SR/OIAF/2008-03

Analysis of Crude Oil Production in the Arctic National Wildlife Refuge

May 2008

Energy Information Administration
Office of Integrated Analysis and Forecasting
U.S. Department of Energy
Washington, DC 20585

Contacts

This report was prepared by the staff of the Office of Integrated Analysis and Forecasting, Energy Information Administration (EIA). General questions concerning the report can be directed to John Conti (john.conti@eia.doe.gov, 202/586-2222), Director of the Office of Integrated Analysis and Forecasting, and Michael Schaal (michael.schaal@eia.doe.gov, 202/586-5590), Director of the Oil and Gas Division in the Office of Integrated Analysis and Forecasting. Specific questions regarding Alaska resources and production can be directed to Philip Budzik (philip.budzik@eia.doe.gov, 202/586-2847).

For ordering information and questions on other energy statistics available from EIA, please contact EIA's National Energy Information Center at:

National Energy Information Center, EI 30
Energy Information Administration
Forrestal Building
Washington, DC 20585

Telephone: 202/586-8800
TTY: 202/586-1181
FAX: 202/586-0727
E-mail: infoctr@eia.doe.gov
World Wide Web Site: http://www.eia.doe.gov/
FTP Site: ftp://ftp.eia.doe.gov/

Preface

On December 6, 2007, Senator Ted Stevens requested that the Energy Information Administration (EIA) provide an assessment of Federal oil and natural gas leasing in the coastal plain of the Arctic National Wildlife Refuge (ANWR) in Alaska (Appendix A). This report responds to that request.

The legislation that established EIA in 1977 vested the organization with a degree of statutory independence. EIA does not take positions on policy questions. It is the responsibility of EIA to provide timely, high-quality information and to prepare objective, credible analyses for use by the Congress, the Administration, and the public. This report should not be construed as representing the official position of the U.S. Department of Energy or the Administration.

The projections in the reference case used in this report are not statements of what *will* happen but of what might happen, given the assumptions and methodologies used. The reference case projections are business-as-usual trend forecasts, given known technology, technological and demographic trends, and current laws and regulations. Thus, they provide a policy-neutral starting point that can be used to analyze policy initiatives. EIA does not propose, advocate, or speculate on future legislative and regulatory changes. All laws are assumed to remain as currently enacted; however, the impacts of scheduled regulatory changes, when defined, are reflected.

Table of Contents

Tables

Figures

Introduction

On December 6, 2007, Senator Ted Stevens requested that the Energy Information Administration (EIA) provide an assessment of Federal oil and natural gas leasing in the coastal plain of the Arctic National Wildlife Refuge (ANWR) in Alaska (Appendix A). In his request, Senator Stevens said that the analysis should develop "plausible scenarios for development of the Coast Plain consistent with the most recent USGS resource assessments and oil price situation." Senator Stevens also requested that the new EIA analysis be based on the approach developed in EIA's 2000 Service Report entitled *Potential Oil Production from the Coastal Plain of the Arctic National Wildlife Refuge*.[1] This analysis assumes that the authorization for Federal oil and natural gas leasing occurs during 2008.

This analysis presents three ANWR cases that assess the potential impact of oil and natural gas leasing in the 1002 Area of ANWR.[2] These ANWR cases represent the following potential oil resource levels:

- A mean oil resource case, which is based on the U.S. Geological Survey (USGS) mean probability estimate[3] of technically recoverable oil resources in the 1002 Area of ANWR;
- A low oil resource case, which is based on the USGS 95-percent probability estimate of technically recoverable oil resources in the 1002 Area of ANWR; and
- A high oil resource case, which is based on the USGS 5-percent probability estimate of technically recoverable oil resources in the 1002 Area of ANWR.

These three ANWR scenarios are compared to the *Annual Energy Outlook 2008* (*AEO2008*) reference case,[4] which serves as the analytical baseline for this report. A similar analysis was requested by then-Chairman Richard W. Pombo in a February 23, 2004, letter to EIA.[5]

---

[1] Energy Information Administration, *Potential Oil Production from the Coastal Plain of the Arctic National Wildlife Refuge: Updated Assessment*, SR/O&G/2000-02 (Washington, DC, May 2000) web site www.eia.doe.gov/pub/oil_gas/petroleum/analysis_publications/arctic_national_wildlife_refuge/html/summary.html.

[2] The 1002 Area refers to the coastal plain of ANWR, which is roughly north of the Sadlerochit Mountains and west of the Aichilik River.

[3] The mean probability estimate refers to a 1-in-2 chance of there being oil resources at least equal to the size of that estimate; the 95-percent probability estimate refers to a 19-in-20 chance of there being oil resources at least equal to the size of that estimate; and the 5-percent probability estimate refers to a 1-in-20 chance of there being oil resources at least equal to the size of that estimate.

[4] Energy Information Administration, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, May 2008) web site www.eia.doe.gov/oiaf/aeo/index.html.

[5] Energy Information Administration, *Analysis of Oil and Gas Production in the Arctic National Wildlife Refuge*, SR/OIAF/2004-04 (Washington, DC, March 2004) web site www.eia.doe.gov/oiaf/servicerpt/ogp/pdf/sroiaf(2004)04.pdf.

Summary

The opening of the ANWR 1002 Area to oil and natural gas development is projected to increase domestic crude oil production starting in 2018. In the mean ANWR oil resource case, additional oil production resulting from the opening of ANWR reaches 780,000 barrels per day in 2027 and then declines to 710,000 barrels per day in 2030. In the low and high ANWR oil resource cases, additional oil production resulting from the opening of ANWR peaks in 2028 at 510,000 and 1.45 million barrels per day, respectively. Between 2018 and 2030, cumulative additional oil production is 2.6 billion barrels for the mean oil resource case, while the low and high resource cases project a cumulative additional oil production of 1.9 and 4.3 billion barrels, respectively.

Crude oil imports are projected to decline by about one barrel for every barrel of ANWR oil production. Opening ANWR results in the lowest oil import dependency levels during the 2022 through 2026 time frame, when oil import dependency falls to the minimum values of 46 and 49 percent for the high and low oil resource cases, respectively. During that timeframe, the mean resource case and *AEO2008* reference case project an average oil import dependency of 48 and 51 percent, respectively. Because ANWR oil production is declining after 2028, U.S. oil dependency rises to 51 percent in 2030 in the mean resource case, compared to 54 percent in the *AEO2008* reference case. The high and low resource cases project a 2030 oil import dependency of 48 percent and 52 percent, respectively.

