Critical Issues

Domestic Oil

The Hidden Solution

by
MILTON R. COPULOS

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Foreword by

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U.S. Senator, Alaska

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Foreword

Over the past several years, federal land management policies have been characterized by a marked trend toward the application of highly restrictive designations to areas falling within the public domain. The advent of this trend has been widely perceived as signaling a sharp departure from the previous federal policy which customarily placed the bulk of public lands in multiple use categories. Concern regarding this shift has fueled a sometimes strident debate between preservationists and those who favor a less exclusionary approach to public lands. Recently, the issue gained considerable media attention through the Senate debate over the treatment of Alaska's "d-2" lands, and from litigation on the part of the Western states associated with the "Sagebrush Rebellion."

Although some view the controversy over federal land management policy as an essentially regional dispute, the fact is that its resolution will have major implications for the nation as a whole. There is far more at stake than the environmental issues which are the nominal source of the conflict, for included among the affected areas are ones which hold vast potential for relieving our perilous dependence on the importation of both energy and of many strategical and critical minerals. The thrust of present policies would be to deny our nation their use.

While no one disputes the need to preserve and protect our environment, we must not lose sight of the fact that the purpose of such safeguards is to allow judicious use. It is of no avail to set aside additional areas for preservation of their pristine condition if the result of that action is to deny access to the bulk of our population. It is foolish to prohibit careful evaluation and development of a resource on environmental grounds if the cost of foregoing its use could be economic chaos or the exacerbation of an already dangerous overdependence on foreign suppliers. It is ludicrous to speak of preserving our children's heritage if we do not include their economic well-being in that legacy.

Frequently, advocates of the exclusionary approach contend that it is not their purpose to lock away forever the resources existing on public lands, but rather to construct a framework for their orderly development. While this would appear reasonable on the surface, the one question they leave unanswered is: When? If such development is only allowed after energy supply interruptions seriously damage our economy, or even lead us into war, it is quite possible that the future development would take place in an atmosphere of panic, which would give no consideration to environmental concerns. This could have the effect of undoing all of the progress which they claim to be making. It therefore follows, that a far better approach would be to allow for the orderly development of such areas now, before a panic mentality sets in, and environmental considerations are cast aside.

One means of accomplishing this goal might be found in the concept of the "priority resource preserve." Such areas could be developed in an expeditious fashion, but would function to limit the actual acreage affected. Their net result would quite possibly be a reduction of the land area involved in development. Through the use of this device, we could insure access to critically important minerals and energy resources and simultaneously provide adequate environmental protection. Moreover, the timeframe for development would be consistent with the needs of our economy and national security.

Our system of government is built on the concept of compromise between competing interests within our population. The notion of providing a judicious framework for development of lands in the public domain is fully consistent with that concept.

It therefore merits the consideration of those who are genuinely interested in preserving the environment, as it represents a means by which their goals can be attained at the same time that our economic well-being is insured.

The concept of the priority resource preserve is outlined in some detail in the following pages, along with an estimate of the potential petroleum resources of the United States, and a recounting of several instances of bureaucratic obstruction of energy development. I commend it to the attention of all who are truly interested in meeting the dual challenges of providing adequate energy for our future and protecting our environment.

Ted Stevens
United States Senate

Introduction

It seems as though hardly a day can pass without some new shock rocking the world energy market. Governments topple, OPEC ministers hike prices, terrorists threaten the thin fabric of peace in the Middle East, and exporting nations cut back on production. Prices at the pump continue their dizzy upward spiral as news media relentlessly bombard us with increasingly dire forecasts of the future. At every turn, we seem to find some manifestation of the economic penalty our dependence on imported oil is extracting. Yet, as severe as this burden is, it remains the least important aspect of the problem.

For the average citizen, the evolution of our present dilemma is beyond comprehension. As a nation we long have been accustomed to ready access to cheap, plentiful supplies of energy. By and large, we have come to regard such access as a right. It is therefore understandable that the notion that the era of inexpensive energy is coming to an end has been slow to take root, and where it has been accepted, has constituted a profound and bitter shock.

Although a few prescient observers predicted the coming of the energy crisis, its advent was met with general disbelief. Prior to the 1973 embargo, widespread interest in the state of our energy supplies was non-existent, and media coverage of energy topics was largely limited to trade and technical publications. Against this background, the skepticism concerning the existence of a shortage is not surprising, especially since both the 1973 and 1979 supply interruptions were of limited duration, and were followed by sharp price increases. These increases gave credence to the conventional wisdom which asserted that the interruptions were manufactured by the oil industry to boost profits. Sensationalistic reporting of industry earnings added further impetus to such notions, and gave rise to a groundswell of emotion-charged rhetoric.

Where the popular analysis of the energy picture fails is in fixing the blame. It does not fall on the shoulders of some inimical corporate cartel in Houston, or on some sheikh in Riyadh, but, rather, squarely on the bureaucrats in Washington.

At every turn, attempts to develop domestic supplies are hampered by a morass of red tape, restrictive policies, and financial disincentives. In a sort of perverse application of Murphy's Law, if the government can do anything to hamper the development of domestic energy supplies, it does. Lease sales are delayed, and sometimes withdrawn.

When they are conducted, government-funded intervenors are bound to try to block their development in the courts. Many of the most promising areas for oil and gas exploration are subject to restrictive land use policies, and, in some instances, are foreclosed to development permanently. The construction of pipelines, refineries, and other needed facilities is thwarted through a seemingly endless process of regulatory deliberation and appeal. Incentives to produce are extended with one hand, and then withdrawn with the other. It sometimes seems as though, contrary to its public posture, the government's real objective is to increase rather than reduce imports.

Some would argue that current federal energy policies must inevitably lead to increased imports, since the underlying assumption of federal policies is the notion that domestic petroleum resources are in danger of imminent exhaustion. This assumption, critics of federal policies contend, leads policymakers to give short shrift to the incentives, assurances, and legislative climate required for the development of domestic resources. Instead, policymakers focus to an inordinate degree on conservation to the detriment of attempts to enhance supplies. Such actions make the continued growth of imports a self-fulfilling prophecy.

While on the surface the contention that domestic oil resources are running out seems reasonable enough, this analysis of our energy position actually stems from a misinterpretation of recent trends in the energy market. The most significant error giving rise to this misrepresentation is the simplistic linking of the decline in additions to domestic "proved reserves" and the corollary increase in the proportion of our oil supplies represented by imports. Both of these trends evidenced themselves most dramatically in the period after 1971, and the conventional wisdom has claimed that the relationship between them demonstrates empirically a declining resource base. However, the analysis fails to take into account significant actions by the federal government which offer a different, yet credible, explanation for their existence. The most important of these actions were the imposition of price controls and the lifting of the ceiling on imports, which together acted to stunt the development of domestic oil and simultaneously spur imports. A secondary, but still important, factor has been the lack of understanding of our overall energy position at the highest policy-making levels.

Contrary to popular belief, our nation is enviably well endowed in terms of overall energy resources. The United States is often referred to as the Saudi Arabia of coal, and there is some understanding of the fact that we possess significant uranium, oil shale, biomass, and other energy resources. What is not well understood, though, is that in terms of potential *oil* resources the United States is similarly well endowed.

It is important to differentiate between "proved reserves," and potential oil resources. Estimates of proved reserves include only supplies which are known with a high degree of certainty to exist, and for the most part only those which have been verified through drilling. Therefore, this particular category of estimate is the *minimum* amount of oil available under present technological and economic conditions, and with no further exploration. Even in these terms, however, supplies are significant.

At present, according to the American Petroleum Institute, the United States ranks seventh in the world in terms of proved reserves.[1] While this places us behind Saudi Arabia, Iran and Kuwait, it still leaves us ahead of nations such as Libya, Nigeria, and Venezuela. Further, what remains to be discovered may be far greater than the doomsayers would have us believe. The problem which must be addressed, then, is not how to deal with the imminent exhaustion of a resource, but rather how to cope with a temporary deficit of *available supplies.*

The question of exactly how much oil remains to be discovered is a matter of considerable controversy. This is to be expected, since any such estimate must be based largely on speculation. However, all credible assessments, while ranging over a fairly broad spectrum, indicate that the remaining resource base is significant. The U.S. Geological Survey, for example, places the resource base at between 112 and 189 billion barrels of recoverable oil.[2] The Institute of Gas Technology, on the other hand, places the resource base in a range between 173 and 400 billion barrels.[3] Calculations made in preparing this study suggest that the remaining U.S. petroleum resource base lies in a range between 276 and 444 billion barrels of ultimately recoverable oil,[4] provided that an economic and statutory climate is fostered which will allow the recovery to take place. Such a climate would, of necessity, require a decision on the part of the government to eliminate the existing impediments to the natural functioning of the market—a move likely to meet strong resistance from those intent on expanding the federal role in regulating energy. Without the fostering of such a climate, the only alternative open will be continuing acceleration of the share of our petroleum supplies accounted for by imports, with all the attendant problems. It is essential, then, from both an economic and national security standpoint to take the steps neces-

[1]Source: American Petroleum Institute, *Basic Petroleum Data Book.*

[2]U.S. Geological Survey, *Circular 725,* p. 35.

[3]The Institute of Gas Technology, *A Survey of U.S. and Total World Production, Proved Reserves and Remaining Recoverable Resources of Fossil Fuels and Uranium* (Chicago, Ill., March 1979).

[4]Heritage Foundation Estimates.

sary to eliminate the governmental impediments to the production of domestic energy generally, and of domestic oil in particular.

To appreciate fully the extent to which federal actions have frustrated and continue to frustrate attempts to develop our native resources, it is useful to look first at the way in which those resources are extracted, how they came to be used in the first place, and how each piece of the energy puzzle fits together.

To know which steps to take requires a thorough understanding of the world oil market as it exists today, and of the events which have occurred in the past to make it what it is now. It is also essential that there be a broader understanding of the techniques, requirements, and problems associated with the search for and development of petroleum reserves, so that an appreciation of the rationale for the necessary federal actions can be fostered among the general public. It is only through the development of such an appreciation that the climate of public acceptance necessary to the facilitation of energy production can occur.

1

The Search for Oil

There is a certain irony to be found in the fact that today's energy crisis had its genesis in the response to the energy crisis of another era. During the period prior to the middle of the 19th century, whale oil and tallow provided the principal means of illumination for most of the world. While petroleum was known to exist, it was used largely for medicinal purposes. By the middle of the 19th century, overfishing had taken its toll of the world's whale population, resulting in a serious shortage of illuminants.

As has so often been the case in history, the market responded to the growing shortage. A group of New York businessmen learned of a report by a professor at Yale University concerning the possibility of using oil refined from petroleum as an illuminant. The practicality of such use had been demonstrated in Europe and in the United States in the early 1850s, but the amount of petroleum available as a feedstock was limited by the fact that, until then, the sole means of gathering oil was to skim if off ponds and streams. The businessmen decided that if they were to attempt to develop this new source of fuel for lamps, they needed a far more efficient method of obtaining feedstock. Their search for such a method led them to the notion of drilling for oil in the same fashion that men drilled for salt.

The group formed the Pennsylvania Rock Oil Company, and commissioned the self-styled Colonel Edwin L. Drake to manage their operation. They selected a site at Titusville, Pennsylvania, near an old oil spring for their initial undertaking. The primitive equipment consisted of an old steam engine and an iron bit. At one point drilling slowed to three feet per day. As time passed, even Drake began to become discouraged. Then, on the afternoon of August 27, 1859, the patience and diligence of those first wildcatters paid off.

