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DRILLING IN ANWR: THE ECONOMIC COSTS AND BENEFITS

Executive Summary

In the current debate over long-term energy policy, the question of whether to open the Arctic National Wildlife Refuge (ANWR) to oil exploration and drilling has been hotly contested. The September 11 terrorist attacks have brought increased focus on the subject, as concerns about dependence on foreign oil increased. A close look at the facts reveals that many of the purported employment, economic, and security gains that would arise if ANWR were opened to drilling are overstated. These claims appear to flow from a fundamental mischaracterization of the functioning of oil markets, questionable assumptions about the oil resources ANWR holds, and simply outdated information. Specifically, the frequently cited assertions that drilling in ANWR would yield 735,000 jobs and allow the United States to achieve independence from Middle Eastern oil suppliers are unsupportable. A more realistic assessment suggests that the potential economic impacts of opening ANWR are less than one-tenth the size of these claims, and that drilling in ANWR can do little to address national security concerns.

Economic Issues

Proponents of drilling argue that opening ANWR would boost the economy and create 735,000 new jobs. These projections rely on an outdated analysis funded by the oil industry, however. The study is based on a series of unrealistic assumptions that inflate the estimated benefits of drilling.

Specifically, the study:

- Assumes that there is about 50 percent more oil in ANWR than is estimated by the U.S. Geological Survey;
- Relies on outdated and unrealistically low assumptions about world oil demand;
- Assumes that peak oil production in ANWR could be achieved as much as 22 years earlier than the Department of Energy considers plausible;
- Assumes that world oil prices would be over $45 per barrel by 2005 (as compared to $21.70 as projected by the Department of Energy); and
- Underestimates increases in labor productivity over time, thus overstating any employment impacts that might arise as a result of drilling.

Any one of these assumptions might lead to a relatively small overestimate of the potential benefits of

drilling. Together their effects are compounded, resulting in an extremely misleading assessment.

Using more realistic assumptions reduces the projected increase in employment by 93 percent. Instead of generating 735,000 jobs, drilling in ANWR would provide no substantial new employment for the next ten years and would generate modest employment gains in the long run, peaking at an estimated 65,000 new jobs nationwide in 2020. This would be an increase in projected employment of less than one-tenth of one percent.

National Security Issues

Drilling in ANWR would not provide enough oil to insulate the U.S. from swings in the global oil market, nor could it free the U.S. from the threat of politically motivated supply interruptions from foreign oil producers. Because oil prices are determined in the global marketplace, the U.S. can only influence the price it pays for oil by influencing world prices, and the amount of oil in the ANWR reserves is not large enough to have a significant impact on world oil supplies.

No oil at all could come out of ANWR for about a decade, which means that there could be no short-run impact on prices or import levels. Even in the long run, drilling in ANWR would increase our projected share of world oil supply in 2020 from 4.1 percent to about 5 percent at the most, which is simply not enough to control prices. By comparison, OPEC currrently supplies about 40 percent of the worlds's oil and is projected to supply 50 percent before ANWR production could reach its peak.

Conclusion

Opening ANWR to oil companies would provide few benefits to the nation as a whole, while at the same time allowing a significant piece of America's natural heritage to be destroyed forever. This policy would create a very small number of jobs almost 20 years from now, and would not enhance national security. For American consumers, ANWR oil might lower gasoline prices by a penny per gallon, with even smaller impacts on overall inflation. However, oil companies – many of them foreign owned—could reap substantial profits from the approximately $180 billion dollars worth of oil that is estimated to be recoverable from ANWR.

Introduction

There have been several recent proposals to open the Arctic National Wildlife Refuge (ANWR) to oil exploration and drilling. For example, the President's National Energy Policy proposal released in the spring of 2001, and HR 4, which passed the House of Representatives in August 2001, both specifically call for the development of ANWR oil resources. Proponents of this policy assert that allowing drilling in ANWR has the potential to reduce substantially or even to eliminate U.S. dependence on foreign sources of oil, a goal that has assumed a higher priority in the wake of the September 11 attacks. Additionally, drilling advocates assert that large employment benefits and economic gains would result from this policy.

In fact, however, any economic or security-related benefits in opening ANWR to drilling would be very small and would not occur for at least 10 years. The frequently cited assertions that drilling in ANWR would yield nearly 750,000 jobs and allow the United States to achieve independence from Middle Eastern oil suppliers are unsupportable. A more realistic assessment suggests that the potential economic impacts of opening ANWR are less than one-tenth this size and ANWR does not hold enough oil to raise the U.S. share of the world oil supply significantly.

The full environmental and ecological costs of drilling in ANWR are unknown at this time and may not be fully understood until they become irreversible. Responsible energy policy requires a careful balancing of the potential costs and benefits of policy alternatives. While drilling in ANWR offers few economic and national security benefits, there are clearly some costs that are potentially high and irreversible. Drilling in ANWR would impose substantial risks for little potential reward, failing the cost-benefit test.

