Unconventional Oil and Gas in Alaska

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Last Modified: 13th April 2015

Nearly all known unconventional petroleum in Alaska is located on the North Slope. Although most of Alaska's petroleum reserves are "conventional fields," where oil and gas move easily through porous rock formations, development of unconventional oil is a future possibility. These deposits would likely be exploited with large-scale **hydraulic fracturing**.

The U.S. Geological Survey (USGS) **estimates** that the North Slope may contain up to 2 billion barrels of recoverable oil (compared to 25 billion in Prudhoe Bay Oil Field when it was first developed), and 80 trillion cubic feet of natural gas in unconventional deposits. Great Bear Petroleum, Haliburton, and Royale Energy have recently or are currently **exploring** for unconventional oil on the North Slope.

The North Slope's unconventional petroleum is distributed through a series of buried shale layers which drape much of the region, extending from slightly east of Prudhoe Bay to just short of Point Lay. Although this resource is much smaller than Alaska's conventional fields, it could still contribute significantly to production, at least in the short term. The North Slope's 2013 total conventional oil production was **roughly 200,000 barrels** .

North Slope Pipelines

Pipelines crossing tundra west of Prudhoe Bay in Alaska's Arctic.
source: Public Domain

Alaska's only major **unconventional petroleum** field currently being explored is the Great Bear shale oil, just south of **Prudhoe Bay** . No large unconventional petroleum fields have been identified outside the North Slope. In 2011, the USGS **concluded** that 5.5 billion cubic feet of unconventional natural gas may be trapped in sandstone and coal beneath Cook Inlet, but commercial concentrations of this resource have not been found, and it is partly speculative. Additional gas is likely present in Alaska's various coal fields, including in the interior and in the North Slope's giant Bering coal field, but this distributed coal gas may never be profitable to commercially extract, due to its wide dispersal in the rock. Other unconventional fields may exist throughout the state, undiscovered.

Development of the North Slope unconventional fields would require the employment of large-scale **horizontal drilling** and **hydraulic fracturing** . This is the same technology currently used in the U.S. "fracking" boom to produce oil and gas from shale formations such as the **Bakken shale** in North Dakota. Unconventional petroleum development might help to offset declining North Slope oil production.

What Makes Unconventional Petroleum Different

Conventional oil and gas reserves are extracted by sinking wells into porous rock and pumping the petroleum out in large quantities. Unconventional petroleum reserves are, in contrast, a negative definition: "petroleum reserves that are not conventional." In practice, this translates to "oil and gas that can't just be pumped out of the ground."

Globally, unconventional reserves encompass shale oil, oil sands (also called "tar sands"), and extra-heavy oils. Oil and gas in these resources are mostly **"tight"** , meaning that it takes advanced engineering interventions to get the petroleum out of the ground in a usable form. Two common examples of this interventions are large-scale hydraulic fracturing in oil shale, and **underground steam injection** in oil sands. In **a 2011 report** , the Alaska Department of Natural Resources (DNR) highlighted the key difference between conventional and unconventional petroleum: Whereas conventional oil has high geological

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risk and low engineering risk, unconventional oil has low geological risk and high engineering risk.

Geological risk is the certainty that petroleum will be present at any given location in a rock formation. Unconventional oil typically has low geological risk, meaning we can be very certain that wherever we dig or drill into the oil-bearing rock formation, petroleum will be present. The very same factors (viscous petroleum or impermeable rock) that make the oil and gas "tight" also mean that petroleum is usually well distributed through the rock. In contrast, in conventional petroleum reservoirs, oil and gas are inconsistently distributed through the rock. Wells must be carefully planned, and many do not produce oil.

Engineering risk refers to the degree to which extracting petroleum from the formation is dependent on successful engineering "stimulations," such as hydraulic fracturing or steam injection. Conventional oil fields usually require relatively little stimulation, and thus have a low engineering risk – although particularly as the well runs dry, major engineering stimulations like gas injection may be conducted to boost production. In contrast, simply getting basic production from an unconventional petroleum field often requires massive engineering stimulations. Production is only as successful as the stimulations. Since these stimulations may fail and leave the well unproductive, unconventional fields have a high engineering risk.