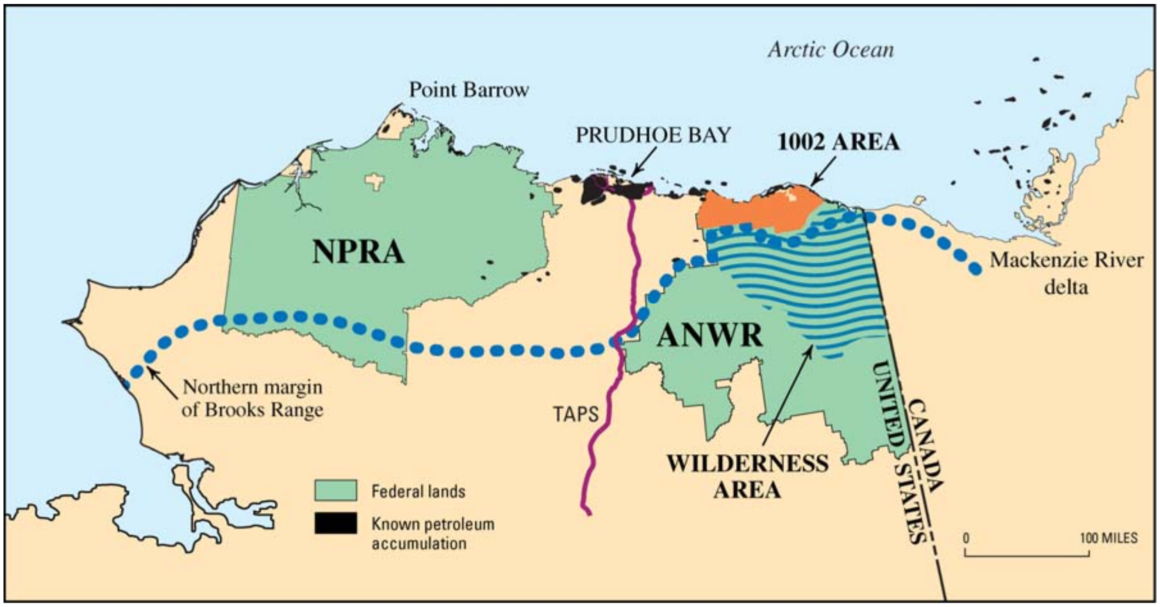
Additional oil production resulting from the opening of ANWR improves the U.S. balance of trade. Cumulative expenditures on foreign crude oil and liquid fuels between 2018 and 2030 are reduced by $202 billion dollars (2006 dollars) in the mean oil resource case and reduced by $135 and $327 billion dollars in the low and high oil resource cases, respectively.

Additional oil production resulting from the opening of ANWR would be only a small portion of total world oil production, and would likely be offset in part by somewhat lower production outside the United States. The opening of ANWR is projected to have its largest oil price reduction impacts as follows: a reduction in low-sulfur, light crude oil prices of $0.41 per barrel (2006 dollars) in 2026 for the low oil resource case, $0.75 per barrel in 2025 for the mean oil resource case, and $1.44 per barrel in 2027 for the high oil resource case, relative to the reference case.

Background

Federal law currently prohibits oil and natural gas development in ANWR. ANWR is located on the northern coast of Alaska due east of both Prudhoe Bay, the largest oil field ever discovered in the United States, and the National Petroleum Reserve-Alaska (NPRA) (Figure 1). In 1998, the USGS estimated that between 5.7 and 16.0 billion barrels of technically recoverable oil[1] are in the coastal plain area of ANWR (also referred to as the 1002 Area), with a mean estimate of 10.4 billion barrels, of which 7.7 billion barrels falls within the Federal portion of the ANWR 1002 Area.[2] In comparison, the estimated volume of undiscovered, technically recoverable oil in the rest of the United States is about 120 billion barrels.[3]

Figure 1. Map of Northern Alaska Showing ANWR and the Coastal Plain 1002 Area



Source: United States Geological Survey.

In developing ANWR's technically recoverable oil resources, the USGS estimated both the original-oil-in-place (OOIP) volumes and the recovery factors for those volumes. This additional information is important for analyses of very long-term issues, such as discussions surrounding the peaking of world oil supply, where the recovery factors implicit in an estimate of

---

[1] Technically recoverable resources are resources that can be produced using current technology.

[2] U.S. Department of Interior, U.S. Geological Survey, *The Oil and Gas Resource Potential of the Arctic National Wildlife Refuge 1002 Area, Alaska*, Open File Report 98-34, 1999; U.S. Geological Survey, USGS Fact Sheet FS-028-01, April 2001; and, *Oil and Gas Resources of the Arctic Alaska Petroleum Province*, by David W. Houseknecht and Kenneth J. Bird, U.S. Geological Survey Professional Paper 1732–A, 2005.

[3] U.S. Department of Interior, Minerals Management Service, *Assessment of Undiscovered Technically Recoverable Oil and Gas Resources of the Nation's Outer Continental Shelf, 2006*, MMS Fact Sheet RED-2006-01b, February, 2006; and U.S. Geological Survey, *USGS National Assessment of Oil and Gas Resources Update*, USGS website: http://certmapper.cr.usgs.gov/data/noga00/natl/tabular/2007/summary_07.pdf, December 2007.

technically recoverable resources may be significantly changed by price and technology developments over time. However, for the present analysis, which focuses on production profiles over the next two decades, the technically recoverable resource estimates provided by USGS provide a reasonable starting point.

For the purposes of this analysis, any reference to ANWR pertains to all Federal, State, and Native lands within and adjacent to the 1002 Area. Both the State officials and Native corporations have expressed a strong interest in developing their respective oil resources, which are legally and/or economically linked to a Congressional decision to allow development in ANWR, as discussed in EIA's 2004 report.[4]

ANWR was created by the Alaska National Interest Lands Conservation Act (ANILCA) in 1980. Section 1002 of ANILCA deferred a decision on the management of oil and natural gas exploration and development of 1.5 million acres of potentially productive lands in the coastal plain of ANWR. The coastal plain area represents about 8 percent of the total area of ANWR. The USGS estimates that 74 percent of the oil resources in ANWR's coastal plain area are on Federal lands, with the remaining 26 percent on State and Native lands.

To date, there has been no assessment of the oil and natural gas resources in the rest of ANWR outside of the coastal plain area. However, it is unlikely that the non-coastal plain area of ANWR has the same level of resources that are estimated to be in the coastal plain area, due to differences in geology.

Methodology and Assumptions

The effects of opening the coastal plain area of ANWR were determined by incorporating the ANWR region into the National Energy Modeling System (NEMS).[5] The key assumptions required to project crude oil production from the coastal plain of ANWR include:

- timing of first production,
- timing of continuing development,
- field size distributions,
- production profiles, and
- current oil market conditions.

