complicated. Again, however, petroleum geologists and engineers did not see any reason to stand back and wait for climate change to free the Arctic Ocean from its icy roof. Scientific advancements and engineering ingenuity were seen to offer solutions to all ice-related problems.

Regular offshore drilling rigs could not be used, vulnerable as they were to the onslaught of sea ice. Instead, the first drillings in waters with seasonal ice cover made use of specially designed drillships, which were anchored up at the respective drill sites for a few summer months, after which they were moved back to ice-free harbors, only to return the next year. In regions where ice was likely to be encountered also in summer, the ships were designed in such a way that they could quickly be moved to a safe location, should dangerous ice be approaching. Alternatively, the ship was accompanied by one or more support vessels whose task, in case of ice encroachment, was to break up the ice around the drill ship (OGJ, 5 August 1985). But seasonally used drill ships, with limited time on the site every year and expensive voyages back and forth between summer and winter locations, were clearly not optimal from a business point of view. Operators were often frustrated by the unpredictability of the year's work, as early winter-ice buildup often forced them to return home weeks and even months ahead of schedule (for example OGJ, 25 June 1984).[2] A first key challenge for operators was thus to find ways of extending the short drilling season and, ideally, enable operation in Arctic waters on a year-round basis.

A central innovation in this context was the artificial drilling island. Built from sand and gravel, it offered a stable operating platform able to withstand the assault of ice. Such islands could only be built in relatively shallow waters (down to depths of 30 meters or so), but even so they enabled the Arctic oil industry to expand their shelf-based activities considerably. The first drilling islands were built in the Beaufort Sea in the mid-1970s and were constructed from sea sand with the help of powerful dredgers. Given the frozen northern seaways, the latter typically had to be brought in from their regular sites of operation on North America's sandy east coast by way of barge transport through the Panama Canal and Bering Strait (OGJ, 6 October 1975). The Soviet Union subsequently also adopted the technology, its first artificial drilling islands being built in 1982 in the Okhotsk Sea (OGJ, 17 May 1982).

By the early 1980s no offshore Arctic oil or gas had yet started flowing and no commercially viable oil field had been found in the Beaufort Sea. Precisely this failure, however, in combination with record-high oil prices and massive R & D support from the Canadian government (OGJ, 20 August 1984),[3] stimulated further efforts in the field of island construction. Increasingly sophisticated island designs fueled a considerable optimism concerning the prospects for important offshore discoveries. A dedicated research station was built on Hans Island, located in the Kennedy Channel separating Greenland from Ellesemere Island. Described as 'a barren, doughnut-shaped rock ½ mile in diameter', it was deemed suitable for island-construction experiments. Ice researchers used it to 'gather data on how multiyear ice affects large structures and how this information could be applied to island building technology'. Since ownership of Hans Island was subject to dispute between Canada and Denmark, however, the erection of the research station may also be interpreted in a geopolitical context.

The oil industry was reportedly 'confident that artificial islands can be built to handle the stress of ice forces', and technical progress in the field was certainly impressive. Whereas the first islands had been designed from natural material, which formed beaches on the island's edges, more advanced constructions took the form of concrete and steel caisson islands, the first of which was built at a depth of 22 meters in the Canadian Beaufort in 1981. The caissons had steep external walls, allowing large savings of sand and reducing the need for dredging, which was here limited to the construction of a subsea sand berm as a platform onto which the caisson was fixed. Smaller versions were still dependent on support vessels for 'ice management', whereas the larger ones looked like massive fortresses planted into the sea.

Arctic oil and gas engineers could also build on an already established tradition of 'iceberg management' developed primarily by the Canadians in non-Arctic operations off Nova Scotia. In the 1980s several Norwegian technology companies started to take interest in this development, forming joint ventures with more experienced US and Canadian firms aimed at new ways of securing offshore rigs against both small and large icebergs. The Gulf Stream made icebergs very rare in the North and Norwegian seas, but the Norwegians already planned to move further north and wanted to prepare for future ice encounters. The most radical innovation was probably the 'fender platform', which used a sawtoothed configuration able to 'withstand the impact of small

icebergs or larger ones that might be encountered once every 100 years' (OGJ, 17 January 1983).

