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Analysis of Oil and Gas Production in the Arctic National Wildlife Refuge

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Preface

On February 23, 2004, Representative Richard W. Pombo, Chairman of the U.S. House Committee on Resources, requested that the Energy Information Administration (EIA) provide an assessment of authorizing oil and gas leasing in the coastal plain of the Arctic National Wildlife Refuge (ANWR) in Alaska. In his request, Representative Pombo cited Division C, Title III, Sections 30401 through 30412 of the H.R. 6, "Energy Policy Act of 2003," as it passed in the House. Representative Pombo asked that the impact of this oil and gas leasing authorization be compared to the projections shown in the *Annual Energy Outlook 2004*. In addition, Representative Pombo asked EIA to assess whether there were any "significant synergies" regarding the opening of ANWR to oil and gas leasing and the potential construction of an Alaska gas pipeline, which would transport natural gas from the Alaska North Slope to the lower 48 States. This report responds to Chairman Pombo's request.

The legislation that established EIA in 1977 vested the organization with an element 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 perform objective, credible analyses in support of the deliberations of both public and private decision makers. 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.

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Introduction

On February 23, 2004, Representative Richard W. Pombo, Chairman of the U.S. House Committee on Resources, requested that the Energy Information Administration (EIA) provide an assessment of authorizing oil and gas leasing in the coastal plain of the Arctic National Wildlife Refuge (ANWR) in Alaska.[1] In his request, Representative Pombo cited Division C, Title III, Sections 30401 through 30412 of the H.R. 6, "Energy Policy Act of 2003," as it passed in the House. Representative Pombo asked that the impact of this oil and gas leasing authorization be compared to the projections in the *Annual Energy Outlook 2004 (AEO2004)*.[2] He also requested that a prior EIA analysis of oil and gas development on the ANWR coastal plain be used, as appropriate.[3] Finally, Representative Pombo asked EIA to assess whether there were any "significant synergies" regarding the opening of ANWR to oil and gas leasing and the potential construction of an Alaska gas pipeline, which would transport natural gas from the Alaska North Slope to the lower 48 States.

This analysis presents three ANWR cases that assess the potential impact of oil and gas leasing in the coastal plain area of ANWR.[4] 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[5] of technically recoverable oil resources in the coastal plain 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 coastal plain 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 coastal plain area of ANWR.

These three ANWR scenarios are compared to the *AEO2004* reference case, which serves as the analytical baseline for this report.[6]

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[1] A copy of the request letter is included in Appendix A.

[2] Energy Information Administration, *Annual Energy Outlook 2004*, DOE/EIA-0383(2004), (Washington, DC, January 2004); http://www.eia.doe.gov/oiaf/aeo/index.html.

[3] Energy Information Administration, *Potential Oil Production from the Coastal Plain of the Arctic Wildlife Refuge: Updated Assessment*, SR/O&G/2000-2 (Washington, DC, May 2000); http://www.eia.doe.gov/pub/oil_gas/petroleum/analysis_publications/arctic_national_wildlife_refuge/html/anwr101.html.

[4] The coastal plain of ANWR is roughly north of the Sadlerochit Mountains and west of the Aichilik River.

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

[6] A similar question was raised by Senator Frank Murkowski in a December 20, 2001, request. See Energy Information Administration, *The Effects of the Alaska Oil and Natural Gas Provisions of H.R. 4 and S. 1766 on U.S. Energy Markets*, SR/OIAF/2002-02, (Washington, DC, February 2002); http://www.eia.doe.gov/oiaf/servicerpt/aong/pdf/sroiaf(2002)02.pdf.

Analysis Summary

The opening of the ANWR 1002 Area to oil and gas development is projected to increase domestic oil production starting in 2013. In 2025, the coastal plain of ANWR is projected to reach 0.9 million barrels per day under the USGS mean oil resource case, and 0.6 and 1.6 million barrels per day under the low and high resource cases, respectively. These cases include the impact of production in the Federal 1002 Area plus Native lands and the State offshore area within a 3-mile limit.

Petroleum imports are projected to decline one barrel for every barrel of ANWR production. Opening the coastal plain of ANWR is projected to reduce 2025 oil import dependence from 70 percent in the *AEO2004* reference case to 66 percent in the mean resource case. The high and low oil resource cases project a 2025 oil import dependency of 64 percent and 67 percent, respectively. Expenditures on foreign oil and petroleum products are also projected to be lower in 2025 by $8 billion dollars (2002 dollars) in the mean oil resource case, and by $15 and $6 billion dollars in the high and low oil resource cases, respectively.

