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ANWR Development: Economic Impacts

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Summary

Congress is deciding 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 development – with good prospects of finding economically recoverable amounts of oil. Less certain are the broad impacts of development on world oil prices and on the U.S. economy, including employment. This uncertainty has been compounded by the September 11, 2001 terrorist attacks with their yet to be fully determined consequences.

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.

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, Visiting Scholar in Economic Growth and Entrepreneurship, Congressional Research Service.

[2] For broader information and discussion concerning ANWR, see CRS Issue Brief IB10073, *The Arctic National Wildlife Refuge: The Next Chapter*.

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 assessment by the U.S. Geological Survey (USGS)[3] 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. Estimated *economically* recoverable amounts are considerably smaller. The USGS estimated that, if the price of crude oil is $24 per barrel (1996 dollars), there is a 95% chance of at least 2.03 billion bbls and a 5% chance of at least 9.37 billion bbls of economically recoverable oil in the 1002 Area, with a mean estimate of 5.24 billion bbls.[4] These estimates rise if a higher price is assumed and decrease with a lower assumption. In 2001, the price ranged between $24 and $29 before the September attacks; it has fallen since then.

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 one or more fields and a 95% chance of four or more fields with 512-1,024 million; and a 5% chance of 0.3 of a field or more and a 95% chance of one and a half 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 progresses, smaller fields probably would become attractive if and when infrastructure is in place.

Thus, given that the sizes 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. USGS Open File Report 98-34. USGS prepared many estimates made under different definitions of recoverability and different oil price assumptions.

[4] In comparison, the original estimate of economically recoverable oil at Prudhoe Bay was slightly under 10 billion bbls. E&G Idaho, Inc. *Alaska Oil and Gas: Energy Wealth or Vanishing Opportunity? Final.* Prepared for the U.S. Department of Energy. January 1991. p. 2-8. More oil has been found; 3 billion bbls are still to be recovered beyond 10 billion already produced.

[5] USGS. *op. cit.* These are arithmetic means of distributions of estimated field sizes; results can have numbers with fractions. The numbers of fields used in the text are rounded.

Two illustrative *hypothetical* cases might be as follows: (1) A discovery of 2.40 billion bbls of economically recoverable oil in four 100-million bbl fields, three 200-million-bbl fields, two 400-million-bbl fields, and one 800-million-bbl field. (2) 5.24 billion bbls of economically recoverable oil in six 200-million-bbl fields, four 400-million-bbl fields, two 800-million-bbl fields, and one 1,200-million-bbl field.[6]

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.[8] 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 2.40-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 2.4 billion bbl discovery would approximate $6.5 billion. If, *hypothetically*, fields associated with a 5.24-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 $14.0 billion.[9]

At roughly $2.70 per barrel of discovery, the Alpine $1 billion and the hypothetical estimate totals, which exclude exploration costs, appear low for Arctic conditions, and low even compared with overall U.S. averages. In recent years, major oil companies have experienced U.S. onshore finding costs of about $5.25 per barrel (with exploration costs accounting for about one-third), based upon Energy Information Administration (EIA) surveys,[10] but such costs have been declining over time. 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 an understatement for the present purpose of estimating hypothetical ANWR development outlays. Moreover,

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[6] The hypothetical distributions of field sizes are 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 treatment of petroleum development technology in the Arctic, see CRS Report RL31022, *Arctic Petroleum Development: Implications of Advances in Technology*.

[8] Phillips Alaska, Inc. *Fact Sheet*. January 1, 2001.

[9] Using a ratio of $1 billion per 400-million-bbl field, the arithmetic is as follows. For the smaller overall discovery: (4 x $250 million) + (3 x $500 million) + (2 x $1,000 million) + (1 x $2,000) = $6.5 billion. For the larger overall discovery: (6 x $500 million) + (4 x $1,000 million) + (2 x $2,000 million) + (1 x $3,000 million) = $14.0 billion.

[10] EIA. *Performance Profiles of Major Energy Producers, 1999*. Table 20, Table B14.

additional costs for infrastructure would be required if fields are distant from existing staging areas, including the cost of 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 2.03 billion and 9.37 billion bbls at $24 per barrel[11] would range from roughly 0.3 million to 1.4 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 2002, peak production levels probably would be reached in about 2020. EIA projects world oil production to total 119.3 million bbls per day in 2020.[12] On the basis of the aforementioned scenarios, ANWR production (from the respective discovery volumes) at their peaks around 2020 would range from about 0.25% to 1.17% of world output projected by EIA.

If supply in the world oil market is tight in 2020 and the market reasonably competitive, 1.4 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 has reduced production volumes three times in 2001.