Economics of World Oil Markets

Oil is a commodity, and as with most commodities, its price depends almost exclusively on supply and demand. Unlike automobiles, for example, where product quality and characteristics vary among producers, oil produced by one supplier is generally indistinguishable from oil produced by another.[1] Because of this, the main factor buyers and sellers consider in buying or selling oil is its price. For individual buyers and sellers, nationality and geography are largely irrelevant.[2]

Another important feature of oil markets is their global nature. Although the U.S. is a relatively large player in the market, accounting for over 8 percent of global supply and 26 percent of global demand in 2000, the price of oil is determined largely outside of our borders. This is because the Organization of Petroleum Exporting Countries (OPEC) supplies about 40 percent of the world's oil and frequently adjusts its output levels to manipulate prices (DOE 2000a).

It is easy to see, for example, that a U.S. buyer could not buy Saudi Arabian oil for less than a Japanese buyer was offering nor could a U.S. producer sell to a Japanese buyer for more than a Saudi Arabian producer was asking. It is important to recognize that buyers and sellers are bound by the world market even when they are both located in the same country. A Californian buyer could not offer below-market prices for Alaskan oil and expect to buy it; neither could an Alaskan producer demand more than the world market price from a Californian buyer and expect to sell it. In the first case, the Alaskan producer could simply sell to a foreign buyer offering full price, while in the second case the Californian buyer could find a foreign seller willing to undercut the high Alaskan price.

Oil price fluctuations during the Asian financial crisis of the late 1990s illustrates this point well. When Asian oil demand dropped steeply, prices paid by American refineries fell by about 41 percent between 1996 and 1998. Importantly, the price of oil purchased by American refineries from domestic oil

producers fell by a similar amount, about 43 percent. This reflects the fact that lower demand and prices elsewhere had a substantial impact on domestic prices, even as domestic demand rose slightly (DOE 2000a).

Even countries that are self-sufficient (i.e. produce enough oil to meet their own needs) are affected by the world market. While oil in self-sufficient countries may be relatively inexpensive because of low transportation costs, prices will still rise and fall with the world market. Because buyers and sellers must compete with their foreign counterparts, they cannot ignore the rise and fall of the world market price. Prices in every region and every open economy are thus dependent on one another.

There is one exception to this rule of interdependence. A self-sufficient country that banned both oil imports and exports could effectively sever itself from the world market. This exception is important not because it is common, but rather because it is rare. As long as domestic buyers and sellers interact with foreign ones, a country cannot insulate itself from fluctuations in world oil prices. The only way an open economy can influence the price it pays for oil is to influence the price the entire world pays.

While the U.S. is incapable of controlling world oil prices, controlling domestic oil prices is not considered to be a serious alternative either. To do so, the government would likely have to ban the sale of domestic oil to foreign buyers and would further require that the government intervene heavily in the wholesale crude oil market. To maintain low domestic prices when world prices were high, the government would essentially have to buy oil from foreign producers at the world price and resell the oil to domestic refiners at a loss, while simultaneously requiring that domestic crude producers sell at the same below-market price. Not only would this require a large amount of federal assets, but it would also discourage domestic oil production as producers would be forced to sell at an artificially low price. Alternately, when world prices were low, the government would have to resell foreign oil at a profit, artificially maintaining high energy prices and inflation while allowing domestic oil producers to charge artificially high prices. Both of these situations would distort market incentives to produce and consume oil resources efficiently. Artificially low prices would blunt incentives to use oil and refined products wisely when resources were scarce while leading to under-production of domestic resources. Artificially high prices would lead to unnecessarily high inflation and over-production of domestic resources.

The geographic concentration of oil supplies combined with the importance of oil to economic growth make the balance of supply and demand critical to oil consumers and policy-makers. In 2000, global oil demand was about 76 million barrels per day (mbd). About 40 percent of that was produced by OPEC, whose members are concentrated in the politically sensitive Middle East. By 2020, world demand is expected to rise to about 120 mbd, while OPEC's share of that is expected to rise to nearly 50 percent (DOE 2000b). Such a concentration of supply gives OPEC substantial power to influence global oil prices, as it has demonstrated in the past.

In addition to being relatively abundant, Middle Eastern oil is also relatively inexpensive to extract and deliver. The geophysical characteristics of Middle Eastern oil fields make the costs there as low as $2.50 per barrel for Iraq and $4 per barrel for Saudi Arabia. In contrast, some American oil fields have extraction costs as high as $15 per barrel. The cost of extracting and delivering oil from Alaska's North Slope to the West Coast (its nearest market) is between $9.70 and $10 per barrel, almost 25 percent higher than the U.S. onshore average of about $8.10 per barrel.

Because American oil tends to be harder to extract and therefore, less profitable, American suppliers are often among the first to cut output when prices fall. When prices began falling from their 1996 peak of over $22 per barrel, U.S. production also began to fall, declining about 3.25 percent between 1996 and 1998 when prices bottomed out at just below $13 per barrel. At the same time, output from OPEC increased about 8.7 percent, and total non-U.S. output grew by about 6 percent. Output from OPEC did not begin to fall until 1998, and even then, U.S. output still fell more quickly (DOE 2000a).[3]

Even if ANWR held enough oil to reduce world oil prices significantly (which it does not), lower oil prices would likely cause other domestic producers to cut back on their output as they did in the late 1990s, offsetting some of the increases in domestic production resulting from ANWR development. Rather than replacing oil imports, opening ANWR would shift some oil development from one domestic location to another.