Drake and his backers could not have forseen in their wildest imaginings what was to follow in the wake of their discovery. Before long, thousands of wells dotted the Pennsylvania countryside and a boom rivaled only by the California Gold Rush began to take place. Overnight, towns sprang up where previously only farmland had existed.

The most famous was Pithole, which at its peak had a population of some 10,000 and the third busiest post office in the nation. In those early days, innovation followed innovation.

Initially, oil was transported in water barrels, hence, from that time forth, the 42-gallon barrel became the standard unit of measurement for crude oil throughout the world. Soon the barrels proved inadequate to transport the volumes needed to supply the growing national appetite for this fuel, and railroads came to the oil fields. Not long after, the first pipeline was laid to further facilitate the torrent of black gold pouring forth from the Pennsylvania hills.

This torrent would seem a mere trickle after the invention of the automobile. Prior to the advent of autos with their gasoline-powered internal combustion engines, gasoline was a waste product of the refining process. Suddenly, it became the most valuable petroleum commodity. The only trouble was that refining technology available at the time could produce it only in relatively limited amounts. The growing demand for gasoline spurred research and development to begin to find ways to squeeze more of it from each barrel of oil.

The growth in demand for petroleum and petroleum products also lead to the advancement of the science of geology. At first, the search for oil was a haphazard affair, based primarily on intuition and guesswork. However, as drilling activity increased, drillers began to perceive a pattern in their successful wells. All of their successful efforts seemed to occur in geologic structures called "anticlines," arch-like folds in the earth's crust which create pockets that can trap oil or gas. The theory that oil migrated upwards and was trapped in such formations was advanced as early as 1861,[5] and was researched during the next three decades. It was confirmed in the 1880s when oil was discovered by drilling into anticlines where no oil had been previously found.[6]

Contemporary geology is a far cry from the largely intuitive methods which prevailed in the early days of the oil industry, but it was all built on the foundation laid by those early pioneers.

Oil Formation

The prevailing theory to explaining the formation and distribution of oil deposits is the "organic" theory.[7] It holds that oil was formed by the natural decay and alteration of plants and marine life which in-

[5]See Richard Foster Flint and Brian J. Skinner, *Physical Geology* (New York: John Wiley & Sons, Inc., 1974), p. 400.

[6]*Ibid.*, p. 401.

[7]*Ibid.*, p. 400.

habited the world's oceans and seas in prehistoric times. According to this theory, these organisms settled to the floor of these ancient bodies of water when they died, and those that were not consumed by scavengers were attacked by bacteria which removed oxygen, nitrogen, and other elements, leaving carbon and hydrogen behind. As ocean sediment built layer after layer on top of this organic material, heat and pressure were generated, eventually destroying the bacteria, and leaving the carbon/hydrogen compounds behind.

Over time, as successive layers of sediment were added, the pressure from the weight of the thick layers of material reduced the space between particles. At the same time, the heat and pressure changed the organic material into bubbles of oil and gas. These bubbles migrated through the sediment and eventually were trapped by an impermeable layer of rock, clay, or some other material.

At a later date, upheavals in the earth's crust caused one of a number of types of geologic traps to form, allowing the oil and gas to gather into a pool. The most common of these traps is the *anticline,* a dome-like formation capped by a layer of impermeable rock. A second type of trap is a *fault,* which occurs when vertical shifts take place in the earth's crust and a nonporous layer of rock ends up next to a porous one. A third type of trap is a *salt dome,* formed when a large body of salt thrust up through the earth pierces the strata above. The action results in oil being trapped either above or on either side of the dome. A final type of trap is what is called a *stratigraphic trap.* These formations are created by lateral alterations rather than as a result of structural deformations of existing portions of the earth's crust. All traps share the characteristics of providing a place for oil and gas to pool which is in some way capped or blocked by an impermeable layer, which prevents migration of the oil and gas beyond the confines of the structure.

As greater understanding of the geology associated with the discovery of oil and gas deposits was gained, increasingly precise methods were employed in the search for them. Shortly after the anticline theory was confirmed, an intensive effort was mounted to locate and map those anticlines which could be discovered through surface observation—which was effective in identifying only a small percentage of the existing structures. Many oil-bearing formations lie deep below the earth's surface and can be located only through the use of sophisticated geophysical techniques. Others lie offshore, covered by the world's oceans, and present unique problems for development, as well as for exploration. Though these barriers are formidable, modern geophysical techniques are continually improving our ability to overcome them.

Technological Improvements

Today the search for oil begins just where the early pioneers would have left off. As a result of the extensive mapping which accompanied the early attempts to identify anticlines, we now have a relatively good picture of where the earth's *sedimentary basins* lie. These basins, the remnants of prehistoric seas and oceans, are the regions which have contained most of the oil fields discovered to date. The sedimentary basins, however, cover vast areas, and so a number of tools have been developed to narrow the search. The most basic of these are the *magnetometer, gravimeter,* and *seismograph.*

The magnetometer is used to detect variations in the magnetic field generated by the rocks comprising a given formation. The importance of the variance in the magnetic field as a tool in looking for oil in a given formation stems from the fact that sedimentary rocks, the type which normally contain oil deposits, are far less magnetic than the other two broad categories of rock, igneous and metamorphic. Igneous rocks, which frequently act as the impermeable barrier which traps oil and gas migrating through sedimentary rock formations, on the other hand, are quite magnetic. Therefore, geophysicists flying over areas thought to hold promise can record slight variations in the magnetic content of the formations lying below them and gain some idea of their nature.

The gravimeter measures variations in the gravity of the earth's surface as small as one ten-millioneth of a percent. Such variations occur as a result of the differing densities of the rocks comprising the underlying strata. Sedimentary rocks are less dense than igneous or metamorphic rocks. By measuring such variations over an area, geophysicists can develop an understanding of the make-up of the underlying strata.

The seismograph is perhaps the best known of the tools used in contemporary oil and gas exploration. It measures sound waves generated by a charge set off on the earth's surface. These sound waves penetrate the ground and are reflected back. By measuring the time it takes for them to return, the relative densities of the underlying strata, and other information which can indicate the presence of hydrocarbons, can be developed. At one time it was necessary to drill down into the rock formation being investigated and detonate a charge underground. Modern techniques no longer require this, and instead use a number of environmentally benign methods to generate the sound waves. For example, in one of the most common, a charge is set off in a canister lying on the surface, eliminating the need to drill. The evolution of these new techniques has lowered both the cost and the environmental impact of seismic exploration. Other advances in technology have gone a long way in expanding the frontiers of oil exploration and in improving our ability to retrieve oil once deposits are located.

One of the most exciting areas of innovation is remote sensing.[8] This is an activity which involves aerial photography of a given tract of land. Pictures taken from great heights can detect deformities in an underlying land mass which might not be readily discernable through surface exploration. Until about ten years ago, the largest area which could be photographed at a given time was about 21 square kilometers, due to the limited height at which aircraft could fly. In 1970, the advent of high altitude photography increased the area which could be covered to around 208 square kilometers. In 1972, the real breakthrough occurred with the launching of landsat. From its vantage point some 990 kilometers out in space, pictures covering as much as 34,225 square kilometers can be taken, increasing the area which can be examined at one time by a factor of 1000 over more conventional methods of aerial photography.

As noted earlier, great strides have also been made in seismic technology. In addition to the elimination of the drilling requirement, other improvements have greatly enhanced the amount of information which can be gleaned from the seismic signal. All seismic data are now analyzed by computer, allowing geophysicists to utilize new color processing techniques which will record relatively slight variations in amplitude and frequency of the returning signal. Areas of high amplitude are displayed as so-called *Bright Spots.* Such differences can serve to flag deposits or accumulations of oil and gas. The value of this particular technique is especially great in fields where geologists and geophysicists have some experience on which to draw. Identification of Bright Spots has proved invaluable in delineating natural gas fields in areas such as the Gulf of Mexico.

Yet another area in which innovation is enhancing our ability to interpret information is the use of three-dimensional displays and graphics, also made possible by the advent of computer technology.

In addition to the technological advances which have facilitated the search for oil, technology has also improved methods to get it out of the ground. Areas which were previously foreclosed to drilling due to insurmountable natural barriers are becoming increasingly accessible, thereby opening up whole new frontiers—some with unexpected promise—for exploration.

One improvement which has shown a marked and immediate result has been the continuing increase in the depths to which we can drill. That first well at Titusville struck oil at a depth of 59½ feet or a little

[8]See P. W. J. Wood, "New Slant on Potential World Petroleum Resources," *Ocean Industry,* April 1979.

less than 20 meters. Recently, depths of as much as 10,000 meters have been attained on shore[9], and offshore drilling at depths of up to 1800 meters has become common. Improvements in this aspect of oil technology seem to be occurring at an accelerating pace. Between 1955 and 1970, we increased the depth to which we could drill on shore by 927 meters.[10] In the last nine years alone, we have increased the depth to which we can drill by more than 1780 meters,[11] roughly twice the amount. With this enhanced ability to reach farther into the earth's crust than ever imagined by Colonel Drake and his associates, we are increasing the amount of oil that can be extracted from a single site. Perhaps the most significant example is the Overthrust Belt of the Rocky Mountains.

During the 1960s, hundreds of wildcatters attempted to find oil and gas in the Overthrust Belt, generally with a disappointing lack of success. So many dry holes were sunk in the region that it earned the dubious reputation of the "driller's graveyard." As time passed, and the methods for deep drilling were developed, the wildcatter's belief in the potential of the Overthrust Belt was confirmed. Their lack of success had not been the result of any failure on their part, in either choice of area or level of effort, but rather a simple lack of adequate technology. At the time they were drilling, they were not able to reach the deposits which were subsequently found to exist due to the unusual nature of the underlying strata, which had become severely deformed and contorted during the geologic upheavals which formed the Rocky Mountains.

The discovery of oil in Alaska has led to other technological breakthroughs, breakthroughs which permit drilling in arctic environments. These include the use of directional drilling from locations on shore, the creation of man-made islands from which to drill offshore, and the use of artificial ice platforms.

A final technological advance which holds great promise for opening yet another vast new frontier area is the enhancement of our ability to drill offshore. In 1979, Getty Oil Company set a world's record for off shore drilling with a well drilled in 1354 meters of water off the coast of Spain.[12] It is believed that our current capability for offshore wells of 1800 meters will be greatly expanded in the near future, giving us the possibility of more and more of our crude supplies coming from deposits lying far offshore. This will necessitate continued advances in the technology of safely transporting oil from such regions to shore

[9] *Ibid.*

[10] *Ibid.*

[11] *Ibid.*

[12] *Ibid.*

areas, but all indications are that such improvements will be forthcoming.

The Current Picture

While all of the advances in the technology of looking for and producing oil hold great promise of significantly broadening our oil reserve base, they do not—because of the high cost of technology—guarantee that petroleum prices will decline, or even stabilize. Rather, the increased reliance on oil produced using new technology means that the overall cost of petroleum products will go up in direct proportion to that reliance. In short, the oil will be there, but it will be more expensive. (Higher costs of drilling are already being reflected both in the oil field and at the pump. For example, an onshore oil well, which might have cost as little as $51,200 in 1967,[13] can now be expected to cost more than $250,000, and might easily cost several million dollars if it is located in an area such as Alaska.)

