

Introduction

History and Outlook

This report is divided into five sections:

- This **Introduction** summarizes historic oil and gas production volume on Alaska's North Slope and Cook Inlet and discusses some of the methods and assumptions used in the report.
- **Section I** examines the state's oil and gas leasing, exploration licensing and incentive programs.
- **Section II** presents oil and gas units in Alaska and describes the individual units on the North Slope and in Cook Inlet and their producing reservoirs, sometimes called participating areas.
- **Section III** includes tables and charts depicting historic and forecast oil and gas production through 2025.
- **Section IV** presents tables describing historical royalty oil and gas production and royalty-in-kind sales contracts by volume and by customer for each unit, participating area, or field.

History of Oil and Gas Development in Alaska – The Early Years

Alaska's oil has long been the subject of interest and speculation. Historically, oil seeps were observed by Inupiat Eskimos and, according to archaeological evidence, oil shale was used for fuel by the indigenous peoples of the Arctic. As early as 1853, during the Russian period, oil was reported on the west side of Cook Inlet in the vicinity of the Iniskin Peninsula and in 1882, a Russian named Paveloff took the first oil samples. In 1892 and 1896, explorers and prospectors staked oil claims along Cook Inlet.



Puale Bay, AK Peninsula
T. Ryherd

In 1896, oil claims were staked at Katalla approximately 50 miles southeast of Cordova. Oil was discovered there in 1902 and an on-site refinery near Controller Bay produced a total of 154,000 barrels over the 30 years it was in operation. The refinery burned down in 1933 and was not replaced.

In about 1903, Austin Lathrop drilled three wells in the Cold Bay area and entrepreneurs drilled several wells near Chignik and other coastal areas of Alaska in search of oil. In 1910, all oil lands in Alaska except Katalla were withdrawn from entry by the federal government. Since oil had been discovered at Katalla in commercial quantities, title was considered valid. Because of the land withdrawals, no oil drilling activity took place in Alaska for the next decade, with the exception of Katalla. Drilling resumed after the Mineral Leasing Act of

1920 provided for two-year prospecting permits.

On the North Slope, the first geologic and topographic studies date back to 1901 and the first formal descriptions were recorded by the U.S. Geological Survey in 1919. By 1921, prospecting permits were filed, and in 1923 President Harding established by executive order the Naval Petroleum Reserve No. 4 (NPR-4), now known as the National Petroleum Reserve-Alaska (NPR-A). The Geological Survey conducted reconnaissance mapping from 1923 through 1926 and published the results in 1930.



Puale Bay, AK Peninsula
T. Ryherd

The first exploration phase of NPR-4 started in 1943 and ended in 1953. Between 1923 and 1953, the United States Navy drilled 37 test wells and found three oil accumulations and six gas accumulations within the reserve. Only two of these discoveries were considered sizable, namely Umiat, with an estimated 50 million barrels of recoverable oil, and Gubik, with an estimated 600 billion cubic feet of recoverable gas. Gas from another of the discoveries during that period, the small South Barrow field, is being produced today for local consumption at Barrow.

Statehood - 1959

At the time of statehood, both Congress and Alaskans recognized the importance of the state's natural resources — specifically, oil and gas. In the late 1950s, Congress was debating the Alaska Statehood Act. A major concern was how the potential new state, which was one of the poorest in the country, could support itself without a sufficient economic base. As a result, the Alaska Statehood Act allowed the state of Alaska to select 104 million acres of land from the federal public domain. The act also granted to Alaska the right to all minerals underlying these selections and specifically required the state to retain this mineral interest when conveying interests in the surface estate. The mineral estate was seen as so important to Alaska's financial survival that the Statehood Act provided that if Alaska disposed of its mineral estate contrary to the act, it would forfeit that mineral estate to the federal government.

The importance of natural resources to the state of Alaska is addressed in Article VIII of the Alaska Constitution which became operative with the formal proclamation of statehood on January 3, 1959. Article. VIII, section. 1 states:

"[i]t is the policy of the State to encourage the settlement of its land and the development of its resources by making them available for maximum use consistent with the public interest."

The Alaska Legislature realized the importance of oil and gas in Alaska's future. The Alaska Land Act of 1959 included a section specifically addressing the leasing and administration of the state's oil and gas resources. It also recognized that other natural resources like coal and geothermal energy would play a major role in Alaska's future.