Assessing ANWR's Potential Resources

Despite all the attention it has received, the actual size of the oil resource beneath ANWR is still not known with precision, and may never be known unless drilling actually begins. Before discussing current estimates of the resource, several important distinctions must be made. Broadly speaking, the oil underlying ANWR can be put into three categories, from largest to smallest: oil in place, technically recoverable oil, and economically recoverable oil. Oil in place is the total amount of oil that exists beneath the site. Technically recoverable oil is the amount of oil in place that could be extracted given current and expected recovery technologies. Economically recoverable oil is the amount of technically recoverable oil that could be extracted and sold at a profit. The relevant measure for any oil resource, including ANWR, is the amount of economically recoverable oil. Oil that is inaccessible or too expensive to extract is unavailable for consumption. In discussions surrounding ANWR, this critical distinction is often ignored.

A second important distinction is between currently restricted and unrestricted portions of the ANWR area. The Coastal Plain is the section of ANWR that is believed to contain oil. The Alaska National Interest Lands Conservation Act of 1980 set a portion of that land aside from oil exploration and extraction. This area is commonly referred to as 'Area 1002' after the relevant section of the Act. The oil resource is not contained entirely within the federally restricted lands of Area 1002, however. Rather, about 26 percent of the oil resource is estimated to lie beneath adjacent state and native lands where federal consent is not required to allow drilling. To date, oil companies have been unwilling to attempt to extract oil from the unrestricted area unless Area 1002 is also open for access.

In its 1999 assessment of the ANWR resource potential, the U.S. Geological Survey (USGS) identified three possible scenarios and assigned probabilities to each (USGS 1999). In the 'high resource' scenario, there would be about 16 billion barrels of technically recoverable oil; in the 'low resource' scenario, there would be about 5.7 billion barrels of technically recoverable oil. The USGS assigned a 5 percent probability to the high resource scenario and a 95 percent probability to the low resource scenario. The 'mean scenario' under which 10.3 billion barrels would be technically recoverable has a 50 percent probability. Factoring out the oil that is already open for development beneath state and native lands, the technically recoverable resources under the high, mean and low resource scenarios fall to 11.8, 7.7, and 4.3 billion barrels respectively.[4] Only a portion of this oil would be economically recoverable.

Table 1: Alternate USGS Assessments of ANWR Oil Resource (millions of barrels).

		95 Percent Probability	50 Percent Probability	5 Percent Probability
Technically Recoverable Oil	Coastal Plain	5,724	10,332	15,995
	1002 Area Only	4,254	7,668	11,799
Economically Recoverable Oil	Coastal Plain	4,579	8,265	12,796
	1002 Area Only	3,403	6,134	9,439

Source: U.S. Geological Survey, 1999.

A major factor in determining how much oil is economically recoverable is the price of oil on the world market. This cannot be known with certainty in advance. The Energy Information Administration (EIA) of the Department of Energy (DOE) estimates that at $26 per barrel, about 80 percent of the oil in ANWR would be economically recoverable. The EIA currently estimates that the world price of crude oil would remain at or below this level through 2020. Applying this to the above assessments lowers the recoverable oil estimates for Area 1002 to 9.4, 6.1, and 3.4 billion barrels for the three scenarios. **Table 1** summarizes the resource potential under the three scenarios.

It would also take a substantial amount of time for any ANWR oil resources to reach the market. The EIA estimates that the time between approval of ANWR extraction and first production would be anywhere from 7 to 12 years. After production starts, it would take a number of years before production could reach peak levels. The EIA based its extraction rates on volumes that could be developed "within practical drilling and operational limits." The actual development rates would depend on the number of wells drilled each year as well as the rate at which individual wells were developed.[5]

Under both of the extraction rates that EIA examined, extraction of ANWR oil would not reach peak levels until somewhere between 17 and 24 years after development began. Under the mean resource scenario and a rapid development rate, the entire coastal plain could meet less than one percent of world oil demand by 2020. More moderate assumptions about development rate and time to first production could bring this estimate below one-half of one percent.

National Security Issues Relating to Drilling in ANWR

The role of national security as it relates to energy markets is loosely defined, but there are two closely related and commonly cited security concerns. One deals with the economic uncertainty associated with relying on international oil markets and foreign oil suppliers. Because petroleum is a major source of energy, the price fluctuations associated with the frequently volatile world oil market can subject the economy to uncontrollable and often unpredictable influences. The second security concern involves the dependence of the United States on foreign suppliers to provide both crude oil to be refined in the U.S. and finished petroleum products that have been refined elsewhere.

The U.S. currently imports about 52 percent of its total petroleum (DOE 2001b). Many are concerned that this leaves the U.S. vulnerable to politically-

motivated supply disruptions from foreign suppliers, such as the ones seen in the 1970s and early 1980s. This vulnerability is one reason for our ongoing military and political involvement in the Middle East. Opening ANWR to drilling has been proposed as a way to alleviate these economic and national security concerns and allow the U.S. greater self-determination in both political and economic processes. However, ANWR resources could not significantly change U.S. dependence on oil imports.

Any country that imports or exports petroleum and maintains reasonably open markets is bound by world energy markets. ANWR oil could only provide the U.S. with greater control over energy prices if there were enough of it to influence world oil markets.