Despite the technological advances, oil exploration remains a high-risk endeavor. Historically, only one well in ten ever strikes oil, and even then there is no guarantee that it will be in economically feasible deposits. In spite of this, drilling for oil is taking place at the highest pace since the late 1950s, the previous peak period. This increase in the search for domestic oil has already paid benefits in the Overthrust Belt, and holds great promise in other frontier areas, provided drillers can obtain access to those areas most likely to contain petroleum deposits.

The question of access is perhaps the central issue in determining our ability to develop domestic oil resources to their fullest potential. The lack of access has already severely hampered both the search for oil and the maintenance of an adequate domestic reserve base. Lack of access also partially explains the tendency for heavy drilling activity on the margins of existing fields, where access has already been granted. This tendency, however, must also be partly attributed to the unfavorable financial picture for exploration which has resulted from the combined effects of the imposition of price controls on domestic oil production and the repeal of various tax incentives previously available to investors in drilling operations.

There is little doubt that elimination of the barriers to access to our most promising petroleum provinces, coupled with relief from the burdens imposed through regulations of dubious value, would enhance significantly our ability to develop domestic petroleum resources. The impact this enhanced ability would have on our present

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[13]American Petroleum Institute, "Facts About Oil."

import problem, and on the continuing decline in our domestic reserve base, is not well understood by either the general public or many of the policymakers whose decisions affect oil production. To them, domestic petroleum production is something which is fading from the picture, soon to be only a memory. Such beliefs have no foundation in fact. Not only is there a significant amount of oil remaining to be discovered, but in actuality we have barely scratched the surface of our nation's potential.

A better understanding of the potential for oil production within the United States is essential to the development of sound energy policy at the federal level. Without such a climate of understanding, we will inevitably repeat the mistakes of the past—mistakes which led to our current dilemma. It is therefore useful to examine the nature of the U.S. petroleum resource base, and to discuss the barriers to its full utilization.

2

How Much Oil?

Measuring Oil Reserves

A major barrier facing anyone attempting to assess the extent of our domestic petroleum reserves is the confusing and often apparently contradictory welter of estimates of oil and gas supplies. There seems to be an endless progression of terms: "proved reserves," "probable reserves," "potential reserves," "oil in place," "oil originally in place," "ultimately recoverable reserves," and so forth. Each of these estimates offers a separate set of figures, and each is put forward with weighty documentation and authority. With many differing estimates and such widely divergent figures, it is little wonder that confusion and disbelief abound.

In the final analysis, the difference between estimates normally can be explained by the fact that they are measuring different things. Oil reserves are categorized in relation to the degree of engineering and geologic data available to verify their existence. When verification is lacking (as is often the case), speculation enters the picture. As a general rule, the higher the estimate, the greater the element of speculation. Despite the confusion they cause, such speculative figures are based on longstanding geologic theory, and are the products of well-established techniques—techniques essential for long-range planning, and the determination of fruitful fields for exploration.

Perhaps the broadest term is "oil originally in place." This measurement attempts to quantify the total amount of oil which existed in a given region *prior* to its development. Such figures provide a base line for determining how much oil is left.

Closely related to estimates of the oil originally in place are those of "ultimately recoverable reserves." These estimates attempt to quantify the total amount of oil which *could* be produced from a given field, region, or pool, and include any past production. As is the case with oil originally in place, ultimately recoverable reserves give a baseline for the computation of other estimates.

A third broad category of estimate is "cumulative production,"[14]

[14]U.S.G.S. *Circular 725,* p. 8.

which represents the sum of all production which has taken place in a field, region, or pool through the date of the estimate. When subtracted from ultimately recoverable reserves, it provides a figure for the remaining recoverable reserves. It should be noted here that the recoverable reserves estimates increase with rising prices or technological advances. The most commonly cited term is the estimate of "proved reserves" compiled on an annual basis by the American Petroleum Institute and American Gas Association. This figure is essentially an inventory of the oil which has been verified through drilling. It has a high degree of certainty attached to it, and has been likened by some economists to the equivalent of the oil we have "on the shelf." This is because even if no further exploration or development were to occur, the "proved reserves" estimate would be expected to change only in relation to the extent to which the resources it represents are consumed. Of course, as is the case with any estimate, periodic adjustments must be made to account for new geologic data or new discoveries, but, by and large, the "proved reserves" estimate is the most precise available measure of the oil which has been discovered and which can be economically produced within the area covered by the estimate. It is effectively the *minimum* amount of oil we may safely assume is contained in our reserve base. At present, domestic proved reserves are 27.8 billion barrels.[15]

While the estimate of "proved reserves" provides a picture of what is relatively certain to exist in terms of petroleum resources (and is therefore a good measure for intermediate planning), it is not comprehensive enough to describe the total resource base we have to draw upon. In formulating longer range plans, a more useful estimate is the U.S. Geological Survey's *Circular 725, Geologic Estimates of Undiscovered Oil and Gas Resources in the United States.* This estimate, more difficult to follow than that of "proved reserves," is comprised of a number of components. Each component quantifies a different portion of the resource base, and each has a different degree of speculation attached to it. This variety of constituent elements also makes *Circular 725* somewhat easier to misinterpret. In spite of these limitations, the estimate contained in the USGS publication is extremely important. Because it represents the official government quantification of our domestic petroleum resources, it is used throughout the government in the process of formulating energy policy and has an impact greater than any other study.

[15]American Petroleum Institute, *Basic Petroleum Data Book.*

The Geological Survey's Estimate

In the fall of 1974, the Federal Energy Administration asked the U.S. Geological Survey to compile an estimate of the undiscovered oil and gas remaining within the boundaries of the United States. The Geological Survey put together a team of more than 70 experts from its staff and published the estimate in 1975.

The results of this analysis may be divided into four broad categories. These are: 1) identified, economic recoverable reserves, 2) identified, subeconomic resources, 3) undiscovered, economic recoverable resources, and 4) undiscovered subeconomic resources. The sum of the estimates contained in these four categories represents the overall estimate of the total recoverable petroleum resource base of the United States.

The first category, *identified, recoverable reserves,*[16] is comprised of three constituent elements. These are measured, indicated, and inferred reserves and they correspond to the API/AGA estimates of proved reserves. Measured reserves are defined by the USGS as "that part of the identified resource which can be economically extracted using existing technology, and whose amount is estimated from geologic evidence supported directly by engineering measurements."

Indicated reserves are the second component of this broad category of identified reserves. The USGS defines these deposits as "reserves that include additional recoveries from known reservoirs (in excess of measured reserves) which engineering knowledge and judgment indicate will be economically available by application of fluid injection whether or not such a program is currently installed."[17] (Fluid injection refers to the technique of forcing water, or sometimes detergent, into the periphery of an oil field in order to recover additional amounts of the oil in place.) The sum of measured reserves and indicated reserves is referred to as "demonstrated reserves" because they are based on actual drilling, seismic, or other hard evidence.

The third and final component of identified reserves is "inferred reserves." This is defined as "reserves in addition to demonstrated reserves eventually to be added to known fields through extensions, revisions, and the new pays."[18] (The term "new pay" refers to a new discovery.)

The total of the three components of identified reserves—measured, indicated, and inferred reserves—comes to around 62 billion barrels.[19]

[16]U.S.G.S. *Circular 725,* p. 8.
[17]*Ibid.,* p. 9.
[18]*Ibid.*
[19]*Ibid.,* p. 34.

As can be seen from the definitions of each of the constituent elements of this figure, it is established with a fairly high degree of certainty, although not with the precision of estimates of proved reserves. It is the only portion of the USGS estimate which is expressed as a single figure, however. The other three major categories are all expressed in terms of a range to reflect the increasing degree of speculation associated with them.

The next major category of the Geological Survey is *identified, subeconomic resources*. This classification is defined by the USGS as "known resources that may beome recoverable as a result of changes in technological and economic conditions."[20] It is estimated to include from 120 billion to 140 billion barrels of oil. The economic recovery factor used at the time the estimates were made was 32 percent of the oil in place.[21] The subeconomic portion of the remaining resources was estimated to be an additional 28 percent of the original oil in place, so that ultimate recovery could be as high as 60 percent. The sum of the estimate of identified, economic recoverable reserves, and of identified, subeconomic resources represents the total amount of ultimately recoverable oil which has been to some extent verified through actual engineering or geologic data. These resources total between 182 and 202 billion barrels.[22]

The third broad category is *undiscovered recoverable resources*, defined as "those economic resources, yet undiscovered, which are estimated to exist in favorable geologic settings."[23] As in the case of identified recoverable reserves, the magnitude of the portion of the resource base assigned to this category is a function of the technology and economics of the oil market at the time the estimate is made. The size of the component, therefore, is subject to modification in relation to any changes which might occur in either the price of oil, or in the technology available to get it out of the ground. In *Circular 725,* the estimate of the quantity of resources falling into this category ranged from 50 billion to 127 billion barrels.[24]

The final category included in the USGS circular is the *subeconomic portion of undiscovered resources*. It represents a segment of the estimate defined as those "quantities of a resource estimated to exist outside of known fields on the basis of broad geologic knowledge and theory."[25] The Geological Survey estimates that the petroleum which

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[20] *Ibid.*
[21] *Ibid.*, p. 27.
[22] *Ibid.*, p. 34.
[23] *Ibid.*, p. 8.
[24] *Ibid.*, p. 34.
[25] *Ibid.*, p. 8.

falls into this category comprises somewhere between 44 billion and 111 billion barrels.[26] Of course, when market prices increase, or technology improves, portions of the subeconomic resources are moved into the "undiscovered recoverable resources" category.

Adding the economic and subeconomic portions of undiscovered resources yields an estimate of the amount of recoverable oil which remains to be found. The sum of these two figures places this quantity of oil between 94 and 238 billion barrels. Of course, some caution should be exercised in the use of this figure, as it is speculative compared to estimates based on drilling, seismic work, or other firmer geologic evidence. It does, however, represent a reasonable "best guess" and is based on widely accepted geologic theories.

On the basis of the estimates of the four components of the USGS resource base, we may reasonably assume that the domestic petroleum resource base of the United States lay in a range between approximately 276 and 440 billion barrels at the date the study was completed. (Revisions are underway now.) Of this base, somewhere between 112 and 189 billion barrels were estimated to be economically recoverable as of that date—a quantity sufficient to meet *all* our domestic needs for 18.7 to 31.5 years without importing a single drop of oil.[27] Should our access to imports remain as it currently is, the same quantity would be sufficient to maintain present levels of production for nearly twice as long.

While the acceptance of these estimates carries with it an implicit acceptance of the USGS assumptions, conditions in the marketplace, and in technology, the USGS assumptions may no longer be valid. It is therefore essential that the effects of the changes in the market be a factor in the analyses of the data base so that U.S. energy policymakers relying on these estimates are able to take them into account. It is useful, then, to look at the original assumptions.

The U.S. Geological Survey Estimate's Assumptions

As has been noted several times, perhaps the least understood aspect of all types of reserve estimates is that the recoverability of a given segment of the oil in place in a particular deposit is a function of economics and technology. As each of these factors changes, so too does the amount of oil which is likely to be recovered. Also, there is a magnifying interaction between these elements. For example, minor increases in the wellhead price may make relatively commonplace techniques such as fluid injection economically feasible. Similarly, ad-

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[26] *Ibid.*, p. 34.