---

[4] Energy Information Administration, *Analysis of Oil and Gas Production in the Arctic National Wildlife Refuge*, SR/OIAF/2004-04 (Washington, DC, March 2004) web site www.eia.doe.gov/oiaf/servicerpt/ogp/pdf/sroiaf(2004)04.pdf.
[5] Energy Information Administration, *The National Energy Modeling System: An Overview*, DOE/EIA-0581(2003) (Washington, DC, March 2003) web site www.eia.doe.gov/oiaf/aeo/overview/index.html.

Timing of First Production

At the present time, there has been no crude oil production in the ANWR coastal plain region. This analysis assumes that enactment of the legislation in 2008 would result in first production from the ANWR area in 10 years, i.e., 2018.

The primary constraints to a rapid development of ANWR oil resources are the limited weather "windows" for collecting seismic data and drilling wells (a 3-to-4 month winter window) and for ocean barging of heavy infrastructure equipment to the well site (a 2-to-3 month summer window).

The assumption that ANWR oil production would begin 10 years after legislation approves the Federal oil and natural gas leasing in the 1002 Area is based on the following 8-to-12 year timeline:

- 2 to 3 years to obtain leases, including the development of a U.S. Bureau of Land Management (BLM) leasing program, which includes approval of an Environmental Impact Statement, the collection and analysis of seismic data, and the auction and award of leases.
- 2 to 3 years to drill a single exploratory well. Exploratory wells are slower to drill because geophysical data are collected during drilling, e.g., rock cores and well logs. Typically, Alaska North Slope exploration wells take two full winter seasons to reach the desired depth.
- 1 to 2 years to develop a production development plan and obtain BLM approval for that plan, if a commercial oil reservoir is discovered. Considerably more time could be required if the discovered oil reservoir is very deep, is filled with heavy oil, or is highly faulted. The petroleum company might have to collect more seismic data or drill delineation wells to confirm that the deposit is commercial.
- 3 to 4 years to construct the feeder pipelines; to fabricate oil separation and treatment plants, and transport them up from the lower-48 States to the North Slope by ocean barge; construct drilling pads; drill to depth; and complete the wells.

The 10-year timeline for developing ANWR petroleum resources assumes that there is no protracted legal battle in approving the BLM's draft Environmental Impact Statement, the BLM's approval to collect seismic data, or the BLM's approval of a specific lease-development proposal.

The Alaska North Slope Badami and Alpine oil fields are recent examples of how long it might take to develop new ANWR oil fields. Located near the western border of ANWR, on State lands, the Badami field was discovered in 1990 and went into production in 1998, thereby taking 8 years between the oil discovery and initial production.[6] On the western border of the State

[6] Alaska Department of Natural Resources, Division of Oil and Gas, *2002 Report: Tables & Graphs Edition*, pages 1-27 and 2-4.

lands, near the National Petroleum Reserve-Alaska, the Alpine field was discovered in 1994 and initial oil production occurred in 2000, thereby taking 6 years from discovery.[7] These Alaska North Slope oil field development time delays do not include the time delays associated with BLM leasing, the collection and interpretation of seismic data, and the drilling of exploratory wells.

Timing of Continuing Development

This analysis assumes that much of the oil resources in ANWR, like the other oil resources on Alaska's North Slope, could be profitably developed given the current levels of technology and at current and projected oil prices. This analysis also assumes that new fields in ANWR will begin development 2 years after a prior ANWR field begins oil production.

The decision to use a 2-year time lag in bringing ANWR fields into production is driven by four factors. First, there is the large expected size of the ANWR fields, which complicates the logistical problems associated with their development. Second, there is considerable investment infrastructure required both to begin production in these fields and to link these fields to the TransAlaska Pipeline System (TAPS). Third, there is competition in investment and drilling resources from other domestic and foreign projects, which potentially limits the resources available for ANWR development. Finally, increasing the rate of ANWR development might also require an expansion of TAPS throughput capacity.

This study does not assume that the expected rate of technological change in the oil and natural gas industry will affect the rate of development of ANWR. While a higher rate of technological development might reduce costs and lead to more efficient development of ANWR resources, the primary impediment to the development of ANWR resources is the current legal restriction that precludes access to these oil resources.

Field Size Distributions

The current analysis uses the USGS assessment of potential field sizes in the coastal plain area, based on its assessment of the underlying geology. For the purposes of evaluating the impact of opening ANWR for U.S. markets, EIA assumed that State and Native lands within the coastal plain of ANWR would be opened for development. In the mean oil resource case, the total volume of technically recoverable crude oil projected to be found within the coastal plain area is 10.4 billion barrels, compared to 5.7 billion barrels for the 95-percent probability estimate, and 16.0 billion barrels for the 5-percent probability estimate. Because the USGS 5-percent and 95-percent probability oil resource estimates are asymmetric around the mean estimate, the expected field size distribution and, in turn, the distribution of projected oil production are also asymmetric with respect to the mean estimate's field sizes and projected production.

[7] Ibid, pages 1-17 and 2-4.

In the mean oil resource case, the largest projected field in ANWR is nearly 1.4 billion barrels. While considerably smaller than the 13.5-billion-barrel Prudhoe Bay field,[8] this would be larger than any new domestic onshore field brought into production in decades. Subsequent fields, which are developed through 2030 in the mean resource case, are expected to be smaller, with two additional fields each with 700 million barrels of oil and four additional fields each with 360 million barrels of oil (Table 1). To put these field sizes in context with recent North Slope Alaska oil discoveries, the Alpine Oil field, the largest field to start producing in recent years, is estimated to have 540 million barrels of ultimate recovery.[9]

Because the larger fields are generally easier to find and cheaper to develop, EIA's analysis assumes that the largest oil fields are developed first.

Table 1. Oil Field Sizes and Their Date of Initial Production for the Three ANWR Resource Cases

(million barrels)

Year In Which Field Begins Production	Mean Oil Resource Case	Low Oil Resource Case	High Oil Resource Case
2018	1,370	700	2,000
2020	700	700	1,340
2022	700	340	1,340
2024	360	340	700
2026	360	340	700
2028	360	340	700
2030	360	180	700
Total	**4,210**	**2,940**	**7,480**

Source: Energy Information Administration, Office of Integrated Analysis and Forecasting.

Because the USGS assessment of ANWR oil resources has not changed since 2001, the ANWR field sizes used in this analysis are the same as those used in EIA's 2004 ANWR analysis.