However, even at peak production levels the addition of ANWR oil to U.S. production would only raise our projected share of world output from 4.1 percent to 5 percent by 2020. At the same time, OPEC output is expected to increase to about 50 percent of world oil supply by then. The potential ANWR resource is simply not large enough to offset the market power that OPEC will have. Even if the OPEC coalition stopped deliberately influencing oil prices or fell apart, the U.S. would not control enough of the world's oil production to control prices. Drilling in ANWR would thus do little if anything to promote energy or economic stability.[6]

According to the EIA, the U.S. imported about 52 percent of our crude oil and refined petroleum consumption in 2000. This is expected to increase to about 64 percent by 2020 (the latest date for which the EIA produces forecasts). Assuming that oil extraction in ANWR were to begin 10 years after Congressional approval (EIA estimates it would take 7 to 10 years), the mean resource scenario and moderate extraction rate provided by the EIA would reduce our import dependence by less than one percentage point, to 63.3 percent by 2020. Under the more optimistic assumption that extraction began 7 years after approval (a time frame viewed as highly optimistic by most of the oil industry[7]) and assuming a more rapid development rate (which would provide more oil in early years and lead to more rapid depletion), the import share would only fall to about 62.8 percent.

If OPEC's share of U.S. imports rises proportionately with OPEC's share of world output, then even in the optimistic scenario we would import 31.4 percent of our petroleum needs from OPEC, down just over one percentage point from 32.7 percent without ANWR. Even in the low probability (5 percent) resource scenario with a high extraction rate, ANWR would reduce our dependence on OPEC imports by only 2 percentage points.[8] Because it would not significantly reduce our dependence on foreign and OPEC oil and would not insulate us from price swings in the global oil market, it is clear that extracting ANWR oil would not shield the U.S. economy from manipulation by foreign oil producing countries.

While OPEC supplies a substantial share of the world's oil needs, non-OPEC members provide 60 percent of global oil supply. In the extreme event of a complete OPEC oil embargo against the United States, there would be more than enough oil from other sources available to fill our needs, although oil prices would certainly rise sharply. OPEC's power comes not from the physical ability to keep oil from flowing into the U.S., but rather from its ability to make oil so expensive that we are forced to consume significantly less of it while paying higher prices for the oil that we do consume.

Even if we didn't import any oil from OPEC, its control over oil prices would still make stability in the Middle East a major political and economic concern. The real security issue is not

that we are heavily dependent on foreign oil, but that we are heavily dependent on oil at all. Oil prices are important to us because oil is important to us. Until we diversify our energy sources and increase our energy efficiency, large swings in oil prices will continue to produce large swings in the economy, and we will remain dependent on world oil markets and foreign oil producers. Drilling in ANWR will do nothing solve this problem.

Macroeconomic Effects of ANWR Oil Production

Another argument made in favor of developing ANWR oil resources is that it would create substantial economic benefits in terms of both employment and national income. Proponents often cite the estimate that drilling in ANWR would generate 735,000 additional jobs. In reality, however, the job impacts are likely to be less than one tenth of that.

The frequently-cited job estimate comes from a 1990 study by the modeling and forecasting firm, WEFA, Inc., prepared for the American Petroleum Institute (API). The study, "The Economic Impact of ANWR Development" (WEFA 1990), attempted to assess the impacts of development under a number of different scenarios, including various world oil price projections and oil resource estimates. One of these scenarios produced an estimated employment impact of 735,000 additional jobs at the peak of ANWR production.

Importantly, the main benefit found by WEFA to result from drilling in ANWR would not be the additional jobs that might result from opening new oil fields, but rather the lower inflation rates and trade deficits that the study suggests would result from a massive drop in world oil prices caused by ANWR oil coming to market. These benefit estimates are based on a set of unrealistic assumptions that inflate the impact that drilling in ANWR could have, however. Additionally, the information and predictions that drive these results are now long out-of-date.

The WEFA study is now nearly 12 years old, and economic and political conditions have changed dramatically since it was done. The study assumed that ANWR production would reach its peak in 2005, when world oil demand was projected to be about 56 million barrels per day (mbd). In reality, world demand has greatly outstripped WEFA's projections, exceeding 75 mbd in 2000. Demand is projected to reach nearly 120 mbd by 2020, which is well before ANWR extraction now could be expected to peak. The larger world oil demand is, the less impact any given amount of ANWR oil would have on world oil prices. Merely updating these projections would cut the expected employment impacts of drilling in ANWR by more than half.

In addition to being based on outdated oil market information and projections, the WEFA report also overestimated the likely price of oil when ANWR oil would reach the market. WEFA projected that world oil prices would exceed $45 per barrel in 2005, rising to about $47.50 by 2010. The Department of Energy projects far lower prices, as does WEFA itself in its more recent work (DOE 2001b and WEFA 1997). In both cases, world oil prices are projected to remain below $26 per barrel through 2020. Overestimating prices inflates the benefits of drilling, because the price relief that a given amount of additional oil could provide is higher when supplies are tight and prices are high. Replacing WEFA's assumptions with newer ones reduces the remaining projected employment benefit from ANWR drilling by half again.

Productivity tends to grow over time, and WEFA's productivity projections are also outdated. According to the WEFA projections, in 2005 the U.S. economy will produce about 13,500 jobs per billion dollars of national income, a measure that falls as productivity increases. In part because the 1990s saw productivity gains that would have been difficult to predict at the beginning of the decade, the economy produced about 13,350 jobs per billion dollars of national income in 2000, well

ahead of WEFA's projections. Assuming that this measure of productivity improves at just 1 percent per year (it improved 1.3 percent per year from 1981-2000 and 1.4 percent per year from 1991-2000), jobs per billion dollars of income would fall to just under 11,000 by 2020. All else equal, this alone would reduce the employment impacts of ANWR drilling by about 15 percent.

