

Under what conditions can oil and gas developments in the Arctic be acceptable, and to whom?

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ABSTRACT. It is sometimes argued that the Arctic is so fragile that oil and gas development is never acceptable. Occasionally the argument rests on a fundamental objection to any development of fossil fuel resources. This paper will argue that under some conditions development can be carried out in a way that safeguards the natural environment, and that when the resources are exhausted all traces can be removed. This conclusion applies both offshore and onshore. It will require great sensitivity and care, and the application of the best technology developed by the petroleum industry for developments elsewhere. Some locations will have to be left inviolate until better technology is discovered, and perhaps for ever. The argument will be illustrated by case studies, some of them taken from completed projects.

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Introduction

One of the main motivations for economic development in the Arctic and sub-Arctic is the presence of oil and gas. There are known to be large quantities of both, and in the Arctic some fields have been developed already, among them oil in the Prudhoe Bay area of Alaska, both onshore and offshore, gas in Yamal', and oil and gas off the east coast of Sakhalin.

Humankind is using fossil fuel reserves at a frightening rate, and there will increasingly be an economic case for further development. In the 1970s, it seemed for a time that there would be many new projects, but hydrocarbon prices failed to rise in the way that was then predicted, and over the next 20 years there was a lull in development. The recent huge increases in prices, coupled with confident predictions of increasing demand, have led to renewed interest, and many projects are in different stages of planning and concept design, among them the Shtockmannovskoye gasfield east of Novaya Zeml'ya, stranded gas in the North Slope of Alaska, gas in the Mackenzie Delta and the Canadian Arctic Islands, and possible hydrocarbons in the Arctic National Wildlife Refuge.

Arctic hydrocarbons have always been controversial. The writer worked in the early 1970s in a US university on one of the engineering questions raised by the design

of the Alaskan oil pipeline (Palmer 1972), and was roundly abused by some of his academic colleagues (and their wives), on the grounds that the pipeline would 'ruin Alaska'. He replied that he had thought about it carefully, did not agree that Alaska would be ruined, and that in any case his work was intended to study a possible source of damage and make sure that it was eliminated. Looking back, the argument that Alaska has been ruined is not sustainable, though there have been mistakes and there have been environmental impacts. Any environmental impact is unfortunate, but tourism and the military have created a much more extensive impact than has oil. Most of the people of Alaska seem to want further development. One of the options for taking North Slope gas to markets in the south is to build a marine pipeline parallel to the Arctic Ocean shore and eastward into Canada, to link up with a pipeline south from the Mackenzie Delta. A newspaper in Fairbanks castigated that option as the worst for Alaska, an option that must be fought tooth and nail, not on environmental grounds but because it would minimise economic opportunities for Alaskans.

To do justice to the question posed by the title requires the knowledge and sensibility of the people who live in the Arctic, as well as engineers, biologists, geologists, economists, social scientists, climatologists, politicians and, perhaps, philosophers. The writer is just one engineer. This paper attempts to explore some of the issues, but recognises that many different arguments need to be brought together.

Acceptable to whom?

This is the heart of the question. Everyone is entitled to an opinion, and it would be impertinent to attempt to speak for anyone else. Clearly opinion is divided, and one of the issues is how heavily the divided opinions of the native peoples of the north should be weighted against the equally divided opinions of incomers, and how far

their opinions should be weighted against those of people who live in distant parts of the same country, or indeed in distant parts of other countries, or against national or local government policy.

This is a central issue in the current hearings about the Mackenzie Gas Project, a US\$16.2 billion project to bring gas from the Mackenzie Delta to markets in southern Canada. That scheme has a long history, and went through lengthy public hearings in the 1970s, at the end of which the Berger Commission advised against the project, largely on social grounds. The current project proponents include the Aboriginal Pipeline Group (APG), which 'secured a right to own one-third of the Mackenzie Valley natural gas pipeline' (Aboriginal Pipeline Group 2006). At the time of the regulatory application, the APG chair Fred Carmichael said:

The filing of our regulatory applications is a positive step forward for both the APG and the project. The regulatory review process will allow active and meaningful participation by the communities in the Mackenzie Valley. Aboriginal ownership in the project provides an opportunity to make a significant difference in the North. We are a step closer to delivering long-term benefits to our Aboriginal stakeholders (Esso Imperial Oil 2004).