A next step was to develop rigs and platforms able to withstand not only the attack of icebergs, but also to cut their way through thick sea ice on their way to a drill site and, once in place, continue defending

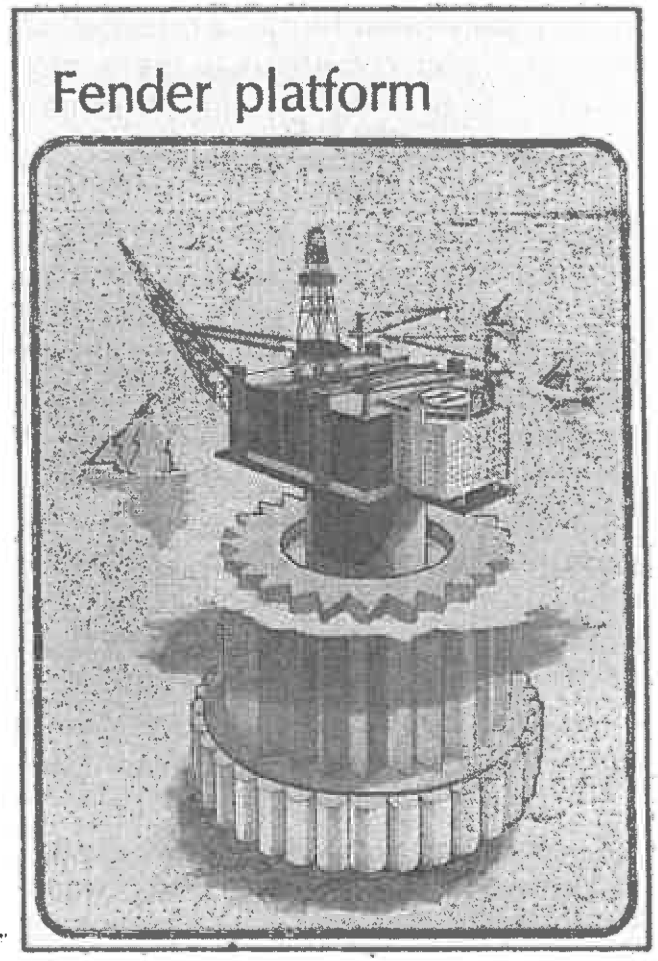

Figure 7.4 Sketch of the 'fender platform', developed in the early 1980s by Norwegian and Canadian companies

Source: OGJ, 17 January 1983.

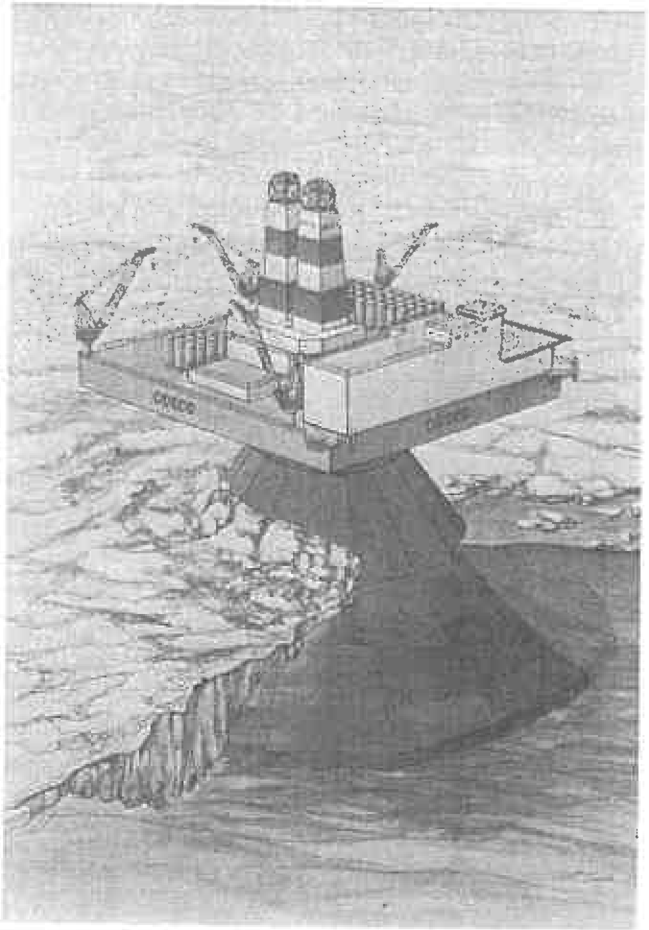

Figure 7.5 Built to cut through thick sea ice en route to drill sites and to withstand moving pack ice during drilling operations
Source: OGJ, 24 June 1985.

