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ANWR Development: Economic Impacts

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Summary

The 109th Congress may again decide whether to continue to protect the ecosystem on the coastal plain of the Arctic National Wildlife Refuge (ANWR) or to open it to oil and gas drilling – with good prospects of finding economically recoverable amounts of oil. Less certain are the actual amounts of oil and gas to be found, the impacts of development on world oil prices and on the U.S. economy, including employment — although recent substantial increases in oil and gas prices tend to boost estimates of economically recoverable oil.

Tight world oil supplies, crude oil and petroleum product price increases, and the decline in crude oil production in the "lower 48" states have produced numerous proposals to expand U.S. oil production or reduce U.S. oil consumption. One of these proposals, to open the Arctic National Wildlife Refuge to oil and gas development, has generated considerable controversy over the years.

ANWR: Ecological and Potential Oil Resource

The coastal plain of Alaska just east of present sites of oil production is the virtually undisturbed home to a wide variety of plants and animals; several species there are protected by international treaties or agreements. This "1002 Area" is part of the Arctic National Wildlife Refuge, which was created in 1960. The Refuge was expanded and made off-limits to oil and gas development in 1980 explicitly to conserve "fish and wildlife populations and habitats in their natural diversity" and for other purposes. ANWR also is a promising U.S. oil prospect. Seismic studies and drilling outside the restricted area have led to estimates of a good chance of finding significant quantities of economically recoverable oil.[2]

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[1] This report benefitted from the petroleum geology and oil industry expertise of Terry Twyman, CRS Visiting Scholar in Economic Growth and Entrepreneurship in 2001.

[2] For broader information and analysis concerning ANWR, see CRS Report RL33523, *Arctic National Wildlife Refuge (ANWR): Controversies for the 109th Congress*.

A Contingency Tree

The oil market and economic impacts of ANWR oil development would depend upon the amount of oil discovered, the sizes of the individual fields, the response of the world oil market to the discovery, the amount of oil eventually produced, the state of the U.S. economy, and the effects of additional U.S. oil production and any change in world oil prices. The response of the world oil market and the economic impact would be contingent upon the unknown and uncertain outcomes of the above factors.

Possible ANWR Volumes and Development Costs

Major determinants of the cost of developing oil fields in ANWR would be the total amount of oil discovered that would be economically recovered and the sizes of the individual discoveries. There are high degrees of uncertainty in both areas. The latest *geologic* assessment (1998) by the U.S. Geological Survey (USGS) estimated that there is a 95% chance that there are at least 4.3 billion barrels (bbls) and a 5% chance there are at least 11.8 billion bbls of *technically* recoverable oil (recoverable with current technology, but ignoring costs) in the restricted area, with a mean estimate of 7.7 billion bbls.[3] Estimated *economically* recoverable amounts are considerably smaller. USGS's latest *economic* assessment found that, if the price of crude oil is $55 per barrel (2003 dollars), there is a 95% chance of at least 3.90 billion bbls and a 5% chance of at least 10.74 billion bbls of economically recoverable oil in the 1002 Area, with a mean estimate of 7.14 billion bbls.[4] These estimates reflect field development practices introduced and cost and price changes since U.S.G.S.'s 1998 assessment. Quantity estimates increase with higher prices and decrease with lower prices, but increments of increase decrease as assumed prices rise.

The USGS estimates also have very wide ranges with respect to oil field sizes. Among the larger sizes, which oil companies probably would consider first, the estimates show a 95% chance of three or more fields and a 5% chance of six or more fields with 256-512 million bbls of technically recoverable oil; a 5% chance of four or more fields and a 95% chance of one or more fields with 512-1,024 million; and a 5% chance of 1½ fields or more and a 95% chance of 0.3 fields or more with 1,024-2,048 million bbls.[5] During the exploratory phase, each company would have data, and then would select the most promising areas based upon its own interpretation of geologic data, its own resource assessment, and its own financial criteria. As exploration and development progress, smaller fields probably would become attractive if and when infrastructure is in place.

Thus, given that the sizes both of a possible overall discovery and of individual fields are unknown, *all estimations of the overall cost of developing ANWR are hypothetical*.