Production Profiles

Potential production from ANWR fields is based on the size of the field discovered and the production profiles of other fields of the same size in Alaska with similar geological characteristics. In general, fields are assumed to take 3 to 4 years to reach peak production,

---

[8] The 13.5 billion barrels of Prudhoe Bay field oil represents the cumulative volume of oil expected to be produced from this field over its entire production life. The amount of original-oil-in-place in Prudhoe Bay is estimated to be 25 billion barrels. Source: U.S. Department of Energy, National Energy Technology Laboratory, Arctic Energy Office, *Alaska North Slope Oil and Gas, A Promising Future or an Area in Decline?* DOE/NETL-2007/1280, (Fairbanks, Alaska, August 2007), Table 3.113, page 3-123.

[9] Ibid, page 3-124.

maintain peak production for 3 to 4 years, and then decline until they are no longer profitable and are closed. Identical production profiles were used in the prior EIA report.

Current Oil Market Conditions

Alaska North Slope crude oil prices have increased dramatically, rising from $23.62 per barrel in 2000 to $47.05 per barrel in 2005, a 99 percent increase, and to $63.69 in 2007, a 170 percent increase.[10] Alaska North Slope oil prices have continued to increase in 2008, in line with other crude prices. The price of West Texas Intermediate crude oil, which typically has a price premium of $5 to $8 per barrel over Alaska North Slope crude, has recently exceeded $120 per barrel.

Considered in isolation, higher prices alone might raise an expectation of higher ultimate recovery from whatever oil resource exists in place.[11] Higher prices can motivate efforts to increase the recovery factor through more intensive drilling and through the application of advanced techniques to increase recovery factors. While the menu of available methods may in some cases be limited by the features of the Alaska North Slope environment, for example, steam-injection enhanced oil recovery of the near-surface West Sak heavy oil deposits could endanger the permafrost, some techniques would likely still be suitable. Higher prices also make it more attractive to go after very small fields that are in close proximity to the larger fields that are presumed to be the initial development targets. However, as discussed below, the main impact of such approaches on the amount of oil actually recovered from ANWR is likely to occur after 2030, the current time horizon for EIA analyses.

As previously noted, there is a strong incentive for serial development of the ANWR resource, starting with the largest fields first. As shown in Table 1, the expected size of fields developed in each year through 2030 declines over time. Based on the field size distributions provided for USGS for each of the resource cases, the expected target field in 2030 is estimated to contain 180 million barrels of recoverable oil in the low (most unfavorable) resource case and even more oil in the other two resource cases. Based on recent development practice, oil fields smaller than 10 million barrels of recoverable oil that lie in close proximity to existing developed fields in Alaska were deemed desirable development targets even when crude oil prices were substantially below their current level.[12] Oil fields of 180 million barrels in proximity to even larger developed fields within ANWR are likely to present attractive development opportunities even at prices well below today's level. Crude oil prices could be a significant factor in determining whether much smaller fields within ANWR would also be attractive to develop. However,

---

[10] Energy Information Administration, *Petroleum Marketing Monthly*, DOE/EIA-0380(2008/05) (Washington, DC, May 2008), Table 18, page 43.

[11] The 1998 USGS ANWR assessment assumed an average recovery factor of 37 percent of the original-oil-in-place. This recovery factor is based on primary (pressure-driven) and secondary (water-injection) recovery techniques, but does not included tertiary (enhanced oil recovery) techniques, which can increase oil recovery by an additional 5 to 15 percentage points.

[12] Examples include the North Prudhoe and West Beach oil fields that are in close proximity to the Prudhoe Bay field.

decisions regarding such smaller fields would most likely be taken sometime after 2030, affecting production levels only after such fields are actually brought on line.

A similar timing issue arises with respect to the application of advanced techniques to raise ultimate recovery factors in fields of various sizes. With all new fields already assumed to be developed in an efficient manner if ANWR resources are opened to leasing and development, investments in such techniques would predominantly occur well after fields are first developed. While prices can influence decisions regarding the application of advanced techniques, the timing of ANWR development is such that the major impact on production from large fields in ANWR is not likely to be felt before 2030. However, a more significant impact could be realized in later years.

The increase in drilling costs over time is another important consideration that mitigates against an immediate impact of higher oil prices on the production profile following initial development in a scenario where ANWR resources are open to leasing and development. For example, the American Petroleum Institute's (API) *Joint Association Survey of Drilling Costs* (JAS) reports, that for the 10,000 to 12,499-foot well-depth interval, the average cost of drilling a domestic[13] onshore oil well increased from $111 per foot-drilled in 2000 to $294 per foot-drilled in 2005, a 165-percent cost increase.[14] For the same well-depth interval, Alaska onshore oil well drilling costs increased from $283 per foot-drilled in 2000 to $1,880 per foot-drilled in 2005, a 564-percent cost increase.[15] The vast majority of the oil wells drilled in Alaska occur on the North Slope.

These API well drilling cost averages illustrate two aspects of Alaska North Slope oil field development costs. First, Alaska oil fields have always been more expensive to develop than lower-48 oil fields due to the North Slope's remote location, harsh winters, and the environmental requirement to maintain the permafrost layer. Second, in the current market environment, where producers are completing for scarce oil field equipment, drilling rigs, and skilled labor, the remoteness of the Alaska North Slope and its limited drilling season works to its detriment, causing oil field development costs to increase more than that witnessed in the lower-48. In the lower-48, a drilling company might move a land rig only a couple of miles, or at most, a couple of hundred miles to another drilling site. In contrast, the deployment of new rigs to the Alaska North Slope requires that they be transported many thousands of miles without any option for quick redeployment.

Over the long-term, both lower-48 and Alaska North Slope oil field development costs are expected to subside as the supply of drilling rigs, oil field equipment, and skilled labor increases to catch up with demand. However, it is unlikely that Alaska North Slope oil field development costs will decline to year 2000 levels.

---

[13] Including Alaska.
[14] American Petroleum Institute, *Joint Association Survey on Drilling Costs*, 2000 and 2005 editions (Washington, DC, December 2001 & April 2006), Table 2.12.
[15] Ibid, Table 2.24.

In summary, the basic intuition that higher crude oil prices would likely result in higher ultimate recovery from whatever resource exists in place is sound. However, given the timing and cost considerations outlined above, EIA does not expect the recent increase in oil prices to affect the projected profile of ANWR development and production activities prior to 2030, the end of the time horizon for this analysis. Therefore, this current analysis of projected production from ANWR through 2030 parallels our prior recent analyses of this topic that have used similar or identical information on ANWR resources notwithstanding the recent run-up in world crude oil prices.