The opening of the coastal plain of ANWR to oil and gas development is expected to have little impact on the development of an Alaska gas pipeline. Although the opening of ANWR might reduce the gas resource risk of building an Alaska gas pipeline, there is expected to be a much larger gas resource in the National Petroleum Reserve-Alaska (NPRA). The NPRA is currently being leased and explored for oil and gas resources, and has an expected gas resource base six times larger than that expected for the coastal plain of ANWR. The NPRA is expected to have a greater impact on reducing the gas resource risk associated with an Alaska gas pipeline than ANWR.

Background

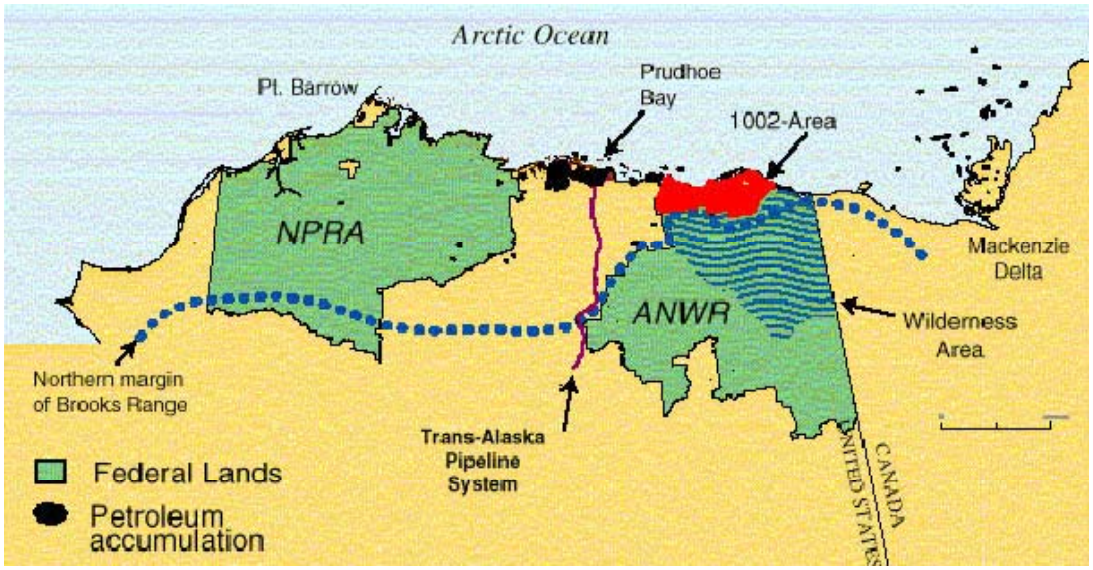
The Federal Government currently prohibits oil and natural gas development in ANWR. ANWR was created by the Alaska National Interest Lands Conservation Act (ANILCA) in 1980. Section 1002 of ANILCA deferred a decision on the management of oil and gas exploration and development of 1.5 million acres of Federal lands in the coastal plain of ANWR. Division C, Title III, Sections 30401 through 30412 of H.R. 6 proposes to open the 1002 Area to oil and gas exploration and production. 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 Tribal lands.

The estimates presented in this report include oil production from the Federal 1002 Area, the Native lands within ANWR, and the State offshore areas of the coastal plain. The linkage between development on Federal and Tribal lands is legally driven: under terms of ANILCA, development on the Native lands can only proceed after a Congressional decision to open the Federal 1002 Area. In contrast, the linkage between development in ANWR and State offshore lands is economic, not legal; without ANWR development, the necessary infrastructure for offshore development would likely not be available. Since

both the State and Native corporations have expressed a strong interest in developing their respective oil resources, an approach that reflects the legal and economic linkages operating on the North Slope is appropriate in evaluating the potential production impact of a Congressional decision to allow development in ANWR. Estimates for the Federal 1002 Area alone, such as those in the USGS Economic Assessment issued in 1999,[7] are most useful for an assessment of physical development impacts within the Federal ANWR area and for development of Federal revenue estimates. The difference in geographical coverage is one of several important factors leading the results of this report to differ from those presented in the USGS Economic Assessment.