themselves against moving pack ice. The lead was here taken by actors involved in exploiting the Beaufort shelf. Canada's Panarctic conducted research on possible rig designs, focusing primarily on development of a 'drilling rig supported on a towed air cushion vehicle and a dynamically positioned, ice cutting semisubmersible rig'. The unit would 'cut its way through the ice on the way to a drillsite, then cut ice to maintain

location while drilling if the ice moved'. As of 1983, laboratory tests and Arctic fieldwork was carried out to determine the feasibility of the project (OGJ, 3 January 1983). Odeco, a US drilling contractor, followed this up by developing a 'massive deepwater Arctic rig' with conical body. Its geometry was seen to pacify the ice more effectively than the normal, cylindrical rig structures used in ice-free waters. The structure weighed some 190,000 tons and was placed directly with its large base onto the sea bottom (OGJ, 24 June 1985).

Overall, engineers and companies were thus confident that ice could be 'managed'. But the harsh Arctic climate and the omnipresence of ice was not always viewed as a problem. *Izvestiya*, discussing the possibility of oil production on the Soviet Union's Arctic coast, argued in 1966 that:

> the Arctic oil industry will have to face many difficulties. But they are not as big as we sometimes think. Producing oil on Arctic shores will even be easier than, say, on the Western Siberian lowland. Permafrost, which often becomes a source of all kinds of angers, will here play a positive role, facilitating drilling and transport. The Northern ocean seaway opens up the way for oil to all parts of the world. (*Izvestiya*, 2 March 1966)

The fact that the Arctic was very sparsely populated was also a major advantage, as projects were rarely troubled by the endless bureaucratic and legal problems encountered on more southerly latitudes in terms of necessary permissions to drill wells and lay pipelines on privately owned land. The local communities that did inhabit the Arctic region often showed themselves worried about the possible negative effects on their environment and culture, but the dimension of the problem was not at all the same as in densely populated provinces. Moreover, the oil industry argued that the harsh climate enhanced environmental security. Dome Petroleum, a leading Canadian oil company, explained in 1983 that 'oil spills are easier to deal with in frozen waters. Oil would be sandwiched between ice layers and would stay there during the winter', giving cleanup operations ample time to plan and carry out their work (OGJ, 3 January 1983). From this perspective, retreating and thinning of the sea ice as a result of global warming was as much a threat as an opportunity for Arctic oil and gas production.

Panarctic, for its part, in the early 1980s developed a new drilling method that it intended to use at sites where water depths ranged to 400 meters, that is, much greater than what was possible with the artificial island method. The new technique made use of the permanent Arctic sea ice and foresaw construction of an 'ice pad drilling base' as much as 6 to 7 meters thick, built 'by flooding and freezing seawater' in combination with 'large blocks of low density urethane in the structure of the ice island to increase the load carrying capacity of the platform and reduce construction time'. The success of the method, however, hinged on the lateral stability of the sea ice: if the ice moved by more than 5 percent of the water depth, the drilling equipment risked being destroyed. Before the method was employed at a site, prospective drillers needed to spend at least two years measuring the movement of the ice with the help of 'automated, computerized stations using overhead satellites for positioning' (OGJ, 3 January 1983). Global warming, to the extent that it loosened more and more sea ice and reduced its stability, tended to reduce the number of sites where the method could be employed.

Concluding discussion

In late 1985, when the first US offshore Arctic field was slated for exploitation and the first crude oil from Canada's Arctic islands had just arrived in Montreal, many industry representatives believed that Arctic oil and gas could expect a brilliant future. North America led the development, and Norway and Russia were eagerly following. Actual finds of oil and gas in the North American Arctic had been quite disappointing, but precisely the many 'dry holes' and 'marginal fields' had stimulated petroleum engineers to develop remarkable technological solutions intended to improve the prospects for success in the harsh northern environment. The first half of the 1980s had seen a burst of activity in this respect, fueled by the second oil crisis. Pushing the Arctic energy frontier was excessively expensive, but high oil prices and technological progress made attempts to explore even the most inaccessible energy regions appear worthwhile. 'The key to commerciality', it was firmly believed, 'will be cost containment through innovation'. Arctic oil and gas was thereby seen to show the way for the industry in a more general sense, as 'the revolution of creativity in the Arctic' would most likely 'spread to other sectors of the petroleum industry' (OGJ, 5 August 1985). What can be seen here is how oil companies and the petroleum engineering community made rhetorical use of the harsh Arctic climate to attract investment, including R & D funding from government sources.

