

Arctic National Wildlife Refuge: Economics of Potential Oil Development

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Research and strategy for the land community.

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Executive Summary

Background

To some, drilling for oil and gas in the Coastal Plain of the Arctic National Wildlife Refuge (Coastal Plain) promises abundant, cheap energy that would displace oil imports, lower domestic gas prices, boost employment, and raise revenue to bring down the deficit. These promises, however, are based on outdated information and rosy assumptions about how much oil the Coastal Plain may hold, the price the oil may fetch, and the speed with which oil and gas could be found, extracted, and brought to market. Given the enormous risk to ecosystems and human welfare that such oil exploration and development would impose, it is essential that promised benefits be closely, carefully, and critically examined.

Estimates of Undiscovered Oil on the Coastal Plain

Potential oil deposits under the Coastal Plain are unproven reserves, meaning there is no guarantee that oil is there and could one day be produced and sold. Ultimately, the only oil that matters is economically recoverable oil—that portion of technically recoverable oil which can be produced for less than the price of oil in the market—contingent on its discovery (Energy Information Administration, 2014). The U.S. Geological Survey (USGS) in 1998 estimated that there is a 50% chance that the Coastal Plain holds 10.4 billion barrels (BBO) of technically recoverable oil, a 95% chance that it holds up to 5.9 BBO, and a 5% chance that as much as 15.2 BBO are present (Attanasi & Freeman, 2009). Economically recoverable oil would be fraction of these volumes. Given the wide range of these estimates (not to mention the fact that they have not been updated in 20 years), Congress should be cautious about relying on oil from the Coastal plain to solve America's energy, budgetary, or broader economic problems.

Arctic Refuge Production Impact on U.S. and Global Oil Supply

Previous assessments suggest that during its peak year of production, the Coastal Plain could bring 700,000 barrels of oil a day to market (Energy Information Administration, 2008). Globally, any added supply from the Arctic Refuge could be offset by a small reduction from OPEC (Behar & Ritz, 2016). Domestically, the argument that Arctic Refuge oil would displace oil imports is not well substantiated: additional oil shipped from Port of Valdez would go primarily to west coast foreign markets. This would initially reduce the flow of tight oil from the Northern Midwest—but only to a limited extent (DeRosa & Flanagan, 2017). After that, additional Arctic Refuge oil would go into storage rather than further displacing imports. Even if each barrel pumped from the Coastal Plain meant one less barrel imported, imports, as a portion of all U.S. oil consumption would fall by only 4% from 52% to 48%, and that impact is during the projected peak of Coastal Plain production (Fineberg, 2011). Meanwhile, unconventional oil production and advances in energy efficiency are the big reasons for reductions in U.S. oil imports in the past decade. Energy conservation displaces 25 times more crude oil imports than oil taken from the Arctic National Wildlife Refuge ever could (Fineberg, 2011).

National and Global Price Impact

The effect on national oil prices would be brief and minimal at best, largely because prices are determined in the global market in which non-OPEC producers act as price-takers rather than price-makers. According to both the EIA (2008) and USGS (2009), the earliest commercial production could begin is 7 to 10 years after Congressional approval. Once production begins, any impact on prices at the pump would likely only be felt during a single peak production year

approximately 10 years later (Energy Information Administration, 2008). At best, consumers could save 1% on gas 15 years after Congressional approval (Energy Information Administration, 2008; Hahn & Passell, 2008).

Potential Jobs Associated with Refuge Development

Changes in employment associated with potential oil production in the Arctic National Wildlife Refuge depend on factors including the phase of development, the number of wells and rigs, specific geographic location, and the type of project (Wood Mackenzie, 2011). Previous employment estimates of these changes vary widely and sit atop a house of cards, the foundation of which is out-of-date assessments of oil volume and oil prices nearly twice what they are today. While it is certain that extracting oil from the Coastal Plain would support some employment, the gains would be temporary and may simply represent a shift of jobs from other regions. Newer data and better models of net changes in economic well-being—that is, those that consider potential loss of traditional and current economic use of the Arctic Refuge—are needed.

Hypothetical Timeline for Oil Development on the Coastal Plain

Various U.S. government, industry, and other entities have estimated the time lag between Congressional approval of oil and gas development in the Arctic Refuge and actual production; estimates range from 7 to 20 years (Thomas et. al, 2009; Arctic Power, 2001; Attanasi and Freeman, 2009). If approval were to be granted in 2018, development and production could occur between 2025 and 2030 based on U.S. Department of Energy phasing (Thomas et. al, 2009). In this scenario, the first payments to the U.S. Treasury would begin in 2022 for leases, and in 2030 for royalties from production, assuming no delays. Under other plausible government and industry scenarios, production might not commence until 10 years later, or by 2040.

Opening the Refuge: Cost to the American Taxpayer

How much revenue the federal government receives will depend on the number of acres leased, the price per acre leased, and the distribution of revenue between the U.S. Treasury and the state of Alaska (Alaska Oil and Gas Competitive Review Board, 2015). Currently, the Trump Administration claims \$1-1.8 billion could be raised by lease sales alone in the next ten years (Office of Management and Budget, 2017). The Center for American Progress, meanwhile, finds no more than \$37.5 million in federal revenue could be raised from leases over the same period, or just 2% of the Administration's estimate (Lee-Ashley & Rowland, 2017). Because the White House and Congress are counting on high estimated revenues to fund expenditures, including proposed tax cuts, any shortfall relative to those expectations will increase the deficit.

Challenges of Frontier Exploration

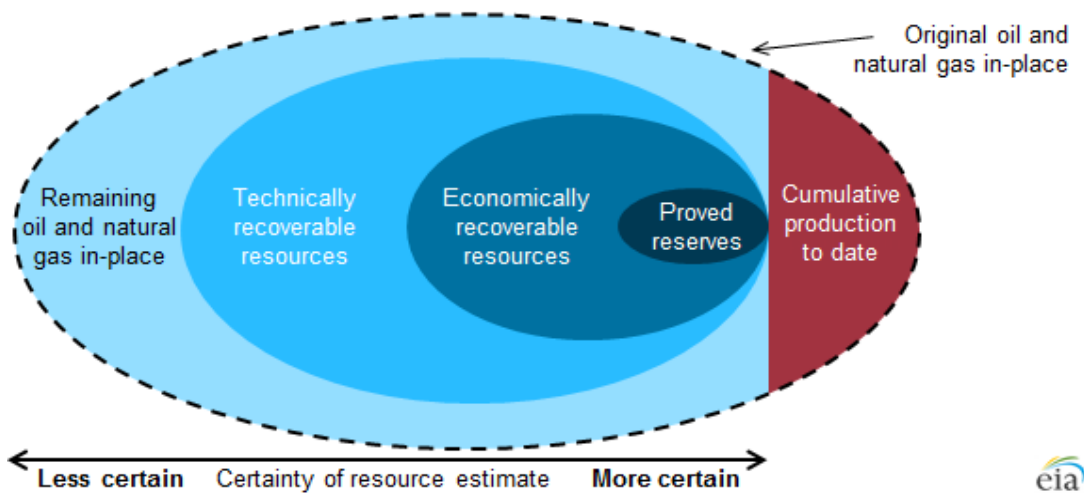
The climate, geography, and isolation of the Arctic present challenges to oil and gas exploration and development. The North Slope of Alaska is remote and sparsely populated with only one road connecting it with the rest of the state. These factors contribute to Arctic development being more expensive, riskier, and lengthier than comparable deposits found elsewhere in the world (Budzik, 2009). In addition to requiring larger investments than comparable projects elsewhere, the long lead-times required for Arctic projects add risk because economic conditions can change significantly between the time exploration leases are secured and when production begins.

Economically Recoverable Oil Potential in the Arctic Refuge

Estimates of technically recoverable oil on Alaska’s Northern Slope continue to fuel the decades-long debate on oil drilling in the Coastal Plain (1002 Area) of the Arctic National Wildlife Refuge.¹ The more important consideration—and one often overlooked by those advocating for drilling—is how much of that oil will be economically recoverable, and to what extent should undiscovered economically recoverable oil inform market and policy decisions? While technically recoverable oil refers to oil that can be produced using current technology and geologic knowledge, economically recoverable oil is the portion of technically recoverable oil that can be produced for less than the price the oil would bring in the market—contingent on its discovery (Figure 1) (Energy Information Administration, 2014).

Figure 1. Visual representation of oil resource categorization (not to scale)

Source: U.S. Energy Information Administration, 2014



In the longer run, changes in technology (which presumably would be adopted only if they make recovery cheaper) would increase economically recoverable reserves. However, if cost-saving technology affects only other reserves elsewhere, the relative cost of North Slope oil will increase and its economically recoverable reserves will fall. Hydraulic fracturing, which has made production from shale and tight sands in the lower 48 states relatively less expensive, is a good example of this dynamic at work. The fracking boom has boosted energy supply and driven down prices, which further narrows the gap between the price of non-fracked oil and the cost of producing it (Nicks, 2014).

¹ The absolute limit to technically recoverable oil is not the total amount of oil available (as shown in Figure 1). Rather, it is the amount that can be extracted at a lower cost *in energy* than the energy content of the extracted oil. The ratio of energy out to energy in is the “energy return on investment” (EROI) and when that ratio falls below one, further effort to produce that energy become thermodynamically nonsensical (Daly & Farley, 2011; Hall, Lambert, & Balogh, 2014). One would not, for example, use 6 million BTUs of energy to pump a barrel of oil that may yield only 5.8 million BTUs (EROI=0.97). Even so, and due either to poor policy or a desire to have energy of a particular type or in a particular form (e.g., liquid fuel), it is possible to produce such oil at an energy loss, so long as other energy is available to make up that gap between energy out and energy in. Moreover, technically recoverable oil can increase over time as energy-saving technology, which increases EROI up, is developed and adopted in the energy industry.

Clearly, estimates of the portion of oil reserves that is economically recoverable are fluid, and they are not nearly as easy to know at any moment as the volume of oil *in situ*, or even the volume that is technically recoverable. Economically recoverable reserves, however, is the more appropriate measure to use when assessing potential undiscovered resources in the Arctic. Otherwise, taxpayer dollars may be spent to facilitate production, incur environmental and social costs, and otherwise subsidize the production of oil that is not worth recovering.

Government Estimates of Recoverable Oil in the Coastal Plain Area of the Arctic Refuge

Government reports published in the last ten years provide estimates of the total undiscovered technically and economically recoverable oil in the Arctic Refuge. The latest U.S. Geological Survey (USGS) assessment, published in 1998 and updated in 2009, provides an average estimate, or 50% chance, that 10.4 billion barrels (BBO) of technically recoverable oil exist on the Coastal Plain (1002 Area) of the Arctic Refuge. Their estimates give a 5% probability that as much as 15.2 BBO exist on the Coastal Plain, and a 95% probability that at least 5.9 BBO are present (Attanasi & Freeman, 2009). Both the National Energy Technology Laboratory and USGS reported that, of the technically recoverable amount on the Coastal Plain, a mean estimate of 7.7 BBO, or 75% of the total estimate, is located on federal lands, while 25% lies under state and native lands within the Refuge. Considering that the economically recoverable volume is almost always a fraction of the technically recoverable volume, the 7.7 BBO represents an upper threshold mean estimate for how much oil could be produced from the Coastal Plain's federal lands (Thomas, et al., 2009).