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 NPRA (Figure 1.) Surveys conducted by the USGS suggest that between 5.7 and 16.0 billion barrels of technically recoverable oil[8] are in the coastal plain area of ANWR, with a mean estimate of 10.4 billion barrels, divided into many fields.[9] This estimate includes oil resources in Native lands and State waters out to a 3-mile boundary within the coastal plain area. The mean estimated size of oil resources in the Federal portion of the ANWR coastal plain is 7.7 billion barrels. In comparison, the estimated volume of technically recoverable,

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



Source: Energy Information Administration, *Potential Oil Production from the Coastal Plain of the Arctic National Wildlife Refuge: Updated Assessment*, SR/O&G/2000-02, May 2000.

[7] U.S. Geological Survey, "The Oil and Gas Resource Potential of the Arctic National Wildlife Refuge 1002 Area, Alaska," Survey Open File Report 98-34, 1999, Chapter EA (Economic Analysis).
[8] Technically recoverable resources are resources that can be produced using current technology.
[9] US Geological Survey, USGS Fact Sheet FS-028-01, April 2001; http://pubs.usgs.gov/fs/fs-0028-01.

accessible, unproved oil in the rest of the United States is 105 billion barrels, as of January 1, 2002.[10]

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. The House version of the Energy Policy Act of 2003[11] calls for opening the coastal plain area to development and does not open any of the rest of ANWR.

Methodology and Assumptions

The effects of opening the coastal plain area of ANWR were determined by incorporating the resources of that region into the National Energy Modeling System (NEMS).[12] The key assumptions required to forecast crude oil production from the coastal plain of ANWR are discussed below.

- ***Timing of first production***

At the present time, there has been little exploration and development activity in the coastal plain region. The EIA report *Potential Oil Production from the Coastal Plain of the Arctic National Wildlife Refuge: Updated Assessment* suggested that between 7 and 12 years were required from an approval to explore and develop the coastal region of ANWR until first production. The study further noted that the time to first production could vary significantly based on the time required for petroleum leasing once approval to develop ANWR has been given. Environmental considerations and the possibility of drilling restrictions also could significantly affect projected schedules.

Following the earlier study, this analysis assumes that passage of the current legislation in 2004 will result in first production from the ANWR area in 10 years, i.e., 2013, assuming that the first lease sale occurs 22 months after enactment, as required by H.R.6 passed by the House of Representatives.

- ***Timing of continuing development***

This study 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. This study assumes that new fields in the coastal plain of ANWR will be sequentially developed every 2 years after a prior field is opened.

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[10] Energy Information Administration, *Assumptions for the Annual Energy Outlook 2004*, DOE/EIA-0554(2004), (Washington, DC, February 2004), page 89, Table 50; http://www.eia.doe.gov/oiaf/aeo/assumption/pdf/0554(2004).pdf.

[11] Energy bill: http://frwebgate.access.gpo.gov/cgibin/getdoc.cgi?dbname=108_cong_bills&docid=f:h6eh.txt.pdf.

[12] Energy Information Administration, *The National Energy Modeling System: An Overview*, DOE/EIA-0581(2003), (Washington, DC, March 2003); http://tonto.eia.doe.gov/FTPROOT/forecasting/05812003.pdf.

The decision to use a 2-year lag in bringing fields into production is driven by four factors. First, there is the large expected size of the coastal plain of 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 Trans Alaska Pipeline System (TAPS). Third, there is competition of financial resources from other domestic and foreign projects, including the projected development of oil fields in the NPRA, 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 gas industry for exploration and development 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, which 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 Tribal 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 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.

In the mean oil resource case, the largest projected field in the coastal plain of ANWR is nearly 1.4 billion barrels. While considerably smaller than the 13-billion-barrel Prudhoe Bay field,[13] this would be larger than any new field brought into production in decades. Subsequent fields, which are developed through 2025 in the mean resource case, are expected to be smaller, with two additional fields with 700 million barrels of oil, 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 435 million barrels of ultimate recovery.

These field size assumptions presume that the largest oil fields are developed first, based on the concept that the larger fields are generally easier to find and cheaper to develop.

[13] The 13 billion barrels of Prudhoe Bay field oil represent the cumulative volume of oil expected to be produced from this field over its entire production life. The amount of in-place oil in Prudhoe Bay is estimated to be 25 billion barrels.