[27] Assuming consumption levels off at approximately 17 million barrels per day.

vances in technology can bring previously uneconomic fields into production. In periods when major advances in both technology and price occur, the expected effect will be a dramatic increase in estimates of recoverable reserves. Two questions on the USGS study must be asked: what were the USGS assumptions regarding these two crucial factors, and what events have occurred since the study was completed which may have had an impact on their validity? The first question may be answered by referring to the introduction of *Circular 725.*

According to the Geological Survey's analysts: *"In making estimates of undiscovered oil and gas resources, it is necessary to make fundamental assumptions pertaining to economics and technology. The estimates of undiscovered recoverable resources take into account relevant past history and experience and are based on assumptions that undiscovered recoverable resources will be found in the future under conditions represented by a continuation of price-cost relationships and technological trends generally prevailing in the recent years prior to 1974."* (emphasis added)[28]

As can be seen—and as is obvious—the substantial increases in the world price of oil which occurred after 1974 were not considered in the USGS estimates. The USGS acknowledges and explains this omission by stating: *"Price-cost relationships since 1974 were not taken into account because of the yet undetermined effect these may have on resource estimates. If fundamental changes in price-cost relationships are imposed, or if radical improvements in technology occur, estimates of recoverable resources will be affected accordingly."* (emphasis added)[29]

The importance of this fact should not be underestimated. The changes in the behavior of world oil prices in the post-embargo period have affected the economics of oil production in at least two significant ways. The first is price increases were of a scope and magnitude previously unheard of in our experience. It is not merely the *fact* that prices increased, but rather the *extent* to which they increased which represents one of the fundamental changes in the economics of the oil market. A second, equally fundamental change is found in the fact that the series of increases, taken as a whole, represents a dramatic reversal of the trend which dominated the price aspects of the world oil market over nearly three decades between the end of the Second World War and the 1973 embargo.

[28] *Ibid.*, p. 1.
[29] *Ibid.*

Price Trends in the Oil Market

In 1950, the average price of a barrel of oil produced in the United States was $2.51 at the wellhead.[30] That price rose to $2.78 by 1954, but following the worldwide trend towards stock oil prices, remained close to that figure from then on. It was not until 1969 that the price of a barrel of oil surpassed the three dollar mark, and the average wellhead price of crude oil in the U.S. was only $3.89 as late as 1973.[31] What is significant about these figures is that, when adjusted for inflation, they actually represent a decline in the price of crude oil in real terms. Thus, the 1973 price, adjusted for inflation, was only $2.36—nearly 6 percent less that the 1950 price! In real terms, gasoline prices also dropped during the post-war period. In 1950, the average price of a gallon of gas in the United States was 26.8¢[32] Over time, the nominal price (that expressed in current dollars, rather than adjusted for inflation) rose slowly to slightly below 40¢ per gallon. When adjusted for inflation, the real price of gasoline in 1950 dollars was actually 21¢, or more than 21 percent less than it had been in 1950! Even more surprising is that, when adjusted for inflation, the real price of gasoline was less than it was in 1950 as late as March of 1979.[33]

In comparison with the period before 1979, it is easy to see how the staggering increases which have taken place since the OPEC embargo (and especially those following in the wake of the Iranian supply interruption) could affect the economics of oil production. The effect of oil prices on oil discovery becomes even more important when one understands the relationship between prices and seismic activity, the basic tool of oil and gas exploration.

Between 1932 and 1952, oil and gas prices increased at a relatively stable rate.[34] During that period, seismic activity also increased at a uniform rate. However, shortly after the end of the Second World War, the major finds in the Middle East led to an increased availability of cheap crude on the world market, and exerted the strong downward pressure on oil and gas prices discussed earlier. The result was that between 1948 and 1972 the real price of crude oil declined by around 31 percent.[35] Further disincentive for domestic exploration was created in 1954 with the Phillips decision, which allowed the Federal Power Commission to impose price controls on natural gas sold on the

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[30] H. A. Merklein and William Murchison, *The Gas Lines and How They Got There* (Dallas, Texas: The Fisher Institute, 1980).

[31] *Ibid.*

[32] *Ibid.*

[33] *Ibid.*

[34] Source: American Society of Petroleum Geologists.

[35] *Ibid.*

interstate market. The combination of these factors resulted in a 73 percent decline in seismic activity in the United States during the period between 1952 and 1970.[36] Because new drilling follows seismic activity, drilling in the U.S. declined 55 percent between 1956 and 1971.[37] It was only in the spring of 1980 that seismic activity increased to its previous 1957 peak.

With the advent of phased decontrol of oil prices, drilling activity has again picked up. Because there is a three-to-seven-year lag between the discovery of an oil field and actual production, additions to reserves are still not sufficient to keep up with domestic consumption of "proved reserves." It may therefore be some time before the full impact of the recent increase in drilling improves our domestic reserve picture.

The central concept these figures demonstrate is that there appears to be a direct and well-documented relationship between the price of oil and the amount of exploratory activity which takes place, and that the amount of such activity is the key factor in determining the level of domestic reserves. Therefore, it would be anticipated that the dramatic increase in world oil prices could result in significant additions to reserves of all categories. At a minimum, the fact that prices have increased as sharply as they have brings a substantial portion of the petroleum resource base previously categorized as subeconomic into the economic category. Additionally, as the trend towards higher prices continues, the inclusions of increasing amounts of subeconomic reserves in the economic category becomes more certain.

The logical question then is: why has there been a consistent and continuing decline in the additions to proved reserves in the face of higher prices? The answer: the government has imposed barriers and constraints on access. Perhaps no single factor has been a greater inhibition to the production of domestic energy than the restrictive land use policies promulgated primarily at the federal level and emulated by some states. No matter how high the price of oil goes on the world market, it is of little avail as long as access to the petroleum deposits is withheld. While many specific examples of limited access hampering energy development exist, perhaps none is so telling as the cases of Alaska and of the Santa Ynez Unit off the coast of California. Each in its own way stands as a monument to the intransigence and shortsightedness so characteristic of governmental lands policy.

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[36] *Ibid.*

[37] *Ibid.*

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Alaska: An Untapped Resource

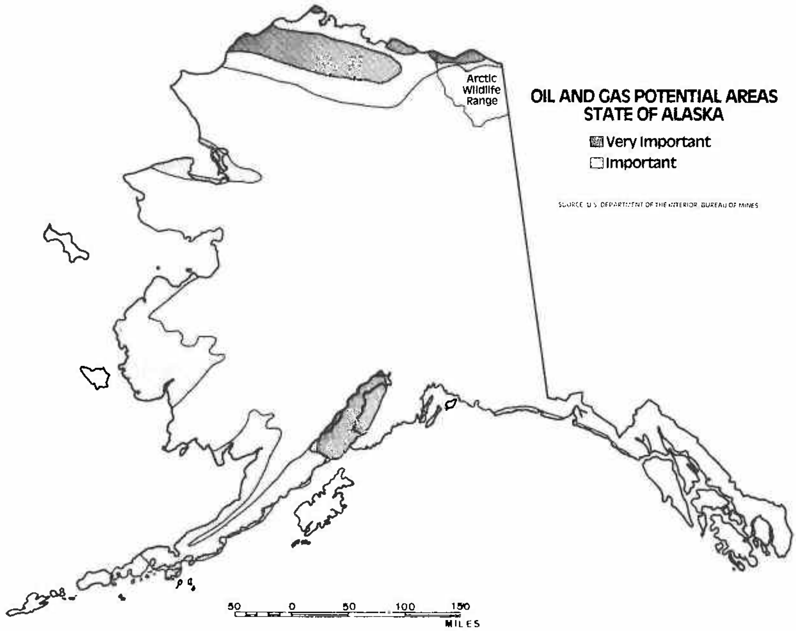
The state of Alaska is characterized by both unique opportunities and unique problems. Although the state of Texas is the state traditionally associated with "bigness," virtually everything in Alaska is of a magnitude to give even a Texan pause. Four time zones are contained within its boundaries, and its 586,412 square miles of territory made it one-fifth the size of the entire United States. It contains the nation's highest mountain, Mt. McKinley, and its largest state park system. It has 6,640 miles of coastline, and an amazing 33,904 miles of tidal shoreline. Its glaciers, mountains, and frozen tundra present vistas of incomparable beauty and magnificence.

In spite of the state's size, it is sparsely populated, claiming only around 400,000 residents, approximately half of whom are concentrated in its largest city, Anchorage. As might be expected, transportation in Alaska presents special problems. The state's 5,000 miles of connecting roads mean that many towns, villages, and cities—including the state capital of Juneau—are accessible only by a state-operated ferry service, or by air.

The remoteness and small population of Alaska have contributed to the growth of many popular misconceptions regarding daily life there. For most Americans, mention of Alaska conjures up romantic visions of Sergeant Preston of the Yukon relentlessly pursuing outlaws across the frozen tundra, or of scenes from Walt Disney's "Vanishing Wilderness." Although life in the more remote areas of the state can still be quite difficult, such idealized visions of our 49th state bear little resemblance to the realities of contemporary Alaskan life.

There is one popular image of Alaska which does remain valid: it abounds in natural resources. While experts may disagree as to the exact size of a given mineral deposit, there is no disputing the fact that Alaska's abundant resources led successive generations of settlers to migrate to our northernmost state.

Alaska's potential strains the imagination. The state is thought to hold as much as half the nation's recoverable coal reserves. It is also known to possess significant deposits of gold, silver, uranium, molyb-



denum, and tungsten. Its fisheries are among the most prolific in the world, and are particularly noted for their salmon and Alaskan King Crab. The vast stores of timber which grow in Alaska's forests are of a scope difficult to comprehend. It cannot be disputed that the cornucopia of natural wealth found in Alaska makes the state one of our most important national assets.

Oil Exploration in Alaska

Of all Alaska's resources, it is the state's oil potential which is currently on the minds of most Americans, for these resources address one of our nation's most critical needs. Although oil exploration in the Arctic began as early as 1902,[38] only recently have serious attempts to develop Alaska's potential been made. The reason for the previous apparent inattention was actually a lack of technology sufficiently sophisticated to permit the deposits to be recovered economically. In recent years, the rapidly escalating rate of improvements in oil recovery techniques have brought increasing amounts of Arctic oil in general, and Alaskan oil in particular, within our reach.

During World War II, the U.S. Navy drilled 37 exploratory wells,

[38]"North Alaska Oil and Related Issues" (Library of Congress, Congressional Research Service publication no. 72-238, SP).

and 45 core tests in Alaska.[39] Most of these tests were conducted on what is now known as the Naval Petroleum Reserve in Alaska (NPR-A), and was then called Naval Petroleum Reserve #4. While the tests did give some indication of the underlying deposits, the lack of adequate recovery methods made this information little more than a subject of geologic curiosity. The Navy eventually abandoned efforts to develop Alaskan oil, and ignored the collected information. Private drillers, however, did not forget the lessons they learned in these early efforts, and continued their search throughout the late 1940s and early 1950s.

In 1954, the efforts of those early pioneers finally paid a dividend with the discovery of the Swanson River Field and other oil and gas deposits in the upper Cook Inlet region. While these discoveries were encouraging, none truly reflected the potential thought to exist in the Alaskan North Slope and in other parts of the Arctic Basin.