The U.S. Energy Information Administration (EIA) (2008) based its estimates of oil production potential in the Refuge on the USGS estimate of about 7.7 billion barrels of oil technically recoverable in the federal land portion of the Coastal Plain. The EIA created three scenarios that reflected the low, mean, and high estimate of *technically* recoverable oil provided by the USGS 1998 assessment. They compare these three scenarios to the 2008 Annual Energy Outlook "reference" case, which is a business-as-usual projection of resource supplies and prices contextualized by economic conditions.

In the reference case, with no additional oil from the Arctic Refuge, U.S. production increases from 5.1 MBD (million barrels per day) in 2006 to a peak of 6.3 MBD in 2018, then falls to an average of 5.6 MBD by 2030 (Energy Information Administration, 2008). In this case, Alaskan production increases post-2014 from the discovery and development of new offshore oil fields expected to be found off the North Slope (Energy Information Administration, 2008).

In all three Arctic Refuge oil resource cases, production starts in 2018 (now 2028, because, the analysis was published 10 years ago), and peaks at 510,000, 780,000, and 1,450,000 barrels per day around 2028 (now 2038) in the low, mean, and high-resource-case scenarios respectively. EIA estimates that Cumulative oil production in the twelve years following initial production would be 1.9 BBO, 2.6 BBO, and 4.3 BBO in the low, mean, and high-resource-case respectively (Energy Information Administration, 2008).

Limitations of Government Agency Analyses

There are a number of reasons to be cautious in using the 2008 EIA and 2009 USGS updated economic analyses as a resource for policy-making. The first and foremost concern with these government analyses is that they are based on outdated information. The last geological assessment was performed two decades ago using financial data and technological assumptions from that time, making it nearly irrelevant as a guide to current energy, budget, or economic

policy. In May of 2017, Secretary of Interior Ryan Zinke ordered a plan for updating assessments of undiscovered, technically recoverable oil in the Coastal Plain, which would include consideration of new data as well as a reprocessing of existing data (U.S. Department of the Interior, 2017). Second, and while often noted at the end of these reports, there is a great deal of uncertainty surrounding resource estimates in the Arctic Refuge.

Another concern arises from the comparison of the three EIA *technical* estimates with a reference case embedded in the 2008 (then current) economy rather than economic estimates tied to long-term oil price projections. These factors suggest that the EIA's 2008 report, while one of the most recent analyses of oil production in the Arctic Refuge, is outdated in significant aspects ten years later, and should not be relied on as a source for economically recoverable estimates in the Arctic Refuge.

Price Projections

Price projections for crude oil are essential for determining the volume of undiscovered economically recoverable oil. Both the USGS 1998 assessment and 2009 economic update estimates are based on data from periods in which crude oil prices were fluctuating significantly. Since 2009, however, the global financial crisis as well as increases in supply erased much of the gain in prices (in real, or inflation-adjusted terms) since 2000, and prices are now more in line with historical norms (Figure 2).

Figure 2. Crude Oil Prices 1989-2016

Source: Macrotrends, L.L.C., 2017



A more relevant estimate of economically recoverable reserves available in the Coastal Plain is obtained by re-examining the 2009 USGS scenario in light of today's prices and the longer-term trends. First, we adjust the current price of crude oil, which was \$50/BBL in September 2017, for inflation to get its 2007 equivalent of \$42/BBL. Assuming all other parameters are unchanged, there would have been 14.9 BBO of economically recoverable oil at that \$42/BBL price point in the entire North Slope study area in 2008. Of that total, 9.1 BBO would have been in the 1002 Area of the Arctic Refuge. Finally, since 75% of the technically recoverable oil in the Coastal Plain of the Arctic Refuge is estimated to occur on federal lands, some 6.8 BBO could be economically recoverable at current (September 2017) prices (Attanasi and Freeman, 2009). The purpose of this calculation is not to provide a new estimate for how much oil production to expect

from the Coastal Plain, but rather to show how price changes alone can affect the implications of assessments from 10 to 20 years ago.

Economically Recoverable Oil vs. Break-even Prices

The most relevant oil prices are those that may prevail during the time at which Arctic Refuge resources would be extracted. If development were permitted today, it is unlikely that any oil would flow before 2028 (Energy Information Administration, 2008). Therefore, the relevant prices to use *today* to estimate economically recoverable oil would be the prices expected in 2028 and through a production period of up to 30 years. Naturally, predicting future price trends is difficult, and any resulting estimates of economically recoverable oil should be understood to come with a wide margin of error, and to be a measure of *undiscovered oil* (Behar & Ritz, 2017).

The price estimates for undiscovered oil cannot be contextualized with regional break-even prices often reported by market analysts; the economically recoverable price is used to inform industry of potential in a region under particular economic conditions, whereas the break-even prices often inform companies on specific producing regions or projects for which costs are more certain.

Other Factors Influencing the Cost of Coastal Plain Oil Production

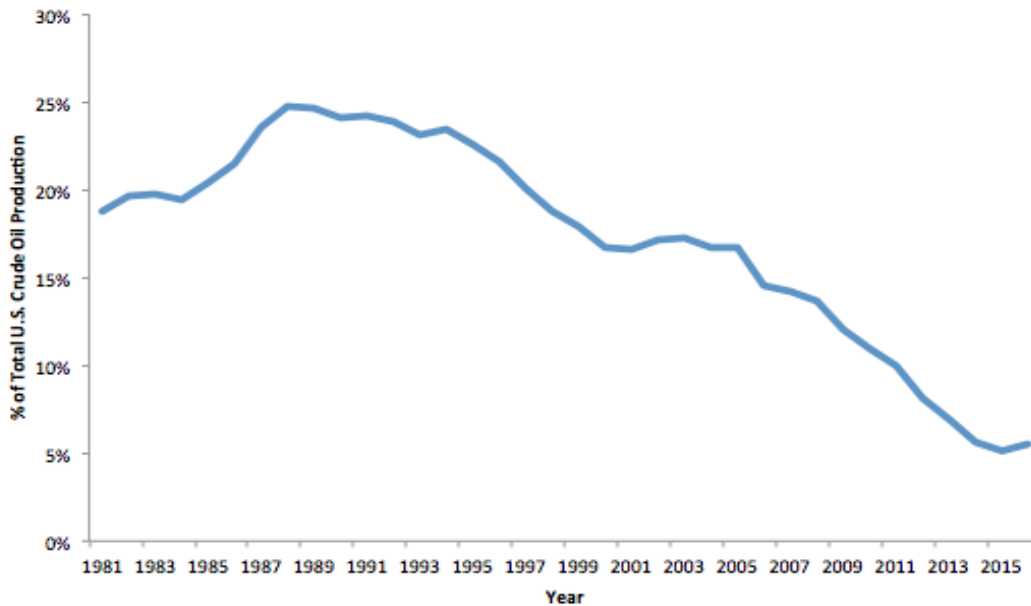
The most important stipulation to projections of economically recoverable oil is that all of the projections described above are based on the estimated *private* or *internal* (to the oil companies) costs of bringing undiscovered oil to market. They do not consider the *external* costs of development, extraction, transportation, and ultimate consumption of energy derived from the Arctic Refuge crude oil. These costs include climate change, loss of habitat, human health effects of the release of toxins, disaster (spill) preparedness and response and a host of other costs that are largely shouldered by taxpayers. These costs are only imperfectly (at best) reflected in the market price of a barrel of oil, and call into question the notion that oil and gas development in the Arctic Refuge would actually generate revenues to balance the federal treasury. Because these costs could total 100% or more of the market value, the *net* price of oil could be zero or even negative. In that case, obviously, the amount of oil economically recoverable from the Arctic Refuge would be zero (Hall, 2004).

Impact of Arctic Coastal Plain Oil Production on U.S. and Global Supply

Since the debate on drilling in the Arctic National Wildlife Refuge began, proponents have insisted that the added domestic production will reduce U.S. dependence on foreign oil while lowering consumer prices and adding industry jobs in Alaska. Historically, Alaska has been one of the highest producing oil states in the U.S. with more than 738 million barrels of oil produced in its peak year in 1988 (Energy Information Administration, 2016a). In the 1980s and 1990s, Alaska accounted for 20% to 25% of total U.S. production annually, but as of 2016, Alaskan crude oil production made up only 5.5% of total U.S. supply (Figure 3). In the past ten years, mostly increases in tight oil production in the Northern Midwest and Gulf Region have contributed to decreased imports and greater U.S. reserves (Energy Information Administration, 2017b).

Figure 3. Alaska Crude Oil Production as a Portion of Total Annual U.S. Production

Source: Adapted from Energy Information Administration, 2016a



The smaller potential increases in U.S. supply—from even the most optimistic estimates of Refuge production—are projected to have little effect on U.S. imports or oil prices. Alaskan oil production will consistently be dwarfed by tight oil production in the lower 48 states in coming decades as companies continue to make oil discoveries around the Permian Basin in Texas and the Bakken Play in the northern Midwest. According to a new analysis by IHS Markit Ltd. the Permian Basin holds another 60 to 70 billion barrels of yet-to-be-pumped oil, which could supply, “every refinery in the U.S. for 12 years and have a market value of about \$3.3 trillion at current prices” (Carroll, 2017). Even in Alaska’s Prudhoe Bay,

companies continue to discover economically recoverable oil within existing plays². For example, Armstrong and Repsol announced a 1.2 billion barrel discovery on the North Slope of Alaska in Spring 2017, noting the potential to bring 120,000 barrels of oil a day to the market beginning in 2022 (Harball, 2017). Not long after, the same companies announced promising results from an exploration drill in the Horseshoe play, meaning geologically connected discoveries by Caleus Energy, ConocoPhillips, and Armstrong-Repsol in the past year could bring over 400,000 barrels per day of new oil potential from the North Slope (Brehmer, 2017). Each discovery within plays that are already producing commercial oil weakens the commercial appeal of pursuing what oil may exist in the Arctic Refuge, where the lack of transportation infrastructure (roads, pipelines) means higher costs.

Misconceptions on U.S. Oil Import Displacement

Arctic drilling advocates, reinforced by the EIA's 2008 report on the Refuge, suggest that each barrel of oil produced in the Arctic Refuge would reduce U.S. imports by one barrel (Hahn & Passell, 2008). This assumption of a 1:1 ratio of Alaskan production to import reduction neglects existing infrastructure capacity and the flow of oil from Alaska's North Slope to its end-consumers on the West Coast. A recent analysis by DeRosa and Flanagan (2017) uses the National Transportation Fuels Model to simulate increased oil production from the North Slope into the Trans-Alaska Pipeline, which provides some insight into potential impacts of Coastal Plain oil development on pipeline infrastructure. The two primary markets that North Slope oil, including production in the Arctic Refuge, would reach from the Port of Valdez are: 1) delivery to export markets, and 2) shipment to ports on the West Coast of the U.S. (DeRosa & Flanagan, 2017). Should all economically recoverable oil be developed on the Coastal Plain, a nonlinear decline in imports would occur on the West Coast in ports connected to Valdez, with a modest impact on the flow of tight oil from Bakken to Washington and California. After a certain volume threshold, additional production from Alaska would go into storage rather than substitute for imported oil (Fineberg, 2011). Even if oil imports were displaced 1:1, U.S. production would increase domestically by a matter of one to two percent while imports would remain a significant portion of total oil consumption, dropping by, at most, 4 percentage points from 52% to 48% (Fineberg, 2011).