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
2013	1,370	700	2,000
2015	700	700	1,340
2017	700	340	1,340
2019	360	340	700
2021	360	340	700
2023	360	340	700
2025	360	180	700
Total	4,210	2,940	7,480

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

- ***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, 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, *Potential Oil Production from the Coastal Plain of the Arctic National Wildlife Refuge: Updated Assessment.*

Results

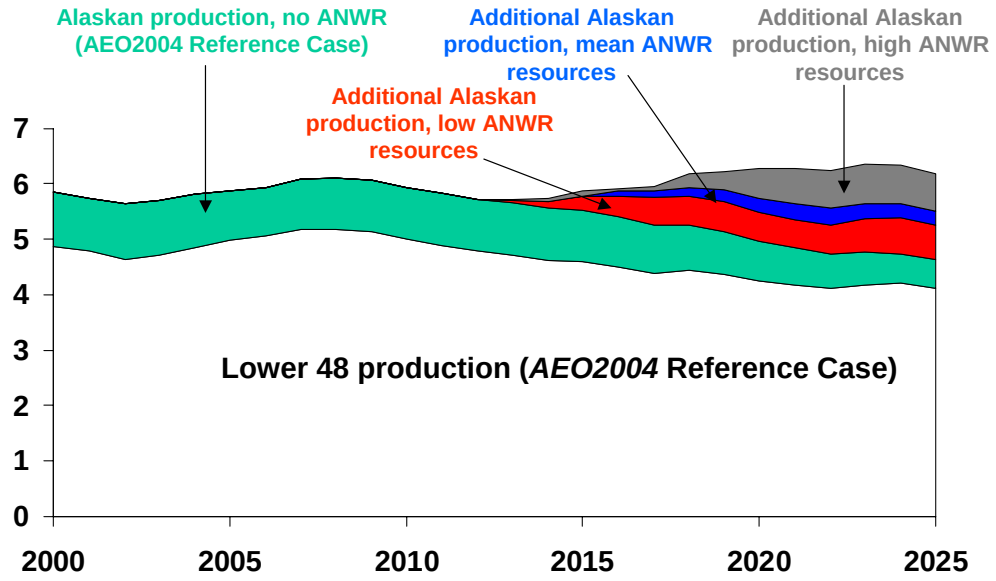
In the *AEO2004* reference case, total U.S. crude oil production is projected to grow from 5.8 million barrels per day in 2002 to 6.1 million barrels per day in 2008 (Figure 2).[14] After 2008, domestic oil production is projected to decline during the remainder of the forecast period, reaching 4.6 million barrels per day in 2025.

In the reference case, Alaska oil production is projected to continue at about 0.9 million barrels per day through 2016, with a projected drop in North Slope oil production offset by new oil production from the NPRA. After 2016, total Alaska oil production is projected to decline to 0.5 million barrels per day in 2025. The decline in Alaska oil production is expected to occur in all regions, including the State lands on the North Slope, the NPRA, and the southern Alaska oil fields of Cook Inlet.

In all three resource cases, ANWR coastal plain oil production begins in 2013 and grows during most of the forecast. In the mean oil resource case, ANWR oil production peaks

[14] The growth in U.S. crude oil production between 2002 and 2008 largely reflects the projected growth in offshore lower 48 oil production.

Figure 2. Domestic Crude Oil Production for Three ANWR Resource Cases and the *AEO2004* Reference Case, 2000-2025 (million barrels per day)



Source: National Energy Modeling System runs anwr_bs.d022304b, anwr_lo.d022304b, anwr_hi.d022304b, and aeo2004.d101703e.

at 876,000 barrels per day in 2024. The low resource case production peaks at 639,000 barrels per day in 2024, while the high resource case production peaks at 1,595,000 barrels per day in 2023.

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

- Reducing the U.S. dependence on imported foreign oil;
- Improving the U.S. balance of trade;
- Extending the life of TAPS for oil;
- Increasing U.S. jobs; and
- Reducing world oil prices.