Cook Inlet Basin

Modern exploration in Cook Inlet began in 1955 when Richfield Oil Corporation began exploration on the Kenai Peninsula in the Swanson River area. Oil was discovered on July 23, 1957, at a depth of 11,000 feet and the discovery well flowed at a rate of about 900 barrels a day. This discovery began an oil rush in Southcentral Alaska.

Shortly after the Swanson River discovery, Standard Oil Company of California and Richfield formed a joint venture to explore for oil. Additional wells were drilled in the Swanson River area, and more onshore leases were taken on both sides of Cook Inlet. Several other oil companies moved in to participate in leasing and drilling activities on the Kenai Peninsula. By 1959, 187,000 barrels of crude oil were produced annually. The state's first competitive sale was held December 10, 1959, bringing the state more than \$4 million in bonus bids.



Cook Inlet Platform
D. Colley

By 1960, further development of the Swanson River and Soldotna Creek Units raised annual oil production to 600,000 barrels. Five other Cook Inlet fields began production between 1965 and 1972. In 1962, Pan American Petroleum Corporation discovered the first offshore oil in Cook Inlet. This led to extensive exploration throughout the Cook Inlet region in the 1960s and 1970s. Chevron opened a refinery in 1963. The Tesoro refinery began operating in 1969. Cook Inlet production peaked at 83 million barrels per year in 1970 and declined to 7 million barrels per year in 2005. Most of the larger fields were found by the mid-1960s.

More recently, the West McArthur River field began production in 1993 and Redoubt oil field in 2002. All Cook Inlet oil is currently shipped to the Tesoro refinery at Nikiski on the Kenai Peninsula. Oil from fields on the west side of Cook Inlet is transported by pipeline to the Drift River terminal, then transported to Nikiski. Oil from the eastside fields is shipped by pipeline directly to the refinery.

By year-end 2005, the Cook Inlet tallied more than 1.3 billion barrels of cumulative oil production, including about 11 million barrels of natural gas liquids (NGLs).

Cook Inlet gas production began as a by-product of Swanson River oil development. The first major gas discovery occurred in the Kenai gas field in October 1959 by Union Oil Company of California and Ohio Oil Company. Gas production began the following year and continues today. Several additional large gas discoveries quickly followed. As more oil and gas fields were discovered, nearby markets for the gas were developed in Anchorage and Kenai to supply space heat and electricity generation. In 1968 Unocal launched the ammonia-urea plant at Nikiski to take advantage of the abundance of cheap stranded natural gas. This plant was acquired in 2000 by Agrium Inc., of Calgary, Alberta. In 1969, Phillips and Marathon began operating the liquid natural gas (LNG) plant, also located at Nikiski.



Kenai Fertilizer Plant
D. Colley

LNG exports to Japan accounted for about a third of total Cook Inlet gas production. Total industrial use of Cook Inlet gas, including LNG exports, fertilizer manufacture, and oil field operations, has remained fairly constant at about 75 percent of total consumption since 1990. Cook Inlet natural gas production has remained relatively stable at an average of 203 Bcf per year from 2001 to 2005. In recent years, the steady increase in residential and commercial demand for space heating and electric power generation has been balanced by declines in field operations and reduced fertilizer production.

The history of Swanson River gas production differs from other Cook Inlet fields. Initially, gas was imported from other fields and injected into Swanson River to enhance oil recovery. In 1992 the operator began to “blow-down” the reservoir. In recent years, the Swanson River field became a major net gas producer in Cook Inlet and, since 2005, has been transformed into a federally approved gas storage facility with approximately 2 Bcf of annual storage capacity. The state has approved two gas storage facilities in Cook Inlet in depleted reservoirs at Pretty Creek and Kenai Field, which contribute 0.7 and 6 Bcf, respectively, annual storage capacity to the Cook Inlet gas pipeline system.

The North Slope

The U.S. Department of the Interior, Bureau of Land Management opened North Slope lands for competitive bidding in 1958 when 16,000 acres were offered in the area of the Gubik gas field. That same year, BLM opened 4 million acres in an area south and southeast of NPR-A (then named NPR-4). From 1962-64, industry exploration programs expanded rapidly. During this period, Sinclair and British Petroleum drilled a total of seven unsuccessful wildcat wells in the Arctic foothills in search of oil.