But not all aboriginal (first nations) groups are in agreement. At least one is supporting the Mackenzie Wild and Sierra Club opposition to the project, in part on the grounds that the pipeline gas would be used to recover oil from tar sands in northern Alberta, and that tar sands oil is a 'dirty' fuel (Mackenzie Wild Declaration 2006). An instructive survey of Gwich'in first nation opinion (Salokangas 2005) concluded that:

... close to half of the Gwich'in were in favour of the Mackenzie Gas Project in 2005, though less than one fifth believed that their communities were ready for the project and assessed that the public consultation had been sufficient. . . The Gwich'in had concerns related to the projects possible negative cultural, environmental and socio-economic impacts. The main concerns identified by the Gwich'in were an increase in substance abuse and violence; an increase in the cost of living; the loss of traditional lifestyle and culture; and negative effects on wildlife and the subsistence economy.

The Gwich'in lands are close to the pipeline route, but the project has impacts further afield, and in November 2006 the Federal Court of Canada ruled that the federal government had failed in its duty to consult the Dene Tha' first nation on the project. Optimism about the project has markedly declined (Campbell 2007; Chandler 2007), particularly in response to a doubling of the estimated project cost, but interest may reawaken in response to continuing rises in petroleum prices.

Again, it is scarcely surprising that there are divergences of opinion. A huge project is certain to be controversial. In this, as in other instances, the Arctic is no different from anywhere else.

Why is the Arctic special?

Plainly there are difficulties in operating in the Arctic. It is cold, it is remote, transportation is expensive and uncertain, and people from outside have to be paid high salaries to work there. Above all, it is environmentally sensitive. Recovery from damage is slow. Whereas in the tropics the vigour of biological activity covers up many kinds of damage rather rapidly, and the same thing occurs more slowly in temperate regions, damage in the Arctic persists for tens and perhaps hundreds of years. Those problems can be dealt with by careful design engineering, construction and operation, and by designing from the start a system that can be sustainably decommissioned when the system is no longer required.

A more difficult problem is psychological. The Arctic holds a special place in the hearts of many people. Most of them will never go there, except perhaps as wealthy short term tourists, and the level of their concern is often proportional to their physical distance. Some see the Arctic as a clean wilderness, free from the untidy presence of billions of people, and free too from the many compromises all those people's desires and needs impose. There are traces of this notion in the wonderful book by Barry Lopez on the Arctic (Lopez 1986). He remarks disdainfully that petroleum workers at Prudhoe Bay have pornographic magazines. Those magazines are available on every airport bookstall: they are part of life in 2008, however much we may deplore them, and it would only be remarkable if they were absent from the Arctic.

Those feelings about the Arctic are cleverly exploited by the environmental business, most vigorously in the continuing argument about the Arctic National Wildlife Refuge (ANWR) (see, for example, Matthiesen 2006), though in fact it is far from certain that there is any oil under the refuge. Illustrated articles about the ANWR invariably incorporate photographs of the mountains in the southern part of the area, and do not show the less photogenic coastal plain, where hydrocarbons are thought most likely to be located.

A marketing genius described the ANWR as 'America's Serengeti'. It is worth pursuing that phrase. The Serengeti is very far from free of economic development. It was once a pristine wilderness, but it is not one now. Paved roads cross it, vehicles drive off the roads, there are intrusive tourist lodges built in a pastiche pseudo-African style, and you do not travel far before you encounter a group of minibuses with video camera-toting tourists hanging out of them, besieging a tree in which a leopard is trying to sleep. It is for each of us to decide how far we think that 'acceptable', but the opinions of northern visitors from rich countries rightly have little impact. Tanzania is a poor country, and its people have somehow decided that commercialisation of the Serengeti is acceptable to them.

In an equally clever way, emotional feelings are exploited by people with different agendas. The 2001

US National Energy Policy document (2001) made 105 recommendations, and one of them was:

The NEPD group recommends that the President direct the Secretary of the Interior to work with Congress to authorise exploration and, if resources are discovered, development of the 1002 Area of ANWR. Congress should require the use of the best available technology and should require that activities will result in no significant adverse impact to the surrounding environment.