The remainder of this section focuses primarily on the first three impacts, because the employment impacts are difficult to determine and are not within the realm of EIA's expertise and because the impact on world oil prices is not expected to be significant. With respect to the world oil price impact, ANWR coastal plain oil production in 2025 is projected to constitute between 0.5 to 1.3 percent of total world oil consumption.[15] It is

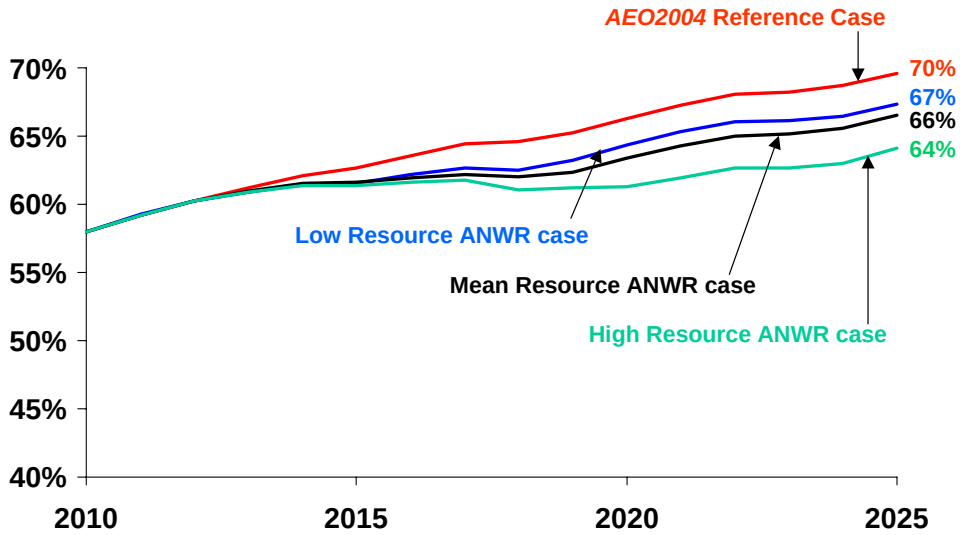
[15] Based, respectively, on the low and high oil resource case ANWR production levels in 2025. World oil consumption is projected to be 118.8 millions barrels per day in 2025, as published in Energy Information Administration, *International Energy Outlook 2003*, DOE/EIA-0484(2003), (Washington, DC, May 2003), Table A4, page 185; http://www.eia.doe.gov/oiaf/ieo/index.html.

expected that the price impact of ANWR coastal plain production might reduce world oil prices by as much as 30 to 50 cents per barrel, relative to a projected 2025 world oil price of $27 per barrel (2002 dollars) in the *AEO2004* reference case. Assuming that world oil markets continue to work as they do today, the Organization of Petroleum Exporting Countries could countermand any potential price impact of ANWR coastal plain production by reducing its exports by an equal amount.

The leasing and development of ANWR oil resources potentially extends the life of TAPS. Currently, TAPS is believed to be uneconomic to operate once the oil throughput falls to between 200,000 to 400,000 barrels per day, depending on prevailing oil prices. Although the reference case projects North Slope production to be above this minimum level (i.e., 510,000 barrels per day in 2025), the development of ANWR coastal plain oil resources extends the life of this pipeline well beyond 2025. The retention of this oil pipeline infrastructure could prove crucial in the future, if and when other regions of North Alaska are leased and developed, such as the offshore Beaufort and Chukchi Seas.

ANWR coastal plain oil production is projected to reduce future petroleum imports on an equal barrel-to-barrel basis. In the *AEO2004* reference case, 70 percent of U.S. oil consumption is projected to be satisfied by crude oil and petroleum product imports in 2025. The mean oil resource case reduces the percentage of petroleum imports to 66 percent, with an import range of 64 to 67 percent for the high and low oil resource cases, respectively (Table 2 and Figure 3).

Figure 3. Net Import Share of Petroleum Consumed in the United States for the Three ANWR Resource Cases and the *AEO2004* Reference Case, 2010-2025 (percent)



Source: National Energy Modeling System runs anwr_bs.d022304b, anwr_lo.d022304b, anwr_hi.d022304b, and aeo2004.d101703e.