Results

In the *AEO2008* reference case, U.S. conventional crude oil production grows from 5.1 million barrels per day in 2006 to a peak of 6.3 million barrels per day in 2018, and then declines to 5.6 million barrels per day in 2030 (Figure 2 and Table 2). The shape of the U.S. production profile is largely driven by lower-48 offshore oil production, which rises from 1.4 million barrels per day in 2006 to 2.4 million barrels per day in 2015, and then falls to 1.9 million barrels per day in 2030. Lower-48 onshore oil production grows slightly through 2030 because high crude oil prices stimulate the growth in carbon dioxide enhanced oil recovery (EOR) production, which offsets the decline in the other lower-48 onshore oil production.

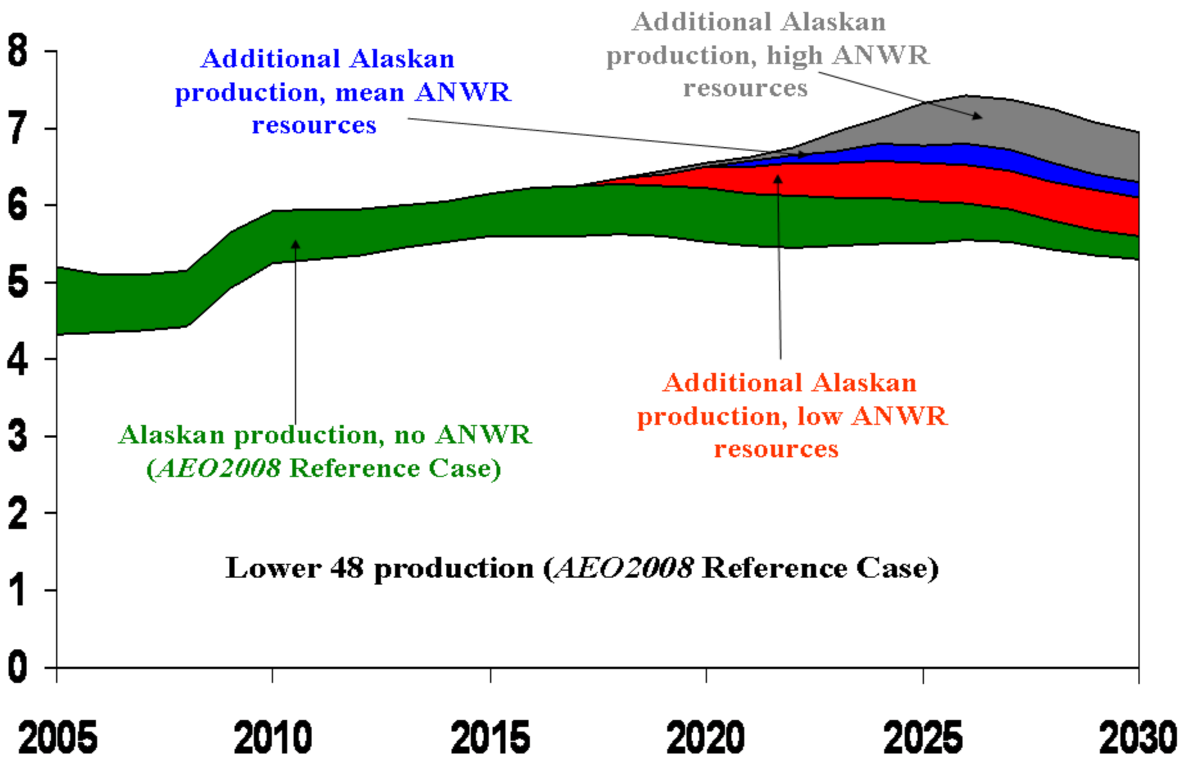
In the *AEO2008* reference case, Alaska crude oil production (without ANWR) declines from 741,000 barrels per day in 2006 to about 520,000 barrels per day in 2014. After 2014, Alaska oil production increases due to the discovery and development of new offshore oil fields that are expected to be found off the Alaska North Slope.[16] These new fields raise Alaska oil production to about 700,000 barrels per day in 2020. After 2020, Alaska oil production declines to about 300,000 barrels per day in 2030.

In all three ANWR resource cases, ANWR crude oil production begins in 2018 and grows during most of the projection period before production begins to decline. In the mean oil resource case, ANWR oil production peaks at 780,000 barrels per day in 2027. The low- resource-case production peaks at 510,000 barrels per day in 2028, while the high- resource-case production peaks at 1,450,000 barrels per day in 2028. Cumulative oil production resulting from the opening of ANWR from 2018 through 2030 amounts to 2.6 billion barrels in the mean resource case, 1.9 billion barrels in the low resource case, and 4.3 billion barrels in the high resource case.

[16] The U.S. Minerals Management Service (MMS) estimates that approximately 23.6 billion barrels of undiscovered technically recoverable oil resources exist in the Beaufort and Chukchi Seas off the North Slope and that approximately 19 billion barrels of oil would be economic to produce at $80 per barrel or less. Source: U.S. Department of Interior, Minerals Management Service, *Undiscovered Oil and Gas Resource, Alaska Federal Offshore, as of 2006* (Washington, DC, 2006).

Figure 2. Domestic Crude Oil Production for the AEO2008 Reference Case and the Three ANWR Resource Cases, 2005-2030

(million barrels per day)



Source: National Energy Modeling System runs - aeo2008.d030208f, anwr2008.d031008a, anwr2008HRref.d040308c and anwr2008LRref.d040308d

The opening of ANWR to oil and gas development includes the following impacts:

- reducing world oil prices,
- reducing the U.S. dependence on imported foreign oil,
- improving the U.S. balance of trade,
- extending the life of TAPS for oil, and
- increasing U.S. jobs.

The remainder of this section will focus primarily on the first four impacts, because the employment impacts are difficult to determine for oil fields being developed on the Alaska North Slope.