In addition to relying on outdated data, the WEFA analysis is also based on assumptions that are indefensibly optimistic. Relying on information supplied by the American Petroleum Institute (API), WEFA assumed that there would be 9.25 billion barrels of economically recoverable oil beneath ANWR, roughly corresponding to the 5 percent probability assessment of Area 1002 developed by the USGS (see Table 1). The USGS mean assessment of this resource is 6.1 billion barrels, about one-third less than WEFA assumed. The size of the resource is important both because it helps determine the value of the oil once it is extracted and also its impact on the world market. Less oil means a smaller reduction in the trade deficit, as we would need to import more oil than WEFA assumed. But it also means that ANWR oil would have lessimpact on the world oil market, providing smaller benefits in terms of energy costs and inflation than WEFA's analysis suggests.

Two other assumptions that serve to overstate the impacts of drilling in ANWR are the rate at which ANWR oil would be extracted and the lag between Congressional approval of drilling and peak ANWR production. WEFA, again relying on information supplied by API, assumed that 1) oil extraction could begin seven years after drilling leases were granted (which WEFA notes is "generally regarded as highly optimistic by most of the industry"), 2) that leases would be granted in 1990, and 3) that peak production would be reached in 2005, eight years after first production and 15 years after leases were granted.

According to the EIA, peak production under the most rapid development scenario it considered would not occur until 17 years after first production. First production, in turn, would not occur until 7 to 12 years after leases were granted. A more moderate production schedule would peak 25 years after first production. Rather than the 15-year lag between approval and peak development assumed by WEFA and API, peak production under federal government scenarios would not take place until 24 to 37 years after approval.

Not only does the WEFA analysis overestimate how quickly benefits of drilling in ANWR would be felt, but the rapid development rate that WEFA assumed also overstates the peak impacts of development. WEFA's forecast of an additional 735,000 jobs at peak production is a major component of its estimated benefits from drilling in ANWR. Five years after peak production, the employment gains fall by nearly half as ANWR production slows. The peak employment impact is highly sensitive to the development rate, and the rapid rate assumed in the study serves to exaggerate the impact of development. A more rapid development rate would also exhaust the resource more quickly, so that the employment gains would dissipate more rapidly.

If Congressional approval were granted immediately, and production began 10 years after that, then under the most rapid development rate considered by EIA and a resource assessment of 8.26 billion barrels, ANWR production would be no more than 789 thousand barrels a day by 2020, about 60 percent lower than WEFA's assumed peak development rate of 1.9 million barrels per day.[9] Any remaining economic benefits of drilling in ANWR would be reduced by about the same 60 percent.

The WEFA analysis relies on assumptions that, in general, inflate the benefits that might result from drilling in ANWR. While any one of these assumptions might lead to a relatively small over-estimate of the impacts, together their effects are compounded, resulting

in an outdated and excessive assessment. Replacing WEFA's string of unrealistic assumptions with more moderate ones reduces its job creation estimate by about 93 percent. Instead of creating 735,000 jobs, drilling in ANWR would not produce any notable employment gains for the next ten years. The largest impact it could have over the next 20 years would be to create about 64,700 jobs in 2020, an employment gain of less than one-tenth of one percent of the U.S. workforce as a whole.

Conclusions

As the debate continues over whether or not to open the Arctic National Wildlife Refuge, proponents of drilling suggested that it would provide both increased national security and large economic benefits. A review of the economics of oil markets and the U.S. resource potential reveals, however, that drilling in ANWR would do little to reduce either political or economic risks. In fact, if increased production in ANWR is used as a substitute for increased energy efficiency, we will become more dependent on foreign oil than we otherwise would. As a result, we would actually become more susceptible to political and economic influence from OPEC and other foreign oil producers.

The economic benefits from drilling in ANWR would also be small. A more realistic assessment of the impacts of drilling in ANWR finds benefits less than one-tenth the size estimated by some proponents. The vast majority of the benefits of extracting ANWR oil would go to the oil companies that would sell the oil. For the average American, opening ANWR would do little to spur economic growth and job creation or to lower energy prices significantly. In fact, in today's terms, drilling in ANWR would lower gasoline prices by no more than 1 penny per gallon.

While the goals of economic growth and national security are laudable, drilling in ANWR would do little to promote them. A more successful approach to reducing our dependence on foreign oil would be to reduce our dependence on oil altogether. Enhancing energy efficiency would insulate the economy from the political and economic uncertainties of global oil markets, while providing substantial economic benefits in both new technology development and reduced energy expenditures. This approach could provide substantial long-term benefits, as opposed to the relatively minor and ultimately temporary benefits drilling in ANWR might provide, without the risk of permanently damaging sensitive ecologies.

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Appendix

This Appendix provides a more detailed examination of the WEFA analysis. The first section summarizes the approach that the analysis takes and identifies several important assumptions used by WEFA that drive its conclusions. The second section details problems with these assumptions and how WEFA's projected peak-year benefit of 735,000 jobs falls to 64,700 as each assumption is reconsidered.

