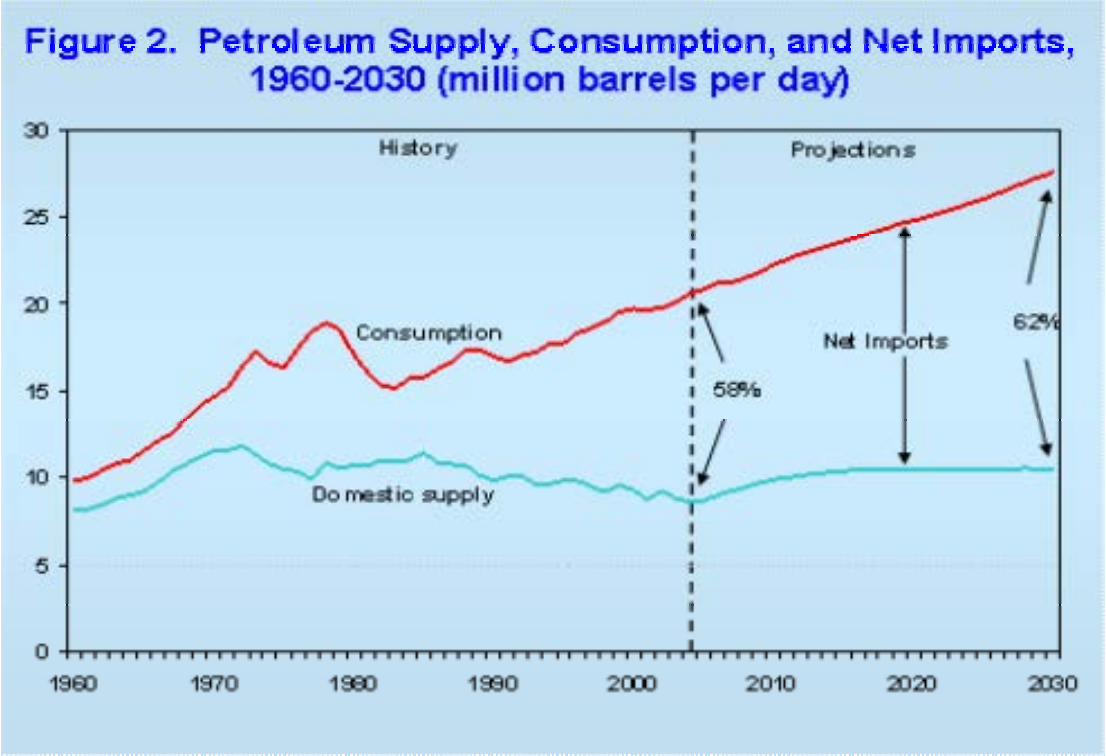
*Review Draft*

# Updated Economic Estimates of Effects of Leasing on the Arctic National Wildlife Refuge Coastal Plain

**United States Production, Consumption and Imports, 2005 – 2030**




**U.S. Energy Information Administration, *Annual Energy Outlook 2006* (Early Release)**

A Background Report for the Alaska Wilderness League

On Various Recent Government Documents

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## I. Introduction

Despite extensive press coverage and political attention to the ongoing debate about whether or not to explore for oil on the Coastal Plain of the Arctic National Wildlife Refuge, the argument is frequently characterized by inaccurate and misleading numbers, uncertainties inherent in the key long-term economic projections and failure to recognize the limited role the Arctic Refuge can play in resolving this nation's increasing dependence on crude oil imports.[1] To assist policy makers in resolving confusion resulting from inaccurate information on this important public policy debate, this report seeks to ensure that information used in formulating decisions on this important public policy issue is accurate, to provide relevant data and to place those data in an appropriate context.[2] The principal issues addressed here include:

- (1) revenue anticipated from lease bonus bids for exploration and development rights to the Arctic Refuge Coastal Plain;
- (2) the amount of oil that might be discovered and produced from the Arctic Refuge Coastal Plain, compared to long-term domestic petroleum consumption needs, domestic production and imports; and
- (3) effects of Arctic Refuge development on jobs nationwide.

[1] For an academic discussion of the treatment of energy data in the Arctic Refuge debate, see Jonathan G. Koomey, *et al.,* "SORRY, WRONG NUMBER: The Use and Misuse of Numerical Facts in Analysis and Media Reporting of Energy Issues," *Annual Reviews: Energy and the Environment,* Vol. 27 [2002], pp. 119-158.

[2] For a comprehensive analysis of the petroleum potential of the Arctic Refuge Coastal Plain, see: ANWR Assessment Team, *The Oil and Gas Resource Potential of the 1002 Area, Arctic National Wildlife Refuge, Alaska,* 1999 (U.S. Geological Survey Open File Report 98-34 [CD]; and "Arctic National Wildlife Refuge, 1002 Area, Petroleum Assessment, 1998, Including Economic Analysis" (fact sheet; updated in 2001, at http://pubs.usgs.gov/fs/fs-0028-01/fs-0028-01.htm).

This report updates effects of high oil prices on each of these fundamental questions through examination of relevant data released by government agencies in recent months.[3]

## II. Lease Bonus Revenue

The President's FY 2007 budget proposal counts $7.0 billion in revenue from bonus bids for petroleum exploration and production rights on the Coastal Plain of the Arctic National Wildlife Refuge, anticipated in FY 2008, plus $1.0 billion from a follow-up lease sale in FY 2010.[4] The revenue from these lease sales would be split between the federal government and the state of Alaska on a 50-50 basis. If 600,000 acres were available for leasing in the first sale,[5] the Administration lease bonus revenue estimate implies an expectation that each and every acre would be leased at an average price of $11,667.00.[6]

The Administration's current estimate of lease bonus revenues from the first proposed Arctic Refuge Coastal Plain lease sale represents a near tripling of the $2.4 billion estimated in the President's budget previous budget proposal.[7] While the prospect of higher long-term oil prices augments the value of undiscovered petroleum, enhancing the prospective value of petroleum leases, increased prices

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[3] The documents reviewed here include the following: *Budget of the United States Government, Fiscal Year 2007*, released Feb. 6, 2006; U.S. Energy Information Administration's *Annual Energy Outlook 2006* (*AEO 2006* [early release]), December 12, 2005; Emil D. Attanasi, *Economics of 1998 U.S. Geological Survey's 1998 Area Regional Assessment: An Economic Update* (U.S. Geological SurveyOpen-File Report 2005-1359), July 2005; Congressional Budget Office discussion of Arctic National Wildlife Refuge lease bonus projections, Dec. 7, 2005; results of a lease sale in the near-shore waters of the Beaufort Sea, including a large stretch immediately north of the Arctic Refuge Coastal Plain, March 30, 2005; and an updated estimate, released by the Congressional Research Service (CRS), updated in October 2005, of the potential impact of Arctic Refuge leasing and development on national employment.

[4] *Budget of the United States Government, Fiscal Year 2007,* "Summary Tables," p. 318 (http://www.whitehouse.gov/omb/budget/fy2007/pdf/budget/tables.pdf).