Table 2. Liquid Fuels Supply Impact of Opening ANWR 1002 Area to Petroleum Development under Three Oil Resource Cases

(million barrels per day, unless otherwise noted)

Liquid Fuels Supply Category	2006	2020			
		AEO2008 Reference Case	Mean Oil Resource Case	Low Oil Resource Case	High Oil Resource Case
LSL Crude Oil Price (2006 dollars per barrel)	**$66.02**	**$59.70**	**$59.46**	**$59.47**	**$59.39**
U.S. Crude Production	**5.1**	**6.2**	**6.5**	**6.5**	**6.5**
Lower-48	**4.4**	**5.5**	**5.5**	**5.5**	**5.5**
Alaska	**0.7**	**0.7**	**0.9**	**1.0**	**1.0**
Net Crude Imports	**10.1**	**9.8**	**9.5**	**9.5**	**9.4**
Total Crude Supply	**15.2**	**16.0**	**16.0**	**16.0**	**16.0**
Natural Gas Liquids	**1.7**	**1.7**	**1.7**	**1.7**	**1.7**
Other Inputs	**1.4**	**3.0**	**3.0**	**3.0**	**3.0**
Net Product Imports	**2.3**	**1.4**	**1.4**	**1.4**	**1.4**
Total Primary Supply	**20.7**	**22.0**	**22.1**	**22.1**	**22.1**
Net Import Share of Total Primary Supply	**60 %**	**52 %**	**50 %**	**50 %**	**50 %**
Net Expenditures for Crude and Product Imports (billion 2006 dollars)	**$265**	**$207**	**$200**	**$201**	**$199**

Liquid Fuels Supply Category	2006	2025			
		AEO2008 Reference Case	Mean Oil Resource Case	Low Oil Resource Case	High Oil Resource Case
LSL Crude Oil Price (2006 dollars per barrel)	**$66.02**	**$64.49**	**$63.74**	**$64.04**	**$63.13**
U.S. Crude Production	**5.1**	**6.0**	**6.8**	**6.5**	**7.3**
Lower-48	**4.4**	**5.5**	**5.5**	**5.5**	**5.5**
Alaska	**0.7**	**0.5**	**1.3**	**1.0**	**1.8**
Net Crude Imports	**10.1**	**10.1**	**9.5**	**9.7**	**9.0**
Total Crude Supply	**15.2**	**16.1**	**16.3**	**16.3**	**16.3**
Natural Gas Liquids	**1.7**	**1.6**	**1.7**	**1.6**	**1.7**
Other Inputs	**1.4**	**3.3**	**3.3**	**3.3**	**3.4**
Net Product Imports	**2.3**	**1.3**	**1.2**	**1.2**	**1.1**
Total Primary Supply	**20.7**	**22.3**	**22.4**	**22.4**	**22.5**
Net Import Share of Total Primary Supply	**60 %**	**52 %**	**48 %**	**50 %**	**46 %**
Net Expenditures for Crude and Product Imports (billion 2006 dollars)	**$265**	**$228**	**$207**	**$216**	**$193**

Liquid Fuels Supply Category	**2006**	**2030**			
		***AEO2008* Reference Case**	**Mean Oil Resource Case**	**Low Oil Resource Case**	**High Oil Resource Case**
LSL Crude Oil Price (2006 dollars per barrel)	**$66.02**	**$70.45**	**$69.78**	**$69.95**	**$69.08**
U.S. Crude Production	**5.1**	**5.6**	**6.3**	**6.1**	**6.9**
Lower-48	**4.4**	**5.3**	**5.3**	**5.3**	**5.3**
Alaska	**0.7**	**0.3**	**1.0**	**0.8**	**1.7**
Net Crude Imports	**10.1**	**11.0**	**10.6**	**10.7**	**10.0**
Total Crude Supply	**15.2**	**16.6**	**16.9**	**16.7**	**17.0**
Natural Gas Liquids	**1.7**	**1.6**	**1.6**	**1.6**	**1.6**
Other Inputs	**1.4**	**3.4**	**3.4**	**3.5**	**3.4**
Net Product Imports	**2.3**	**1.3**	**1.1**	**1.2**	**1.0**
Total Primary Supply	**20.7**	**22.9**	**23.0**	**23.0**	**23.1**
Net Import Share of Total Primary Supply	**60 %**	**54 %**	**51 %**	**52 %**	**48 %**
Net Expenditures for Crude and Product Imports (billion 2006 dollars)	**$265**	**$262**	**$241**	**$248**	**$223**

Source: National Energy Modeling System runs - aeo2008.d030208f, anwr2008.d031008a, anwr2008HRref.d040308c, and anwr2008LRref.d040308d.
LSL=Low-sulfur, light.
Note: Totals may not equal the sum of the components due to independent rounding.

With respect to the world oil price impact, projected ANWR oil production constitutes between 0.4 and 1.2 percent of total world oil consumption in 2030, based on the low and high resource cases, respectively.[1] Consequently, ANWR oil production is not projected to have a large impact on world oil prices. Relative to the *AEO2008* reference case, ANWR oil production is projected to have its largest oil price reduction impacts as follows: a reduction in low-sulfur, light (LSL) crude oil[2] prices of $0.41 per barrel (2006 dollars) in 2026 in the low oil resource case, $0.75 per barrel in 2025 in the mean oil resource case, and $1.44 per barrel in 2027 in the high oil resource case. Assuming that world oil markets continue to work as they do today, the Organization of Petroleum Exporting Countries (OPEC) could neutralize any potential price impact of ANWR oil production by reducing its oil exports by an equal amount.

[1] World oil consumption is projected to be 117.6 millions barrels per day in 2030. Source: Energy Information Administration, *International Energy Outlook 2007*, DOE/EIA-0484(2007) (Washington, DC, May 2007), Table A5, page 88, web site www.eia.doe.gov/oiaf/ieo/index.html.
[2] Low-sulfur, light crude oil, such as West Texas Intermediate, is one of the more common price benchmarks used for world oil prices.

High oil prices and high Corporate Average Fuel Economy (CAFE) standards are projected to restrain the growth in future U.S. liquid fuels consumption. In the *AEO2008* reference case, total U.S. liquid fuels consumption grows slowly from 20.7 million barrels per day in 2006 to 22.8 million barrels per day in 2030. Lower projected U.S. liquid fuels consumption results in ANWR oil production causing a larger percentage reduction in future oil and liquid product imports than was the case in prior ANWR analyses conducted by EIA.