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[3] U.S. Geological Survey. *The Oil and Gas Potential of the Arctic National Wildlife Refuge 1002 Area, Alaska, 1999,* Chapter EA; and U.S.G.S., *Frontier Areas and Resource Assessment: The Case of the 1002 Area of the Alaska North Slope,* Open-File Report 02-119, March 2002, p. 16.

[4] U.S.G.S. *Economics of 1998 U.S. Geological Survey's 1002 Area Regional Assessment: An Economic Update,* Open-File Report 2005-1359 (Washington, DC: 2005).

[5] USGS. *Oil and Gas Potential.* These are arithmetic means of distributions of estimated field sizes. The numbers of fields used in the text are rounded.

Two illustrative *hypothetical* cases might be as follows: (1) The existence of 3.9 billion bbls of economically recoverable oil in seven 100-million bbl fields, six 200-million-bbl fields, three 375-million-bbl fields, and one 750-million-bbl field. (2) The existence of 10.74 billion bbls of economically recoverable oil in ten 200-million-bbl fields, six 375-million-bbl fields, four 750-million-bbl fields, and two 1,500-million-bbl fields.[6] These cases are based upon the previously-described 95% probability and the 5% probability of economically recoverable oil at $55 per barrel (2003 prices).

Advances in Arctic oil development technology, equipment, and configuration of facilities reduce both the surface footprint and the development cost per barrel of discovery.[7] These advances have made development more capital intensive onsite but more labor intensive offsite, mainly performing data analysis. A very crude benchmark to use for estimating the outlays that would be entailed could be the $1 billion reported to be the cost of constructing the Alpine field, which has about 430 million bbls of reserves. Alpine is a recently developed field on the Alaskan North Slope that employs advanced Arctic technologies. However, Alpine is appropriate as a cost benchmark *only to the extent* that the geological conditions, accessibility of the hypothetically discovered fields, and a variety of other factors in the Refuge are similar to those at Alpine, all of which adds another dimension of uncertainty to this hypothetical formulation.

If, *hypothetically*, the fields associated with an overall 3.90-billion-bbl discovery of economically recoverable oil are of the same nature and degree of difficulty to develop as Alpine, and if, *as is unlikely*, development costs are proportional to field size (using Alpine as the benchmark), and if it is assumed that the Alpine development cost was $1 billion, total development cost of a 3.90 billion bbl discovery would approximate $9.4 billion. If, *hypothetically,* fields associated with a 10.74-billion-bbl overall discovery are of the same nature and degree of difficulty to develop as Alpine, and if, *as is unlikely*, development costs are proportional to field size, total development cost of that overall discovery would approximate $26.9 billion.[8]

At roughly $2.40 and $2.50 per barrel of economically recoverable reserves, the hypothetical estimate totals (which exclude exploration costs) appear low for Arctic conditions, and low even compared with overall U.S. averages. In 2001-2003, major U.S. oil companies experienced U.S. onshore *finding* costs of $9.35 per barrel (with exploration costs accounting for about one-third), based upon EIA surveys.[9] However, because the extent to which the developer of Alpine may have included exploration costs in the $1 billion is not known (cost accounting differs by company), that figure may be

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[6] The pattern of the distribution of field sizes is based upon Figure EA2 in: USGS. *The Oil and Gas Potential of the Arctic National Wildlife Refuge 1002 Area, Alaska, 1999,* Chapter EA.

[7] For more detailed discussion of petroleum exploration and development technology in the Arctic, see CRS Report RL31022*, Arctic Petroleum Technology Developments.*

[8] Using a ratio of $1 billion per 400-million-bbl field, the arithmetic is as follows. For 3.90 billion bbls: (7 x $250 million) + (6 x $500 million) + (3 x $937 million) + (1 x $1,875 million) = about $9.4 billion. For 10.81 billion bbls: (5 x $250 million) + (10 x $500 million) + (6 x $937 million) + (4 x $1,875 million) + (2 x $3,750 million) = about $26.9 billion.

[9] Energy Information Administration. *Performance Profiles of Major Energy Producers, 2003.* Financial and Operational Developments in 2003, Finding and Production (Lifting) Costs, [http://www.eia.doe.gov/emeu/perfpro/ch1sec5.html] viewed October 14, 2005.

too low for the purpose of estimating hypothetical ANWR development outlays. Moreover, additional infrastructure would be required if fields are distant from existing staging areas, including a pipeline to the Trans Alaska Pipeline System.