[5] Although drilling proposals considered in 2005 required that the first sale offer a minimum of 200,000 acres, previous Administration budget proposals called for leasing 400,000 to 600,000 acres in the first sale (see, for example, *Budget of the United States Government for Fiscal Year 2004*, General Provisions, p. 603). For purposes of this calculation, it is assumed that the Administration offers 600,000 acres in the first sale, and that each and every acre is leased.

[6] $7.0 billion / 600,000 = $11,667.00 per leased acre. (Note that leasing of fewer acres would result in an increase in the average price per leased acre required to meet the proposed budget's $7.0 billion target.)

[7] *Budget of the United States Government, Fiscal Year 2006,* Department of the Interior, General Provisions, p. 657.

alone do not appear to explain the increase in revenue that drilling advocates anticipate from leasing on the Arctic Refuge Coastal Plain. *(See Figure 1.)*

**Figure 1. Oil Prices and White House Budget Projections for Arctic Refuge Coastal Plain Lease Bonus Payments (2005 and 2006 Budget Proposals)**

| | FY 2006 Budget Proposal | FY 2007 Budget Proposal | Percentage Change |
|---|---|---|---|
| *Annual Energy Outlook* Crude Oil Price in 2025 | $37.75/bbl.[1] | $50.55/bbl.[2] | +33.9% |
| Average Bonus Payment Per Leased Acre (First Lease Sale) | $4,000.00 [3] | $11,667.00 [4] | +191.7% |

1. World crude oil price from Energy Information Administration, *Annual Energy Outlook 2005* (December 2004 "Current Futures" case [converted to 2006 $ using GDP chained price index).
2. Imported crude oil price from Energy Information Administration, *Annual Energy Outlook 2006* (December 2005 reference case (converted to 2006 $ using GDP chained price index).
3. From: *Budget of the United States Government, Fiscal Year 2006*, Department of the Interior, p. 657 (assumes 600,000 acres leased).
4. From: *Budget of the United States Government, Fiscal Year 2007*, Department of the Interior, p. 665 (assumes 600,000 acres leased).

Government hopes that leasing on the Arctic Refuge Coastal Plain will generate billions of dollars in initial lease bonus revenue stand in extreme contrast to the reality of much lower bidding on Alaska's North Slope during the last two decades, a trend that is mirrored in the Gulf of Mexico.[8] When adjusted to constant (2006) dollars, 38 lease sales on Alaska's North Slope and near-shore waters have averaged just $64.38 per leased acre.[9] Thus, the administration's FY 2007 budget proposal is based on the expectation that the first lease sale on the

[8] For details and documentation, see Richard A. Fineberg, *Projected Bonus Payments from Proposed Leasing On the Arctic National Wildlife Refuge Coastal Plain Greatly Exceed North Slope Historical Trends* (report to the Alaska Wilderness League, Jan. 15, 2005; http://www.finebergresearch.com/pdf/arbr.pdf); and "The Arctic National Wildlife Refuge: Independent Analysis of CBO's Federal Revenue Projections and Related National Energy Issues" (briefing for members and staff, U.S. House of Representatives, September 14, 2005; http://www.finebergresearch.com/pdf/brief1.pdf).

[9] This figure represents amounts received from Alaska North Slope lease sales between 1961 and 2004 (listed in *Projected Bonus Payments from Proposed Leasing On the Arctic National Wildlife Refuge Coastal Plain Greatly Exceed North Slope Historical Trends*, Figures A1 and A3-A5, updated with 2005 sales and adjusted by the author, using the GDP Chained Price Index from *Budget of the United States Government, Fiscal Year 2007* (Historical Tables), pp., 192-193.

Arctic Refuge Coastal Plain will bring in approximately 181 times the average received per leased acre on the North Slope since 1991.[10]

Apart from the great disparity between the amounts drilling advocates hope for and the amounts actually received from North Slope leasing over the last two decades, the Administration's latest increase in lease bonus bids runs counter to the trend of declining North Slope bids, despite significant increases in oil prices. During the five-year period between 1996 and 2000, when the price of Alaska North Slope crude oil averaged approximately $19.60 per barrel, 9 lease sales on Alaska's North Slope and near-shore waters generated an average bid price of $93.58 per leased acre. In contrast, during the 2001-2005 period, as oil prices rose to average approximately $33.60 per barrel, the amount that bidders were willing to pay in 17 North Slope lease bonus sales declined to $48.15 per leased acre (all figures in real [2006] dollars; see Figure 2). Put otherwise: During the most recent five-year period, in which oil prices rose by approximately 71% over the preceding

**Figure 2. Oil Prices, Lease Sales and Bonus Bids on Alaska North Slope Lease Sales, 1996 – 2000 and 2001 – 2005**

| | 1996 – 2000 | 2001 – 2005 | Percentage Change |
|---|---|---|---|
| North Slope Crude Oil Price (Real 2006 $) | $19.60 [1] | $33.60 [1] | +71% |
| No. of Lease Sales | 9 [2] | 17 [2] | -- |
| Average Lease Bonus Price per Leased Acre | $93.58 [3] | $48.15 [3] | (48%) |

1. Calculated from Alaska North Slope crude oil monthly market price as reported by Alaska Department of Revenue (http://www.revenue.state.ak.us); adjusted for inflation using GDP Chained Price Index.
2. From agency data (see *Projected Bonus Payments from Proposed Leasing On the Arctic National Wildlife Refuge Coastal Plain Greatly Exceed North Slope Historical Trends*, Figure A1; updated by author with 2005 data).
3. From: *Projected Bonus Payments from Proposed Leasing On the Arctic National Wildlife Refuge Coastal Plain Greatly Exceed North Slope Historical Trends*, Figure A1, updated with 2005 data and adjusted by the author, using the GDP Chained Price Index,

[10] $64.38 * 181.22 = $11,667.

five years, average bonus bid prices declined by approximately 48%. Comparison between the entire decade of the 1990s and the 2001-2005 period shows a similar contrast between rising oil prices and declining lease bids.

These empirical observations underscore the importance of the fact that the price of oil is just one of the key factors that determine the amount that potential investors are willing to spend on a petroleum lease. Other factors include the attractiveness of the prospect relative to other potential investments and economic factors that include inflation and interest rates, field operating and capital costs and financing strategies. Due to factors such as these, the outcome of petroleum lease sales is usually a matter of speculation until the bids are opened.

There is another important point that drilling advocates do not like to discuss: the fact that the possible discovery of a super-giant field on the Arctic Refuge Coastal Plain – a tantalizing prospect that encouraged high speculative bids more than two decades ago – is now deemed highly unlikely. That possibility has been virtually precluded by the U.S. Geological Survey study of the Arctic Refuge Coastal Plain on which most government agencies rely.[11] The scant likelihood that explorers will find another Prudhoe Bay on the North Slope may be one reason that although the 1994 Alpine discovery (to the west of Prudhoe Bay) generated subsequent interest in that region, the increase in lease bonus bids near that discovery was nowhere near the magnitude necessary to validate the Administration's optimistic projections of bonus bids from the Arctic Refuge Coastal Plain. Following the success at Alpine, three lease sales in that vicinity averaged approximately $135.00 per leased acre in 2006 dollars -- roughly twice the North Slope lease bonus bid average rate for the 1991-2005 period.[12] Despite the notable post-Alpine boost in bonus bid payments, the increased amounts that

[11] E. D. Attanasi and J. H. Scheunemeyer, "Frontier areas and resource assessment: the Case of the 1002 Area of the Alaska North Slope" [U.S. Geological Survey Open File Report 02-119, March 2002], p. 10 .