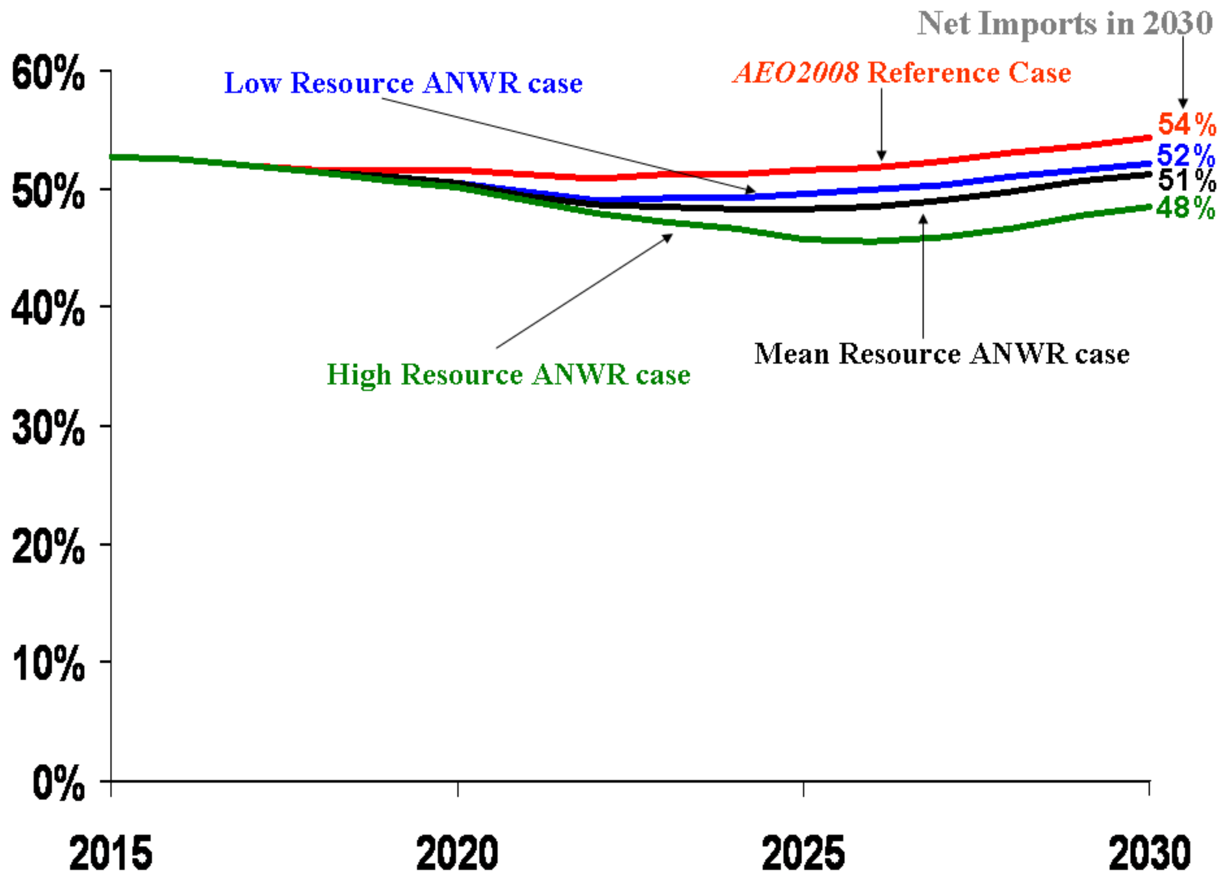
Every barrel of ANWR oil production reduces crude oil imports by about a barrel (Figure 3 and Table 2). In the *AEO2008* reference case, the proportion of crude oil and liquid fuel imports to total supply remains relatively constant during the 2018 through 2025 time period at an average value of 51 percent. After 2025, reference case oil dependency increases to about 54 percent of U.S. liquid fuels supply in 2030. Because U.S. liquid fuels consumption grows slowly during the entire projection period, the lowest import dependency levels occur between 2022 and 2026 across the three resource cases.[1] The mean oil resource case projects a minimum import share of 48 percent in 2024, before rising to 51 percent in 2030. The low and high resource cases project minimum import shares of 49 and 46 percent in 2022 and 2026, respectively.

The reduction in oil import volumes also reduces the level of expenditures on crude oil and liquid fuel imports (Figure 4 and Table 2). In the *AEO2008* reference case, high projected oil prices cause cumulative net U.S. expenditures on imported oil and liquid fuels to cost about $2.9 trillion (2006 dollars) between 2018 and 2030. The mean oil resource case reduces this import expenditure by $202 billion dollars, or about 7 percent. In the low and high resource cases, ANWR oil production reduces cumulative net expenditures on imported crude oil and liquid fuels by about $135 to $327 billion (2006 dollars), respectively. As a result, the opening of ANWR to Federal oil and natural gas leasing improves the U.S. balance of trade by $135 to $327 billion during the 2018 through 2030 timeframe, based on the world oil prices projected in the *AEO2008* reference case.

The development of ANWR oil resources potentially extends the lifetime operation of TAPS. Currently, TAPS is believed to be uneconomic to operate once the oil throughput falls below 200,000 barrels per day.[2] Although the reference case projects North Slope production to be above this minimum level, at about 280,000 barrels per day in 2030, the development of ANWR oil resources extends the life of this pipeline well beyond 2030. Greater TAPS throughput also reduces oil transportation rates, thereby prolonging the life of existing oil fields and encouraging the development of new, small North Slope oil fields.

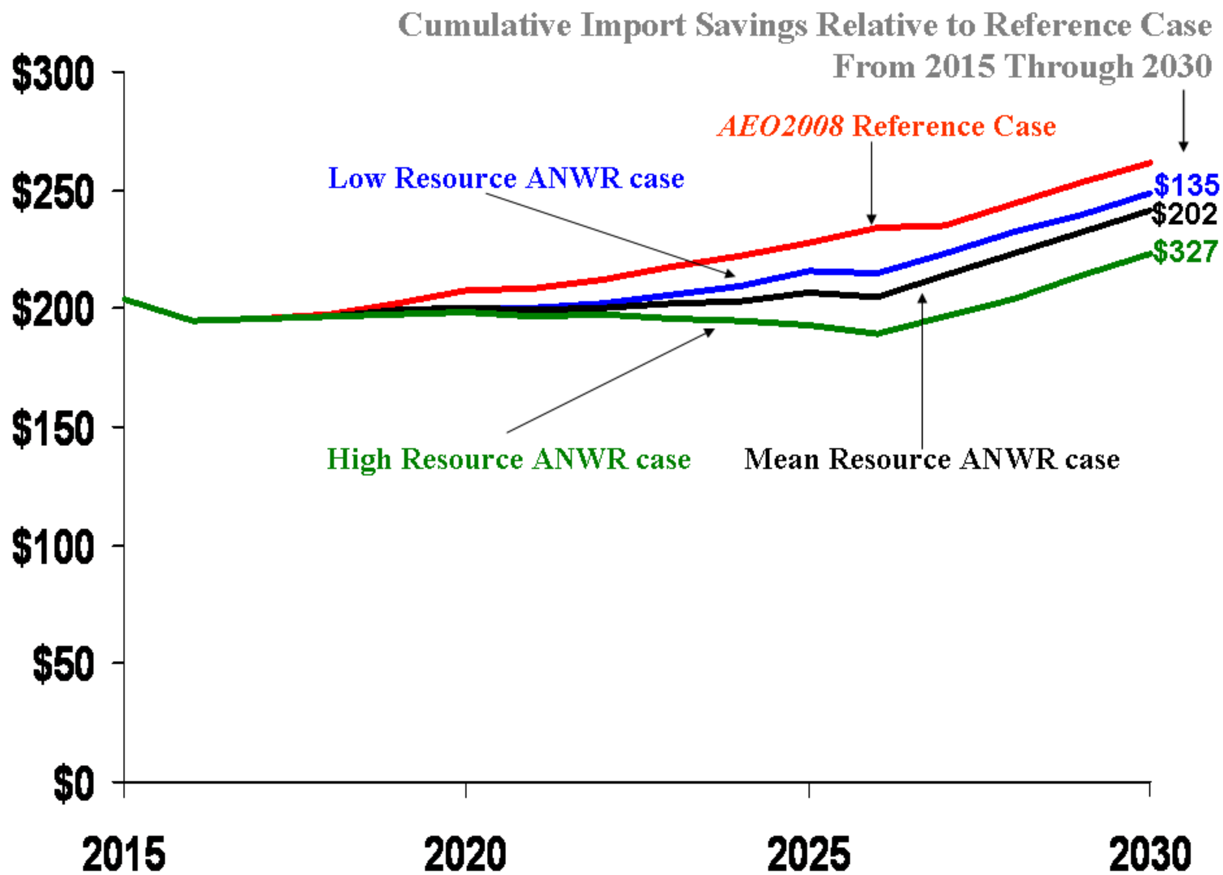
[1] The maximum volumetric reduction in imports occurs in 2027 and 2028 when ANWR oil production peaks across the three cases.
[2] Petroleum News, *TAPS Switches into the 21st century*, Volume 12, Number 9, March 4, 2007, pages 9 – 10.