Table 2. Petroleum Supply Impact of Opening ANWR to Petroleum Development under Three Oil Resource Cases (million barrels per day, unless otherwise noted)

Petroleum Supply Category	2002	2015			
		AEO2004 Reference Case	Mean Oil Resource Case	Low Oil Resource Case	High Oil Resource Case
U.S. Crude Production	5.8	5.5	5.8	5.8	5.9
---- Lower 48	4.8	4.6	4.6	4.6	4.6
---- Alaska	1.0	0.9	1.2	1.2	1.3
Net Crude Imports	9.1	13.5	13.2	13.2	13.1
Total Crude Supply	14.9	19.0	19.0	19.0	19.0
Natural Gas Liquids	1.9	2.3	2.3	2.3	2.3
Other Inputs	1.6	1.4	1.4	1.4	1.4
Net Product Imports	1.5	2.1	2.1	2.1	2.1
Total Primary Supply	19.9	24.8	24.8	24.8	24.8
Net Import Share of Total Primary Supply (percent)	53	63	62	62	61
Net Expenditures For Crude & Product Imports (billion 2002 dollars)	$90.4	$143.8	$141.5	$141.5	$141.0
Petroleum Supply Category	2002	2020			
		AEO2004 Reference Case	Mean Oil Resource Case	Low Oil Resource Case	High Oil Resource Case
U.S. Crude Production	5.8	5.0	5.7	5.5	6.3
---- Lower 48	4.8	4.2	4.2	4.2	4.2
---- Alaska	1.0	0.7	1.5	1.3	2.1
Net Crude Imports	9.1	14.5	13.7	13.9	13.1
Total Crude Supply	14.9	19.5	19.4	19.4	19.4
Natural Gas Liquids	1.9	2.5	2.5	2.5	2.5
Other Inputs	1.6	1.5	1.5	1.5	1.5
Net Product Imports	1.5	3.0	3.0	3.0	3.1
Total Primary Supply	19.9	26.4	26.4	26.4	26.4
Net Import Share of Total Primary Supply (percent)	53	66	63	64	61
Net Expenditures For Crude & Product Imports (billion 2002 dollars)	$90.4	$169.0	$161.9	$164.3	$157.0

Table 2. (continued) Petroleum Supply Impact of Opening ANWR to Petroleum Development under 3 Oil Resource Cases (million barrels per day, unless otherwise noted)

Petroleum Supply Category	2002	2025			
		AEO2004 Reference Case	Mean Oil Resource Case	Low Oil Resource Case	High Oil Resource Case
U.S. Crude Production	5.8	4.6	5.5	5.2	6.2
---- Lower 48	4.8	4.1	4.1	4.1	4.1
---- Alaska	1.0	0.5	1.4	1.1	2.1
Net Crude Imports	9.1	15.7	14.8	15.0	14.0
Total Crude Supply	14.9	20.4	20.3	20.3	20.2
Natural Gas Liquids	1.9	2.5	2.5	2.5	2.5
Other Inputs	1.6	1.5	1.5	1.5	1.5
Net Product Imports	1.5	3.9	4.0	4.0	4.1
Total Primary Supply	19.9	28.3	28.3	28.3	28.3
Net Import Share of Total Primary Supply (percent)	53	70	66	67	64
Net Expenditures For Crude & Product Imports (billion 2002 dollars)	$90.4	$200.2	$191.9	$194.4	$185.1

Source: National Energy Modeling System runs aeo2004.d101703e, anwr_bs.d022304b, anwr_lo.d022304b, and anwr_hi.d022304b.

The reduction in oil import volumes also reduces the level of expenditures on crude oil and petroleum product imports. In the *AEO2004* reference case, expenditures in 2025 on foreign oil and petroleum products are projected to be $200 billion (2002 dollars). The mean oil resource case projects expenditures in 2025 of $192 billion, with a range of $185 to $194 billion for the high and low oil resource cases, respectively. So, the opening of ANWR is projected to improve the U.S. balance of trade by $6 to $15 billion in 2025.

ANWR Production Uncertainties

Significant areas of uncertainty regarding the impact on U.S. oil production and imports of opening ANWR are:

- *The size of the underlying resource base*. Because there has been little petroleum drilling or exploration in ANWR, there is little first-hand knowledge regarding the petroleum geology of this region. The USGS oil resource estimates are based largely on the geologic conditions that exist in the neighboring State lands. 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 uncertain.

- *The underlying field structure*. The size of reservoirs that are found in ANWR will determine the rate at which ANWR oil and gas resources are developed. If the reservoirs are larger than expected, then production will be greater in earlier years. Similarly, if the reservoirs are smaller than expected, then production will be less in the early years.