[12] The three post-Alpine sales were: the State of Alaska's North Slope sale #86A (September 1996) and MBuyreau of Land Management NPR-A Lease Sales 1 (May 1999) and 2 (June 2002). For additional information on these sales, see *Projected Bonus Payments from Proposed Leasing On the Arctic National Wildlife Refuge Coastal Plain Greatly Exceed North Slope Historical Trends,* pp. 10-12 and Figure A1.

bidders were willing to pay for the right to explore and produce in this demonstrably successful part of Alaska's North Slope pencils out to less than 1.2% of the per-acre price necessary to meet OMB's current expectations for its first proposed lease sale.[13]

The Administration is not alone in its belief that bidding on the Arctic Refuge Coastal Plain can generate billions of dollars in revenue. In February 2005, the Congressional Budget Office (CBO) promulgated an estimate of $5.0 billion in lease bonus revenue from the Arctic Refuge Coastal Plain, based on model-created potential outcomes of leasing that ranged from $2 to $8 billion. Although CBO projections for the FY 2007 budget cycle have not yet been released, in response to a December 5, 2005 request from Alaska Senator Ted Stevens, CBO reported that at a long-term oil price of $50.00 per barrel in real (inflation-adjusted) dollars, prospective developers could pay up to $10 billion in lease bonuses for exploration and development rights on the Arctic Refuge Coastal Plain.[14] In its response to Senator Stevens, CBO emphasized the uncertainty inherent in its estimates and linked that uncertainty to a number of variables other than the price of oil. In this regard, CBO stressed the importance of "a wide range of possible assumptions regarding capital investment costs, depreciation of such capital, likely operating costs, and alternative investment opportunities."[15]

CBO defended the results of its model-generated projections in a March 14, 2005 response to an inquiry from Senator Russell Feingold and ten colleagues.[16] But how the CBO model works and how its results are tested remains a mystery. Moreover, several points in CBO's response call the agency's model outcomes into

[13] $11,667 x 0.012 = $140 per leased acre.

[14] Letter from Douglas Hotz-Eakin (Director, Congressional Budget Office) to Senator Ted Stevens, Dec. 7, 2005. (CBO's Dec. 7, 2005 letter did not make clear whether the $10 billion figure represented an extension to the top limit of its range or a doubling of its February 2005 mid-point estimate.)

[15] Letter from Hotz-Eakin to Senator Ted Stevens, Dec. 7, 2005. CBO's Dec. 7, 2005 letter did not make clear whether the $10 billion figure represented an extension to the top limit of its range or a doubling of its February 2005 mid-point estimate.

[16] Letter from Douglas Hotz-Eakin (Director, Congressional Budget Office) to Senator Russell Feingold, March 14, 2005.

question. For example, to justify its current estimates, CBO cited the bid results of a 1982 lease sale that brought in over $3,000.00 per leased acre (equivalent to more than $5,400.00 per leased acre in 2006 dollars). But CBO neglected to note that the 1982 sale resulted in failure. In the 1982 sale, much of the money went to the purchase of the infamous Mukluk dry hole, which the U.S. Minerals Management Service has called the most expensive dry hole in history. The Mukluk experience initiated the decline in North Slope bid results to the significantly lower levels reported consistently during the last two decades. In light of this history, common sense suggests that the 1982 results are unlikely to be replicated today.[17]

The possible discovery of a super-giant field is deemed to be highly unlikely on the Arctic Refuge Coastal Plain (discussed above) is another important point that CBO failed to address in its March and December 2005 discussions of its methodology.

CBO "does not consider average amounts paid per acre . . . (to be) a useful metric." Instead of looking at bids received per leased acre, CBO prefers to discuss lease bonus revenue in terms of the value of the oil that might be discovered.[18] Indeed, it is the potential value of the oil and gas that might be discovered and produced in a given area, relative to other prospects, that ultimately drives the lease bonus bidding process. But this does not mean that it is not useful to analyze the amount prospective developers are willing to pay per leased acre, In May 2005 *Oil & Gas Journal* published an analysis of North Slope lease bidding trends that measured results using amounts paid by bidders per leased acre – the same yardstick CBO rejected two months earlier as "not useful."[19]

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[17] For sources and additional information on the Mukluk dry hole, see *Projected Bonus Payments from Proposed Leasing on the Arctic National Wildlife Refuge Coastal Plain Greatly Exceed North Slope Historical Trends,* pp. 3-4. CBO's use of the 1982 Mukluk bids to justify future projections raises the possibility that the agency's high lease bonus bid estimates are based at least in part on outdated numbers whose historical context reduces – or even reverses -- their significance.

[18] Letter from Holtz-Eakin to Senator Feingold, p. 4.

[19] David M. Haas, "The case of Alaska: modeling lease sales in a mature market," *Oil & Gas Journal*, May 16, 2005, pp. 17-18, 40-41.l

While CBO has not made enough information about its model available to the public to permit empirical confirmation of its model results, an unusual circumstance associated with the March 30, 2005 U.S. Minerals Management Service Beaufort Sea lease sale provided an opportunity for cursory analysis of sale results from CBO's preferred perspective – the projected value of a given volume of oil, rather than dollars received per leased acre. Those data, too, raise questions about the optimistic Arctic Refuge projections of the federal agencies. The March 2005 MMS sale included specific tracts encompassing two known discoveries in coastal waters off-shore from the Arctic Refuge Coastal Plain, each known to hold over 200 million barrels of oil. One might expect that companies counting on Arctic Refuge development would be eager to obtain rights to known deposits nearby that could be shipped with any oil that might be discovered on the Arctic Refuge Coastal Plain. Nevertheless, Shell Oil acquired the rights to this already-discovered oil at bargain-basement prices. The winning bids for approximately 45,000 acres at and adjacent to the Hammerhead deposit, where bidders face no discovery risk and limited exploration costs, are conservatively estimated to have averaged approximately $0.115 per barrel.[20] At that rate, the mean estimate of undiscovered oil that might lie beneath the federal portion of the Arctic Refuge Coastal Plain – approximately 7.2 billion barrels[21] – would generate approximately $0.83 billion.[22] That amount is less than half of CBO's low-end estimate of $2.0 billion for undiscovered (and, therefore, presumably less valuable) oil on the Arctic Refuge Coastal Plain and just over ten percent of CBO's February 2005 high-end estimate of $8.0 billion. [23] The

[20] Shell Offshore Inc. paid $22,910,255.00 for eight tracts at Hammerhead; 95 percent of this amount was on tract numbers Y1807, Y1808 and Y 1812. See: Minerals Management Service (U.S. Department of the Interior(, "Final Bid Recap (all Bids by Area/Tract)," Sale Number 195, Beaufort Sea, March 30, 2005, p. 7. ($22,910,255.00 / 200,000,000 barrels = $0.115 per barrel.)

[21] The basis for this estimate will be discussed in the following section.

[22] 7,200,000,000 x $0.115 = $828,000,000.00.