Outside the energy industry, much of the discussion centred on that recommendation alone, whereas many of the others have much greater impact. It is tempting to suspect that the ANWR proposal was sacrificial and designed as a distraction.

Environmental arguments are subject to shifts in fashion, sometimes opportunistic ones. Environmentalists argued against the Ramparts Dam on the Yukon, on the grounds that nuclear power was preferable, and against the Alaskan oil pipeline and for oil export by rail, on the ground that the pipeline would be temporary but a railroad would be permanent. In the UK, some environmentalists support the current 'dash for gas' because of its short term advantage in minimising carbon dioxide emissions, and seem not to be concerned with the long term impact of exploiting a premium fuel first, and leaving coal and tar sands to the future.

In what sense do we need Arctic oil and gas?

Opponents of development often argue that Arctic oil and gas are not 'needed'.

To a degree, that argument is unanswerable (and can be used to oppose very nearly anything). We can do without additional further supplies of oil and gas, just as we can do without additional supplies of wheat or rice or silver (or music or poetry, or indeed journals). What is certain is that humankind has become accustomed to exploiting fossil fuels on a huge scale. The damaging effects of carbon dioxide emissions are acknowledged by the overwhelming consensus of scientists, though scientists are subject to the herd instinct like anyone else, huge pressure is brought to bear on dissenters, and the consensus might be wrong. There is as yet little public pressure for change, and politicians have done next to nothing. Asked about taxing air fares, the UK prime minister, A. Blair, responded

Hands up around this table how many politicians facing a potential election in the not too distant future would vote to end cheap air travel? (*The Times* (London) 7 February 2005).

He was answered by one hand, an opposition MP who was not standing in the next election. A hundred similar quotations could be collected. It can also be argued that climate change is not the greatest of the problems facing humanity, and that there are other ways of deploying resources that will have a much greater positive value (Lomborg 2001, 2006).

Substitution by other energy sources such as nuclear, wind and solar energy is progressing very slowly, and whether or not we develop Arctic oil will have no effect on those collective decisions. The only answer appears to be that at one level we shall go on needing oil and gas for a long time, and that on another level we need to balance their value against other priorities such as the atmosphere and the health of the planet. In the medium term, oil and gas will become very expensive, and in the long term they will be too precious to burn, and what remains will only be used as a chemical feedstock.

Minimising environmental impact

The Wytch Farm oilfield is the largest onshore field in western Europe, and is operated by BP. At its peak it produced more than 100,000 b/d, but it is now in decline. It lies partly onshore, under a beautiful area of heathland and pine forest to the south of Poole Harbour in the south of England, and partly under the sea. Going with his petroleum engineering students to see it, the writer takes them first to a viewpoint on a Purbeck chalk ridge, from which they can look north across the field. Asked what they can see of the oil development, the students reply that they can see nothing. In fact there are wellheads and a gathering station, but they are hidden among the trees, designed so that they are lower than the trees and painted in minimally obtrusive dull colours. Extreme precautions are taken. Public access to most of the area is permitted but not encouraged, and there are occasional explanatory signboards. When the field is depleted and production is no longer economic, the gathering station and everything else will be removed, and their sites will be returned to the forest.

The view of the field from Purbeck Ridge carries an obvious irony. The oilfield is in the foreground, and there is no sign of development. Beyond it lies the harbour, and beyond that, 10 km or so away, there is the hideous sprawl of the cities of Bournemouth and Poole, home to hundreds of thousands of people. No one has any plan to return that land to its natural state. Those people would be up in arms if you were to point out that they and their homes are ugly, unsustainable and unacceptably polluting, and that they should be removed.

Wytch Farm also demonstrates that technological progress can minimise impacts. The eastward extension of the field is some 10 km to the east, under water to the south of Bournemouth. At one time it was thought that it was too far to be reached by slant drilling, and that the eastern parts of the Sherwood reservoir could only be reached by building an artificial island, which would have been visually intrusive and would have affected sediment movements and navigation. Further study showed that it would be possible to drill horizontally, contrary to received opinion at the time, and the island would not be necessary. Well M11 was drilled from an existing wellsite 10.7 km eastward, a world record. That kind of extended reach drilling can usefully be applied in the Arctic.