- *The costs of developing oil resources in ANWR*. This analysis assumes that the costs of developing ANWR are not significantly different than developing the Prudhoe Bay field. Oil field development costs depend upon the quality of oil found (e.g., light or heavy) and the field's reservoir characteristics, such as permeability, faulting, and water saturation. If the ANWR oil field development costs are higher than those associated with the Prudhoe Bay field, the timing of ANWR production could be delayed.

- *Timing of ANWR production*. This analysis assumes that production in the ANWR coastal plain will begin in 2013. This analysis also assumes the size of the oil fields expected to be discovered in ANWR (based on USGS estimates) and their production rates (based on the industry's experience in the State lands on the North Slope). The actual timing of ANWR production could vary significantly from the timing assumed in this study. In addition, in the high oil resource case, North Slope production is slightly below the throughput capacity of TAPS. Although the TAPS throughput capacity could be expanded through the construction of additional pumping stations and/or the use of surfactants, it might be more economic to restrict ANWR oil production to the level of TAPS throughput capacity.[16]

- *Environmental considerations*. Environmental restrictions could affect access for exploration and development.

Synergies with the Alaska Gas Pipeline

The Alaska natural gas pipeline faces three types of business risk: gas market price risk, pipeline construction cost risk, and resource availability risk. Gas price risk is associated with the potential that future lower 48 natural gas prices might be too low to recover all pipeline and production costs, along with an adequate rate of return. Gas market price risk is further enhanced by the 9- to-10-year permitting and construction period for a gas pipeline, which increases the possibility that lower 48 gas market conditions and prices could have changed considerably by the time the pipeline goes into operation. For example, more than 35 North American liquefied natural gas (LNG) terminals, with more

[16] The maximum throughput capacity of TAPS is 2.136 million barrels per day, which is slightly above the 2.12 million barrels per day projected in the high oil resource case in 2023. (Rates exceeding 1,440,000 barrels per day assume drag reduction agent injection.) Source: Alyeska Pipeline Service Co., http://www.alyeska-pipe.com/PipelineFacts/PipelineOperations.html.

than 30 billion cubic feet of daily delivery capacity, have been proposed for completion over the next decade. Some analysts have concluded that LNG imports are a less expensive gas supply option for the lower 48 than the transportation of gas from the Alaska North Slope.[17] If this is true and if a significant portion of the proposed North American LNG capacity is built, then gas prices might be lower than the breakeven cost for gas transported by an Alaska gas pipeline.

The last two *Annual Energy Outlook*s have projected a need for both new LNG terminals and an Alaska gas pipeline to satisfy future natural gas consumption requirements. However, no new LNG terminals have been built since the 1970s, and LNG terminal project sponsors are faced with local siting issues, because many landowners do not want such facilities situated near them.

The risk of potential economic loss is also increased by the possibility that an Alaska gas pipeline might experience significant construction cost overruns, as happened with the construction of TAPS. A significant construction cost overrun could result in an Alaska gas pipeline being uneconomic upon its completion, especially if lower 48 gas prices decline substantially.

A gas resource risk exists because gas producers have proven the existence of 35 trillion cubic feet (tcf) out of the 51 tcf of natural gas needed to supply an Alaska gas pipeline.[18] Of the 35 tcf of proved recoverable natural gas assets that have already been found on State lands in the Alaska North Slope, about 26 tcf reside in the Prudhoe Bay Field, about 8 tcf reside in the Point Thomson Field, with the remainder located in various other fields. The difference between the 51 tcf required for a pipeline and the 35 tcf of proved gas resource constitutes a requirement to discover an additional 16 tcf of recoverable gas resources for an Alaska gas pipeline.

Other areas of the Alaska North Slope besides ANWR are expected to hold considerable natural gas resources, which are sufficient to cover this 16-tcf deficit. In particular, the NPRA portion of the North Slope is estimated to contain between 40 to 85 tcf of technically recoverable non-associated gas resources and 7 to 17 tcf of technically recoverable associated-dissolved gas resources.[19] The NPRA is already being leased for oil and gas development, with the eastern portion of NPRA under an active exploration program.

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[17] Deutsche Bank, *Picking the winners from the liquid gas boom*, May 2, 2003, Figure 6, page 8.

[18] Based on a presentation prepared by BP, ConocoPhillips, and ExxonMobil entitled: "Alaska Producer Pipeline Update," May 2002, Slide 16. Includes natural gas volumes required as lease, pipeline, processing, and electricity generation fuel.