[23] For eight leasing tracts comprising nearly 45,545.6 acres contiguous to the tracts immediately over the Hammerhead deposit, Shell paid approximately $22,910,.255.00, or $503.00 per leased acre. (See U.S. Minerals Management Service, Alaska OCS Region, "Final Bid Recap (all Bids by Area/Tract)," Sale Number 195, Beaufort Sea, March 30, 2005, p. 7 [Tract Nos. Y1804, Y1805, Y1806, Y1807, Y1808, Y1809, Y1812 and Y1813]).

March 2005 sale also included the rights to the second known deposit (Kuvlum), which was purchased for significantly less – perhaps $0.01 per barrel.[24] While this cursory analysis is by no means conclusive, once again empirical data from North Slope lease sales appears to be radically inconsistent with the much higher government agency projections for lease bonus payments on the Arctic Refuge Coastal Plain.

## III. Updated USGS Analysis of Potential Arctic Refuge Production

While lease bonus revenues are of interest to budget makers, the broader public policy question is this: Is the oil that might be discovered beneath the Arctic Refuge Coastal Plain likely to make a significant contribution to reducing this nation's oil imports? Only a portion of discovered oil is in pools or reservoirs whose size and geologic characteristics will permit production. Therefore, it is necessary to ask two other questions:

- How much oil that can be produced using existing technology might be discovered in this region?
- How much of this undiscovered oil, once discovered, would be economic to bring to market?[25]

For public policy purposes, the first question is best answered by determining the mean estimate of technically recoverable oil, or the amount of oil that can be discovered and produced using existing technology; that figure, determined by the geology of the region, sets the upper limit on potential production.[26] The portion of

[24] Shell acquired the second discovery, known as Kuvlum, for approximately $14.00 per leased acre (see "Final Bid Recap (all Bids by Area/Tract)," p. 7 [Tract No. Y1815]).

[25] For general description of the uncertainty inherent in the assessment of oil and gas potential, see U.S. Congress, Office of Technology Assessment, *Oil Production in the Arctic National Wildlife Refuge: The Technology & the Alaskan Oil Context* (U.S. Government Printing Office, February 1989 [Report No. #OTA-E-394]), pp. 73, 113, 121-123.

[26] The mean volume represents the point at which likelihood that more technically recoverable oil will be discovered is balanced by the likelihood that less will be discovered. Drilling advocates often use the 5 percentile, or one-in-20 probability figure (16 billion barrels), without making clear that the USGS analysis assigned this potential outcome a limited (one-in-20) probability. Use of the five percentile (one-in-20) probability without specifying the context is inappropriate because the omission obscures the logic of the mathematical system used to derive the esimate. For an academic discussion of use – and abuse -- of energy data in the Arctic Refuge debate, see Jonathan G. Koomey, *et al.,* "SORRY, WRONG NUMBER: The Use and Misuse of Numerical Facts in Analysis and Media Reporting of Energy Issues," *Annual Reviews: Energy and the Environment,* Vol. 27 [2002], pp. 119-158.

the technically recoverable volume that is economically recoverable is price-sensitive. At low oil prices, an incremental increase in price yields significantly more oil. But as a reservoir – or region – approaches its upper limit of technically recoverable oil, additional increases in price will yield little more oil.[27]

In a three-year study of the Arctic Refuge published in 1998, The U.S. Geological Survey (USGS) estimated the technically recoverable mean for the Arctic Refuge Coastal Plain region at 10.4 billion barrels; for purposes of public policy analysis, that figure sets the upper limit of potential production.[28] As stated above, the portion of the technically recoverable mean of an undiscovered resource that might be developed depends on the price of oil. In October 2005, The USGS released an updated estimate of the economically recoverable oil from the Arctic Refuge Coastal Plain region. According to that report, at a long-term oil price of $50 per barrel approximately 93% of the estimated 10.4 billion barrels of technically recoverable oil, or 9.7 billion barrels, is economically recoverable from the Arctic Refuge Coastal Plain region. USGS estimates that approximately 74% of this volume is on federal land.[29] On this basis, the USGS report estimates that at $50.00 per barrel the federal portion of the Arctic Refuge region will yield a mean estimate of approximately 7.2 billion barrels of economically recoverable oil; [30] USGS believes the remaining 26% will be located on Native lands and in state near-shore waters.

The 1998 USGS report and the October 2005 economic update set the stage for the next task, which is to understand how the estimated quantity of

[27] See "Arctic National Wildlife Refuge, 1002 Area, Petroleum Assessment, 1998, Including Economic Analysis" (fact sheet), Figure 6, in which the vertical axis represents price and the horizontal axis represents volume. As prices rises and volume approaches the technically recoverable mean, the curve bends upwards, indicating that incremental increases in price will yield negligible increases in production.

[28] *The Oil and Gas Resource Potential of the 1002 Area, Arctic National Wildlife Refuge, Alaska*.

[29] Emil D. Attanasi, *Economics of 1998 U.S. Geological Survey's 1998 Area Regional Assessment: An Economic Update* (U.S. Geological Survey Open-File Report 2005-1359), pp. 8-9.

[30] 10.4 x 0.74 x 0.93 = 7.16. .

undiscovered oil that may lie beneath the Arctic Refuge Coastal Plain fits into the immediate and long-term national energy picture.

## ***Annual Energy Outlook 2006*** **(December 2005 early release)**

The U.S. Energy Information Administration (EIA) *Annual Energy Outlook 2006 (AEO 2006)*, released in December 2005, anticipates that long-term oil prices will average more than $50 per barrel. The EIA says its new estimate is about $21 per barrel higher than the reference case price in last year's *AEO*. The EIA's new forecast has important consequences for the long-term domestic petroleum picture. With regard to the Arctic Refuge question, examination of data in the EIA report spotlights the following trends, summarized in Figures 3 and 4 below:

- Higher oil prices will slow the long-term increase in petroleum consumption. As shown in Lines (2) and (6) of Figure 3, the lower prices of the EIA's December 2004 "current futures" or high case scenario, domestic consumption in 2025 was projected to be 27.3 million bpd. But EIA now expects domestic consumption in 2025 to be about 26.1 million bpd. When compared to a consumption level of approximately 20.0 million bpd in 2003, the amount of the projected increase in consumption in 2025 represents a 30 percent increase. At the same time, when compared to the previous forecast, the size of the increase has been reduced by approximately 16 percent, from 7.3 million bpd in the previous forecast to 6.1 million bpd.[31] By comparison, the Administration anticipates the Arctic Refuge can contribute "up to one million barrels per day" at peak production.[32] Thus,

[31] U.S. Energy Information Administration, *Annual Energy Outlook 2006* (early release), Table A11 ("Petroleum Supply and Disposition Balance" [reference case]) and *Annual Energy Outlook 2005* (early release), Table 2 ("Total energy supply and disposition in the October oil futures case: summary, 2002-2025"). Although the *AEO 2005* "current futures" or "high" case long-term oil prices were generally $4.00 to $5.00 per barrel higher than the reference case, then-current (and anticipated) oil prices were even higher. Because the AEO 2005 high case more closely reflects actual oil prices than the AEO 2005 reference case, in this analysis AEO 2005 high case is used as the basis for comparisons with the AEO 2006 reference case unless otherwise noted.