After a forty year ban on exporting oil, the United States began exporting American oil in 2016, and is expected to become one of the top ten exporters globally by 2020 (Slav, 2017). For Arctic Refuge drilling advocates to suggest that the U.S. would benefit from Arctic Refuge drilling because it would reduce America's dependence on foreign oil imports is disingenuous, runs counter to Congress's decision to break the U.S. ban to allow exports and is simply not compelling.

Global Supply

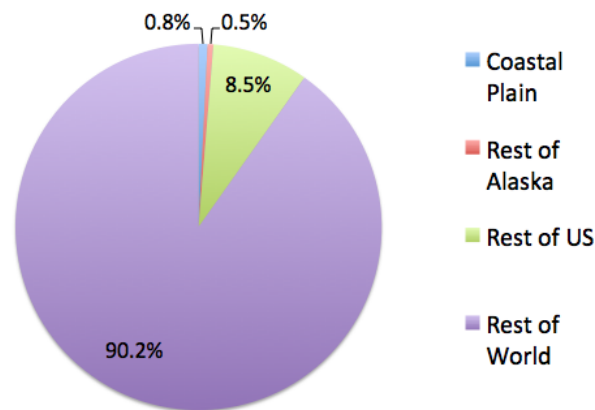
In 2016 world crude oil production averaged 97.23 MBD, while Alaskan production averaged 0.49 MBD, making up approximately 0.5% of total production (Figure 4) (Energy Information Administration, 2016b). Additional production of available, technically recoverable, resources in the Arctic Refuge would total about 0.6% of current *annual* global supply. However it is important to keep in mind that only 1.8 BBO, at most, could be produced before 2035, indicating its overall percent contribution to global supply could vary and ultimately be negligible depending on the rate of global oil

² A set of known or postulated oil and gas accumulations sharing similar geologic, geographic, and temporal properties, such as source rock, migration pathway, timing, trapping mechanism, and hydrocarbon type (Klett, et al., 2000).

consumption, new discoveries in existing wells across the world, and the strategic decisions of OPEC³ (Energy Information Administration, 2008). As of 2015, OPEC members held a market share of just over 40% of global oil production, allowing a degree of market power over non-OPEC producers who act as a price-taking⁴ competitive fringe (Behar & Ritz, 2016). With this market power, OPEC can choose one of two strategies to maintain considerable control over prices, both of which can be optimal for the organization under certain conditions: 1) Accommodate non-OPEC producers to maximize profits via a “high” oil price which allows high-cost non-OPEC countries to remain profitable, or 2) squeeze out non-OPEC producers by driving up production/refusing to cut current supply, thereby driving down price and inducing high-cost producers to exit the market (Behar & Ritz, 2016).

Figure 4. Percent of Global Annual Production of Crude Oil by Region⁵

Source: Adapted from Energy Information Administration, 2016b



With the rapid increase of U.S. shale production in the past decade, many analysts agree that OPEC’s decision not to cut production in November 2014, leading to a crude oil price crash, was a strategic move to squeeze out U.S. unconventional oil producers (Behar & Ritz, 2016). Understanding OPEC’s past decisions to cut or flood supply provides context for how OPEC may act in the future. These characteristics and trends in the global oil market suggest that any increased production on Alaska’s North Slope is only a drop in the barrel in the first instance, and, if it ever were to be an important source of supply it could be subject to OPEC’s strategic behavior. High-cost producers/plays, which would include the Arctic, would likely be the first “squeezed” out of the market if OPEC supply expands in the global market, resulting in decreased oil prices.

³ OPEC (Organization of the Petroleum Exporting Countries) is an intergovernmental organization created in 1960 with the purpose of coordinating and unifying petroleum prices among member countries in order to attain fair and stable prices for producers, regular supply for consumers, and a fair return on capital for investors. The founding members include Iran, Iraq, Kuwait, Saudi Arabia, and Venezuela, and has since been joined by ten other countries (OPEC, 2017).

⁴ In economics, price-takers are agents that must accept prevailing market prices because their transactions are not a great enough share of the total market to influence prices.

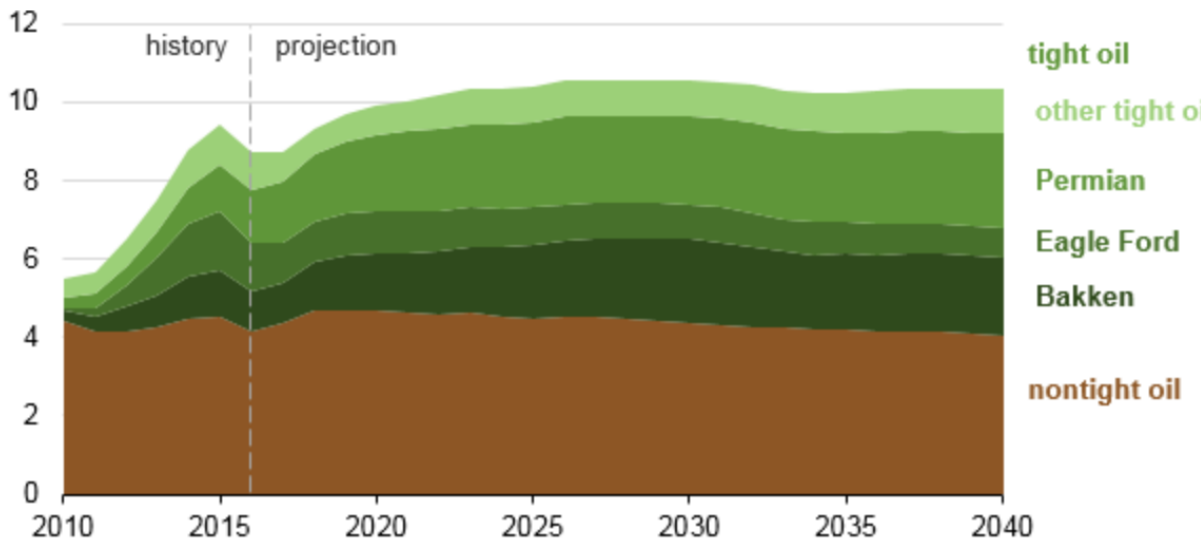
⁵ Annual production figures drawn from 2016 EIA reports, Coastal Plain estimate for *peak* annual production retrieved from a 2008 EIA report on hypothetical production from the Arctic Refuge.

The Future of Tight Oil and U.S. Energy Production

The outcome of the most recent oil production glut in the world market is still unclear; the U.S. tight oil boom drastically altered the structure of U.S. oil production in the past few years, and while OPEC's refusal to cut production left oil prices below \$30/BBL at the start of 2016, the falling cost of producing tight oil has kept unconventional U.S. production competing in the world market at lower oil prices (Murphy, 2017). By 2037, which is the approximate time frame the Arctic Refuge would reach peak production if drilling were to be authorized in 2017-2018, tight oil is predicted to make up 57% of U.S. oil production (Figure 5) (Murphy, 2017). Even so, in the next few decades U.S. tight oil will not become a major source of oil in the world. The U.S. only contains 3% of the world's reserves, and even if technical advances allow more U.S. oil to become economically recoverable, U.S. supply will not become a significant portion of world production (Murphy, 2017).

Figure 5. U.S. Oil Production (2010-2040) (million barrels a day)

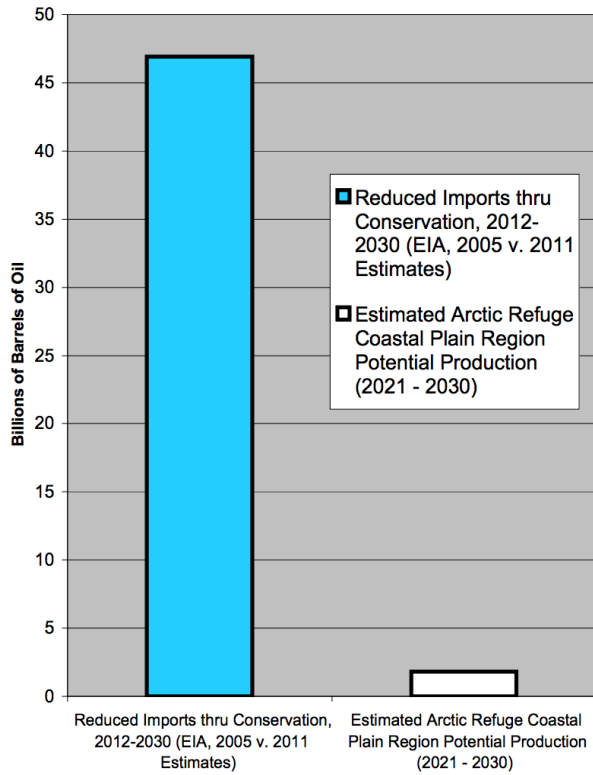
Source: Energy Information Administration, 2017b



Projections in the demand for oil show a tapering, slowed growth as technological advances and economies of scale make electric alternatives and conservation measures increasingly viable (Energy Information Administration, 2017d). Gains in energy efficiency have proven to have a much more significant impact on oil imports than domestic production; U.S. imports increased annually since the 1980s, but from 2005 to 2011, net petroleum imports decreased by almost 30%, going from 12.5 MBD to less than 9 MBD (Fineberg, 2011). Additional domestic crude oil production is a contributing factor in the trend reversal, but reduced dependence can be largely attributed to lower consumption. Figure 6 quantifies the 25:1 ratio of conservation to production in reducing U.S. oil imports through a discrete timeline, which could be pushed back to 2017-2035 considering at most 1.8 billion barrels of oil could be produced in the Coastal Plain by 2035 if Congress approved drilling today (Fineberg, 2011).

Figure 6. Reduced Oil Imports vs. Potential Coastal Plain Production 2012-2030

Source: Fineberg, 2011



What may not have been foreseen even 5 years ago is the increasing affordability of electric vehicles; from 2014 to 2016, the number of electric vehicles on the road worldwide *tripled*, reaching 1.2 million vehicles last year (International Energy Agency, 2017). The growing niche in the automobile market could displace oil demand of 2 MBD by 2023, enough to create an oil glut equivalent to what triggered the 2014 oil price crash (Randall, 2016). Electric vehicles will soon compete with their gasoline counterparts without the help of subsidies, but policy may continue to shape the automobile market, leading to a more rapid transition away from traditional cars. A handful of nations, including Norway, India, and Germany, have set goals to reach 100% zero-emission cars in the next twenty to thirty years (Pressman, 2017).