Then, in 1986, oil prices unexpectedly plummeted. The 'reverse oil price shock', as it was sometimes referred to, was devastating for the economics of Arctic energy. For consumers the fall in prices was welcome, but for the oil industry it was a disaster. North American companies, which had led the development, were particularly exposed. Suddenly it became apparent how vulnerable operators in the Beaufort Sea and on the Arctic islands were to turmoil on world markets. Companies opted to leave their exploratory sites, plugging the holes that had been drilled at vast cost and abandoning them – at least for the time being. Some actors moved their operations to the Norwegian and Barents seas, which during the second half of the 1980s emerged as the Arctic's new drilling hot spots. The absence of ice here made it feasible to sustain exploration in spite of the depressed market.

It would take until the late 1990s before fuel prices turned upward again. When they did, the world's energy companies felt motivated to invest, once again, in research, development and exploration in offshore areas above the summer ice limit. However, the global political and economic environment was no longer the same. The world economy had become more globalized and dynamic; neo-liberalism had established itself as a political dogma almost everywhere; the Soviet communist bloc had collapsed; China was emerging as a new world power; and the information age was just experiencing its breakthrough. In addition, there was a new surge in environmentalism and a growing concern with global warming.

Analyzing the dynamics of this more recent period is beyond the scope of this chapter, but it might still be commented upon from a historical point of view. Currently, the reported retreating and thinning of Arctic sea ice is at the very heart of the Arctic energy debate, particularly if the general news media are taken as the main point of reference. This is a new theme, but the attempts to exploit the Arctic's energy resources are anything but new. As we have shown, they did by no means start in the age of the climate debate. There is a striking continuity, from the late nineteenth century to the present, in Arctic energy exploration, and the current development is merely the latest addition to an impressive historical trajectory. During this longer period, which started in an era when coal was the world's most strategic fuel, actors repeatedly set out to make use of Arctic fuel without expecting global warming to assist them in making it more accessible. It thus appears plausible that the current quest for Arctic oil and gas would have come about even in the absence of climate change. Technological development and high fuel prices would have sufficed to sustain the race.

In the period analyzed, actors dealt with Arctic sea ice in a practical, technological sense, and simultaneously used it for rhetorical purposes. Depending on the situation, it was argued that ice offered unique opportunities, constituted a problem that needed to be dealt with and funded, or was no problem at all. In the era of coal, it was important for energy companies to assure investors that sea ice did not pose a risk to operations in Spitsbergen and elsewhere, while at the same time the harsh Arctic environment was deliberately invoked to produce an image of the industry as cutting-edge engineering, pushing the frontier of economic development and modernity into the Arctic. This image of the iced Arctic as a region that needed to be conquered and tamed by energy explorers lived on into the age of oil and gas. The Arctic was framed discursively as an energy frontier and an important laboratory in which new technologies could be pioneered to be used later on in other parts of the world as well. But ice could also be a resource in its own right, transformed – materially and conceptually – into artifacts that formed integral parts of drilling, production and transport equipment. Moreover, Arctic sea ice was even seen as a contributor to environmental safety in case of oil spills. Finally, the high costs of energy exploration in iced Arctic waters was used rhetorically as an argument for bringing actors together in cooperative ventures, both nationally and internationally. In other words, Arctic sea ice was also a political resource.

Notes

1. Murmansk on the Kola peninsula was identified as the most suitable option, but as an alternative it was proposed that the pipeline might be extended into northern Norway. This would give the Americans greater control over the envisaged LNG export terminal.
2. In the Beaufort Sea 1975 and 1983 were particularly difficult years.
3. Especially after the 1984 elections.

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Media and the Politics of Arctic Climate Change

When the Ice Breaks

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