[32] *Budget of the United States Government, Fiscal Year 2007,* Department of the Interior, p. 158.

the reduction in oil consumption due to high oil prices will result in a greater contribution to the domestic oil supply than the Arctic Refuge.

- Figure 4 focuses on the sources of increased domestic production that EIA expects due to higher oil prices. By comparing Line (10) to Line (5), it can be seen that by 2025, the amount of the increase in domestic production – from approximately 9.28 million barrels under last year's high scenario to approximately 10.44 million barrels in the *AEO 2006* reference case -- also exceeds the anticipated contribution from the Arctic Refuge. Note that the bulk of this 12.5% increase over last year's forecast will come from refining gains, including alternative refinery feedstocks, such as alcohols, ethers, other blending components, natural gas and coal conversion to liquids.[33]
- Together, these changes in the nation's oil supply and demand outlook would reduce this nation's import requirement by 2.34 million bpd in 2025, compared to last year's high case -- more than twice the Administration's estimate of Arctic Refuge peak production (see Figure 3, at lines [3] and [7]). Put otherwise: In the *AEO 2006* reference case scenario, EIA anticipates that this nation will be importing 60% of its oil in 2025 (see Figure 3, below). This figure represents a six percent reduction from the import forecast for 2025 in last year's high case. By comparison, in a 2004 report EIA estimated that developing the Arctic Refuge would reduce imports by as much as six percent in 2025, from 70% to 64%.[34]

[33] *Annual Energy Outlook 2006* (early release), Table A11 ("Petroleum Supply and Disposition Balance" [reference case]) and *Annual Energy Outlook 2005* (early release), Table 2 ("Total energy supply and disposition in the October oil futures case: summary, 2002-2025").

[34] U.S. Energy Information Administration, *Analysis of Oil and Gas Production in the Arctic National Wildlife Refuge* (Report No. SR/OIAF/2004-04), March 2004, p. 10.

## Figure 3. Domestic Petroleum Supply and Imports: Comparison between EIA December 2004 and December 2005 Forecasts (December 2004 "Current Futures" [High] Case v. December 2005 Reference Case)

(Millions of Barrels of Oil per day, except as indicated)

| Year | 2003 | 2010 | 2015 | 2020 | 2025 | 2050 |
|---|---|---|---|---|---|---|
| | Actual | EIA December 2004 Forecast | | | | Projection |
| ***EIA December 2004 "Current Futures" (High) Case*** | | | | | | |
| **(1) Total Domestic Oil Production** | **8.82** | **9.94** | **9.72** | **9.54** | **9.28** | **8.27** |
| **(2) Total Domestic Oil Consumption** | **20.05** | **22.54** | **24.17** | **25.76** | **27.30** | **36.51** |
| **(3) Net Import Requirement (crude oil + product)** | **11.23** | **12.60** | **14.45** | **16.22** | **18.02** | **28.24** |
| (4) Imports as Percentage of Total Domestic Consumption | 56.0% | 55.9% | 59.8% | 63.0% | 66.0% | 77.3% |
| | Actual | EIA December 2005 Forecast | | | | Projection |
| ***EIA Decenber 2005 Reference Case*** | | | | | | |
| **(5) Total Domestic Oil Production** | **8.82** | **9.88** | **10.34** | **10.45** | **10.44** | **10.03** |
| **(6) Total Domestic Oil Consumption** | **20.05** | **22.21** | **23.57** | **24.87** | **26.12** | **34.72** |
| **(7) Net Import Requirement (crude oil + product)** | **11.23** | **12.33** | **13.23** | **14.42** | **15.68** | **24.69** |
| (8) Imports as Percentage of Total Domestic Consumption | 56.0% | 55.5% | 56.1% | 58.0% | 60.0% | 71.1% |

**Notes**

2003: "Actuals" from EIA, *Annual Energy Outlook 2006* , Table A11 (Petroleum Supply and Disposition Balance)
2010 - 2025: December 2004 "Current Futures" (High) Case from EIA, *Annual Energy Outlook 2005* , Table 2 (Total Energy Supply and Disposition in the October oil futures case: summary, 2002-2025).
2010 - 2025: December 2005 Reference Case from EIA, *Annual Energy Outlook 2006* , Table A11 (Petroleum Supply and Disposition Balance).
2050 (December 2004): Projected from *AEO 2005* "Current Futures" 2021-2025 rate of change.
2050 (December 2005): Projected from *AEO 2006* Reference Case 2026-2030 rate of change.

Lines (1), (5): "Black oil" plus natural gas plant liquids, refinery gains, alcohols, ethers, other blending components and feedstocks and stock withdrawals.
Line (3) = Line (2) - Line (1)
Line (7) = Line (6) - Line (5)

## Figure 4. Domestic Petroleum Production: Key Components of EIA *Annual Energy Outlook (AEO) Estimates*
## (December 2004 "Current Futures" [High] Case v. December 2005 Reference Case)

(Millions of Barrels of Oil per day)

| *Year* | *2003* | *2010* | *2015* | *2020* | *2025* | *2050* |
|---|---|---|---|---|---|---|
| ***DOMESTIC PRODUCTION ESTIMATES*** | ***EIA Actual*** | ***EIA Forecast*** | | | | ***Projection*** |
| ***EIA December 2004 "Current Futures" (High) Case*** | | | | | | |
| **(1) "Black Oil" production** | **5.69** | **6.16** | **5.78** | **5.36** | **4.98** | **(N.A.)** |
| **plus:** | | | | | | |
| **(2) Natural gas plant liquids** | **1.72** | **1.99** | **2.01** | **2.08** | **2.07** | **"** |
| **(3) Volumetric changes in refinery distillation and cracking processes** | **0.97** | **1.12** | **1.35** | **1.53** | **1.61** | **"** |
| **(4) Alcohols, ethers, blending combonents, other hydrocarbons, natural gas and coal conversion and product stock withdrawals** | **0.44** | **0.67** | **0.58** | **0.57** | **0.62** | **"** |
| **(5) Total Domestic Oil Production** | **8.82** | **9.94** | **9.72** | **9.54** | **9.28** | **8.27** |
| ***EIA Decenber 2005 Reference Case*** | | | | | | |
| **(6) "Black Oil" production** | **5.69** | **5.88** | **5.84** | **5.55** | **4.99** | **(N.A.)** |
| **plus:** | | | | | | |
| **(7) Natural gas plant liquids** | **1.72** | **1.75** | **1.88** | **1.94** | **1.90** | **"** |
| **(8) Volumetric changes in refinery distillation and cracking processes** | **0.97** | **1.31** | **1.37** | **1.44** | **1.63** | **"** |
| **(9) Alcohols, ethers, blending combonents, other hydrocarbons, natural gas and coal conversion and product stock withdrawals** | **0.44** | **0.94** | **1.25** | **1.52** | **1.92** | **"** |
| **(10) Total Domestic Oil Production** | **8.82** | **9.88** | **10.34** | **10.45** | **10.44** | **10.03** |