Inflated Estimates of the Impacts of ANWR Development

The estimate of impacts that the Administration and other proponents of drilling choose to cite come from a 1990 study by the modeling and forecasting firm, WEFA, Inc., prepared for the American Petroleum Institute, entitled "The Economic Impact of ANWR Development." (WEFA 1990). The study attempted to assess the impacts of development under a number of different scenarios, including various world oil price projections and oil resource estimates. The scenario that produced the735,000 job creation estimate uses WEFA's baseline forecasts of world oil prices and assumes a high level of ANWR oil resources. (Other scenarios include high and low oil price scenarios as well as low and zero ANWR oil assumptions; these scenarios all produced smaller impacts than the one examined here).

Written in 1990, the study assumed that permission to drill was granted in that year, and that development would begin in 1997. The study further assumed a fairly rapid development rate, so that peak production was reached in 2005. The high resource scenario assumed that 9.25 billion barrels of oil would be economically recoverable from ANWR. Peak daily production is assumed to be about 1.9 million barrels per day (mbd), or about 3.4 percent of global oil supply. This is just below the physical capacity limit of the Trans-Alaska Pipeline of 2 million barrels a day and could only be achieved if output from other non-ANWR Alaskan wells was reduced to nearly zero. The increased output puts downward pressure on oil prices, causing other producers to cut back on their supply, either because it is no longer profitable to extract and sell oil at the lower price or because suppliers with the power to influence the market (like the OPEC cartel) cut output in a deliberate attempt to sustain higher prices.

The combined effect of the increased ANWR production and reduced production from other sources in 2005 is projected to be an increase of about 1.1 mbd, or just over 2 percent of world oil supply. As a direct result, world oil prices in 2005 are almost 11 percent lower than they would otherwise have been (as projected by WEFA's baseline).

ANWR production would have two principal impacts on U.S. employment. The first, direct impact is the increased demand for labor in the extraction and refining industries. These increases would lead to additional economic activity, as increased employment and production in these industries would lead, for example, to increased demand for consumer goods and services by newly employed refinery workers. The WEFA report does not report figures from this direct effect. They are likely to be small, however, for a number of reasons. The first is that any new drilling activity will compete with other drilling already taking place in the state. Unless there is a large pool of unemployed oil industry workers, any increase in employment will simply hire workers away from other drilling sites. The second is that any additional drilling in Alaska is likely to be at least partially offset by reductions in drilling elsewhere in the U.S. In either case, the "new" drilling activity in ANWR is in part only a shift of resources away from other drilling sites.

The second, indirect impact would be much larger than the direct impact and can be broken down into two components. One results from the fact that lowering global oil prices reduces the amount of money producers have to spend on energy to produce any given level of output which in turn results in lower prices for goods and services.

At the same time, lower oil prices reduce the amount households have to spend on any given amount of direct petroleum consumption (heating oil and gasoline, for example). Individuals and the nation as a whole would be able to buy more goods and services with a given level of income. This will be referred to as an 'income effect' because lower prices effectively raise real national income.

The second component is the trade impact that results from importing less oil than would otherwise be the case. Every dollar of oil purchases that goes to an Alaskan producer rather than a foreign one reduces net imports by a dollar, improving our balance of trade and national income. Together, the trade and income effects make up the vast majority of the economic benefits that would result from extracting ANWR oil. Adding these two dollar values provides a convenient measure of the economic benefits of drilling in ANWR.

According to the WEFA study, in its peak year, the reduction in oil prices would free up about $29.4 billion of national income that could be spent on other goods. The fact that more of our oil consumption comes from domestic sources adds another $28.1 billion dollars that would have gone to foreign oil suppliers. Together, these two impacts would effectively add about $57.5 billion to national income in 2005, which WEFA assumed would be the peak production year. WEFA's projected employment gains of 735,000 amount to about 12,750 jobs per billion dollars, slightly lower than the average of about 13,500 jobs per billion dollars of national income in its baseline scenario for the same year.

Correcting the Analysis

There are several factors and assumptions that explain why the WEFA study arrived at its conclusions. These include assumptions about the state of the world oil market, the quantity of oil underlying ANWR, the rate of ANWR development, labor productivity, and the responsiveness of domestic and foreign oil producers to an increase in global supply. A close examination shows that in many cases, these factors and assumptions are overly optimistic and produce results that are unrealistically high.

One important caveat to the WEFA results is the temporary nature of the jobimpacts. The frequently cited 735,000 job creation estimate is WEFA's estimate of employment creation in the peak year of ANWR oil production (assumed to be 2005). WEFA's results are reported in five-year increments, so it is impossible to know exactly how long these jobs last, but by 2010, the employment impacts fall by nearly half to 372,000 additional jobs.

A more accurate description of the employment impacts would be to measure the average annual additional employment or the number of additional job-years (calculated as the product of additional employment and the duration of employment in years). Because the results are reported in 5-year increments, it is impossible to calculate either of these precisely. However, assuming that employment impacts change in step-wise fashion (e.g. that all 735,000 additional jobs in 2005 last until 2010 after which 372,000 additional jobs remain which in turn last until 2015) yields a rough estimate of average annual impacts of 393,000 additional jobs over the first 20 years of ANWR oil extraction.[10]

Using updated and more realistic inputs, this analysis will produce a more reliable estimate of the impacts of drilling in ANWR for both the average of the 20 years as well as the peak year.