In 1964, in conjunction with the Statehood Act, the state of Alaska selected some 80 townships across the northern tier of lands between the Colville and Canning Rivers and received tentative approvals on 1.6 million acres from the federal government in October of the same year. In December 1964, the state held the first North Slope Competitive Sale. Lease Sale 13 covered 625,000 acres in the area east of the Colville River Delta. In July 1965, the state held Lease Sale 14, which included the onshore area in the vicinity of Prudhoe Bay. In Lease Sale 18, held January 1967, the offshore Prudhoe Bay tracts were offered and leased.

After drilling several dry holes in the area immediately surrounding the Prudhoe Bay structure, a rig was moved to the Prudhoe Bay State No. 1 location near the mouth of the Sagavanirktok River in early 1967. This proved successful, and in early 1968, Atlantic Richfield (ARCO) announced the discovery of what was to become the first commercial North Slope oil field at Prudhoe Bay. In 1969, Atlantic Richfield and British Petroleum agreed to jointly operate Prudhoe Bay. Prudhoe Bay Field did not begin production until 1977, after the construction of the 800-mile trans-Alaska pipeline.

After the Prudhoe Bay discovery, exploration activity on the North Slope increased dramatically. Thirty-three exploration wells were completed in 1969 as industry prepared for Lease Sale 23 in September of that year. The state offered more than 450,000 acres along the Arctic coast between the Canning and Colville Rivers and earned more than \$900 million in bonus bids on 164 tracts. The next North Slope sale was not held until 1979; however, during this time, more than 100 exploratory wells were drilled on the North Slope with 19 discovering oil or gas.

Oil production on the North Slope began in 1969 at Prudhoe Bay. Production was initially restricted to small quantities used to fuel field operations until the trans-Alaska pipeline system (TAPS) was completed in July 1977. The operators injected surplus crude and residual oil back into the Prudhoe Bay reservoir. Similarly, oil production at the Endicott Field in the Duck Island Unit was re-injected into the reservoir until a pipeline linking Duck Island to TAPS was completed. From the beginning of Prudhoe Bay production, dissolved gas and water were separated from the crude oil and injected back into the reservoir. Over time, the proportion of both produced gas and water to oil increased. Eventually, oil production was constrained by the rate at which the separating plants could process gas and water. To alleviate this constraint the gas and water handling facilities were expanded in 1986, 1991, and 1993-94. The 1999 miscible injectant (MI) project known as "MIX" also added to the field's gas handling capacity.



Arco Prudhoe Bay St #1 flare
G. Mull

Cumulative North Slope production has exceeded 15 billion barrels of oil and NGLs by the end of 2005; nearly all from the large Prudhoe Bay and Kuparuk fields. NGLs produced on the North Slope are blended with oil and shipped down TAPS or used to make MI for enhanced oil recovery projects. Since 1996, NGLs have been shipped from Prudhoe Bay to the Kuparuk River Unit via the Oliktok pipeline for MI in the large-scale enhanced oil recovery project at Kuparuk.

Exploration wells drilled on North Slope state leases since the Prudhoe Bay discovery have resulted in dozens of discoveries, many of which were found in the vicinity of Prudhoe Bay. Most of the post-Prudhoe Bay discoveries are currently producing oil because of the existence of Prudhoe Bay infrastructure and their relatively close location to the trans-Alaska pipeline. Five of these — Lisburne, Kuparuk, Milne Point, Endicott, and Point McIntyre — are major fields. Fields recently brought into production are Alpine, Northstar, Tarn, Meltwater, and West Sak. Although initial production on the North Slope was from onshore areas, seven fields produce at least some of their reserves from offshore areas including Endicott, Lisburne, Prudhoe Bay, Point McIntyre, Milne Point, Niakuk, and Northstar. Today, incremental oil production from new fields brought on line since 1995 account for 34 percent of total yearly Alaska North Slope production.

North Slope local gas production began near Barrow in the mid-1940s. This gas initially was used to fuel a nearby military base. Gas service was extended to the village after World War II. The East Barrow and Walakpa fields were developed in 1980 to provide gas to Barrow.