For a period of time after the discoveries at Cook Inlet, interest in Alaska began to wane. The worldwide surplus of crude oil (in large part stemming from discoveries in the Middle East), had the effect of keeping prices low, which, in turn, created an economic climate unfavorable to further Alaskan development. Towards the end of the 1960s the worldwide glut of crude oil began to recede, and once again companies began the scramble for new petroleum deposits. Among the companies involved in this search was the newly formed Atlantic Richfield (ARCO), which had grown out of a merger of the Atlantic Refining Company and the Richfield Oil Company.

ARCO had acquired a number of oil leases on the Alaskan North Slope, and had decided to drill two wildcat wells on their holdings. The first of the two was drilled near the Sagvanirktok River. The results were disappointing: a dry hole costing $4.5 million. At this point, the company started rethinking its efforts in the 49th state. Having poured such a substantial sum down a dry hole, they were hesitant to take additional risks. After much deliberation, however, a decision was made to go ahead with the second drilling operation, this time at Prudhoe Bay. The first hint of the success of their endeavor came in February of 1968 with the cautious announcement that they had found a substantial flow of gas, and that there were indications of oil-bearing sands below. In early March of that year, the find was confirmed. The well was tested, and was found to flow at an amazing 1,152 barrels per day.

It was not very long before every company with an interest in Alaska was busy looking for oil, and very often finding it. The most significant find was made by British Petroleum at its Put River #1 well. This strike rocked oil markets around the world when it was an-

[39] *Ibid.*

nounced that the discovery was estimated to be 4.8 billion barrels, making Prudhoe Bay a "Super Giant" oil field. Some estimates of the North Slope ranged as high as 40 billion barrels at that time,[40] giving rise to wild speculation on the advent of yet another of the oil industry's historic gluts. Specters of oil prices plummeting to 10¢ a barrel raised themselves once again, and companies which did not have holdings in Alaska began to look nervously over their shoulders. Some analysts were even asserting that the advent of Alaskan crude would spell disaster for some exporting nations such as Venezuela which would loose their lucrative export market in the United States.

There was more than a little geologic evidence to provide a rational basis for such fears. As noted earlier, there had long been speculation over the potential of the Arctic Basin, most of which anticipated major finds. Even today, such speculation continues. There is no question that the area has attributes which strongly indicate that it may become one of the world's richest petroleum provinces.

The formation, which extends into Canada and into Soviet Siberia, as well as into Alaska, is comprised of one of the world's younger sedimentary basins. It dates from a period between 65 and 225 million years ago, placing it in a time span referred to by geologists as the Mesozoic Era—the geologic age during which many of our most prolific sedimentary basins were formed.

There are a number of factors other than the general configuration of the Arctic Basin which enhance the likelihood that Alaska in particular might be the site of additional, significant deposits of oil. Nearly half of the state's onshore and offshore area is underlain by the types of geologic formations thought to hold the greatest promise for oil exploration. Among the most notable of these are the anticlines common to the area, which are thought to hold oil-bearing sands from 500 to 600 feet thick. Rich fields in the Gulf of Mexico and Maracaibo were discovered in formations of a similar configuration. One of these structures in particular, the Marsh Creek Anticline on the Arctic Wildlife Range, is some 46 miles long, and 3 miles wide. A number of competent geologists with experience in the Arctic Region believe that this formation could hold as much as 14 billion barrels of recoverable oil.[41] Should this prove to be the case, then the Marsh Creek Anticline would comprise the largest oil field in North America, overshadowing even Prudhoe Bay.

Experience in the Arctic Basin outside Alaska seems to reinforce the contention that the area is likely to prove exceptionally fertile for oil exploration. For example, a Canadian firm, Dome Petroleum, has

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[40] *Ibid.*

[41] Source: State of Alaska.

met with considerable success on the Canadian side of the Beaufort Sea, with their first discovery there testing at 12,000 barrels per day. Other discoveries in Canada's McKenzie Delta and in Soviet Siberia give added weight to the assertion that the Arctic Basin is perhaps the most promising petroleum province remaining to be explored.

Given the vast potential of Alaska, and the widespread concern over our inordinate reliance on imported oil, it would seem logical that every effort would be made to facilitate the development of the petroleum resources we are relatively certain lie under the soil and off the shores of our 49th state. What is logical, however, does not necessarily bear any resemblance to what is likely to occur in the political arena, and that is exactly where the question of Alaskan oil has been catapulted. The effects of this politicization have been dramatic. They are best illustrated by a simple fact: at present there are only eight active rotary rigs in the state. By comparison, there are more than 845 active onshore in the Gulf Coast.[42]

At every turn, any effort to develop the potential thought to exist in Alaska seems to run up against some federally-constructed barrier which stops it cold. Arbitrary decisions, unilateral actions, and blatant manipulation of conservation statutes abound. Where the direct actions of the federal government are insufficient to block development, hosts of federally-funded intervenors stand waiting to enter the courts with dilatory motions aimed at obstructing, delaying, or merely harassing any company with the temerity to attempt a major industrial project in the state. Perhaps the worst aspect of the problem is that these delays are taking place in direct opposition to the expressed wishes of the state's residents, and over their loud protestations. The most graphic illustration of this problem is found in the controversy over the "d-2" lands.

The "d-2" Lands Question

Despite the current high level of attention being directed at the Alaskan Land question, the origin of the problem dates back to the advent of Alaskan statehood, and the special circumstances which prevailed at that time, for it was in this event that the seeds of the current controversy were sown.

At the time of Alaska's admission to the Union, less than 1 percent of its territory was held either by the state or by private citizens. The remainder, more than 99 percent, was held by the federal government. Moreover, only about a third of the state's land area was even surveyed. Although the Constitution is silent on the question, portions of

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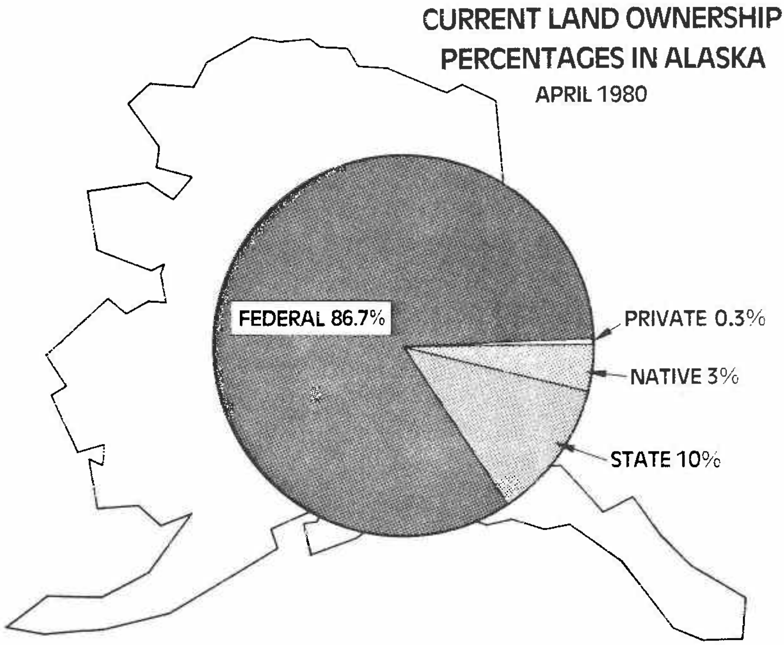
[42]Source: American Petroleum Institute.



the federal lands lying within the borders of a state traditionally are ceded to it when it is granted statehood. Such land grants normally included any township which might have been formed, lands for the construction of schools and colleges, rights of way for transportation systems, and so forth. In the case of Alaska, rather than specifying which acres should change hands, the Congress provided for the transfer of 104.5 million of the state's 365 million acres, to take place over a period of 25 years.

It was thought that conveying a right to a certain number of acres rather than granting specific parcels would allow the state time to survey its territory, so that selection could take place in a rational fashion. In accepting this provision, Alaska gave up any claim it might have on other types of land conveyances such as school lands and the like.

While the amount of acreage conveyed may seem large, it is roughly in proportion to cession which occurred when other states were admitted to the Union. In fact, the percentage of total federal holdings conveyed at the time of statehood (about ⅓ of the total) was only about half as great as that conveyed to Florida upon its admission.

Initially, the process of state lands selection took place at a relatively slow pace. By 1969, the state had selected only about 25 percent of the acreage to which it was entitled. In that year, however, the situation suddenly underwent a radical change when Stewart Udall, then serving as Secretary of the Interior, placed a freeze on further land selections by the state pending the disposition of the claims of Alaskan natives.

In response to the move by the Interior Department, the Congress enacted the Alaska Native Claims Settlement Act of 1971. Under the provisions of this law, Alaskan natives had the right to select up to 44 million acres of land from a pool of some 116 million acres to settle their aboriginal claims. During the drafting of the legislation, environmental interests in the Congress added a provision which allowed the Interior Department, through the Secretary of the Interior, to withdraw up to 80 million acres of Alaska for incorporation into the national conservation system. This provision was contained in Section 17(d)(2) of the law, giving rise to the term "d-2 lands."

For the next five years, the situation remained uncertain, with various "d-2" proposals being made in the Congress, but none being acceptable to all parties. The issue finally came to a head in 1977 when Representative Morris K. Udall (D-Ariz.) introduced H.R. 39, a bill which would have set aside some 140 million acres of the state in various extremely restrictive land use categories.

It was not long before opposing interests began to line up either for or against H.R. 39. During the 95th Congress, there were several attempts to reach a compromise between the Udall position and one more open to development (as was favored by the state), but these efforts were of little avail.

Responding to the apparent impasse in the Congress, Interior Secretary Cecil Andrus decided to take unilateral action. In November 1978, Secretary Andrus used emergency powers under the Federal Lands Policy Management Act to withdraw 110 million acres of Alaska for three years. This action was followed in December 1978 by President Carter's designation of some 56 million of the acres withdrawn by Secretary Andrus as a National Monument.

During the 96th Congress, yet another attempt at resolving the "d-2" issue was made. In the House, Representative Udall successfully introduced a new version of H.R. 39, which would restrict the use of some 155 million acres of the state. In the Senate, Senator Henry Jackson (D-Wash.) introduced a compromise measure which would include 118 million acres. In August 1980, a compromise measure, introduced on the Senate floor by Senator Paul Tsongas (D-Mass.) was passed by a vote of 78 to 14 and sent to the House. At the time Congress recessed for the elections, the House had not acted.

In 1979, while the Congress was deliberating the Alaska Lands question, the Secretary of the Interior once again took unilateral action. In this instance, Secretary Andrus withdrew some 40 million acres for a period of 20 years. The acreage withdrawn was part of that originally affected by his November "emergency" withdrawals. Moreover, the Interior Department began a series of "scoping studies" in February of 1980 aimed at possibly identifying an additional 12 million acres to withdraw.

Whatever the outcome of the "d-2" lands debate, it stands as a singular example of how the federal government can act as a barrier to petroleum development. The lands in question in the "d-2" controversy contain many of Alaska's most promising basinal areas and potential petroleum provinces, including the Marsh Creek Anticline. Although the Tsongas compromise would allow some exploratory activity, actual leasing would require additional congressional action. Furthermore, in addition to the petroleum deposits, other strategic minerals are thought to exist in significant deposits within the boundaries of the areas to be permanently closed to exploration.