World Oil Market Projections

Two important inputs in the WEFA analysis are the oil price and production levels that were projected in both its baseline and ANWR extraction scenarios. In addition to being a decade old at this point, the study under-predicted global production and over-predicted the price by a wide margin.

The model predicted that by 2005, without ANWR, world producon would

be 55 million barrels per day (mbd) and the price would be over $45 per barrel. With ANWR production, these were projected to be 56 mbd and $40.50 per barrel. In contrast, we now know that by 2000, world oil production had already exceeded 76 mbd. By 2015 (a time frame roughly equivalent to 2005 in the WEFA analysis), production is expected to reach almost 107 mbd (nearly twice WEFA's 2005 forecast) and 120 mbd by 2020. Additionally, prices are expected to be considerably lower than the WEFA projections. Using current EIA projections, world oil prices in 2015 are expected to be much lower, around $22.50 per barrel rising to just under $23 in 2020. In fact, a more recent projection from WEFA, a 1997 analysis of the Kyoto Protocol on climate change, produced baseline oil price forecasts much closer to the EIA projections, about $24 in 2015 and just over $25 in 2020.

Both of these are very important to the analysis. Revising production levels is important because, for any given amount of oil that might come out of ANWR, a higher world production level means that the ANWR oil will be less important relative to world supplies and will thus have a smaller impact on oil prices. The projected price levels are also important because price impacts depend on percentage changes in prices.[11] In the WEFA analysis, ANWR production is projected to reduce world oil prices by about 11 percent in 2005. At the higher prices predicted by WEFA, this is about $4.77 per barrel. At the lower updated prices from EIA, this impact is much smaller in dollar terms, reducing prices by $2.37 per barrel.

Updating these two numbers results in lower estimates of the income and trade benefits associated with drilling in ANWR. Simply updating the production numbers alone cuts the benefits approximately in half, as the price impact falls from 10.5 percent to 5.4 percent, because ANWR oil is about half as important as WEFA predicted it would be (1.77 percent of world oil supply as opposed to 3.45 percent). Updating the price forecasts further reduces the benefits, so that instead of lowering prices by $4.77 per barrel, prices would fall by about $0.73 per barrel.

Together, updating these two numbers reduces the income benefit from $29.4 billion to $7.5 billion and reduces the trade impact from $28.1 billion to $14.7 billion, lowering the total impact from $57 billion to $22.2 billion. Assuming that $1 billion continues to generate about 12,750 jobs, this would reduce the peak year employment impacts from 735,000 to 283,000.

Quantity of Oil

As mentioned above, the EIA and USGS assessed several different scenarios for the potential oil resource underlying ANWR. The size of the resource is important because it helps determine not only the value of the oil once it is extracted but also the impact extracting it would have on the world market. The WEFA study assumed that there would be 9.25 billion barrels of economically recoverable oil beneath ANWR, which corresponds roughly to the EIA 5 percent probability assessment of oil underlying Area 1002. The mean assessment of this resource, as shown above in Table 1, is 6.1 billion barrels. The high assumed level of economically recoverable oil appears to be due, at least in part, to the high oil prices WEFA projected, which would make more of the technically recoverable oil profitable to extract. Reducing the potential ANWR resource from 9.25 billion to 6.1 billion barrels (and assuming that the extraction rate falls proportionally) lowers the economic benefit further. Combining this with the other corrections above reduces the income effect to just under $5 billion and the trade effect to $9.9 billion. This total effect of about $15 billion would reduce the employment impacts further to about 191,000 new jobs. Using the higher resource assessment of 8.27 billion barrels that includes the entire coastal plain (rather than just Area 1002) reduces

the benefits by a smaller amount, to $19.9 billion with employment impacts of 255,000.

Development Rate

Two other assumptions that overstate the impacts of drilling in ANWR are the rate at which ANWR oil is extracted and the lag between the time that Congress approves drilling and when ANWR production reaches its peak. WEFA, using information supplied by the API, assumed that oil extraction could begin seven years after drilling leases were granted (which WEFA notes is "generally regarded as highly optimistic by most of the industry"), that leases would be granted in 1990, and that peak production would be reached in 2005, eight years after first production and 15 years after leases were granted. According to EIA and USGS, peak production under the most rapid development scenario they considered would not occur until 17 years after first production, which in turn would not occur until 7 to 12 years after leases were granted. A more moderate production schedule would peak 25 years after first production. Rather than the 15-year lag between approval and peak development assumed by WEFA and API, peak production under federal government scenarios would not take place until 24 to 37 years after approval.

Not only does the WEFA analysis thus overestimate the how quickly benefits would be felt, but the rapid development rate also overstates the peak impacts of development. The forecast of an additional 735,000 jobs is the largest impact in any single year in the 20-year forecast. As noted above, five years after peak production, the projected employment gains fall to 372,000. The peak employment impact is highly sensitive to the development rate, and the rapid rate assumed in the study serves to exaggerate the impact of development. A more rapid development rate would also exhaust the resource more quickly, so that the employment gains dissipate more rapidly.