Arctic Refuge Drilling Impact on National and Global Oil Prices

While oil prices would influence energy corporations' decisions regarding whether and when to invest in exploration and development of oil in the Arctic National Wildlife Refuge, there is very little chance that oil production from the refuge would have any effect on oil prices or downstream gas prices for consumers. The effect on national oil prices would be brief and minimal at best, largely because prices are determined in the global market and non-OPEC producers act as price-takers rather than price-makers. Increased production within a single region would not lower prices noticeably for consumers, and even if that was the case, Alaskan oil reaches markets on the West Coast and markets for export exclusively (DeRosa & Flanagan, 2017). Hahn and Passell (2008), assert that decreases in crude oil prices associated with production areas currently closed to development, "are likely to be on the order of one percent, and would thus not have a significant impact on prices that consumers pay at the gasoline pump now or in the future."

The most recent government estimates for the oil price impact from potential Arctic Refuge production are approximately ten years old, when oil prices were significantly higher and unconventional oil in the continental United States had not reached the high levels of production achieved in the last five years. In their 2008 analysis on Arctic drilling, the EIA asserted, "Additional oil production ... would only be a small portion of total world production, and would likely be offset in part by somewhat lower production outside the United States." In the EIA reference oil resource case, the peak impact of Arctic drilling would result in a \$0.75 decrease in oil per *barrel* in 2025 (what would now be projected in 2035, adjusted to 2017 dollars), a less than one percent impact on prices for consumers at its peak influence (Murse, 2016). This \$0.75 price drop per barrel was projected at a time when prices hovered around \$131 per barrel, which suggests the absolute price drop may be even smaller as prices currently sit closer to \$50 per barrel (United Press International, 2008). The USGS 2009 resource assessment does not provide an estimate for oil price impact in its economic analysis, and the Arctic National Wildlife Refuge Primer provided to Congress by the Congressional Research Service (2011) reinforced the perspective of Alaska and the United States as a price-taker: "Whether oil is produced domestically or imported, it is traded in a global market, and any one part of the market can affect other parts. The result is that oil prices are set in world markets."

World Price Projections

World price projections for the next five years, which precede any point when Arctic oil could reasonably be commercially produced, continue to be revised downwards amid the U.S. shale boom of recent years. Goldman Sachs, JP Morgan, and Credit Suisse all cite increased tight oil production as a reason for short term oil price projections staying relatively low, with Credit Suisse now predicting the price to stay below \$60/BBL through 2020 (DiCristopher, 2017). These projections for tight oil production make conventional oil prospects, particularly Arctic drilling, less attractive for oil companies considering profitable exploration in the Arctic may require much higher prices. A recent Deloitte report concludes that the average cost of extracting oil from the Arctic is \$75/BBL, which is almost three times the cost of extraction in the Middle East, where a significant historical market share of oil originates (Hoag, 2016).

Figure 7. Weekly U.S. and International Crude Oil Prices

Source: Energy Information Administration, 2017a

Daily crude oil spot prices, 2010-16
dollars per barrel

America as a Price-Taker

Oil prices are notoriously difficult to predict, as small shocks to oil supply and demand can lead to, “large movements in the price of oil” over time (Arezki, et al., 2017). The difference between changes in national prices versus international prices can be impossible to disentangle. And while natural gas prices fluctuate regionally, they are also tied to crude oil prices, which operate in the world market, meaning any one major producer of oil can impact output and subsequently price (Behar & Ritz, 2016). OPEC’s most recent attempt to cut output was offset partly by an increase in supply from Nigeria and Libya, which were exempt from the agreement reached among other OPEC members (DiCristopher, 2017). This development reinforces that any action from a major producer can influence the price of oil, which in turn could impact the profitability of oil production in the Arctic. Regardless, even if OPEC members did not alter output in response to the opening of the Arctic, the increase in supply would have essentially no effect on international prices for oil, making up at most 1% of global production in any given year (Energy Information Administration, 2016b).

The 2014 oil price crash (Figure 7) did not just hurt the prospect of Arctic oil exploration for American companies on Alaska’s North Slope; after Shell abandoned its offshore operations, Statoil, Norway’s largest energy company, announced it would drop 16 active leases in the Chukchi Sea that were “no longer competitive in Statoil’s global portfolio” (Hoag, 2016). Russia, which receives approximately half its state income from oil and gas revenue, only followed through with 2 of the 14 offshore wells it planned to drill in 2017 (Hoag, 2016). These cases augment the relationship between oil prices and Arctic oil production. With an overwhelming amount of the oil supply being produced at a much cheaper cost than Arctic production both in Alaska and outside the U.S., oil prices are a significant factor in potential Arctic production, not the other way around.

Empty Promise of Lower Prices at the Pump

Constituents are often inclined to support legislation that would yield short-term if not immediate relief rather than long-term benefits. Proponents of Arctic drilling claim economic benefits for the American consumer, but fail to provide any details on the timeline, extent, or magnitude of price reductions. According to both the EIA (2008) and USGS (2009), the two government agencies publishing information on potential resources in the Arctic Refuge, commercial production could begin 7 to 10 years after Congressional approval. Once production begins, any impact on prices at the pump would likely only be felt during a single peak production year that happens another 10 years down the road (Energy Information Administration, 2008). At best, consumers would save 1% on gas 15 years from the point in which Congress approves drilling in the Refuge (Energy Information Administration, 2008). Even more likely, which the EIA notes in its most recent analyses, Coastal Plain production would amount to 0.4 percent to 1.2 percent of total world oil consumption in 2030, which is low enough that, “OPEC could neutralize any price impact by decreasing supplies to match the additional production from Alaska” (Lavelle, 2008). Lower gas prices at the pump are simply not a strong argument for drilling in the Arctic, and U.S. government agencies have avoided making any assertion that Arctic drilling would yield any lower prices for consumers perhaps because the economic evidence is absent.

Potential Jobs Associated with Refuge Development

Changes in employment associated with potential oil production in the Arctic National Wildlife Refuge depends on factors including the phase of development (e.g., exploration or production), the number of wells and rigs, specific geographic location, and the type of project (onshore or offshore drilling) (Wood Mackenzie, 2011). In turn, some of these factors depend on economically recoverable discovered oil, global demand and the market price of oil.

In addition to “direct” oil industry jobs in Alaska—jobs with oil producers or oilfield service companies—there are jobs in related industries such as security, catering, accommodations, transportation, engineering services, and pipeline transportation (Fried, 2017). These “indirect” jobs as well as “induced” jobs⁶ are commonly estimated using a “multiplier” representing the number of indirect and induced jobs “created” for each direct job. These multipliers are obtained from empirical studies or input-output models (such as RIMS II or IMPLAN⁷).

Because oil is a non-renewable finite resource, even direct oil industry jobs in the Refuge would not be long-term. After peak production, production levels would diminish and employment would decline as well. Once the oil is depleted, companies would abandon the region and related employment would cease.

Refuge Job Projections

Employment estimates for allowing oil and gas leasing in the 1002 Area of the Alaska National Wildlife Refuge vary widely and all are based on higher oil prices than currently prevail. The most recent estimates, prepared for the Institute for Energy Research (an industry trade association), assessed the economic effects of opening restricted Federal lands and waters (Atlantic and Pacific Outer Continental Shelf, Gulf coast, and Alaska National Wildlife Refuge) to oil and gas leasing (Mason, 2013). Results suggest an increase of 61,314 job-years nationwide during the pre-production phase, or 8,759 jobs annually for each of 7 years⁸ (Mason, 2013). During production, 199,044 job-years were forecast for the U.S., or 6,635 over each of 30 years (Mason, 2013). These estimates represent less than 0.01% total US employment of 137 million in December 2013 (Bureau of Labor Statistics, 2017). These employment projections are based on economic activity resulting from oil sales at an assumed oil price of \$101.34 per barrel (in 2012 dollars), oil reserves of 8 billion barrels, and a multiplier of 5.1 indirect and induced jobs per direct job (Mason, 2013). Because oil prices are about half that today and the oil reserve assumption is based on twenty-year-old model results, these job estimates are overestimates and outdated.

Mason (2013) also forecast expected employment by industry associated with opening restricted Federal lands and waters to leasing. Jobs in trade, transportation and utilities; professional and business services; educational and health

⁶ “Induced” employment results when those directly employed in the energy industry and those employed indirectly (at companies doing business with the energy industry) spend their paychecks at grocery stores, service providers, and other businesses in the community.

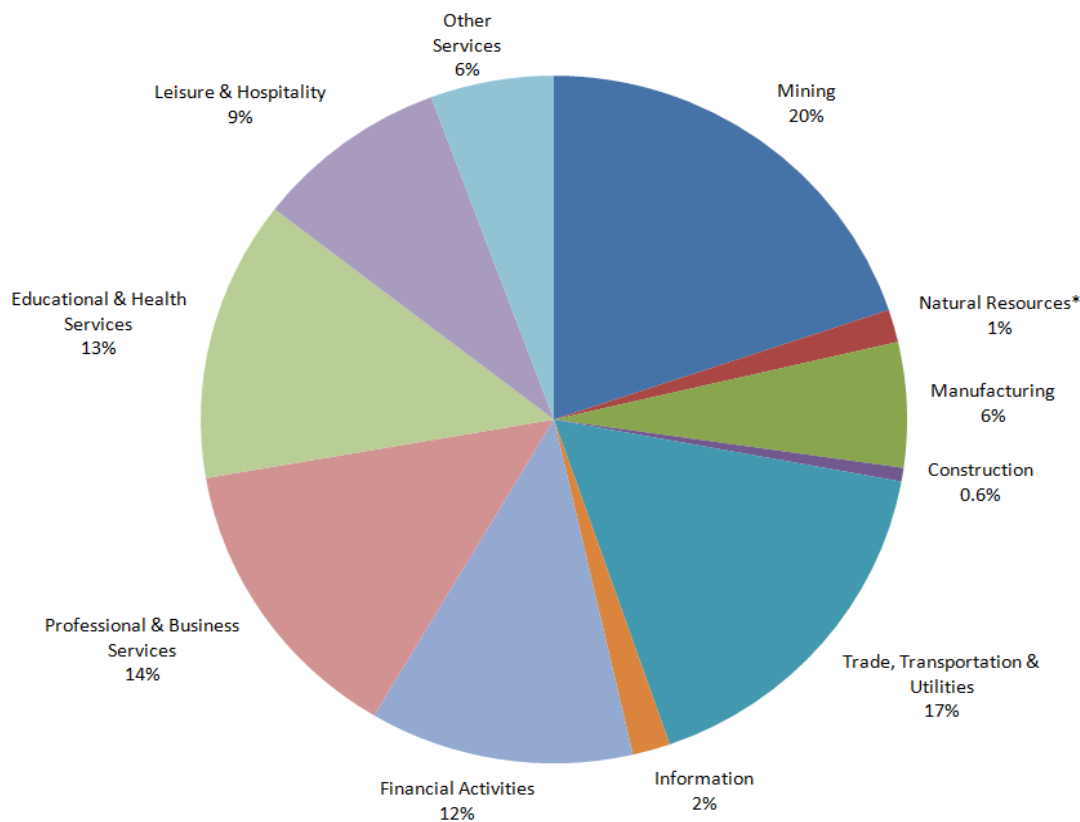
⁷ RIMS II, the Regional Input-Output Modeling System, is available from the U.S. Bureau of Economic Analysis; IMPLAN is a model available from MIG, Inc., a software firm in North Carolina. As with any predictive model, the relative accuracy of results depends on the assumptions, data, and method used.