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 $6.5 billion and $14.0 billion with an income multiplier of two[13] applying to both would come to roughly 0.12% and 0.26% of projected Gross Domestic Product (GDP) in current dollars for the year 2002, assuming for simplicity that all the outlays occur in one year. If the outlays are spread over more than one year, the

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[11] EIA projects the average price of landed oil imports at $22.41 in 2020 (1999 dollars). *International Energy Outlook 2001*. March 2001, p. 41. EIA's oil price, oil production, oil imports, and economic growth projections used in this report are its best-guess "reference case."

[12] *International Energy Outlook 2001*. p. 42.

[13] Changes in investment spending have a magnified impact on the economy as a result of 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. Such multipliers differ depending upon the sector of the economy in which the investment takes place. A multiplier of two is reasonable for the type of spending discussed here.

impact in each year would be less, but the total effect would be about the same.[14] 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. Outlays of similar magnitudes in 2015 or 2020, when the economy is projected to be 45%-70% larger,[15] would have much smaller relative effects. Impacts on some geographic regions and industrial sectors – e.g., Alaska, oil producers, and manufacturers of drill pipe – would be greater, or 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, and energy use per unit of output has fallen as well. The proportions of production costs accounted for by energy have dropped across the economy; and energy costs as a share of GDP have declined.

It appears also that any price effect would have to be considerable and sustained for the effects to be significant on a macroeconomic scale. The Organization for Economic Cooperation and Development (OECD) estimated that an increase in oil prices of $10 per barrel above its baseline scenario would result in U.S. GDP being 0.2% lower one year and two years after the shock.[16] Also, the price effect of a 1.17% addition to world oil supply resulting from ANWR production probably would be modest and temporary, although the macroeconomic result of a price *drop* may well 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 is 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 3.89 jobs directly and indirectly "required" per $1 million of sales by oil and gas producers and 16.53 jobs per $1 million of sales by oil and gas field service companies, as estimated by the Bureau of Labor Statistics (BLS).[17] Adjusting for price increases since 1992 and assuming that each of the above groups accounts for half of the outlays, it can be estimated that $6.5 billion would lead to about hypothetical 60,000 jobs, and that $14.0 billion would lead to hypothetically about 130,000 jobs.[18]

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[14] GDP projection by DRI-WEFA in *U.S. Economic Outlook*. August 2001. p. 9.

[15] EIA. *Annual Energy Outlook 2001*. p. 152.

[16] OECD. *Economic Outlook*. December 1999. p. 9. Macroeconomic simulations by other organizations have had comparable results.

[17] U.S. Bureau of Labor Statistics web site: stats.bls.gov:80/datahome.htm. While in terms of sales in 1992 dollars, the ratios are based upon 1998 productivity relationships.

[18] CRS could not locate data that would indicate the proportions. Hypothetical lower scenario: $3.25 billion by oil producing companies ÷ 1.097 (deflator) x 3.89 (jobs per million $) = 11,525 jobs; $3.25 billion by oil field service companies ÷ 1.097 (deflator) x 16.53 (jobs per million $) =

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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.[19] The major portion of the gain results from estimated large beneficial macroeconomic effects of lower world oil prices caused by an increase in world oil supply attributable to ANWR, based upon an oil discovery near the high end of 1987 ANWR resource estimates. 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.[20]

The impact of ANWR development on employment would be affected by the continually changing overall state of the economy. In the aftermath of the September 11 attacks, there is considerable uncertainty about near term full employment, and estimates are problematic. In the long run, the unemployment rate is determined by the structure of the labor market; and, at full employment, any jobs generated by ANWR development would come at the expense of an equal number of jobs lost in the rest of the economy.

Even without the impact of recent events, the effect of ANWR oil on world oil prices would be uncertain, and any price drop would have to be considerable and sustained for the macroeconomic effects to be reasonably noticeable, and the job effects would be highly uncertain. Any employment gain from beneficial macroeconomic effects of a drop in oil prices may be offset by harm to oil producers that do not participate 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 projection for 2020 of refiners' acquisition cost of foreign crude oil of about $22.40 per barrel (footnote 12) and 12.14 billion bbls per day in net imports,[21] the oil import bill would be cut by $2.5 billion to $11.4 billion in that year, improving the U.S. merchandise trade balance in the short run. The relative fall in dollars flowing abroad, however, could cause the dollar to appreciate. This would tend to reduce exports and expand imports to some extent, reversing the initial improvement. A possibly greater increase in demand for imports of other goods and services could result from a higher level of economic activity caused by lower oil prices. 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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[18] (...continued)
48,975 jobs. Hypothetical higher scenario: $7.0 billion by oil producing companies ÷ 1.097 (deflator) x 3.89 (jobs per million $) = 24,825 jobs; $7.0 billion by oil field service companies ÷ 1.097 (deflator) x 16.53 (jobs per million $) = 105,475.

[19] *The Economic Impact of ANWR Development.* Bala Cynwyd, PA: May 1990.

[20] CRS Report 92-169, *ANWR Development: Analyzing Its Economic Impact* also comments on the WEFA report.

[21] *Annual Energy Outlook*. p. 143.