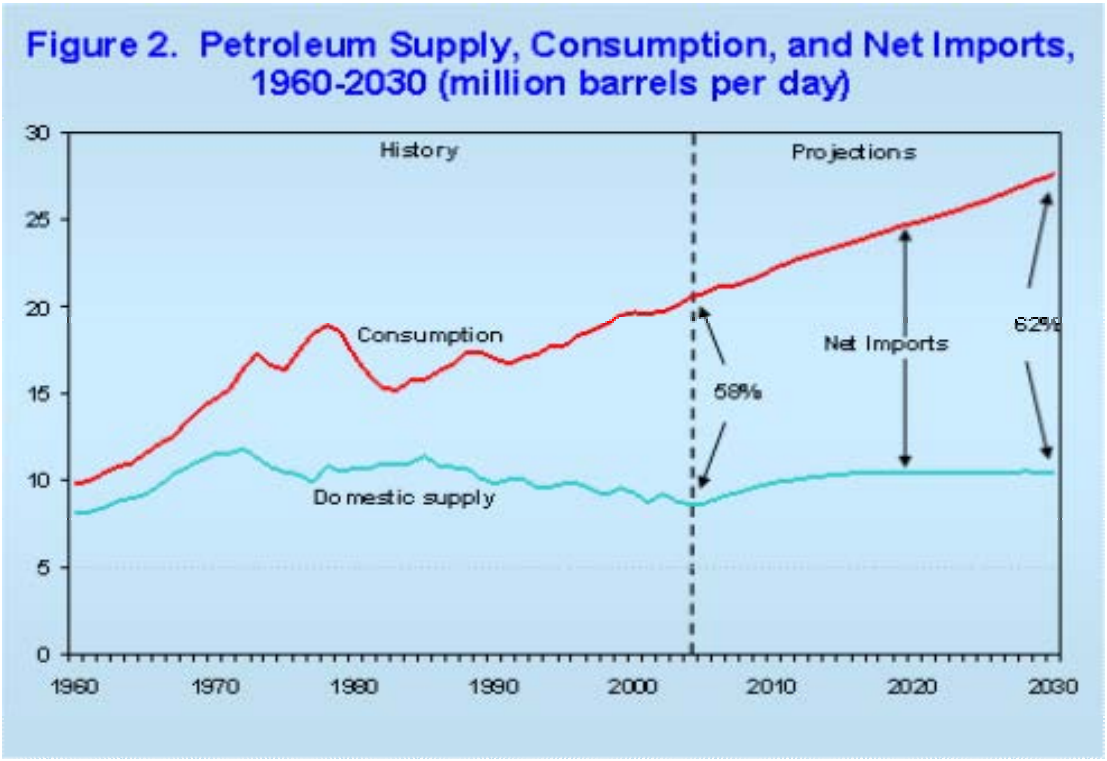
**Notes**

2003: "Actuals" from EIA, *Annual Energy Outlook 2006* , Table A11 (Petroleum Supply and Disposition Balance)
2010 - 2025: December 2004 "Current Futures" (High) Case from EIA (from data provided by EIA, January 2005).
2010 - 2025: December 2005 Reference Case from EIA, *Annual Energy Outlook 2006* , Table A11 (Petroleum Supply and Disposition Balance).
2050: Projected from EIA 2026-2030 rate of change.

Lines (1), (5): "Black oil" plus natural gas plant liquids, refinery gains, alcohols, ethers, other blending components and feedstocks and stock withdrawals.
Line (3) = Line (2) - Line (1)
Line (7) = Line (6) - Line (5)

In Figure 5, the data summarized in the lower tier of the two preceding tables are arrayed in historical perspective.

**Figure 5. The Energy Information Administration's Long-Term Oil Picture**




This chart, from the press release of the U.S. Energy Information Administration, *Annual Energy Outlook 2006* (*AEO 2006*; early release), reflects the EIA's understanding of the long-term petroleum picture. Due to the resulting increased production (principally using alternative feedstocks) and reduced consumption, , AEO 2006 anticipates that the U.S. will import 60% of its petroleum needs in 2025, compared to 66% in AEO 2005 (see Figures 3 and 4).

Although high oil prices may have beneficial effects on this nation's imbalance between supply and demand, this does not mean (as industry representatives and some Administration officials argue) that petroleum policy should be left to the vagaries of the free market. High energy prices often hit low-income folks, who can

least afford it, the hardest.[35] Apart from the pain of high prices at the gas pump and the skyrocketing cost of heating poorly insulated homes, Figure 5 provides a graphic reminder that even if the percentage of imports holds steady at 60%, total consumption – and, consequently, the gross volume of imports – will continue to rise. As global competition for petroleum becomes increasingly intense, further action to reduce the steady increase in domestic consumption may be warranted.

Perhaps the most important contribution of the EIA chart displayed in Figure 5 is that it spotlights the consumption decline in the early 1980's – and the reversal of that trend. This figure is best understood in the context of fluctuating oil prices. After the major price spikes of 1973 and 1977-79, consumption declined dramatically during the early 1980s. But after oil prices crashed at the end of 1985, domestic consumption, which had been dropping during the first half of the 1980s, immediately began increasing again, initiating a trend of increasing consumption that has continued for two decades. Although it is safe to say that most industry observers think oil prices will stay high for years to come, those prices have a nasty habit of reversing suddenly, fooling the experts. One forecasting group that would not be surprised is the band of State of Alaska agency personnel who prepare the annual long-term outlook for state budgeting. In December 2005, that group forecasted that in 2015 Alaska North Slope crude would sell for $19.73 per barrel in 2005 dollars.[36] The data summarized in Figure 5 underscore the importance of the well-known maxim, "Those who cannot learn from history are doomed to repeat it."

For purposes of public policy analysis, the long-term data presented to here have one major problem: Based on the history of North Slope fields, it is estimated that if leasing is initiated and oil is discovered in commercial quantities on the Arctic Refuge Coastal Plain, production will not begin until about 2015, would peak

[35] During the coldest January in 35 years in Fairbanks, Alaska, when temperatures averaged 22 degrees below zero, homeless shelters reported a significant increase in attendance (personal communication from social service personnel, February 3-8, 2006).

[36] Alaska Department of Revenue, *Fall 2005 Revenue Sources Book*, December 2005, p. 95.

around 2025 and would decline thereafter, continuing until approximately 2050. But EIA's long-term model only extends 25 years into the future.[37] When the model ends in 2030, approximately half of the production from the Arctic Refuge will still remain. Therefore, to understand how Arctic Refuge production potential fits into this nation's long-term petroleum supply and demand picture, it will be useful to extend the long-term energy horizon beyond that of the EIA's model.

Before attempting to extend the quantitative analysis to match the field life of potential Arctic Refuge discoveries, some words of caution are in order. A longer outlook means greater opportunities for unforeseen events to invalidate the model results, and for the compounding effects of the inevitable errors in projections to grow. As a result, the further into the future one looks, the less reliable that information is liable to be. Therefore, these projections should be understood not as predictions, but as points that lie within a broad range of potential outcomes. Despite the inherent risks of long-term modeling, the alternative to attempting to understand the possible long-term consequences of policy choices is to fly blind. A carefully crafted blueprint, with limitations clearly noted, is better than none at all.