Unfortunately, circumstances surrounding the "d-2" lands lock-up are not unique in Alaskan experience. For example, the recent lease sale in the Beaufort Sea was challenged in court and delayed several months. The original Trans-Alaska Oil Pipeline was delayed for several years while litigation was pending and the proposed Northern Tier Pipeline remains embroiled in environmental litigation to this day. Through it all, the resources which could help ease the way to energy security stand hostage to a host of environmental, sociological and political considerations.

Were the petroleum potential in question of limited magnitude, an argument might be made on behalf of assigning top priority to environmental and other concerns. However, this is not the case. The potential of Alaska is unprecedented elsewhere in the United States, and may prove sufficient to release us from the deathgrip of dependence on foreign imports.

How much oil is there?

Alaska's Potential

At a minimum, the state of Alaska is likely to hold 47.9 billion barrels of recoverable oil,[43] or nearly one and three-quarters as much as the total currently used at U.S. "proved reserves." At the upper limit, the recoverable resource base may be as high as 123.9 billion barrels, and the mean is 81.6 billion barrels. Were all our oil supplied from Alaska's fields (something which in practical reality would not occur),

[43]Source: State of Alaska.

its reserves would be sufficient at the upper limit to provide for all our needs at current consumption levels for nearly 20 years. Even at the median figure, the state's resources would be equal to nearly 13.2 years' consumption. This potential, however, will continue to remain merely a potential as long as access to the areas most likely to hold oil is withheld. More importantly, the unresolved questions regarding the extent of Alaska's oil deposits will remain unanswered as well, and therein lies one of the central dilemmas concerning the development of Alaska's potential.

Some environmental groups dispute the contention that significant deposits of oil remain to be discovered in the areas which would be affected by the various administrative and legislative actions currently locking up vast portions of the state. However, at present, only two of Alaska's 23 basinal areas, have been intensively explored, and 12 have never felt a drill bit. Moreover, contemporary exploration techniques can be used without permanent or significant disruption of the environment. When one weighs the minimal environmental costs of determining with some certainty the extent and nature of Alaskan petroleum resources in relation to the cost of continued dependence on imported oil for significant portions of our domestic consumption, there can be little doubt that the scales fall heavily on behalf of further exploration.

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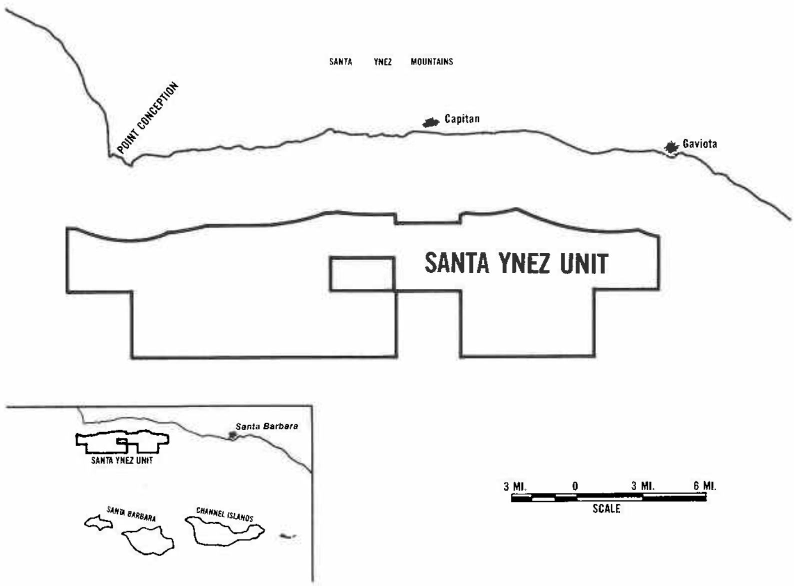
The Santa Ynez Unit

At a time when serious consideration is being given to military options for protecting U.S. energy interests in the Middle East, the notion of foreclosing many of our most promising areas for petroleum development to exploration seems ludicrous. However, even more ludicrous is the fact that *at the present time, there are a number of discovered, fully explored oil fields which could and should be producing oil but are not—primarily due to the red tape involved in obtaining the necessary permits.* Moreover, in one particular instance, *the lack of a single permit was the sole obstacle* inhibiting the flow of some 80,000 barrels of oil per day from a field off the California coast. This field, the Santa Ynez Unit in the Santa Barbara Channel, is estimated to contain as much as one half billion barrels of oil, and a large amount of natural gas as well. Eleven years have now passed since it was discovered, and yet, not one drop of its oil has flowed into California's refineries, and none will until sometime next year. Santa Ynez stands as a monument to the intransigence, single-mindedness, and shortsightedness which has characterized so much of the regulation of energy development to date.

Background of the Controversy

On July 13, 1969, the Exxon Company first struck oil in the Santa Ynez Unit, discovering what is known as the Hondo Oil Field. When tested, the well flowed at 1,000 barrels per day and was also found to have a considerable amount of associated natural gas. As the company proceeded to develop their leasehold, two additional fields (the Pescado and the Sacates) soon were discovered, confirming early indications of a major find.

Exxon's holdings in the area, in combination with those of Chevron and Shell comprised some 83,000 acres, and were thought to contain as much as 500,000,000 barrels of recoverable oil, and significant amounts of natural gas. Since all of the three companies' holdings were part of the same formation, and Exxon held the largest propor-



tion of the leases, it was decided that the field would be operated as a single unit so as to insure the most efficient development of the resource. The companies applied to the U.S. Geological Survey for permission to operate in this fashion and their request was granted in November 1970. In January of the following year, Exxon submitted an initial plan of operation to the USGS for their approval.

While Exxon was in the process of applying for permission to develop the offshore area represented by the Santa Ynez Unit, a fundamental change was taking place in the way in which the government dealt with resource development questions. In January of 1969, a spectacular oil spill had occurred in the Santa Barbara Channel, about 25 miles from where Exxon was preparing to initiate operations. For days, television viewers were accosted with news film of Santa Barbara residents trying, often in vain, to save aquatic birds covered with the black slime which had spewed forth from a blown-out offshore oil rig. The reaction from Congress was not long in coming. It took the form of the National Environmental Policy Act of 1969. One of the new requirements imposed by the act was that federal agencies prepare Environmental Impact Statements (EIS) for any activity under federal jurisdiction which might have a major effect on the environment. In the case of the Santa Ynez Unit, the EIS ran some 1800 pages, and one section alone had 258 citations.

It took until May 3, 1974, for the U.S. Geological Survey to issue the final Environmental Impact Statement on the Exxon project, and shortly thereafter the Department of the Interior approved the company's plan of operations. Throughout the balance of 1974, a series of state, federal and local government units with jurisdiction over some portion of the project issued various approvals, and it appeared that the project would obtain all the necessary permits. During this period, citizen opposition was expressed by a small but vocal segment of the population. Public hearings on the matter had been stormy to say the least, with one local official reportedly threatening to "arrest any oil company employee promoting the project as a public nuisance."

One key segment of the overall development plan for the Santa Ynez Unit entailed the construction of an onshore facility to treat the oil and gas produced from the field. In order to build the plant, local officials on the County Board of Supervisors had to approve a zoning change for the project. This approval was obtained on February 10, 1975, after a series of public hearings. However, opponents to the project were not satisfied, and proceeded to have an initiative placed on the ballot to determine its fate. Again, the project was approved, and slowly the paperwork continued to move forward. At another level of government, though, the project was not moving quite as smoothly.

At the California State Coastal Commission, one of the Santa Barbara County Commissioners suggested that the oil from the field be piped 140 miles to Los Angeles rather than the few miles to the proposed Exxon treatment facility on shore. Discussions of this option eventually broke down when the Coastal Commission sought to impose unreasonable financial conditions on the company and, as a result, Exxon brought suit in March of 1976. Faced with the specter of a long and bitter court fight, the company eventually decided to drop the suit and instead proceed with an option to treat the oil and gas produced from the Santa Ynez Unit offshore. At this point, the State Coastal Commission changed its tactics.

It asked the Secretary of the Interior to determine whether or not Exxon had made a good faith effort to obtain all of the necessary approvals, permits and permission required by the state for proceeding with the offshore option. In a July 21, 1976, decision, the Department of the Interior indicated that they had determined that Exxon had acted diligently and in good faith, that the terms the State Coastal Commission had attempted to impose were unreasonable and that the company should be allowed to proceed with their offshore option.

It would normally be expected that at this point, some seven years after the initial discovery, the business of developing the field could proceed. However, as has been the case so often with major energy projects around the nation, the stage was set for the Environmental Protection Agency to throw a monkey wrench into the works.

EPA Changes Its Mind

Although it had determined that there would be no significant environmental impacts from the offshore facilities planned for the Santa Ynez Unit in a review conducted in 1973, in September of 1976, the Agency changed its mind. In so doing, they informed Exxon that the company might be required to obtain an air quality permit for their offshore treatment and storage operations.

This was particularly surprising as there existed some questions as to EPA's jurisdiction over such matters on the Outer Continental Shelf. Although the company supplied the information requested by the agency in October of that year, it did so under protest, claiming that the Department of the Interior rather than the EPA had jurisdiction over the matter. EPA then went a step further, telling the company that it also must obtain a water discharge permit. Exxon again protested, due to the fact that the Offshore Storage and Treatment Vessel which would be anchored in the channel would be under Coast Guard jurisdiction.

In May of 1977, the Environmental Protection Agency finally issued a draft water discharge permit from the Exxon facility, but the permit had a number of conditions attached to it concerning air quality. After much legal maneuvering, in October of 1977, EPA informed Exxon that it would issue the water discharge permit without the air quality conditions, but that it also felt that the company needed an air quality permit, and would therefore withhold issuance of the water discharge permit until the air permit had been obtained. Exasperated, the company went to court, and three days later the EPA issued the water discharge permit.

At this point, everybody seemed to get into the act. The California Air Quality Board decided that it had jurisdiction, and decreed that the company would have to install some $10 million worth of emission control equipment on the facility before the state would approve its operations. The State Attorney General also entered the conflict, filing suit in court to assert the state's jurisdiction in the matter. The Air Resources Board, not to be outdone, filed suit against the State Attorney General claiming that he had a conflict of interest because his wife owned 52 shares of Exxon stock. The Air Quality Board also asked the court to enjoin Exxon from proceeding with their project. The Air Quality Board suit was dismissed in October of 1978. Finally, on August 21, 1979, the court held that EPA did not have jurisdiction over the Exxon facility, as had been the company's contention all along, but, rather, the responsibility lay with the Department of the Interior.

Santa Ynez and Imports

Viewed from one perspective, the delays, frustrations, and disappointments are merely another in the seemingly endless examples of bureaucratic bungling and environmental obstructionism which plague efforts to develop domestic energy supplies. When viewed in the context of the desperately perilous situation which has evolved from our dependence on imported oil, it becomes a far more serious problem. Had the Santa Ynez Unit been developed on schedule, it could by now be producing as much as 80,000 barrels of oil each day, reducing our balance of imports deficit by nearly a billion dollars each year, and contributing nearly 1.7 million gallons of gasoline to our motor fuel supplies *each day.* While this contribution is relatively small in terms of our overall gasoline requirements, the sum of such small amounts, blocked by overzealous regulation, most certainly adds up to an impressive, albeit undetermined, amount. Moreover, even now, with all approvals in hand, it will be sometime in 1981 before the oil finally begins to flow, and several years after that before it is in full production. Ironically, when the final approvals were at last issued, Secretary Andrus chastised the company, stating his "extreme displeasure at the pace of drilling. . . ." (It was also Secretary Andrus who once stated, in direct contradiction of the weight of geologic evidence that there wasn't more than "a few weeks" supply of oil to be found on Alaska's William O. Douglas Arctic Wildlife Range.)