⁸ The author states, “It may help the reader to interpret the resulting jobs numbers as “job-years” or divide the number of jobs by the number of years to establish the number of jobs created for the life of the project. I use the job-years concept in reporting my results—the standard method for reporting results of RIMS II analysis — and leave it to the reader to interpret the numbers appropriately” (Mason, 2013, footnote 61).

services were projected to represent nearly half (44%) of all new positions (Figure 8) (Mason, 2013). Because the same employment multiplier would apply to all areas considered, based on Mason’s assumptions a similar proportion of jobs by industry would apply to potential Refuge oil and gas production.

Figure 8. Jobs Forecast by Industry during Oil and Gas Production

Source: Mason, 2013



The State of Alaska’s ANILCA Section 1002(e) Exploration Plan and Special Use Permit Application submitted by Alaska’s Governor Parnell to the U.S. Department of the Interior in July, 2013 claimed that oil in the Alaska National Wildlife Refuge would generate, “from about 20,000 to over 170,000 jobs...according to analyses based on data from the Bureau of Labor Statistics” (Ribbink, 2015). As this document is no longer accessible from the Alaska Department of Environmental Resources⁹ further details on these estimates—such as whether jobs were estimated for Alaska or the U.S.—are not readily available.

⁹ This document is no longer available on the Alaska Department of Environmental Resources website: http://dnr.alaska.gov/commis/priorities/ANWR/ANWR_Exploration_Plan_7_9_13.pdf

A study by Wood Mackenzie (2011) for the American Petroleum Institute examining the implications of enacting policies to encourage the development of North American hydrocarbon resources forecast a total of 60,000 new jobs in the U.S. annually for production in the Refuge, with increases each year thereafter. These estimates assume Refuge oil resources of 10.8 BBL; oil priced at \$80 per barrel (in 2012 dollars), inflated at 2.5% annually; and a multiplier of 2.5 indirect and induced jobs for every direct job (Wood Mackenzie, 2011).

A much earlier study by Wharton Econometric Forecasting Associates (1990) projected development of oil reserves would create 736,000 new jobs nationwide over 10 years, of which 84,000 would be in the mining sector (Arctic Power, 2001). These are estimates of total jobs – jobs directly associated with the oil operation, as well as indirect and induced jobs: “These jobs would benefit workers in every U.S. state, in supplying equipment and services needed to develop the expected oil discoveries” on the Refuge’s coastal plain (Arctic Power, 2001). The results of this nearly 30-year old study have been critiqued by many, including the Congressional Research Service; Economic Policy Institute; and Chemical and Atomic Workers Union (Natural Resources Defense Council, 2001). They found job estimates to be overstated and based on improbable assumptions.

Current Alaska Oil and Gas Industry Employment

Oil and gas industry employment¹⁰ – jobs in oil and gas exploration and oilfield services – averaged 10,156 for the first three months of 2017, about 3% of state employment totaling 315,773 (Alaska Department of Labor and Workforce Development, 2017). The decline in oil prices since 2014 led to job losses for the oil and gas industry in 2016, a 20% reduction compared to 2015 (Fried, 2017; Alaska Department of Labor and Workforce Development, 2017). In 2016 several firms (BP, ExxonMobile, and ConocoPhillips) reduced the number active rigs and other operations in the region (DeMarban, 2016). Shell and Apache Corporation announced they were ending their efforts to find oil in the Alaska region, and ENI, Repsol and Brooks Range Petroleum planned project delays (DeMarban, 2016).

The Alaska Department of Labor and Workforce Development reports that the North Slope of Alaska accounts for two-thirds (66%) of all industry jobs, and Anchorage—which is the headquarters or service center for many firms—for about a quarter (26%) (Fried, 2017). They add that other related jobs are in Valdez, the end of the Trans-Alaska Oil Pipeline (counted as transportation jobs) and in Fairbanks, a major logistic and supply center for the North Slope. Over one-third (36%) of all industry employees are residents of states other than Alaska (Fried, 2017), so major portions of their wages are likely spent out-of-state and do not benefit the state’s economy.

Job Forecast through 2024

The Alaska Department of Labor and Workforce Development forecasts there will be 19,652 new jobs in the state by 2024, an increase of 5.8% over the decade (Martz, 2016). A third of the new jobs are projected to be in health care and social assistance (7,176 jobs) with other substantial additions to accommodation and food service (3,205 jobs) and retail trade (2,744 jobs) (Martz, 2016). Because Alaska’s unemployment rate is 7.2% (in September, seasonally adjusted; Alaska Department of Labor and Workforce Development, 2017), greater than the 3% to 5% rate generally associated with full employment, some of these jobs would be filled by people previously unemployed and therefore count as

¹⁰ The Alaska Department of Labor and Workforce Development defines this as North American Industry Classification System codes 211, 213111 and 213112.

“new.” Other openings could be filled by workers already employed in Alaska, or in other states, resulting in no net increase in job creation or decrease in the unemployment rate.

Without credible estimates of the number of jobs that could be associated with potential Arctic Refuge oil and gas development based on current geologic conditions, technology, and forecasts of price and demand, it is difficult to hypothesize the extent to which such opportunities might benefit Alaska in the future. Previous employment estimates of these changes vary widely and rely on out-of-date assessments of oil volume and oil prices nearly twice what they are today. While it is certain that extracting oil from the Coastal Plain would support some employment, the gains would be temporary and may simply represent a shift of jobs from other regions. Newer data and better models of *net* changes in economic well-being—that is, those that consider potential loss of traditional and current economic use of the Arctic Refuge—are needed.

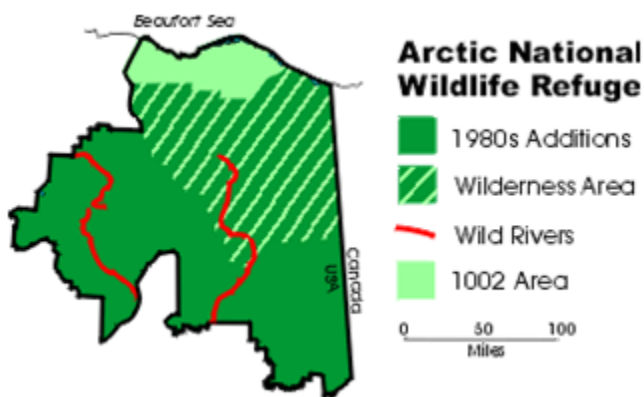
Hypothetical Timeline for Refuge Oil Development

The Arctic National Wildlife Refuge encompasses 19.6 million acres in northeastern Alaska (U.S. Fish and Wildlife Service, 2017). Most of the original Arctic National Wildlife Range established in 1960 was designated as Wilderness in 1980 by the Alaska National Interest Lands Conservation Act (ANILCA) (P.L. 96-487, Dec 2, 1980). The exception has been 1.5 million acres on the coastal plain (Figure 9). Management of that area was addressed in Section 1002 of ANILCA, and is now often referred to as the "1002 Area." The 1002 Area and 10.1 million acres added to the Refuge by ANILCA are "minimal management" areas — managed to, "maintain existing natural conditions and resource values" and open to recreational (including motorized access) and subsistence uses (U.S. Fish and Wildlife Service, 2017).

ANILCA stipulates that the, "production of oil and gas from the Arctic National Wildlife Refuge is prohibited and no leasing or other development leading to production of oil and gas from the [Refuge] shall be under-taken [sic] until authorized by an Act of Congress" (Section 1003). Thus, without Congressional approval, oil and gas development may not occur in the 1002 Area.

Figure 9. Management Areas in the Arctic National Wildlife Refuge

Source: U.S. Fish and Wildlife Service, 2017



Oil & Gas Development Prohibited in the Refuge

Oil and gas development of the coastal plain of the Alaska National Wildlife Refuge has periodically been debated in Congress—as has designation of the area as Wilderness—in the years since ANILCA expanded the Refuge and prohibited oil and gas production within the Refuge. The current Administration has stated that opening the Refuge to drilling is among its top priorities, and in January 2017 bills were introduced in both the House (H.R. 49) and the Senate (S. 49) to allow oil leasing in the Coastal Plain of Alaska (Young, 2017; Murkowski, 2017). In July 2017 the House Subcommittee on Energy and Mineral Resources held an oversight hearing on oil and gas development in Alaska and potential benefits to the U.S. if the Arctic Refuge were opened to exploration and development and if development of the National Petroleum Reserve-Alaska were expanded (House Committee on Natural Resources, 2017). These presumed benefits include an abundance of oil, reduced oil imports, additional federal and state revenues from leasing and royalties, and job creation. The Trump Administration's budget request for fiscal year 2018 includes \$1.8 billion in

revenue from federal oil and gas leasing in the Alaska National Wildlife Refuge between fiscal years 2022 and 2027 (as one of many proposed deficit reduction measures) (Office of Management and Budget, 2017).

Timeline of Typical Development

Various U.S. government, industry, and other entities have estimated how long it would take to get from Congressional approval of oil and gas development to actual production. Their estimates range from 7 to 20 years:

- The Energy Information Administration (2002 and 2004) used the 1998 USGS assessment to establish a timeline from approval date to exploration and development of 7 to 12 years (Thomas, et al., 2009).
- The managing director of Hillhouse Resources, an independent oil and gas company in Houston, asserts, “It’s going to take seven to fifteen years to finish the seismic review, the geological review, and then begin to develop the technological aspects of building the play” (Granitz, 2013).
- The progression from exploration to development is expected to take about 15 years or more. These long lead times result from the remoteness of the region, concerns for protection of the environment, and the regulatory requirements (Arctic Power, 2013).
- The Brooks Range Petroleum Company (2011) “Brooks Range Petroleum Timeline” projected a 15-year process for exploration to production for their North Slope operation: 2001 exploratory studies, 2014 development, and first oil production 2016.
- The 2009 USGS “Economics of Undiscovered Oil and Gas in the North Slope of Alaska” (Attanasi & Freeman, 2009) considered two scenarios to investigate the effect of timing on the economics of new oil and gas developments: (1) 10 years between discovery and production, and (2) a 20-year delay between discovery and production.

Sample North Slope Alaska Timeframe

The Mineral Leasing Act (1920, as amended) and Federal Onshore Oil and Gas Leasing Reform Act (1987, as amended) govern the leasing of public domain lands for oil and gas (Hatch, 2017).