Oil Market Response

Other things being equal, an increase in supply would be expected to result in a price decline (or a lower price than would occur otherwise). The size of price decrease would depend to some extent upon how close world oil output would be in relation to world production capacity and upon the reaction of other suppliers to the world oil market.

CRS estimates – again, based on hypothetical and uncertain scenarios – that peak plateau production from economically recoverable volumes of 3.90 billion and 10.74 billion bbls (based upon $55 per barrel in 2003 dollars, or about $58 in 2005 dollars) would range from roughly 0.4 million to 1.6 million bbls per day, assuming pipeline capacity imposes no constraints. Production could begin within 10 years, and could last at least 30 years, declining from the peak. If exploration starts in 2006, peak production levels probably would be reached in about 2025. EIA projects world oil production to total 118.9 million bbls per day in 2025.[10] On the basis of the aforementioned scenarios, ANWR production (from the respective discovery volumes) at their peaks around 2020 would range from about 0.3% to 1.3% of world output projected by EIA.

If supply in the world oil market is tight in 2025 and the market reasonably competitive, 1.6 million bbls per day of ANWR production could result in lower world oil prices in the short run. OPEC and other producers, however, may cut output sooner or later to offset the supply effect, as has occurred before. For example, OPEC reduced production volumes three times in 2001 in response to falling oil prices.

U.S. Economic Effects

Development of ANWR for oil production could affect the U.S. economy directly through new economic activity generated by the development and production itself, indirectly through the ripple effect of such activity, indirectly through the effects of any change in oil prices, and indirectly through any effects on the amount spent to import oil. A key factor would be the unpredictable state of the economy.

Hypothetical outlays of $9.4 billion and $26.9 billion with an income multiplier of two applying to them would come to 0.05% and 0.15% of projected Gross Domestic Product (GDP) in current dollars for the year 2025, assuming for simplicity that all the outlays occur in one year.[11] If the outlays are spread over more than one year, the impact in each year would be less, but the total effect would be about the same. If there is some spare capacity, the oil and gas producing industry and its suppliers would benefit. However, if the economy is at full employment, the multiplier effect would be transitory.

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[10] Energy Information Administration. *International Energy Outlook 2005*. Tables 5 and 6 at [http://www.eia.doe.gov/oiaf/ieo/pdf/oil.pdf], viewed January 23, 2006.

[11] Projected GDP by Global Insight, Inc. in *The U.S. Economy: The 30-Year Focus*, Third Quarter 2005, Table 1.

Outlays of similar magnitudes in 2025, when the economy is projected to be about 80% larger than in 2005,[12] would have much smaller relative effects.[13] Impacts on some geographic regions and industrial sectors — Alaska, oil producers, and manufacturers of drill pipe — would be greater, but some smaller. In analyzing the impact of changes in energy costs on the economy as a whole or on individual sectors, it is worth noting that the relative price of oil has decreased since the oil price spikes of the 1970s and early 1980s.[14] Energy use per unit of output has fallen, the shares of production costs accounted for by energy have dropped across the economy with relatively few exceptions, and energy costs as a share of GDP have declined.

It appears also that any price effect would have to be large and sustained for the effects to be substantial on a macroeconomic scale. The Organization for Economic Cooperation and Development (OECD) estimated that a rise in oil prices of $15 per barrel would cause U.S. GDP to be lower by 0.45% and 0.55% in the first and second years after the shock.[15] The price effect of a 1.3% addition to world oil supply resulting from ANWR production probably would be modest and temporary, but the macroeconomic result of a price *decline* may not be proportional.

Employment Effects. Oil and gas development in ANWR would generate *additional* jobs in the national economy to the extent that development results directly and indirectly in a *net* economic stimulus. A key factor is whether the economy would be at less than full employment. The direct effects are less uncertain than the indirect, given the uncertainty of the effects of ANWR oil on world oil prices and any consequent beneficial effects of lower energy prices on the economy as a whole.