Arctic petroleum offshore

Several major oil and gas fields lie under water, off the Beaufort Sea coast, off Sakhalin, west of Novaya Zeml'ya, and probably elsewhere. Much effort has been put into developing schemes for production islands, platforms, and pipelines, but very few projects have proceeded to construction. The impact on the land is obviously smaller and the impact on native people is minimal, but there are potentially damaging impacts on fish, birds and marine mammals. The risk of major damage is plainly much smaller for gas than for oil.

Pipeline design and construction encounters several difficulties, but nothing that is insuperable (Palmer 2000; Woodworth-Lynas and others 1996). A pipeline is potentially at risk from seabed gouging, which occurs when large pieces of ice drift into shallow water and run aground, pushed forward by the wind and the ice, and cut into the seabed gouges that can be 5 m deep and 80 m wide. The ice could apply large and potentially damaging forces if the pipeline were simply placed on the seabed, and it has to be trenched to protect it. Another problem is strudel scour, when river water floods over sea ice, opens up holes at weak points, and pours downwards in vortex jets that cut into the seabed. Conventional construction from floating equipment is impeded by the ice, and where possible it is often better to use the sea ice as a strong and stable working platform, though the ice is more reliably stable in some locations such as the Arctic archipelago than in the Beaufort Sea. Construction has to be scheduled to minimise interference with whales, seals, and polar bears.

Several Arctic marine pipeline projects have been constructed. As long ago as 1978, Panarctic Oil constructed and tested the Drake F76 flowline system off Melville Island (Palmer and others 1979), as a demonstration of the technology needed to develop the Drake and Hecla gas-fields in water depths out to 400 m, and in the expectation that there would be either a pipeline or liquefied natural gas (LNG) tankers to take the gas to market. The project applied various innovative technologies, and they had a lasting influence elsewhere. The well was tested and the area was monitored for some time, but the transportation schemes never materialised, because the gas price failed to rise. Twenty years later, it was decided to plug the well and to clear the onshore site. Regrettably, the operator and the regulators did not take that opportunity to survey the flowline system to see how it had fared. The well and the system remain on and in the seabed. At some time in the future, there will be a transportation system, and at some later time the field will be depleted and the facilities can be removed. Ultimate decommissioning raises complex legal and financial issues (Lissaman and Palmer 1999).

More recently, BP built the Northstar oil pipeline (Lana and others 2001) from a gravel production island to the shore near Prudhoe Bay, and tied it into the TAPS pipeline. The pipeline was trenched to 2.1 m below the

natural bed level, well below the maximum gouge depth, and the trench was backfilled. A similar project is being built further to the west, and other projects in deeper water are in the conceptual engineering stage.

In the completely different environment of Sakhalin, several marine pipelines are under construction. One of them has been delayed to reroute it around an area important to whales, and further delays have occurred to the land pipeline, though it is widely suspected that political factors are present.

It can be argued that Arctic construction offshore has lighter impacts than construction onshore, but that any oil leak offshore would be more difficult to clean up than a leak onshore.

Conclusions

Lopez (1986) sets out a guiding philosophy:

The land retains an identity of its own, still deeper and more subtle than we can know. Our obligation toward it then becomes simple: to approach with an uncalculating mind, with an attitude of regard. To try to sense the range and variety of its expression- its weather and colors and animals. To intend from the beginning to preserve some of the mystery within it as a kind of wisdom to be experienced, not questioned.

This is an ideal that we could try to apply to all our relations to the physical world.

Some places have such a high value to humanity that no development can ever be acceptable. Angkor Wat, Lascaux, Venice, Uluru, Yellowstone and Machu Picchu are in their different ways so special that almost nobody would be ready to accept the presence of any oil and gas hardware. Indeed, any human presence has a harmful effect. At Lascaux visitors are only allowed under unusual circumstances, climbing Uluru is discouraged, and all the other sites are under damaging pressure from mass tourism.

A few Arctic places may fall into the same class, but many will not. There we can contemplate petroleum development, but only as long as it is carried out with extreme sensitivity to the biological and social environment. Following through with that commitment will require additional time and money, and will impose an obligation to engage with many people, to plan carefully, and to draw on the best technology available. As the example of Wytch Farm demonstrates, wise applications of technology can do much to minimise impact.

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