If one assumes that approval is granted in 2018, development and production could occur between 2025 and 2030 based on U.S. Department of Energy estimates (Thomas, et al., 2009). The steps in their timeline assume a minimum of 10 years to complete development and also that there would be no inordinate delays due to litigation. The timing is envisioned as follows (Table 1) (Hatch, 2017; Thomas, et al. 2009), with the first receipts from production to the U.S. Treasury in 2030:

Table 1. Potential North Slope Exploration and Production Timeline

Year(s)	Milestone
2018	Exploration and development in the 1002 Area of the Arctic Refuge approved
2018-2020	Update resource assessments of undiscovered technically recoverable oil
2018 to 2019	2-D seismic data from 1984-1985 reprocessed (1 calendar year) (Werkheiser, et al., 2017; Thomas, et al., 2009)
<i>or</i>	
2018 to 2020	new 3-D seismic survey conducted (2 calendar years) (Werkheiser, et al., 2017; Thomas, et al., 2009)
2020	Nomination of lease parcels by industry and/or BLM, BLM selects parcels, notice of lease sales
2022	First lease sales held, leases issued (for a primary term of 10 years), drilling permits issued
	Lease terms include rentals of \$1.50 per acre for the first five years, then \$2 per acre thereafter (Hatch, 2017). If a tract does not receive any bids or the minimum acceptable bid, the tract becomes available to be leased non-competitively for a period of two years following the lease sale to the first qualified applicant (Hatch, 2017).
	Permits. Before drilling a well on a Federal or Indian lease, an operator must file an Application for Permit to drill to the Bureau of Land Management (U.S. Department of the Interior, 2014). The processing time for Applications submitted to the Anchorage Field Office was about 40 days, on average, from 2009 to 2013; the national average was 228 days, about 7.5 months (U.S. Department of the Interior, 2014).
2023/2024	First exploration drilling
2025/2026	First “economic” discovery
2026/2027	Evaluation of first “economic” discovery
2027	Field development begins
2030	First production from the 1002 Area First royalty payments to U.S. Treasury Lease terms include royalty interest of 12.5% (Hatch, 2017)

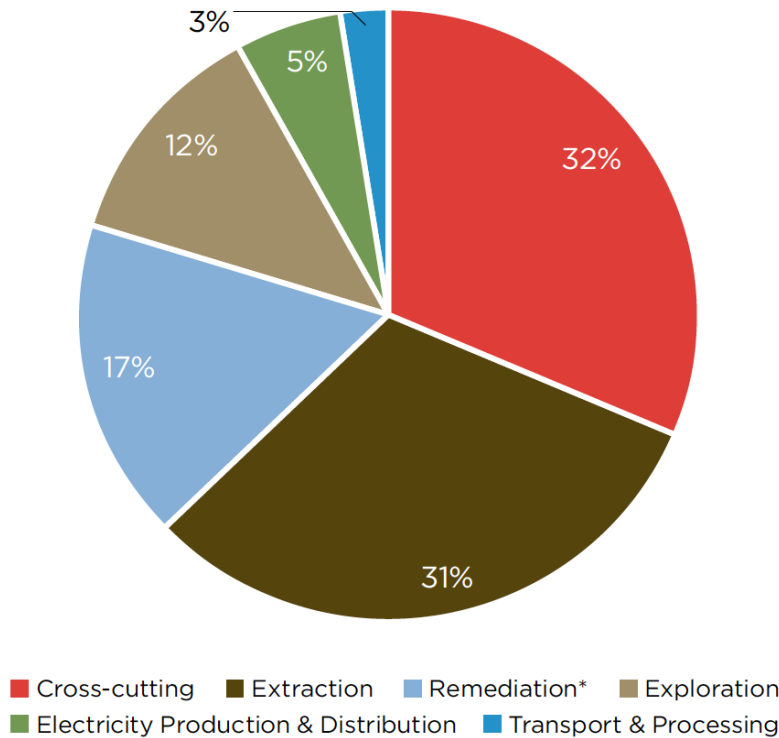
In this hypothetical timeline, the first payments to the U.S. Treasury would be for leases in 2022 and royalties from production in 2030, assuming there would be no delays at any step of the process. These years are consistent with the target dates in the administration's proposed budget for fiscal year 2018 which projects receipts in 2022 and 2023, and later in 2026 and 2027 (Office of Management and Budget, 2017). However, as noted above, time estimates from other government and industry sources suggest the first production could begin 5 or 10 years later, or by 2040.

Opening the Refuge: Cost to the American Taxpayer

Fossil fuel subsidies cost American taxpayers billions every year, and while many in the oil industry may deny receiving government handouts, they come in many forms that are often hidden from the public (Redman, 2017). Subsidies can be a mix of tax breaks, tax credits, liability easements, loosened regulations, or government services provided at below-market rates (Leahy, 2017). An Oil Change International (“OCI”) report (Redman, 2017) breaks down the types of fossil fuel subsidies in the U.S. from both the federal and state governments, which totaled over \$20 billion from 2015 to 2016. OCI defines a fossil fuel subsidy broadly: “any government action that lowers the cost of production, lowers the cost of consumption, or raises the price received by producers.” Fossil fuel subsidies can be given as production or consumption support (Figure 10), and there’s strong reason to believe the

Figure 10. U.S. Fossil Fuel Subsidies by Stage of Production, 2015-2016

Source: Redman, 2017



*The estimated total targeted to remediation may significantly undercount total taxpayer liability, given the limitations in quantifying the risks related to inadequate bonding, insurance, and liability caps that limit industry responsibility for damage and clean-up costs.

development of the Coastal Plain would be no exception as the current administration incentivizes expanding fossil fuel reserves in the name of “energy dominance.” A recent study from *Nature Energy* determined that at \$50 per barrel, and assuming projects need a 10% rate of return in order to be considered economic, approximately half of new oil investments are subsidy-dependent and would not be profitable without a government handout (Banarjee, 2017).

Estimated Federal Costs and Savings of Opening the Arctic Refuge

The Department of the Interior (“DOI”) has laid out detailed plans for expanded oil exploration in the Arctic Refuge, particularly updating current resource assessments in the 1002 Area on the Refuge’s Coastal Plain (Werkheiser et al., 2017). The DOI memo presents two scenarios for updating current resource assessments on the Arctic Refuge. In one, USGS would pay \$4.8 million for interpreting, “state-of-the-art industry reprocessing of vintage data” to be completed by the end of 2018 (Werkheiser et al., 2017). In the other, “a new 3-D seismic survey is conducted” and paid for by the private sector, although USGS costs would still be approximately \$3.6 million (Werkheiser et al., 2017). (Note that these revised assessments would be just the first step in the process of opening the Arctic to drilling.)

In the Congressional Budget Office analysis for a 2012 bill proposed to open the Arctic Refuge, the estimated administrative costs for a federal leasing program were \$8 million in the first five years, or \$1.6 million per year (LaFave, et al., 2012). Other implementation costs were expected to total \$1 to \$2 million annually if the Refuge were to be opened to leasing. Because the previous bill (and both current proposals, S. 49 and H.R. 49) deemed the previous environmental impact statement “sufficient,” the cost of complying with any environmental regulation is expected to be minimal (LaFave, et al., 2012).

Drilling proponents tout benefits of drilling in the Arctic Refuge including federal revenue that could help offset the budget deficit. The Trump Administration stands behind this argument, evidenced by the inclusion of Arctic drilling revenue in both the White House 2018 Budget Plan and Congress’ blueprint (Office of Management and Budget, 2017; House Budget Committee, 2017). The 2018 House budget, released in July 2017, calls for \$5 billion in reconciliations, or savings, from the Natural Resources Committee, \$1.5 billion of which is expected to come from the Arctic Refuge (Page, 2017). This sets a dangerous precedent, as any shortfall from the amount assumed by Congress will end up adding to the federal budget deficit.

State Subsidies

The current subsidies received on Alaska’s North Slope are a useful indicator for estimating how much future Coastal Plain drilling may cost American taxpayers. Currently, Alaska residents receive the most federal government aid per capita and pay no income or sales tax to the state government. Instead, the state is dependent on the oil and gas industry for approximately 85% of its budget (Semeuls, 2015).

Alaska’s total subsidies to fossil fuel production in 2015 totaled about \$1.2 billion, which includes over \$500 million from a per-taxable-barrel credit for North Slope Production (Redman, 2017). Congressional approval for drilling in the Refuge would have a disproportionate impact on Alaskan taxpayers, who rely on the oil and gas industry for government revenue and thus benefits. The drawbacks to the once-lucrative prospects in the northern part of state have become apparent with lower oil prices: Alaska finds itself in a deep budget deficit, largely because of lower interest in Arctic exploration, reduced production on the North Slope, and generous production subsidies for oil companies on the North Slope (Alaska Oil and Gas Competitive Review Board, 2015). To balance the budget, Alaska’s state legislature and governor recently approved oil subsidy cuts that will save the state around \$200 million annually (Redman, 2017).

North Slope Lease Bids and Projected Revenue

The Congressional Budget Office’s latest estimate of potential federal revenue generated from opening the Refuge assumed the sale of 400,000 acres for drilling at \$7,500 an acre, whereas recent bids in Alaska have come in well below

\$100 an acre (Page, 2017). Alaska's Department of Natural Resources publishes a summary of annual lease sales in Alaska beginning in 1959 (Appendix A) providing data on total acres leased, average price per acre, the total bonus (or cumulative lease bids), and the fixed terms from the sale. Since 2010, the average price per acre on the North Slope has ranged from \$14.81 to \$80.59, with a weighted average for the cumulative 2,442,868 acres sold in the past six years equaling \$41.59. Undoubtedly, North Slope bonus bids are the best indicator of how much federal revenue could be made leasing out the Coastal Plain, and while the minimum bid per acre could be raised, no evidence exists that oil companies may be inclined to pay more for land with no existing infrastructure or proven reserves.

An October 2017 analysis by the Center for American Progress (CAP) found that offering oil and gas leases in the Arctic Refuge will likely amount to no more than \$37.5 million in federal revenue over 10 years, which is substantially short of the \$1 billion to \$1.8 billion that the White House, Congress, and drilling proponents claim could be raised (Lee-Ashley and Rowland, 2017). (Ironically, CAP finds that \$1 billion in added federal revenue would not even cover Trump's personal tax breaks under the proposed tax reform plan, which reduces tax revenue by \$1.5 trillion annually.)

Another unaddressed issue with projected federal revenue lies in Alaska's current law governing lease sales. Oil and gas revenue is split 90%-10% between the Alaska and federal governments respectively, while the projected federal revenue outlined in the Trump administration budget assumes a 50%-50% split, which is the common practice in the continental U.S. (Alaska Oil and Gas Competitive Review Board, 2015). Some estimates of federal revenue gained from opening the Refuge to oil and gas leasing have assumed the federal government, not Alaska, will get 90% of lease bids, while others assume Alaska would receive half of revenue generated from the bids in the Refuge. This single detail, while not affecting how much total revenue is raised from opening the Arctic Refuge to oil development, explains how the revenue would be distributed and who would end up getting compensated. If 90% of the revenue from leasing federal lands on the Coastal Plain were to be distributed to Alaskans, rather than 50%, the average American taxpayer would end up paying more to offset the resulting increases in the federal deficit.