Gross gas production at the Prudhoe Bay industrial complex was 3.4 trillion cubic feet in 2005. Nearly all of this — about 3.2 trillion cubic feet (8.7 bcf per day) — was re-injected into oil-producing reservoirs. The remaining produced gas, 285 Bcf in 2005, was consumed locally on the North Slope to fuel oil-field equipment, operations, and pipelines (including TAPS). Yearly industrial local gas consumption on the North Slope is about 50 percent greater than yearly gas consumption for all uses, including industrial, in Southcentral Alaska.

Reserves and Production Summary and Outlook

The notion of reserves begins with original oil (or gas) in-place. Only a fraction of the original oil or gas in any reservoir can be extracted, depending on available technology and production economics. Recoverable reserves — those which are considered economically and technically feasible to extract — vary between 15 percent and 85 percent of oil or gas in-place, depending on the reservoir depth, rock and fluid type, technology and, to a lesser extent, market price. Total estimated recoverable and remaining recoverable reserves are the focus of this report, specifically Section III. Reserves can be calculated by many methods and there is often no consensus on which method is best to apply to each reservoir at any given point in time. Three state agencies are responsible for evaluating oil and gas reserves and production: the Alaska Oil and Gas Conservation Commission (AOGCC), the Alaska Department of Revenue's Tax Division, and the Department of Natural Resources' Division of Oil and Gas (DO&G). Each agency calculates reserves using slightly different methods. AOGCC emphasizes geologic and engineering factors to estimate the total recoverable resource. Department of Revenue calculations emphasize oil and gas production economics forecasted far into the future. These agencies cooperate and coordinate the preparation of reserves estimates and production forecasts. Reserves reported herein are based partly on Department of Revenue estimates and are calculated from the forecast of production from existing and planned developments that may reasonably be expected to occur in the near future. The forecast horizon is 30 years.

Ultimate recovery of hydrocarbons from large oil fields typically increases through their development years and is often greater than early predictions. In the 1970s, estimated reserves for the Prudhoe Bay Unit Initial Participating Area (PBU IPA) were between seven and nine billion barrels. By January 1986, ultimate recovery at the PBU IPA was projected to be 10.2 billion barrels; 4.4 billion produced and 5.8 billion remaining. By December 2002, estimated recovery increased to 13 billion barrels: 10.8 billion produced and 2.2 billion remaining reserves. By year-end 2005, we estimated the PBU IPA contains 2.5 billion recoverable barrels of oil plus another 426 million in reserves from satellite development. New investments, improved technologies, and careful cost management all have helped to increase the portion of oil or gas in-place extracted from the Prudhoe Bay and Kuparuk fields. Further improvements in technology may increase future reserve estimates. Other factors affecting ultimate recovery are energy prices, the cost of new investment and ongoing operations, the impact of fiscal incentives, and competing development opportunities available to the state's oil and gas operators in other parts of the world.

North Slope oil reserve estimates developed by DO&G are illustrated in detail in the oil forecast tables found in Section III. As indicated above, remaining reserves in any particular North Slope production unit are defined in terms of cumulative production projected for the next 30 years. Many of these units will likely produce well beyond the displayed forecast period that ends in 2025. This additional production will increase the ultimate recovery estimated in this report. Oil and gas reserve estimates for Cook Inlet fields also are based on cumulative forecast production. Reserves of undeveloped North Slope and Cook Inlet oil and gas fields are included in the forecast and, while speculative, they are based in part on the latest reports available from the producers as well as on DO&G in-house interpretation.

The State of Alaska's royalty reserves are calculated by finding the product of each field's reserves with the state's royalty ownership interest in the field. On average, the state retains a 1/8th royalty interest in most of the producing oil and gas fields in Alaska. There are third-party royalty owners in the Colville River and North Star Units on the North Slope, and the Beluga River, Cannery Loop, Kenai, Sterling, Ninilchik, Nicolai Creek, Deep Creek, and West Forelands fields in the Cook Inlet. These units and fields include federal and private Native Corporation acreage. Also, the state derives royalty from numerous non-unitized oil and gas leases. The state has no royalty interest in the reserves in the East Barrow, South Barrow and Walakpa fields on the North Slope nor does the state have any royalty interest in the Swanson River, Beaver Creek, Lone Creek, Moquawkie or Birch Hill fields in the Cook Inlet.