It is important to realize that the examples of bureaucratic frustration of attempts to develop domestic petroleum reserves found in the case histories of Alaska and of the Santa Ynez Unit are not isolated aberrations or unique instances of singularly poor decision-making. Rather, they are typical of the day-to-day frustrations associated with any attempt to foster greater domestic energy production. Also, they serve to underscore one of the primary obstacles to such development: the inability of companies to gain access to the areas which hold the greatest promise. Finding a solution to this problem may well prove to be the single most important step we can take towards achieving energy independence.

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Solving the Problem: Priority Resource Preserves

As we enter the decade of the 80's, we do so in full awareness of the precarious vulnerability caused by our nation's inordinate dependence on imported oil. The experience of two supply interruptions from the Mideast within a period of seven years has brought home to us just how tenuous a source of energy our oil imports are. We also are aware that the effects of another stop in the flow of imports from the Mideast would be far more severe than the gas lines and minor inconveniences of the past. It is not unimaginable that the impact could be severe enough to cause a worldwide depression.

Against such a background, there can be little doubt that the attainment of a secure, domestically-based energy supply must rank among our highest national priorities in the coming decade. The manpower, capital, and physical resources required by any program aimed at fully developing our domestic energy potential are of a scope and magnitude unprecedented in history. Even such monumental undertakings as the Manhattan Project and the Space Program pale by comparison. As this study has attempted to demonstrate, despite the awesome task we can approach it in full confidence that it is within the limits of our technological and managerial capabilities. In fact, the only obstacle which could prove insurmountable is the morass of legislative and regulatory constraints on energy development which have been promulgated by federal, state, and local governmental agencies. It is therefore essential for our continued economic viability, and quite possibly for the continued survival of our democratic institutions, that a solution to this thorny problem be found.

There is one central issue which must be resolved by any plan to facilitate energy development if it is to have the slightest hope of success. This issue is the perceived conflict between our energy needs and our desire to protect the environment. The past has taught us painful lessons about the need for environmental protection; no rational observer can deny the necessity for safeguards. The trouble is that many of the safeguards imposed through statutes enacted in good faith have become the tools of activists bent on implementing a radical restructuring of our economic, political, and social institutions. Such zealots use the banner of environmental protection as a smokescreen to obscure their true aims. While the need for environmental protection remains, environmental extremism is a luxury we can no longer afford.

At the same time, we know now that we cannot return to the "Public be damned" spirit of the past. Husbanding and protecting our resources must be social and economic imperatives. Although the age of scarcity proclaimed by some doomsayers may not be upon us, the era of conservation certainly is. We simply cannot afford to squander our children's birthright for the expediency of the moment. Conservation, however, does not, as some would have us believe, mean curtailment. Rather, it implies efficient use and prudent management. Both of these characteristics are fully consistent with the dual goals of environmental protection and energy development. We must always bear in mind that the purpose of protecting the environment is so that man can use and enjoy it.

How can the current conflict be resolved?

A Framework for Progress

In order to solve this dilemma, certain criteria must be met. First, the impact on the environment should be minimized. At the same time, some mechanism must evolve—a mechanism that can assure access to these areas which contain critical petroleum and mineral deposits, and at the same time eliminate the procedural delays, uncertainties, and obstacles that characterize our present system. The market should be allowed to function with as few impediments as possible. Also, the concerns of the residents of the affected states should be taken into consideration to the maximum extent consistent with the attainment of energy security. While on the surface these criteria may appear to present irreconcilable conflicts, if good faith is exercised by all parties, this need not be the case. In fact, all of these criteria could be met by a straightforward program implemented at the federal level with the cooperation of the states. Such a program would use the mechanism of the federal lands management policy as it currently exists, but with the addition of two elements aimed at allowing domestic energy resources to be found and developed.

The National Resource Inventory

The first phase of this two-step program would entail conducting an inventory of all the critical minerals and resources which might be found on lands controlled or owned by the federal government. It is important for several reasons that this accounting not be limited to petroleum resources. First, there may be trade-offs between the relative value of resources contained on a given tract of land which must be assessed prior to its development. For example, there may be a prolific fishery which would be jeopardized by development of an oil deposit (as was the case in one instance in Alaska), and therefore deferring development of the petroleum deposit might be well advised. Secondly, we must realize that petroleum is just one of the strategic materials we import. In fact, some observers believe that our reliance on imports of certain critical minerals may prove to be a greater threat to our national security in the long run than our oil imports. Moreover, as in the case of petroleum, at present we lack adequate information as to the extent and nature of our domestic deposits of strategic minerals. Finally, it is only in an environment of complete and timely information that prudent decisionmaking can take place.

The actual work of taking the inventory would be performed by firms in the private sector. In order to encourage their participation, costs associated with these operations would be taken as a tax credit rather than an expense. During the inventory process, the current restrictions on certain exploratory activities on some categories of federal lands would be suspended, although there would be a strict standard of liability for damage to the environment. Should more than one firm desire to explore a given tract, the companies would be allowed to engage in the project as a joint venture, or, if no agreement can be reached and, in the opinion of the appropriate Cabinet officer the firms are equally competent to perform the task, a lottery would be held as a basis for awarding exploration rights. Should one firm abandon the area either by giving notice to the appropriate Cabinet Department, or through lack of activity for a specified period of time, other firms would have the option of entering for the purpose of engaging in exploratory activity as long as the suspension of restrictions remained in effect. Should a significant deposit of a critical natural resource be identified, the second phase of the program would take effect. It would entail the addition of a new category of public lands: the priority resource preserve.

Priority Resource Preserves

The purpose of the priority resource preserve is to limit the area affected by resource development. The notion has its genesis in the fact that the actual land mass which would normally comprise a resource deposit is relatively limited. For example, the William O. Douglas Arctic Wildlife Range includes some 9.6 million acres. By contrast, an oil field the size of Prudhoe Bay would comprise around 50,000 acres —slightly more than one half of one percent of the total land mass of the Range. You could fit some 192 Prudhoe Bay-sized oil fields in an area that size.

By limiting extractive or developmental activities to an area whose boundaries are defined by the physical limits of the deposit, the total portion of the environment affected by such activities could be relatively small. It is this area which would be designated a priority resource preserve. This designation would carry with it certain automatic rights, one of the most important of which would be a guarantee of access.

Construction of the Alaska Pipeline and the Alcan Highway have shown that it is possible to allow access to environmentally sensitive areas without imposing unacceptable levels of environmental disruption. Moreover, by limiting access to functions directly associated with the extraction or development of a specific mineral or petroleum deposit, only insignificant portions of the total land areas would be involved. For example, along its total length (nearly 700 miles), the Alaska Pipeline only takes up about 8.6 square miles of surface area. It would therefore follow that by allowing what would amount to an easement (a concept well established in statute and common law), one could insure access to resource-rich areas while still permitting areas which do not contain valuable resources to be placed in far more restrictive categories, thus protecting their ecosystems.

A second characteristic which would be associated with a Priority Resource Preserve is that such areas would be exempt from certain provisions of the National Environmental Policy Act. Specifically, the present lengthy hearing and appeals process currently applicable to virtually any major undertaking on federally owned or controlled lands would not apply. There would be no requirement for a time-consuming and expensive environmental impact statement, an avenue through which intervenors bent on obstructionism could constantly delay or hamper a project. Instead, the companies benefiting from the relaxed procedures associated with such areas would be held to a strict standard of financial liability for any environmental damage which might result as a consequence of their operations. Moreover, any company found to be acting with a callous disregard of the environment would be subject to loss of lease rights without compensation.

The leases themselves would automatically convey to the company making a discovery. The company could then exercise one of a number of options. It could choose to develop the lease itself, it could form a joint venture for its development, or it could choose to assign its rights to another firm. The federal government would receive bonuses or royalties in the same fashion it does on leases at present, although the payment of bonuses could be deferred until production actually is initiated to allow for capital formation for development of the property. States would be entitled to a portion of the federal government's royalties as compensation for any environmental degradation which might occur as a consequence of the resource extraction activities taking place on the preserve.

In order to insure that the desires of the citizens of the state or states affected by the activities associated with granting of a Priority Resource Preserve designation are taken into account, such an award will require the concurrence of the Governor or Governors of the areas involved. Moreover, while exempting activities from federal constraints, the designation will not apply to state laws unless states can agree to grant similar waivers. Should they choose to do so, then the proportion of the lease royalties assigned to them would be increased.

The major advantage which stems from the use of the Priority Resource Preserve is that it permits some sort of rational planning to take place in making decisions which apply to federal lands, while at the same time providing an expeditious framework for development of those resources which are essential to our national security. Moreover, in determining the exact nature and extent of resources to be found on lands controlled by the federal government, we also provide a base of information which can help us to anticipate those resources which may become critical in the future.

The Rationale for Development

It should be noted here that the first phase of this program, the inventory of our national resource base, can be conducted without any serious deterioration of the environment. Contemporary techniques used to assess the petroleum or mineral potential of a given tract of land leave no significant or lasting marks on the area in which they take place. In fact, even seismic work, commonly thought to require the use of large underground explosions to generate sound waves, no longer employs such methods. Rather, methods such as small explosions generated on the surface inside metal cannisters are used. After the research is conducted, the equipment is moved, and the environment remains essentially as it was before the work took place.

Were the likely returns from such activities minimal, an argument might be made to forgo them as a concession to environmental protection. However, this is not the case. By some estimates, as much as 98 percent of the nation's sedimentary basins remain unexplored. While all of them may not prove to be prolific sources of oil and gas, some will. We know that because of major price increases, and the major technological advances, areas previously thought to be unlikely prospects are proving to be highly productive.

In order for this recovery to take place, certain conditions must pervade the domestic market. First, the companies involved in developing our domestic potential must be able to recapture the world market price for new discoveries. Allowing them to do so would not provide them with an unjustified "windfall," but would serve as a mechanism whereby the capital necessary for meeting the higher costs associated with extraction and exploration in some of the more remote and difficult petroleum provinces can take place. We must realize that the era of "easy oil" has passed; while a substantial amount remains to be recovered, it will be far more expensive than in the past. For example, an offshore oil rig can cost as much as one half billion dollars, and some specialized deep drilling rigs can cost as much as one billion dollars.

The second necessary condition is the easing of access to the areas which hold the oil. Without access, we cannot expect the success rate of exploratory activities to increase. The search for oil has always been characterized by a high degree of luck, and to exclude some of the most promising areas from exploration is tantamount to stacking the deck against success. Should these two conditions be met, the impact on domestic oil recovery could be staggering.