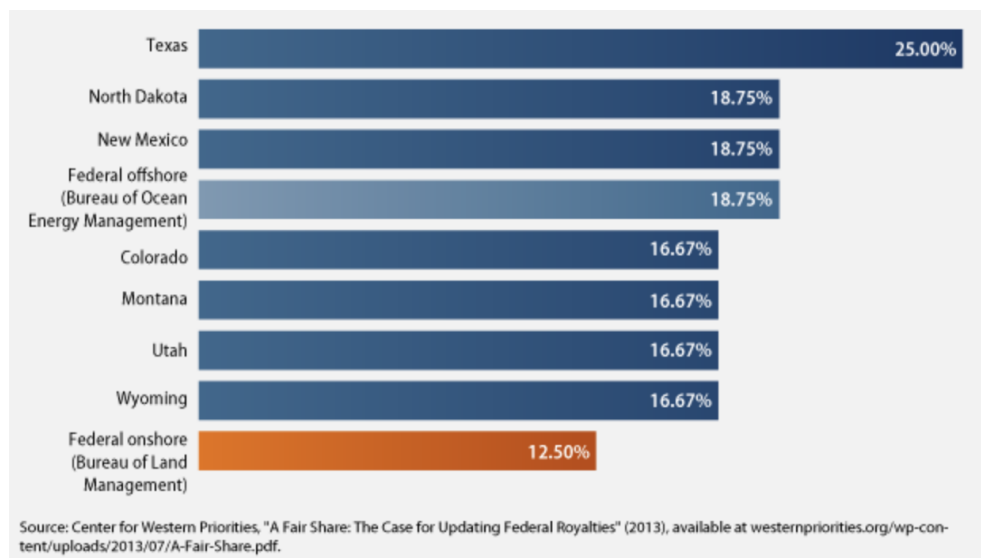
Below-Market Royalty Rates and Estimated Revenue

Royalty payments made on active leases are another source of federal revenue once oil production on federal land has begun, but the federal royalty rate has not been updated since 1920 and stands at 12.5% (Gentile, 2017). While some states, including Texas, Colorado, and Utah, have raised their royalty rates for state lands, Alaska state law offers royalty rates at 12.5%, well below the estimated market rate of 18-25% (Gentile, 2017). This outdated rate is shortchanging American taxpayers, who are receiving a rate 30%-50% less than many private and state royalties.

The total acreage proposed for lease sales in the Arctic Refuge ranges widely, and has a direct impact on the amount of revenue the federal government could expect; H.R. 49, sponsored by Don Young (2017), specifies a minimum of 2,000 acres be leased out on the Coastal Plain, while some of the federal government's estimates for revenue generation seem to assume all 1.5 million acres in the Coastal Plain area of the Arctic Refuge would be leased for oil exploration and drilling (Young, 2017; Lazzari, 2008). While the federal government is able to claim that leasing production on all 1.5 million acres would generate a certain sum from royalty payments, they are simultaneously providing the oil industry with massive subsidies by only charging a 12.5% royalty rate on lands that should arguably receive at least private market rates, which could be twice the amount the federal government charges.

Figure 11. Federal and State Royalty Rates for Oil and Gas Leases

Source: Gentile, 2015



Subsidized Environmental Risk

Not only would American taxpayers fund production of Arctic oil, but they would be financially liable for oil companies' environmental risks and damage. Being one of the last untouched regions of the planet, the environment of the Arctic Refuge is far more vulnerable than other regions of the world known for oil development, and by way of its remote location, cleanup costs from a spill could be much higher than those witnessed from other spills elsewhere in the U.S. All too often, companies pay for direct costs after the damage is done but are not funding resources on standby in the event of a disaster, which should be accounted for as liability for operating in environmentally fragile or vulnerable regions.

Challenges of Frontier Exploration

The climate, geography, and isolation of the Arctic present challenges to oil and gas exploration and development. The Arctic is defined as the area located north of the Arctic Circle, at the northernmost part of Earth at 66°34' north latitude (Figure 12). It encompasses the Arctic Ocean and adjacent seas, and parts of Alaska, Canada, Finland, Greenland, Iceland, Norway, Russia, and Sweden. About one-third of the Arctic is land and two-thirds is water. The central Arctic Ocean is ice-covered year-round, and snow and ice are present on land for most of the year (National Snow and Ice Data Center, 2017). Large areas of the land are underlain by permafrost, frozen ground (i.e., soil and rock) that remain at or below 32°F for at least two years (National Research Council of Canada, 1988).

Figure 12. The Arctic Circle

Source: National Snow and Ice Data Center, 2017



Within the Arctic Circle, there are long periods of daylight during the summer and extended darkness during the winter. The sun remains visible at midnight during the summer months (“midnight sun”); in winter, there are periods of darkness lasting for more than 24 hours (“polar nights”) (National Snow and Ice Data Center, 2017). On the North Slope

of Alaska, temperatures are below freezing for most of the year, ranging from -20°F in February to 46°F during July. The average annual precipitation is 4 inches or less, mostly in the form of snow (Budzik, 2009).

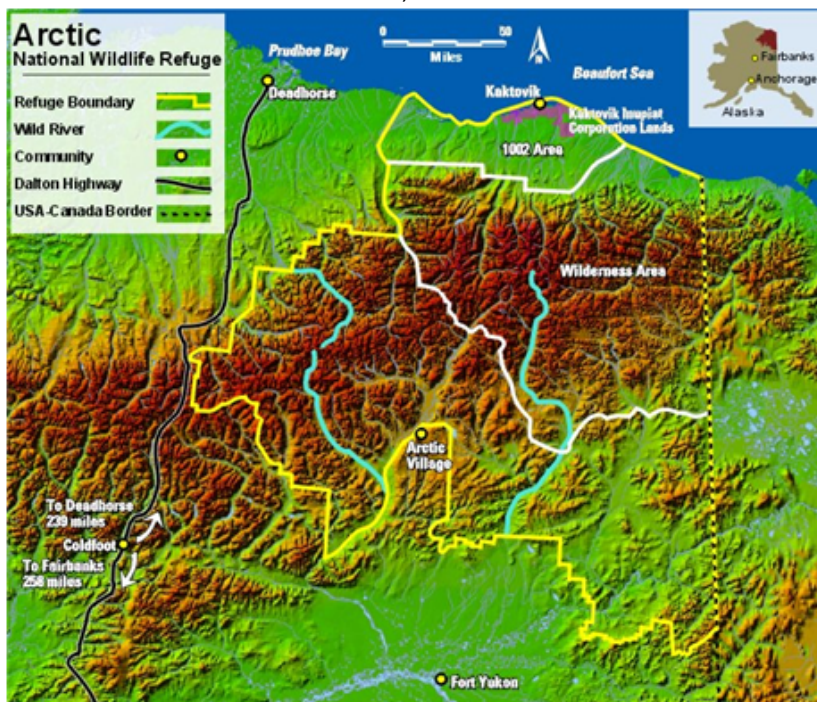
The North Slope Frontier

The North Slope of Alaska is remote and sparsely populated with only one (mostly gravel) narrow road connecting it with the rest of the state (Figure 13). The 415-mile Dalton Highway, built as a haul road between the Yukon River and Prudhoe Bay during construction of the Trans-Alaska Pipeline, begins 84 miles north of Fairbanks and ends at Deadhorse (The Milepost, 2017). There are no paved roads to Arctic Village or Fort Yukon, both of which can be reached by air; Kaktovik is reachable by air and water (North Slope Borough, 2017).

Energy analyst Pavel Molchanov notes that, “Arctic drilling is a textbook example of frontier exploration—that is to say, drilling in remote, historically underexplored regions....Frontier exploration, no matter the specific geography, is inherently high-risk” (Mufson, 2015). The lack of access and infrastructure are obstacles in exploring for oil and gas resources in frontier basins, defined by the Alaska Oil and Gas Competitiveness Board (2015) as areas away from population centers and existing oil and gas production facilities.

Figure 13. The Dalton Highway and North Slope Towns^a

Source: U.S. Fish and Wildlife Service, 2017



^a Population in 2010 - Prudhoe Bay: 2,174; Coldfoot: 10; Kaktovik: 239; Arctic Village: 152; Fort Yukon: 583; Fairbanks: 31,535 (U.S. Census Bureau, 2017).

Arctic Development is Costlier, Riskier and Lengthier

The U.S. Energy Information Administration surmised that Arctic oil and natural gas resources are more expensive, riskier, and take longer to develop than comparable deposits found elsewhere in the world (Budzik, 2009). Studies

examining the additional costs associated with oil activities in Alaska compared to those in the continental United States found costs are 1.5 to 10 times larger. For example, the capital costs of onshore Alaska North Slope project developments are from 1.5 to 2 times more than similar oil and natural gas projects in Texas (Budzik, 2009). The subzero weather and remote locations mean drilling in Alaska typically costs three times as much as in the lower 48 states, according to industry researcher IHS Markit, Inc. (Mufson, 2015). And, the Alaska Oil and Gas Competitiveness Review Board (2015) found the investment needed to explore and develop the North Slope's oil resources plus transportation to markets to be an order of magnitude higher—that is, ten times as much—than the investment required to produce and transport oil in much of the continental U.S.

Increasing temperatures in the Arctic have shortened winter access across the tundra by more than 50% and led to changes in standards for use of the ice roads that are typically used to reach remote areas during exploratory drilling¹¹ (Corn, Ratner & Alexander, 2015). The Congressional Research Service suggests that in the rolling terrain of the North Slope, the use of ice roads and pads could be limited due to safety concerns; gravel structures (permitted for exploration on state lands south of Prudhoe Bay) may provide better traction than ice structures. They caution that relying on ice technology may be infeasible in the future, forcing greater use of more expensive gravel structures with longer-lasting environmental impacts—or, projects would need to adapt to a shorter operating season (Corn, Ratner & Alexander, 2015).

Where access is by water, operating costs are increased by the ice-pack conditions that extend over much of the Arctic Ocean. The need for ice-resistant tankers and ice-breaker escorts adds to the cost of transporting oil and natural gas through Arctic waters (Corn, Ratner & Alexander, 2015; Budzik, 2009).

In addition to requiring larger investments than comparable projects elsewhere, the long lead-times required for Arctic projects add risk because economic conditions can change significantly between the time exploration leases are secured and when production begins. For example, crude oil prices could be considerably lower when an Arctic project begins producing than was anticipated at the planning stage. And, longer lead-times reduce the return on capital investment, all other being equal (Budzik, 2009).

¹¹ These roads may later be linked to large insulated ice pads for housing, storage and maintenance facilities, airfields, and other support (Corn, Ratner, & Alexander, 2015).

