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Should DoD be Concerned with Potential Petroleum Supply Shortage and What Could It Do to Stimulate Alternative Fuels Development?

Brent Fisher
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FOREWORD

We submit this white paper as an input for Defense Science Board (DSB) consideration under the questions that constitute one of DSB's tasks:

> to re-examine DoD's energy usage practices, recommend technologies, strategies and policy to achieve an assured energy supply for a broad range of military functions while simultaneously improving energy reliability and security, reducing system vulnerability and risk, reducing demand, and where feasible *stimulating commercially viable enterprises for possible incorporation into a national energy plan* designed to achieve a meaningful level of energy independence nationwide" (DSB May 2006 Newsletter, our italics).

We hope that this input will be useful for DSB's immediate study and that it will also instigate further Department of Defense (DoD) investigation of these ideas thereafter.

CONTENTS

SUMMARY

This white paper addresses the issue of energy supply challenges for DoD in the context of greater national energy issues, and it proposes a strategy that DoD might consider to hedge against future energy supply and cost uncertainties, while helping to drive the market development of select energy alternatives for the nation as a whole.

The first part of this work is a brief assessment of the energy (oil) challenges facing the United States and DoD, which aims to distinguish the genuine problems from issues that are either not new or are outright red herrings. We argue that commonly cited goals of DoD energy security—independence from the Middle East and assured fuel access—miss the point. Oil from the Middle East accounts for less than 20% of total U.S. imports, but the Middle East, because of its large global market share, effectively sets prices for all oil, regardless of its origination. Instead, DoD faces two different but urgent concerns over its fuel supply costs: the overhead logistics costs associated with fuel use and exposure to unpredictable price swings. Improving the fuel efficiency of fleet vehicles, thus lowering demand for fuel, will reduce the logistics burden. Developing alternative fuel sources, among other strategies, may contribute to price stability.

The second part of this work outlines a proposal for mitigating DoD's exposure to oil price instability, which affects DoD's ability to budget and plan. Moreover, development of an alternative fuel supply would represent a long-term investment for which DoD has a unique need, on account of the long lead times required for development and acquisition of weapons systems that themselves have long lifetimes.

I. IDENTIFYING THE ISSUES

"ENERGY INDEPENDENCE" IN AN OPEN GLOBAL MARKET

We begin with a basic review of some key features of the global oil market to illustrate why the goal of eliminating oil imports from the Middle East and other politically unstable regions is not the issue—imports from the Middle East are not really that large, but the price the United States pays for oil is effectively set by the Middle East because it exclusively through the *global* oil market.

Figure 1 shows world trade of crude petroleum (based on "BP Statistical Review of Energy") and provides some basic insights. First, it is obvious how the global balance of trade is tipped. Organization for Economic Co-operation and Development (OECD) countries produce little oil and import the lion's share of oil, which is produced mostly by non-OECD countries. The United States depends heavily on imports (65%), but this is hardly unique among OECD countries—Europe imports about the same percentage as the United States, and Japan imports near 95% of its oil [1]. What is noteworthy is that in spite of widespread perceptions, the United States does not in fact acquire an overwhelming fraction of its oil from the Middle East. Less than 20% of U.S. imports are from the Middle East, whereas imports from Canada, Mexico, South America, West Africa, and the North Sea constitute nearly 80% of U.S. imports [1]. This occurs because although oil prices are set on a worldwide marketplace, in practice, the actual volumes of oil tend to flow between nearest neighbors to minimize transport times and costs. As a result, most of Middle Eastern oil is exported to Southeast Asia or by pipeline to Europe. So U.S. dependence on Middle Eastern oil is not so much the case of the majority of its physical supplies being held hostage by a potentially unfriendly (or worse irrational) foreign government. Instead, the risk is associated with the huge leverage that the Middle East holds on the price that the United States must pay for oil—even oil that does not physically originate in the Middle East.