Oil Production and Natural Gas Development

While production from the largest North Slope fields, Prudhoe and Kuparuk, is in decline, smaller and more numerous satellite oil and gas reservoirs are being developed and produced. New companies have entered the Alaska crude oil and gas upstream sector in recent years. Interest continues to grow, especially among independent exploration and production companies and in areas beyond the mature oil provinces of the North Slope and Cook Inlet.



State Oil and Gas Lease Sale

Drilling activity has decreased since 2001, but the total number of feet drilled per year has been relatively steady since the mid-80s. Sustained drilling activity is a result of new discoveries, satellite field development in or near Prudhoe/Kuparuk infrastructure, in-field drilling, reworking of wells, and side-tracking of wells to reach “behind the pipe” oil and gas. Advances in drilling and completion efficiency (new fluids, technology, tools, and materials) at the main Prudhoe and Kuparuk fields is also recognized.

Nevertheless, the long-term outlook for oil production is one of gradual decline supplemented with smaller field-size oil development and with gas field development in or near existing infrastructure. The lion’s share of Alaska oil production comes from Prudhoe Bay and Kuparuk, the nation’s largest oil fields. The current production rate from the North Slope is about 900,000 barrels per day. We expect the rate of production to hold at about this level for at least the next five years with added production from state leases and from the NPR-A.

Cook Inlet oil production peaked at 230,000 barrels per day in 1970 and declined to 19,500 barrels per day in 2005. Oil production in Cook Inlet is expected to continue beyond 2025, including oil production from the Beaver Creek field and other non-state lands. Stepped-up oil and gas exploration drilling since 2000 in Cook Inlet is driven by strong demand and rising prices for both oil and gas, coupled with decline in production from existing fields. Details for both the North Slope and the Cook Inlet can be found in Section III.

Leasing, Exploration Licenses, and Incentives

Since 1959 the state has held more than one hundred competitive lease sales in which it has offered millions of acres throughout Alaska. By year-end 2005, 27 exploratory wells had been drilled in the federal waters of the Beaufort Sea resulting in four discoveries. These discoveries are Kuvlum, Hammerhead, Sandpiper, and Tern Island/Liberty.

Since 2001, the state of Alaska has seen a new surge in exploration interest with smaller, aggressive companies looking for gas, not just oil, in under-explored areas like the North Slope Foothills, other Interior Alaska basins and the Alaska Peninsula. This exploration is driven by increasing demand for energy in Alaska and across North America coupled with the availability of land and prospects in Alaska. Alaska oil and gas will continue to play a critical role in meeting the nation’s energy needs.

The total number of separate producing reservoirs is increasing, yet they are smaller in size and may not offset the decline in overall North Slope production later this decade. In an attempt to avert the decline in oil production, the state has created new programs to attract explorers to areas of Alaska.

The Division of Oil and Gas traditionally held four regularly scheduled, areawide oil and gas lease sales each year. In 2005 the Alaska Peninsula basin was added to the areawide leasing program. Also, the Division of Geological and Geophysical Survey is working to obtain geologic and geophysical data as well as to conduct fieldwork in new areas. DGGS and DO&G geologists completed fieldwork that will help companies in evaluating hydrocarbon potential in wildcat areas. In addition to areawide leasing, DO&G instituted an exploration licensing program to encourage exploration in oil and gas basins outside of Cook Inlet and the North Slope. The state has issued four exploration licenses covering 1.66 million acres and has received applications for three other areas. For details, see Section I.

The Alaska Department of Natural Resources remains committed to environmentally safe exploration and development of its oil and gas resources. The Division of Mining, Land and Water and the University of Alaska completed a study on tundra travel which resulted in a longer exploration season on the North Slope. The Division of Oil and Gas has worked closely with new Cook Inlet and North Slope explorers, including Pelican, Alliance, Pioneer Oil & Gas, Pioneer Natural Resources, AVCG, Kerr-McGee, and Armstrong to facilitate their exploration activities, and ADNR has made a special effort to disseminate information to new companies seeking to invest in Alaska. Steps have been taken to streamline permitting, including revising the Alaska Coastal Management Program and creating a large project permit office in ADNR.