Take, for example, the case of Alaska. Under the conditions described above, it is likely that the state would contain a *minimum* of 47.9 billion barrels of additional recoverable oil, and might contain as much as 123.9 billion barrels. The mean for the state's potential is over 81 billion barrels. Even areas not commonly associated with oil discoveries might yield surprising amounts of the precious fluid. The Appalachian Basin, for instance, could have the potential of holding as much as 6.3 billion barrels, about two-thirds as much as Prudhoe Bay. As noted, however, none of this will take place unless the conditions necessary for it to do so are established.

We must ease access. We must simplify the regulatory process. We must instill a sense of certainty into the process by which leases are let and exploration rights granted. Without the evolution of an institutional and regulatory framework conducive to maximizing our domestic energy potential, we will become increasingly dependent on the same perilous sources of supply which are the cause of our current dilemma.

One other key element which must be resolved centers on the groups who would obstruct any major industrial project without consideration of the consequences of their actions. Many of the individuals active in such groups would have us return to a pastoral era characterized by what they term "elegant frugality." Although presented as an attractive alternative to our present social and economic structure, the true nature of their suggestion becomes more clear on closer examination. What would actually take place is that our society would be transformed from one in which each American can hope to achieve the best that is within him to one characterized by the creation of a permanent underclass. To no small degree, it will be the lack of access to energy which will bring this about.

Although we may try, we will never fully sever the relationship between the growth of energy supplies and the growth of our economy. As long as that relationship remains, the growth of energy supplies will also be inextricably linked to the continued availability of opportunities for upward mobility within our economic structure. New and better jobs can only be created where there is energy available to fuel the industrial expansion necessary to create those jobs. Therefore, any limitation on the production of energy carries with it the potential of simultaneously limiting the ability of those striving to achieve the promise of America.

The problem presented by our present energy dependence is a difficult one, but not an insoluble one. All of the decisions that must be made if we are to attain energy security are political, not technical. It is therefore incumbent on those who have the responsibility for guiding our nation's political course to focus their efforts, and to move forward with resolve. With such resolve, and with the leadership from which it comes, we can free ourselves from the fetters of dependence and once again begin to move forward as a nation.

Appendix

In our analysis of the domestic petroleum potential of the United States, we have relied on the U.S. Geological Survey's *Circular 725* for our baseline data. There are a number of reasons why we felt this approach was appropriate. First, the USGS estimates represent the official government assessment of our nation's petroleum resources. As such, they provide the factual basis for many of the policy decisions which affect oil and gas production. Secondly, they are the most widely available comprehensive estimates, and are therefore widely used outside the policy-making sphere by analysts following energy issues. Finally, using these estimates as a starting point provides a basis for comparison.

The actual compilation of our estimates did not rely solely on the USGS data. Rather, they were the product of tens of thousands of miles of travel, and nearly a year of effort. Our data were subjected to rigorous peer review at all stages of development, including numerous experts from both industry and the academic community. While there were far too many participants to acknowledge them all, two are deserving of special mention: Dr. H. A. Merklein, Dean of the Graduate School of Management of the University of Dallas, and Dr. Glen Seay of the Institute of Gas Technology. Without their comments, criticisms, and counsel in the early stages of this effort, our final product would have been far less meaningful.

In using the figures provided in our estimates, a degree of caution should be exercised. Since it was our intent to include the largest possible universe in our model, there is an element of subjectivity in our conclusions. This element of subjectivity is no greater or less than those of similar estimates, but it should be understood that the aggregates do not have the same degree of certainty associated with them as more narrowly defined estimates such as those of the American Petroleum Institute.

Since any estimate is largely a function of the assumptions on which it is based, it is useful to examine those made by the USGS, and see how they compare with the ones used in compiling our estimates.

In *Circular 725,* the USGS differentiates between "economic" and "subeconomic" recoverable resources. In so doing, they state: "The subeconomic recovery factor used was based on the current national average of 32% for oil and 80% for natural gas. The subeconomic portion of the remaining resources for oil is estimated to be an additional 28% for a total of 60% recovery (Geffen 1975). Subeconomic identified resources of crude oil were calculated on the following assumptions: (1) that on average 32% of the original oil-in-place is recoverable if there are no substantial changes in present economic relationships and known production technology, and (2) that ultimately the recovery factor could be as large as 60%. By definition, the sum of cumulative production to date plus the current estimate of demonstrated reserves will account for 32% of the original oil-in-place in *known* fields; an increase to 60% will allow another 28% to be recovered."[44]

This statement contains the key to understanding the difference between our estimates and those of the Geological Survey. As they note, their estimates reflect a 32 percent recovery rate for original oil-in-place. This rate is based, however, in what amounts to an assumption of stagnant technology and prices. To determine if such an assumption is valid, it is necessary to look at the performance of the oil market in these two areas during the period which has ensued since they were made. This would comprise the years since 1973, as they state in their introduction that "price-cost relationships since 1974 were not taken into account. . .", and that they only considered price-cost relationships and technological trends "generally prevailing in the years prior to 1974."

There are certain characteristics of the period used by the USGS which give rise to questions as to the validity of these estimates in the current market. First among these is that the period in question was generally characterized by declining or stagnant oil prices. For example, in 1950 the average price of crude oil in the United States was $2.51. By 1973, the price had risen to $3.89, a nominal $1.38 increase, but when adjusted for inflation, the actual effect on prices over the 23-year period was a net decline of 6 percent, with the 1973 price expressed in 1950 dollars equalling $2.36.

Although there was a brief decline in oil prices immediately following the 1973 embargo, period adjustments have been made to allow for inflation and for the devaluation of the dollar on international money markets. A much sharper rise in world oil prices began in early 1979, and may be expected to continue, although somewhat abated in the future. Clearly, the price-cost relationships have changed.

The same can be said for technological trends. We have witnessed a dramatic increase in the depths to which we can drill, both offshore and onshore, and have also seen advances in seismic technology, and in the use of airborne geophysical equipment. The effects of these ad-

[44]U.S.G.S. *Circular 725,* p. 27.

vances are already being felt in the Overthrust Belts, and offshore. Other similar strides can be expected in the coming years.

Given the conditions set above, it would appear that the requirements for the retrieval of the 28 percent currently categorized as subeconomic are present, and that as a result, a 60 percent recovery factor should be used.

The estimate for the lower range is computed as follows:

Where C equals Cumulative Production, and
IR equals Identified Resources, and
UR equals Undiscovered Resources, and
RB equals the Recoverable Resource Base, then

$$\text{The Sum of } \left(\frac{C}{.32} \times .198\right) \text{ plus } \left(\frac{IR}{.32} \times .6\right) \text{ plus } \left(\frac{UR}{.32} \times .6\right) \text{ equals RB}$$

The estimate for the Median range is computed as follows:

Where C equals Cumulative Production, and
IR equals Identified Resources, and
UR equals Undiscovered Resources, and
RB equals the Recoverable Resource Base, then

$$\text{The Sum of } \left(\frac{C}{.32} \times .23\right) \text{ plus } \left(\frac{IR}{.32} \times .6\right) \text{ plus } \left(\frac{UR}{.32} \times .6\right) \text{ equals RB}$$

The estimate for the Upper Range was computed as follows:

Where C equals Cumulative Production, and
IR equals Identified Resources, and
UR equals Undiscovered Resources, and
RB equals Recoverable Resource Base, then

$$\text{The Sum of } \left(\frac{C}{.32} \times .26\right) \text{ plus } \left(\frac{IR}{.32} \times .6\right) \text{ plus } \left(\frac{UR}{.32} \times .6\right) \text{ equals RB}$$

Estimates of Recoverable Petroleum Resources by Geologic Province (in Billions of Barrels of Recoverable Oil)

Province	High	Median	Low
	Onshore		
Alaska	65.8	52.7	41.5
Pacific Coastal States	40.7	31.7	34.6
Western Rocky Mountains	18.1	10.5	5.9
Northern Rocky Mountains	30.9	22.9	18.6
West Texas and Eastern N.M.	63.7	50.4	40.7
Western Gulf Basin	78.5	68.0	59.3
Mid Continent	42.7	29.9	22.4
Michigan Basin	4.9	2.9	1.6
Eastern Interior	8.4	6.0	4.9
Appalachians	6.3	4.0	2.8
Eastern Gulf and Atlantic Coastal Plain	4.0	2.1	0.7
	Offshore		
Alaska	58.1	28.9	6.4
Pacific Coastal States	13.1	9.2	7.2
Gulf of Mexico	27.1	21.1	16.9
Atlantic Coastal States	7.5	5.6	3.8

Selected Heritage Foundation Policy Studies

Earth Day Reconsidered
edited by John Baden (1980, $4.00)
The SALT Handbook
edited by Michael B. Donley (1979, $3.00)
Energy Perspectives: An Advocates Guide
edited by Milton R. Copulos (1979, $6.95)
Forty Centuries of Wage and Price Controls
by Robert L. Schuettinger and Eamonn F. Butler (1979, $4.95)
The Welfare Industry
by Charles D. Hobbs (1978, $3.00)
The Consumer Impact of Repeal of 14b
by Marshall R. Colberg (1978, $3.00)
Congress and the New International Economic Order
by Edwin J. Feulner, Jr. (1976, $3.00)

Fiscal Issues

Philanthropy in America
by Stuart M. Butler (1980, $2.00)
The Value Added Tax: Facts and Fancies
by Norman B. Ture (1979, $2.00)

Critical Issues

The Family, Feminism, and the Therapeutic State
by Onalee McGraw (1980, $2.00)
Enterprize Zones: Pioneering in the Inner City
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Critical Issues

Domestic Oil
The Hidden Solution

The so-called energy crisis and our nation's dependence on imported oil have become facts of life for most Americans. It is not generally known that reputable estimates rank the United States seventh in the world in terms of proved reserves of oil—ahead of such major exporters as Libya, Nigeria and Venezuela—and there is much more to be discovered. Calculations made in preparing this study suggest that the U.S. petroleum resource base lies between 276 and 444 billion barrels of recoverable oil. Yet, this oil must remain in the ground because of restrictive actions by federal, state, and local governments, closing the door to development of some of the nation's most promising sites.

At issue is the perceived conflict between our energy needs and the desire to protect the environment. Unfortunately, statutes and safeguards enacted in good faith have become the tools of activists bent on a radical restructuring of our economic, political and social institutions. While the need for environmental protection remains, environmental extremism is a luxury we can no longer afford. Instead, efficient use and prudent management are needed.

In this study, Milton Copulos examines an innovative new concept, the priority resource preserve. The idea is based on the fact that the actual land area which normally would contain a resource deposit is relatively small. By using the many sophisticated techniques available to pinpoint the locations of deposits, and limiting access and development to those areas, neighboring sites could be preserved.

It would be in effect an easement, a concept well established in statute and in common law. With the regulatory process simplified, oil companies would have the incentive to develop domestic sites, thus lessening the need for imports. The priority resource preserve is a commonsense, free market proposal, with business bearing most of the responsibilities. An additional benefit would come from the inventory of resources which would be made by the private sector in order to determine the preserves: a base of information which can help anticipate those resources, such as strategic metals, which could become critical in the future.

The problems presented by our present energy dependence, Copulos concludes, are difficult but not insoluble. The obstacles are political, not technical. Rational development, along the lines described in this study, would go a long way towards loosening the OPEC noose.

Milton R. Copulos is currently a policy analyst with The Heritage Foundation in Washington, D.C., specializing in energy issues. His studies for The Heritage Foundation have been widely quoted in publications including *The Wall Street Journal, Barron's,* and *U.S. News and World Report.*

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