Figure 3. Net Import Share of Liquid Fuels Consumed in the United States for the AEO2008 Reference Case and the Three ANWR Resource Cases, 2015-2030 (percent)



Source: National Energy Modeling System runs - aeo2008.d030208f, anwr2008.d031008a, anwr2008HRref.d040308c, and anwr2008LRref.d040308d

Figure 4. Net Expenditures for Crude Oil and Liquid Fuel Imports for the AEO2008 Reference Case and the Three ANWR Resource Cases, 2015–2030
(billions of 2006 dollars)



Source: National Energy Modeling System runs - aeo2008.d030208f, anwr2008.d031008a, anwr2008HRref.d040308c, and anwr2008LRref.d040308d

ANWR Production Uncertainties

There is much uncertainty regarding the impact of opening ANWR on U.S. oil production and imports, due to several factors:

- *The size of the underlying resource base*. There is little direct knowledge regarding the petroleum geology of the ANWR region. The USGS oil resource estimates are based largely on the oil productivity of geologic formations that exist in the neighboring State lands and which continue into ANWR. Consequently, there is considerable uncertainty regarding both the size and quality of the oil resources that exist in ANWR. Thus, the potential ultimate oil recovery and potential yearly production are highly uncertain.
- *Oil field sizes*. The size of the oil fields found in ANWR is one factor that will determine the rate at which ANWR oil resources are developed and produced. If the reservoirs are larger than expected, then production would be greater in the 2018 through 2025 timeframe. Similarly, if the reservoirs are smaller than expected, then production would be less.
- *The quality of the oil and the characteristics of the oil reservoirs*. Oil field production rates are also determined by the quality of oil found, e.g., viscosity and paraffin content, and the field's reservoir characteristics, i.e., its depth, permeability, faulting, and water saturation. This analysis assumes oil quality and reservoir characteristics similar to those associated with the Prudhoe Bay field. If, for example, the oil discovered in ANWR has a considerably higher viscosity than the Prudhoe Bay field oil, e.g., over 10,000 centipoise, then oil production rates would be lower than projected in this analysis.
- *Environmental considerations.* Environmental restrictions could affect access for exploration and development. Also, legal challenges to the BLM's leasing program and to its approval of seismic data collection and of specific oil field projects could significantly delay ANWR oil development and production.

Although there is considerable uncertainty regarding future ANWR oil production, the current upper limit to ANWR oil production is the transportation capacity of TAPS. TAPS has maximum throughput capacity of 2.136 million barrels per day. [3] The high ANWR oil resource case comes closest to reaching this pipeline capacity, when total North Slope oil production peaks at 1.9 million barrels per day in 2026.

---

[3] Alyeska Pipeline Service Co. web site www.alyeska-pipe.com/PipelineFacts/PipelineOperations.html.

Appendix A: Request Letter from Alaska Senator Ted Stevens

EXEC-2007-014030
12/17/2007 11:00 AM

United States Senate

Ted Stevens
Alaska

Washington, DC 20510
(202) 224-3004
Fax (202) 224-2354

Committees:
Vice Chairman
Commerce, Science, and Transportation

Appropriations
Governmental Affairs
Rules and Administration
Library of Congress

December 6, 2007

Guy Caruso
Administrator
Energy Information Administration
James Forrestal Building
1000 Independence Avenue, S.W.
Washington, D.C. 20585

Dear Administrator:

I am writing to request an update of the Energy Information Administration's (EIA) Service Report entitled *Potential Oil Production from the Coastal Plain of the Arctic National Wildlife Refuge* prepared by the Reserves and Product Division in May 2000. Given recent developments, particularly with regard to the price of oil, the report should be revised to reflect today's circumstances.

The May 2000 report was based on 1998 U.S. Geological Survey (USGS) resource estimates of technically recoverable oil and natural gas from the Coastal Plain and the imported refiner acquisition cost in 2020 as projected in EIA's *Annual Energy Outlook 2000* of $22.04 (1998 dollars). This information is outdated and no longer gives an accurate picture of potential oil recovered from the Coastal Plain or its value. The USGS' most current data on the Coastal Plain was released in 2005. In addition, oil prices have increased exponentially since 2000. On December 6, the price of oil was over $88 per barrel, compared to oil prices in the $20 range at the time of the last EIA report.

As was similarly requested for the May 2000 assessment, the updated report should develop plausible scenarios for development of the Coast Plain consistent with the most recent USGS resource assessments and oil price situation.

Thank you for your time and attention. Please direct any questions to my staff, Kate Williams, at 202-224-8158.

With best wishes,

Cordially,

TED STEVENS

Anchorage	Bethel	Fairbanks	Girdwood	Juneau	Kenai	Ketchikan	Wasilla
(907) 271-3915	(907) 543-1638	(907) 456-0261	(907) 783-3301	(907) 586-7400	(907) 283-5808	(907) 225-6880	(907) 376-7665