If Congressional approval was granted immediately and production began 10 years after that, then under the more rapid development rate assessed by EIA and a resource assessment of 8.26 billion barrels, ANWR production would be as high as 789,000 barrels a day by 2020. Using this as the peak production magnitude and date, and maintaining WEFA's other assumptions about the reaction of world oil markets to ANWR production, world oil supplies would increase by about 469,000 barrels. This is an increase of about 0.4 percent, leading to a reduction in price of about 2.02 percent, as compared to WEFA's assumption that world supply would increase by 2.05 percent leading to a price reduction of over 10 percent. Correcting this reduces the income effect to $2.8 billion and the trade effect to about $6.1 billion. Together, this comes to $8.9 billion with employment impacts of 112,000 jobs. Using the more modest development rate lowers this further to $5.9 billion and 75,000 jobs.

Other Factors

Because the majority of the economic benefits from extracting ANWR oil would come from the indirect impact of lowering world oil prices, WEFA's assumptions regarding the response of world oil markets are critical to its projections. As noted above, WEFA projects that in 2005, ANWR production would be approximately 1.9 mbd, but that world oil supply would increase by only 1.13 mbd because some production becomes unprofitable at lower prices or due to market manipulation by large suppliers like OPEC.

WEFA assumed that peak ANWR production would reduce world oil prices by about 10.5 percent, leading to supply cuts of about 1.4 percent by OPEC and other oil suppliers, implying a supply elasticity of about 0.13. While elasticities can be difficult to determine with precision, the value used by WEFA is at the decidedly low end of estimates of long-term oil supply elasticity. In fact, a survey of the literature found supply elasticities ranging

between 0.144 and 0.98, with an average of 0.38 (Huntington 1991). This is important, because the rate at which other suppliers respond to ANWR production will largely determine what, if any, impact ANWR oil will have on world oil prices. Using a more moderate elasticity of supply would further reduce the expected benefits of drilling, as OPEC and other producers would offset more ANWR production with cutbacks of their own.

Finally, another problem resulting from the age of the WEFA analysis is the growth in labor productivity. In 2000, the U.S. economy produced about 13,350 jobs per billion dollars of national income, similar to the rate projected by WEFA for 2005, and slightly higher than the rate WEFA projected as a result of ANWR drilling. As productivity increases over time, however, this rate will fall. Over the last 20 years, this rate fell by over 20 percent – an annual rate of about 1.27 percent. Using a more moderate rate of just 1 percent per year would reduce the projected 2020 employment gains by about 15 percent. This would lower the peak year employment gains to 96,800 under a rapid development rate or 64,700 under the more moderate rate.

Over the next 19 years, the average increase in employment for any given year would be about 27,600 jobs in the rapid depletion rate and 19,500 jobs at the moderate development rate (about 0.013 percent of projected average annual employment). By any measure, these projected impacts are vastly smaller than those implied by the WEFA analysis, which appears to overstate the employment impacts by a factor of more than 10.

End Notes

[1] While there are different types of oil, defined by sulfur content and density, similar types of oil are easily substitutable for one another regardless of producer.

[2] The main role that geography plays in oil markets is in transportation costs. The relevant measure for crude oil consumers is the price of the oil plus transportation costs. These costs are generally moderate. In 2000, the average landed cost of oil imported to the U.S. was about $27.58 per barrel, while domestic oil cost $25 per barrel.

[3] Unless otherwise noted, all prices in this report are in 2000 dollars, deflated with the GDP implicit price deflator.

[4] Some argue that since the unrestricted lands require no further Congressional action for drilling to commence, these lower resource levels are the relevant measure of the amount of oil that would become available if Area 1002 were opened. It is not clear, however, why oil companies have not already drilled these available areas. Given that substantial additional pipelines would have to be built to connect the ANWR oil sites to the Trans-Alaska pipeline, oil companies may feel that it is not profitable enough to invest in the pipeline and other capital requirments to extract and transport ANWR oil unless the entire Coastal Plain is available. Wherever relevant, this discussion will address both the total and the Area 1002-only resources.

[5] Unlike the oil at Prudhoe Bay, which is a single giant oil field, the ANWR oil resource is likely spread out among many small accumulations, which would require a large number of wells to develop.

[6] Further, unlike OPEC where output decisions are made by political leaders, U.S. production levels are determined by individual decisions made by several different oil companies based on business considerations. Even if the U.S. dominated world oil markets, U.S. companies would not be likely to change output levels in order to achieve some political goal. Their output decisions would instead be made to achieve their business goals, as they are now.

[7] See WEFA 1990, p. 29

[8] These estimates themselves exaggerate the benefits of drilling because they assume that none of the oil extracted from ANWR is exported and that it does not offset any domestic production, reducing only imports. While it is impossible to know in advance how much domestic production would be offset by ANWR oil, if it were proportionate to consumption patterns, the import reduction would fall by about 25 percent. These calculations are based on the oil assessment of the entire coastal plain. Applying this analysis to only the restricted 1002 area would reduce the impacts by a further 26 percent.

[9] This estimate is also unrealistic because it would require almost the full capacity of the Trans Alaska Pipeline, the pipeline, which is projected to remain between 640,000 and 960,000 barrels per day through 2020. Instead of increasing domestic oil supply by the stated 1.9 mbd, the pipeline is projected to have only enough excess capacity to carry an additional 1.04 to 1.36 mbd over the next 20 years.

[10] Because no drilling or extraction occurs prior to 1995, the 20-year time span relevant for the WEFA analysis is 1995 to 2015.

[11] The relevant measure is called an 'elasticity', which measures the percentage change in price caused by a percentage change in production.

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