Arctic oil and natural gas resource exploration and development are expensive because:

- Harsh winter weather requires that the equipment be specially designed to withstand the frigid temperatures;
- On Arctic lands, poor soil conditions can require additional site preparation to prevent equipment and structures from sinking;
- The marshy Arctic tundra can also preclude exploration activities during the warm months of the year;
- In Arctic seas, the ice-pack can hinder the shipment of personnel, materials, equipment, and oil for long time periods;
- Long supply lines from the world's manufacturing centers require equipment redundancy and a larger inventory of spare parts to insure reliability;
- Limited transportation access and long supply lines reduce the transportation options and increase transportation costs;
- Higher wages and salaries are required to induce personnel to work in the isolated and inhospitable Arctic; and
- Protecting the Arctic environment is costly.

Source: Budzik, 2009

Future Prospects

Ultimately, energy companies make the decision on whether and how much the costs and risks of frontier exploration influence their investment decisions. The president and CEO of the Alaska Oil and Gas Association, Kara Moriarty, has said that low oil prices won't diminish companies' interest in drilling in the 1002 Area; "The reality is companies don't plan on a two-to-three-year horizon, they plan for a 50-60-year one" (Patterson, 2017). But, the EIA cautions, "The high cost and long lead-times of Arctic oil ... development diminish the economic incentive to develop these resources" (Budzik, 2009).

Regarding the potential for oil leasing in the Refuge, the spokeswoman for ConocoPhillips (Alaska's biggest oil producer) says if it, "were to be opened, we'd consider it within our opportunities" and that the area, "would have to compete with other regions for our exploration dollars" (Nussbaum, 2017). In contrast, a senior research manager at industry consultant Wood Mackenzie Ltd. says, "There are a lot of other, cheaper areas that are currently open to exploration that big companies can attack" (Nussbaum, 2017). At this point in time, given the uncertainties regarding how much oil could actually be within the 1002 Area, the probability of development in the frontier even if Congress were to authorize it remains unknown.

Conclusion

Despite the frigid climate and isolation of the Arctic National Wildlife Refuge's Coastal Plain, policymakers and energy industry officials periodically raise the prospect of allowing oil and gas drilling in the region. In contrast to the economic conditions during earlier efforts to open the Refuge, oil prices have dropped substantially, and the increase in oil demand has slowed as conservation and the use of alternative fuels grows. The EIA projects the slower growth in demand to continue at least through mid-century, beyond the time any production could occur if development in the 1002 Area was approved this year. New discoveries from established drilling sites in the continental U.S. as well as Alaska's North Slope/Prudhoe Bay are expected to sustain U.S. production for decades, providing oil for domestic consumption as well as for export.

Even the most optimistic estimates of oil production in the 1002 Area (by the USGS and EIA during the past two decades) are projected to have little effect on U.S. imports, global supply, or prices. Leasing and royalty revenues destined for the U.S. and Alaska coffers, as well as jobs, were projected based on *undiscovered* economically recoverable reserves estimated using now-outdated financial data and technological assumptions. These projections did not consider external costs such as climate change, loss of habitat, human health effects of the release of toxins, and spill preparedness and response. Despite their lack of currency, these projected benefits are still being touted.

Federal taxpayers would subsidize any effort towards opening the Refuge—beginning with the first step of updating the assessments of undiscovered, technically recoverable oil and gas resources per Secretary Zinke's directive in May (U.S. Department of the Interior, 2017). Once completed, these resource assessments would influence the industry's interest in exploring the 1002 Area if development were approved by Congress. Ultimately, though, even the hypothetical revenue from Refuge oil and gas leasing in the Administration's fiscal year 2018 federal budget would do very little to alleviate the federal deficit. Projected receipts from leasing represent less than 0.5% of the total budget deficit reductions proposed (Office of Management and Budget, 2017) and would cost the nation the loss of nonrenewable resources and potentially irreparable ecological harm.

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Appendix A: 2010-2017 Lease Bids on the North Slope

Summary of State Competitive Oil and Gas Lease Sales -- 1959 to Present											
Sale Date	Sale	Sale Area	Acres Offered	Acres Leased	Percent Leased	Average \$/Acre	Tracts Offered	Tracts Leased	Bonus Received	Bid Variable	Fixed Terms
5/26/2010	AP 2010	Alaska Peninsula	Areawide	0	N/A	\$0.00	N/A	0	\$0	Bonus \$5/acre Min	12.5% Royalty
5/26/2010	CI 2010	Cook Inlet	Areawide	104,629	N/A	\$16.40	N/A	35	\$1,716,407	Bonus \$10/acre Min	12.5% Royalty
10/27/2010	FH 2010	NS Foothills	Areawide	0	N/A	\$0.00	N/A	0	\$0	Bonus \$5/acre Min	12.5% Royalty
10/27/2010	NS 2010**	North Slope	Areawide	558,683	N/A	\$14.81	N/A	123	\$8,271,480	Bonus \$10/acre Min	12.5% & 16.66667% Royalty
10/27/2010	BS 2010A	Beaufort Sea	Areawide	62,965	N/A	\$10.08	N/A	21	\$634,485	Bonus \$10/acre Min	12.5% & 16.66667% Royalty
6/22/2011	AP 2011	Alaska Peninsula	Areawide	0	N/A	\$0.00	N/A	0	\$0	Bonus \$5/acre Min	12.5% Royalty
6/22/2011	CI 2011 A & B	Cook Inlet	Areawide	449,164	N/A	\$17.50	N/A	104	\$8,214,181	Bonus \$10/\$0/acre Min	12.5% Royalty
12/7/2011	FH 2011	NS Foothills	Areawide	0	N/A	\$0.00	N/A	0	\$0	Bonus \$10/acre Min	12.5% Royalty
12/7/2011	BS 2011W	Beaufort Sea	Areawide	242,796	N/A	\$24.07	N/A	77	\$6,845,102	Bonus \$10/\$25 acre Min	12.5% & 16.66667% Royalty
12/7/2011	NS 2011W**	North Slope	Areawide	295,194	N/A	\$40.69	N/A	165	\$12,011,666	Bonus \$10/\$25 acre Min	12.5% & 16.66667% Royalty
5/16/2012	AP 2012	Alaska Peninsula	Areawide	0	N/A	\$0.00	N/A	0	\$0	Bonus \$5/acre Min	12.5% Royalty
5/16/2012	CI 2012W	Cook Inlet	Areawide	128,300	N/A	\$35.58	N/A	41	\$4,564,459	Bonus \$25/acre Min	12.5% Royalty
11/7/2012	FH 2012	NS Foothills	Areawide	45,476	N/A	\$20.88	N/A	8	\$948,646	Bonus \$10/acre Min	12.5% Royalty
11/7/2012	BS 2012W	Beaufort Sea	Areawide	80,689	N/A	\$17.86	N/A	25	\$1,440,888	Bonus \$10/\$25 acre Min	12.5% & 16.66667% Royalty
11/7/2012	NS 2012W**	North Slope	Areawide	152,067	N/A	\$89.33	N/A	86	\$10,542,283	Bonus \$10/\$25 acre Min	12.5% & 16.66667% Royalty
5/8/2013	AP 2013	Alaska Peninsula	Areawide	0	N/A	\$0.00	N/A	0	\$0	Bonus \$5/acre Min	12.5% Royalty
5/8/2013	CI 2013W	Cook Inlet	Areawide	100,322	N/A	\$30.72	N/A	24	\$3,081,417	Bonus \$25/acre Min	12.5% Royalty
11/6/2013	FH 2013	NS Foothills	Areawide	0	N/A	\$0.00	N/A	0	\$0	Bonus \$10/acre Min	12.5% Royalty
11/6/2013	BS 2013W	Beaufort Sea	Areawide	2,560	N/A	\$20.47	N/A	2	\$52,403	Bonus \$10/\$25 acre Min	12.5% & 16.66667% Royalty
11/6/2013	NS 2013W**	North Slope	Areawide	157,701	N/A	\$32.45	N/A	89	\$5,117,140	Bonus \$10/\$25 acre Min	12.5% & 16.66667% Royalty
5/7/2014	AP 2014	Alaska Peninsula	Areawide	9,561	N/A	\$5.00	N/A	3	\$47,807	Bonus \$5/acre Min	12.5% Royalty
5/7/2014	CI 2014W	Cook Inlet	Areawide	83,521	N/A	\$48.42	N/A	32	\$4,044,467	Bonus \$25/acre Min	12.5% Royalty
11/9/2014	FH 2014	NS Foothills	Areawide	0	N/A	\$0.00	N/A	0	\$0	Bonus \$10/acre Min	12.5% Royalty
11/9/2014	BS 2014W**	Beaufort Sea	Areawide	99,218	N/A	\$45.68	N/A	42	\$4,522,271	Bonus \$10/\$25 acre Min	12.5% & 16.66667% Royalty
11/9/2014	NS 2014W**	North Slope	Areawide	494,530	N/A	\$80.59	N/A	254	\$39,853,691	Bonus \$10/\$25 acre Min	12.5% & 16.66667% Royalty
5/6/2015	AP 2015	Alaska Peninsula	Areawide	0	N/A	\$0.00	N/A	0	\$0	Bonus \$5/acre Min	12.5% Royalty
5/6/2015	CI 2015W	Cook Inlet	Areawide	20,840	N/A	\$32.20	N/A	7	\$671,033	Bonus \$25/acre Min	12.5% Royalty
11/8/2015	FH 2015	NS Foothills	Areawide	0	N/A	\$0.00	N/A	0	\$0	Bonus \$10/acre Min	12.5% Royalty
11/8/2015	BS 2015W	Beaufort Sea	Areawide	0	N/A	\$0.00	N/A	0	\$0	Bonus \$25/acre Min	16.66667% Royalty
11/8/2015	NS 2015W**	North Slope	Areawide	184,813	N/A	\$50.38	N/A	131	\$9,311,065	Bonus \$25/acre Min	12.5% & 16.66667% Royalty
5/4/2016	AP 2016	Alaska Peninsula	Areawide	0	N/A	\$0.00	N/A	0	\$0	Bonus \$5/acre Min	12.5% Royalty
5/4/2016	CI 2016W	Cook Inlet	Areawide	0	N/A	\$0.00	N/A	0	\$0	Bonus \$10/acre Min	12.5% Royalty
12/14/2016	FH 2016	NS Foothills	Areawide	0	N/A	\$0.00	N/A	0	\$0	Bonus \$10/acre Min	12.5% Royalty
12/14/2016	BS 2016W	Beaufort Sea	Areawide	32,136	N/A	\$25.77	N/A	7	\$828,292	Bonus \$25/acre Min	16.66667% Royalty
12/14/2016	NS 2016W †	North Slope	Areawide	598,880	N/A	\$28.17	N/A	384	\$16,900,490	Bonus \$25/acre Min	12.5% & 16.66667% Royalty
6/21/2017	AP 2017	Alaska Peninsula	Areawide	0	N/A	\$0.00	N/A	0	\$0	Bonus \$5/acre Min	12.5% Royalty
6/21/2017	CI 2017W†	Cook Inlet	Areawide	26,823	N/A	\$34.39	N/A	6	\$922,393	Bonus \$25/acre Min	12.5% Royalty
TOTAL: 163 Sales									\$2,299,179,518		