Order of magnitude estimates can be made for jobs generated by the hypothetical development outlays by using the national averages of 5.73 jobs directly and indirectly "required" per $1 million of sales by oil and gas producers as estimated by the Bureau of Labor Statistics (BLS), and 16 jobs per $1 million of sales by oil and gas field service companies, as estimated by the author based upon historical data.[16] Adjusting for price increases since 1996 and assuming that each of the above groups accounts for half of the outlays, it can be estimated that $9.4 billion would lead hypothetically to about 86,000 jobs, and that $26.9 billion would lead hypothetically to about 245,000 jobs.[17]

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[12] GDP projections by Global Insight. 2005: *U.S. Executive Summary*, October 2005, p. 11; 2025: *The U.S. Economy, The 25-Year Focus*, First Quarter 2005, p. 55.

[13] Changes in investment spending have a magnified effect on the economy from the ripple effects on the income and spending of other businesses and of households. Income multiplier is the term used to denote the total impact of the initial spending. Multipliers differ by the sector of the economy in which the investment takes place. A multiplier of two is reasonable for the type of spending discussed here.

[14] Only the oil prices of 2005 and January 2006 have attained the levels of the early 1980s.

[15] *OECD Economic Outlook.* December 2004, p. 135. It is assumed that monetary policy would accommodate the price rise. Other estimators' simulations have had comparable results.

[16] BLS estimates at [http://www.bls.gov/emp/empind4.htm]. Estimates are based upon 2002 labor productivity. BLS does not publish estimates for oil and gas field services separately.

[17] CRS could not locate data that would indicate the proportions. Hypothetical lower scenario:
(continued...)

In contrast, a 1990 report by The WEFA Group estimated that the economic impact of oil development in ANWR would result in a net gain in employment of 735,000 in the peak year of job creation.[18] Much of WEFA's job gain results from estimated large beneficial macroeconomic effects of lower world oil prices that are based partly upon its assumption that the amount of ANWR economically recoverable oil would be near the high end of 1987 ANWR resource estimates.[19] These differences in estimates of job generation illustrate the importance of the role played by macroeconomic relationships and other assumptions used in making such estimates.

The impact of ANWR development on employment would be affected by the continually changing overall state of the economy. In the long run, the unemployment rate is determined by the structure of the labor market; and, at full employment, jobs generated by ANWR development would come at the expense of an approximately equal number of jobs taken from the rest of the economy.

The effect of ANWR oil on world oil prices would be uncertain, and any price drop would have to be large and sustained for the macroeconomic effects to be reasonably noticeable. Any employment gain from beneficial macroeconomic effects of a drop in oil prices may be offset by harm to oil producers not participating in ANWR development, who may reduce their operations and workforce, other things being equal; their suppliers and local economies may be affected as well.

Import Effect. As the U.S. marginal source of petroleum, *net* imports would be reduced by virtually one barrel for every barrel of ANWR output. The economy would benefit temporarily through a reduction in its oil import bill and in the income transferred overseas to pay for the oil. Using EIA's crude oil price projection for 2025 of foreign crude oil of $54 per barrel and assuming mid-range ANWR output of one million bbls per day, the oil import bill would be cut by $19.7 billion in that year, improving the U.S. merchandise trade balance in the very short run. However, the relative fall in dollars flowing abroad could cause the dollar to appreciate, which would tend to reduce U.S. exports of other goods and services and expand imports to some extent, reversing some of the initial improvement. Should ANWR oil lower oil prices, a consequent increase in economic activity may further increase U.S. imports of other goods and services. The trade deficit basically reflects the desire of Americans to borrow abroad versus the desire of foreigners to invest or borrow in the United States.

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[17] (...continued)
$4.7 billion by oil producing companies ÷ 1.19 (deflator) x 5.73 (jobs per million $) = 22,600 jobs; $4.7 billion by oil field service companies ÷ 1.19 (deflator) x 16 (jobs per million $) = 63,200 jobs. Hypothetical higher scenario: $13.45 billion by oil producing companies ÷ 1.19 (deflator) x 5.73 (jobs per million $) = 64,800 jobs; $13.45 billion by oil field service companies ÷ 1.19 (deflator) x 16 (jobs per million $) = 180,100.

[18] *The Economic Impact of ANWR Development.* Bala Cynwyd, PA: May 1990. The figure of 700,000 jobs continues to be used by some proponents of opening ANWR to oil and gas drilling.

[19] Dean Baker, using WEFA's procedure but different assumptions, estimated the job gain at 46,300 in *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 4, 2001. 11 pp.