[19] United States Geological Survey, *U.S. Geological Survey 2002 Petroleum Resource Assessment of the National Petroleum Reserve in Alaska (NPRA)*, USGS Fact Sheet 045-02, Table 1, and personal communication on March 1, 2004, with Emil Attanasi, Ph.D., U.S. Geological Survey, Reston, Virginia. Estimates include NPRA, native lands, and adjacent offshore areas within a 3-mile boundary surrounding NPRA. The USGS mean gas resource estimates for NPRA are 61 tcf for non-associated gas and 12 tcf for associated-dissolved natural gas. The NPRA figures cited in the text represent the 95-percent and 5-percent probability gas resource estimates, respectively. Associated-dissolved natural gas is co-located with crude oil in a reservoir, while non-associated gas is found without any crude oil in a reservoir.

In contrast, the USGS estimates that the technically recoverable non-associated natural gas resources available in the ANWR coastal plain are between 0 and 11 tcf, with a mean estimated value of 3.8 tcf.[20] An additional 2.3 to 5.2 tcf of technically recoverable associated-dissolved natural gas is estimated to exist in the ANWR coastal plain, with a mean estimate of 3.6 tcf.[21] So, under the mean gas resource estimates, total associated and non-associated ANWR coastal plain gas resources are estimated to be 7.4 tcf, which is less than half of the 16 tcf necessary for the gas pipeline. Even the 5-percent probability estimates (a 1-in-20 chance) for associated-dissolved and non-associated gas resources just barely cover the 16-tcf gas resource deficit. Consequently, opening the ANWR coastal plain to petroleum development might reduce the resource risk associated with an Alaska natural gas pipeline, but only marginally, because the expected size of the NPRA gas resource base is so much larger and because NPRA is already under an active leasing and exploration program.[22]

[20] U.S. Geological Survey, *The Oil and Gas Resource Potential of the Arctic National Wildlife Refuge 1002 Area*, Alaska Open File Report 98-34, Table AO3. Gas resource estimates include Federal lands, Native lands, and the State offshore area within the 3-mile limit.

[21] Ibid. Table EA3. These associated-dissolved gas figures are for the Federal lands portion of ANWR only (ie, the 1002 Area) and do not include the Native lands and the 3-mile offshore portions of the ANWR coastal plain. The more inclusive gas resources estimates were not available from USGS at the time of publication.

[22] The phrase "might reduce" is used in this context because this resource risk is only reduced if large volumes of natural gas are, in fact, found in ANWR. However, the finding of such resources can only occur if ANWR is opened to exploration and development. If ANWR is opened to petroleum development and no large gas deposits are found, then the pipeline's resource risk remains unchanged.

Appendix A

Request Letter from Representative Pombo

U.S. House of Representatives
Committee on Resources
Washington, DC 20515

February 23, 2004

Mr. Guy F. Caruso
Administrator
Energy Information Administration
U.S. Department of Energy
1000 Independence Ave. SW
Washington, D.C. 20585

Dear Mr. Caruso:

On February 2, 2004, Senator John Sununu requested that EIA provide information regarding the impact of certain provisions of the conference report of the Energy Policy Act of 2003. Last week, the EIA produced an analysis of those provisions using the National Energy Modeling System (NEMS).

I ask that you perform a similar analysis for the potential impacts of Division C, Title III of the H.R. 6 as it passed the House. These Sections, 30401 through 30412, authorize the leasing of the Coastal Plain of the Arctic National Wildlife Refuge in Alaska for oil and gas exploration and development. I am particularly interested in the impact of these Sections compared to EIA's 2004 annual energy outlook. I would ask that you use as appropriate, EIA's May, 2000, analysis regarding potential oil production from the Coastal Plain (SR/O&G/2000-02).

If possible in the time allotted, I am also interested in EIA's assessment of whether there may be significant synergies involved between ANWR development and other Alaska North Slope development, including the impact of possible additional natural gas discoveries on the economics of a proposal to build a natural gas line to the lower 48 States. In other words, does EIA's analysis of the scenarios for ANWR development suggest that Alaska's North Slope could be a major contributor to domestic production of oil and natural for decades into the future?

I would appreciate receiving your analysis as soon as possible, but in any case by March 8, 2004. If you should have any further questions regarding this request, please do not hesitate to contact my Committee office.

Sincerely,

Richard W. Pombo
Chairman