The fact that the United States possesses reserves of less than 31 billion barrels of oil leads some to question EIA's projection that domestic production of more than 150 billion barrels between 2006 and 2050 is possible. Figure 4, above, reflects EIA's view that sustained high prices will result in refining efficiencies and increasing use of feedstocks other than oil. In this regard, it should be noted that since 1985 the United States has produced approximately 50 billion barrels of petroleum, while estimated reserves have declined from approximately 36 billion barrels to present level of approximately 30 billion. EIA believes this nation can continue to discover and turn new sources of oil into reserves. On the other hand, petroleum geologists and energy experts who subscribe to the "peak oil" theory believe that new reserves will become increasingly difficult to locate and expensive to develop, making continued reserve replacement highly unlikely, if not

[37] *AEO 2005* data terminated in 2025; *AEO 2006* is the first long-term outlook to extend to 2030.

impossible.[38] This chart is not meant to endorse the EIA position. Rather, its purpose is to display, in graphic form, this nation's increasing consumption and the resulting dependence on imported crude oil, with or without the Arctic Refuge production. If the peak oil theorists are correct, diminished domestic supplies will cause the dependence on imports to rise above the levels presented in this analysis.

To create a long-term domestic petroleum outlook that is synchronistic with anticipated production from the Arctic Refuge, the game plan is simple:

- The Arctic Refuge production profile (presented in white in Figure 6), created by the author, is based on the history of North Slope fields and review of the algorithms that various energy analysts have developed since the 1970s for forecasting North Slope field performance.[39]

This production profile is displayed against:

- total domestic consumption (the top of the blue swath in Figure 6), which is based on EIA data through 2030, straight-lined through 2050 at the rate of EIA forecast rate of change for 2026-2030;

- and estimated domestic production (shown in red), calculated in a similar manner from EIA data through 2030.

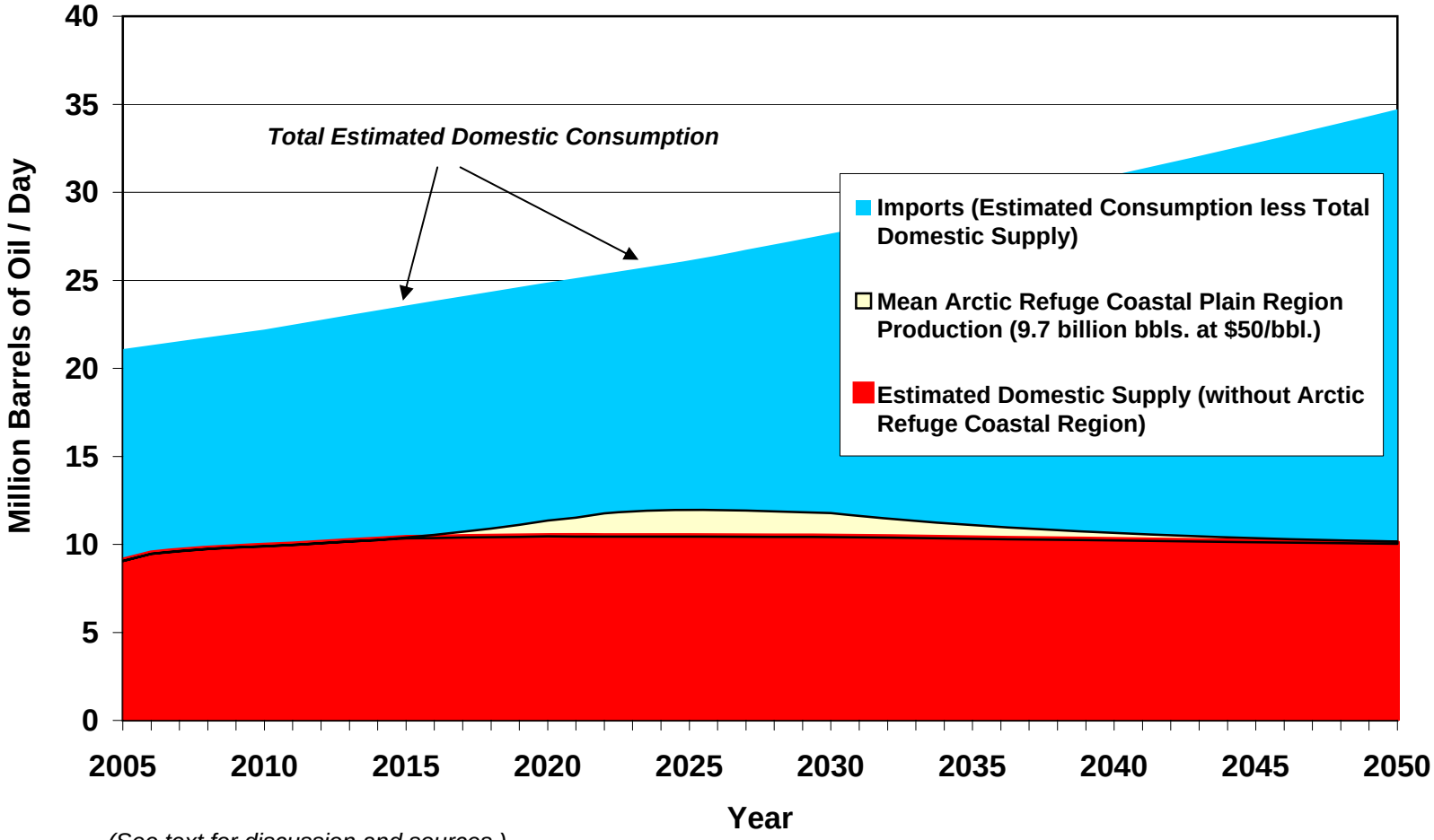
[38] The peak oil argument has graced the cover of *Scientific American* (Campbell C.J., and J.H. Laherrère, "The End of Cheap Oil," March 1998, pp. 80-86) and, more recently, the front page of the *Wall Street Journal* (Jeffrey Ball, "Dire Prophesy: As Prices As Soar, Doomsayers Provoke Debate on Oil's Future – In a 1970s Echo, Dr. Campbell Warns Supply is Drying Up, But Industry Isn't Worried – Charges of 'Malthusian Bias,'" Sept. 21, 2004, p. A1).

[39] See, for example, J.H. Young and W.S. Hauser, *Economics of oil and gas production from the Arctic Refuge (ANWR)* (U.S. Bureau of Land Management, Anchorage, 1986); Charles Thomas, *et al., Alaska Oil and Gas: Energy Wealth or Vanishing Opportunity?* (U.S. Department of Energy, Report No. DOE/ID/01570-H1; in cooperation with the State of Alaska, January 1991), p. 3-42.; and Emil D. Attanasi, *Economics of Undiscovered Oil in Federal Lands on the National Petroleum Reserve, Alaska* (U.S. Geological Survey Open-File Report 03-44, January 2003).

**Figure 6.**

## Estimated U.S. Imports, Domestic Supply and Potential Production from the Arctic National Wildlife Refuge Coastal Region, 2005-2050

(based on estimated domestic production and imports from *AEO 2006* Reference Case scenario data)




*(See text for discussion and sources.)*

*Research Associates, Ester, Alaska / February 2006*

In this scenario, Arctic Refuge production peaks at approximately 1.52 million bpd, remaining at approximately that level for four years, from 2024 through 2027. Production declines gradually to 1.2 million bpd in 2031, declining thereafter at a rate of 10% per year. By the time production shuts in 2050, this profile has produced at total of 9.7 billion barrels.[40]

Because the out-years of the long-term projections are based on the EIA model projections for the next two decades, it should come as no surprise that sustained high oil prices result in increased domestic production and decreased total petroleum consumption. These trends, summarized in Figure 7, result in a reduction to this nation's import requirement through 2050 by more than 35 billion barrels – nearly four times the production potential of the Arctic Refuge region.