The Great Bear Field

The Great Bear, located on the North Slope, is Alaska's only major unconventional petroleum field that is being actively explored. The Great Bear is a source-reservoired oil field, meaning that the source rock for the petroleum (the rock formation in which the oil formed originally) has also acted as a trap (a rock formation that captures the oil), and therefore the source rock, the trap, and the reservoir are all the same formation. Within the Great Bear, petroleum is trapped in shale rock formations, which are largely impermeable to water and other gases or fluids, like shales elsewhere in the world (including the oil-rich Bakken shale and **Marcellus shale**).

By contrast, in conventional petroleum fields, the oil and gas have often migrated out of source rock (frequently limestone) through porous rocks like sandstones and limestone, and become trapped beneath impermeable rock formations. The oil and gas typically do not absorb into the trap rock. Therefore, the source, the trap, and the reservoir may all be different. Exemplifying this phenomenon, the Great Bear oil shales are also **believed** to be the source rock for the oil of the Prudhoe Bay field. As petroleum escaped in various ways from the Great Bear over tens of millions of years, it migrated through porous rocks, and become trapped at the current location of the Prudhoe Bay field.

Trans-Alaska Pipeline

Exploitation of the Great Bear would likely involve extensive horizontal drilling and high-volume hydraulic fracturing. The potential productivity (and the full extent) of the Great Bear is still unknown, and productivity would depend on both the intrinsic properties of the deposit and the successful execution of the engineering interventions to stimulate production. As with other petroleum exploration and extraction operations on the North Slope, development of Great Bear faces logistical challenges due to its remote location. Establishing production operations close to the Dalton Highway and the Alyeska Pipeline may be key to **initial success** . The current lack of a natural gas pipeline to bring gas – likely to be released in large volumes from the tight shale deposits – to market may also be a strong constraint on economic viability. If the **Alaska LNG Project** goes forward, it might radically increase the economic viability of Great Bear development.

Very little debate has arisen over the exploration of Alaska's Great Bear, in contrast to the controversies surrounding the current exploitation of the Bakken oil field, the **Alberta oil sands** , and the **Utah oil sands** . This is likely due to a number of factors, including Alaska's **economic reliance on oil**, and the remoteness of the Great Bear from immediately identifiable conflicting interests (as opposed to the **Pebble**

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prospect, for instance, which is in the headwaters of the **Bristol Bay salmon fishery** and would produce potentially acid-generating **mine tailings**).

Uncoventional petroleum development using high-volume hydraulic fracturing is a controversial subject, and messaging by both proponents and critics is intense (and difficult to parse for scientific merit). Shale development using high-volume hydraulic fracturing has been subject to intense criticism, primarily due to complaints of **groundwater contamination.** Without entering into a detailed investigation of water pollution risks of unconventional petroleum development, it can be noted that the Great Bear area groudwater is a saline aquifer unsuitable for human use, eliminating the contamination of deep groundwater as an immediate concern. Surface water conntamination could threaten wildlife and subsistence use of the area.

Current Development

The current high-profile player in exploring Alaska's unconventional petroleum is **Great Bear Petroleum LLC** , which leased 500,000 acres of state land south of Prudhoe Bay in 2010. Great Bear Petroleum garnered **considerable publicity** in Juneau in 2010-2011, **envisioning** a commerical operation by 2013, which might produce 200,000 barrels or more per day by 2020 and peak at 600,000 barrels per day in ~40 years. Great Bear Petroleum subsequently drilled test wells, then suspended operations to examine the results. It **resumed** drilling on the North Slope in February 2015.

In early 2015, Caelus Energy also announced it plans to use large-scale hydraulic fracking on its **Nuna project** on the North Slope.

88 Energy is also **reportedly** pursuing potential shale projects on the North Slope, along the Dalton Highway.

Date Created: 24th March 2014

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