**Figure 7. Estimated U.S. Imports, Domestic Supply and Potential Production, 2006-2050**

| | *(1)* | *(2)* | *(3)* | *(4)* | *(5)* |
|---|---|---|---|---|---|
| | | */ - - - - - - - - - - - - - - - Billion Barrels - - - - - - - - - - - - - - - - - - /* | | | |
| **Case** | **Avg.ANS Price (2025)** ***(2006 $/Bbl.)*** | **Domestic Production** ***(without Arctic Refuge)*** | **Potential Arctic Refuge Region** | **Total Domestic Consumption** ***(2006-2050)*** | **Import Requirement** ***(2006-2050)*** |
| ***AEO 2005* Current Futures Case** | **$36.87** | **149.2** | **9.7** | **467.2** | **308.3** |
| ***AEO 2006* Reference Case** | **$54.77** | **168.0** | **9.7** | **450.6** | **272.9** |

***Sources***:
Col. (1): From U.S. Energy Information Administration, *Annual Energy Outlook 2005,* Current Futures Case, Table 2, and *Annual Energy Outlook 2006* (early Release, Table A11). (Prices in 2006 $ adjusted using GDP Chained Price Index (*Budget of the United States, FY 2007,* Historical Tables, pp. 192-1923.).
Col. (2), (4): Calculated from: *Annual Energy Outlook 2005,* Current Futures Case, Table 2, and *Annual Energy Outlook 2006* (early Release, Table A11). (*AEO 2005* 2026-2050 calculated at 2021-2025 rates of change; *AEO 2006* calculated at 2026-2030 rates of change; see discussion in text).
Col. (3): From: E.D. Attanasi, *Economics of 1998 U.S. Geological Survey's 1998 Area Regional Assessment: An Economic Update* (U.S. Geologucal Survey, Open-File Report 2005-1359), pp. 8-9.
Col. (5): Col. (4) - (Col. [2] + Col. [3]).

[40] It should be noted that the production life of the Arctic Refuge Coastal Plain region is likely to exceed 35 years. If this is the case, then the data presented here probably overstated Arctic Refuge production in any given year.

Despite the beneficial effects of assumed high oil prices, under this scenario, due to increasing consumption, this nation's import requirement still:

- increases every year;
- doubles by 2050, from roughly 12 million bpd in 2006 to 24 million bpd in 2050;
- amounts to 28 times more petroleum than likely production of mean discovery volumes technically recoverable from the Arctic Refuge Coastal Plain.

In sum, this scenario suggests that this nation is becoming increasingly dependent on imported crude oil, and that exploration of the Arctic Refuge is not likely to alter (or significantly mitigate) this disturbing trend.

## Employment Effects

Drilling advocates frequently claim the Arctic Refuge would create more than 700,000 jobs nation-wide. The source usually cited is a 1990 report, commissioned by the American Petroleum Institute, by the WEFA group.[41] In 1992, the Congressional Research Service (CRS) questioned the WEFA findings, noting pointedly that "[e]xamination of the report reveals that there was a tendency to select the more, or most, optimistic of underlying scenarios when there was a choice."[42] Nevertheless, the report continued (and continues) to play a prominent role in the Arctic Refuge debate.[43]

In 2001, the Center for Economic and Policy Research reviewed the WEFA study and found that many of the assumptions were clearly wrong or implausible. Baker concluded that correcting each of the erroneous or overstated factors that

[41] WEFA Group, "The Economic Impact of ANWR Development "(May 1990).

[42] Bernard A. Gelb, "ANWR Development: Analyzing Its Economic Impact" (Congressional Research Service, Report No. 92-169-E, Feb. 12, 1992), p. 6.

[43] Most recently, on Nov. 2, 2005, speaking in floor debate, Senate Resources Committee Chair Pete V. Domenici cited the WEFA estimate, erroneously attributing it to the Wharton Business School (rather than a consulting group). According to Sen. Domenici, the authors of the WEFA report say that current high oil prices validate their original report.

WEFA used to create the 1990 estimate of 750,000 jobs would reduced that estimate to 46,000 jobs.[44]

In October 2005, the CRS revisited the jobs issue in a new report on economic impacts. In its update, CRS observed that much of WEFA's job gain results from the macroeconomic effects of lower world oil prices. However, CRS said, "the effect of the Arctic Refuge on oil prices "would be uncertain, and any price drop would have to be large and sustained for the macroeconomic effects to be reasonably noticeable." Using hypothetical assumptions and published estimating factors, CRS estimated that Arctic Refuge development might create 86,000 to 245,000 jobs.[45]

In December 2005, Secretary of Labor Elaine Chow said the Arctic Refuge would create one million jobs. When questioned by reporters, the Administration official said her estimate was based on "congressional sources."[46] At its web site, the "jobs" page of the U.S. House Resources Committee declares that opening the Arctic Refuge "would create 1 million new jobs throughout all 50 states. Just below that statement is this question: "Want |American Jobs? Open ANWR."[47] The committee's "jobs" page does not provide a source or link for these statements.

In sum, drilling advocates in the House, Senate and Administration do not provide substantive support for their job estimtes. On the other side, although CRS

[44] Dean Baker, "Hot Air Over the Arctic? An Assessment of the WEFA Study of the Economic Impact of Oil Drilling in the Arctic National Wildlife Refuge" (Center for Economic and Policy Research, September 2001; http://cepr.net/publications/anwr_2001_09.htm).

[45] Citing reported costs of $1.0 billion for Alpine (estimated at 430 million barrels), CRS estimated development costs ranging from $9.4 billion to $26.9 billion (to produce, respectively, 3.4 to 10.8 billion barrels of oil). Then, using Bureau of Labor Statistics estimates of 5.73 jobs per $1 million of sales by oil and gas producers and 16.0 jobs per $1 million of sales by oil and gas field service companies (each assumed to constitute one-half of a field's development) and adjusting for inflation, CRS arrived its estimate. Bernard A. Gelb, "ANWR Development: Economic Impacts" (Congressional Research Service, Order Code RS21020, Oct. 17, 2005,), pp. 3, 5-6.

[46] Dana Milbank, "Arctic Oil Gets an Administration Gusher," Washington Post, Dec. 12, 2005 (http://www.washingtonpost.com/wp-dyn/content/article/2005/12/12/AR2005121201401.html).

[47] U.S. House of Representatives, Committee on Resources, "Jobs" accessed Feb. 8, 2006 at http://resourcescommittee.house.gov/issues/emr/report/jobs.htm#jobs).

candidly admits that its critique of the WEFA data is based on a number of hypothetical assumptions, the agency's clearly calculated lower estimate appears to supports the thrust, if not the exact numbers, of the 2001 rebuttal to the WEFA report by Dean Baker.