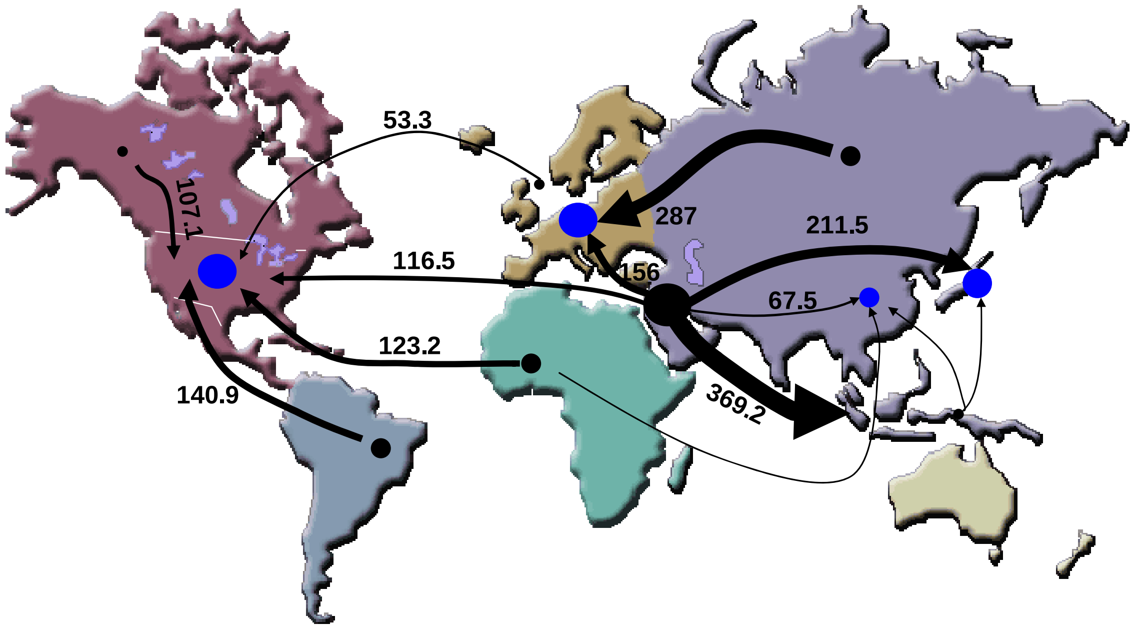


Figure 1. World Oil Trade Flows. Arrow thickness roughly illustrates trade flux and is reported in units of million tons. Blue spots represent some of the major oil importers, and black spots represent some of the major exporters. Only the largest trade flows are illustrated. (Source: "Quantifying Energy: BP Statistical Review of Energy.")

The reason for this leverage is that oil is fungible. Any barrel of oil is (roughly) exchangeable for any other barrel of oil; that is, "all oil is created equal."[1] A shortage from any supplier will result in greater global competition for the remaining resources, regardless of their location of origin or grade. So in general, the spot and futures market for crude oil are driven directly by the current (or expected future) global aggregate supply/demand ratio. It is true that the majority of oil is not traded on the spot and futures market, but the contract price in most of these non-spot transactions is tied to one of the spot-market price values (e.g., West Texas Intermediate or North Sea Brent) plus some negotiated premium. The bottom line is that *reducing the fraction of oil imports that physically originate in the Middle East would do practically nothing to minimize U.S. dependence on Middle Eastern oil production, since it is the Middle East that effectively sets the market prices through its large market share.* Nor would U.S. abstinence from Middle Eastern oil do anything to reduce the money that flows to the Middle East through oil sales. So long as the United States needs oil from the world market, it is

1 Of course this is not absolutely true. Crude comes in a variety of grades and compatibilities with the refining capacities of the markets for which it is destined, and the proximity of its production also affects its sale price, as demonstrated in Figure 1. All these factors make oil not quite perfectly fungible. In a shortage situation, however, these factors are much less important.

exposed to price instabilities from the Middle East and contributes to the net cash flow from nonproducers to oil-producing countries.

Exhaustion of Global Oil Supplies

Our review of reported global resource and reserves estimates strongly persuade us that conventional petroleum is sufficiently abundant to cover expected global demand—and by extension U.S. and DoD demand—over the next 20 to 30 years. Projections of global demand through 2030 made by International Energy Agency (IEA), Energy Information Administration (EIA), Organization of Petroleum Exporting Countries (OPEC), and Royal Dutch/Shell are all within a few percent of one another and show demand increasing from about 82 million barrels/day in 2005 to 90 million barrels/day in 2010, 102 million barrels/day in 2020, and 120 million barrels/day in 2030 [2]. These projections add up to 900 billion barrels cumulative consumption over the next 25 years, or nearly as much as has been cumulatively produced in history to date. While this is an enormous figure, remaining volumes of petroleum are still much greater. Primary sources of information on *proven* reserves of conventional oil are provided by *Oil and Gas Journal, World Oil,* and IHS (Petroconsultants), and they are uniformly reported to be about 1,200 billion barrels, depending on the exact methodology. Table 1 presents a breakdown of these proven reserves by country/region as compiled in the 2006 "Quantifying Energy: BP Statistical Review of Energy." We note that total proven reserves are more than 30% greater than the IEA-projected cumulative global demand between now and 2030 (900 billion barrels under business-as-usual conditions, with no aggressive conservation efforts), and at current production rates (82 million barrels/day) this quantity would last 41 years. At the IEA projected average consumption rate of the next 25 years (around 100 million barrels/day), current global reserves would last about 32 years. This does not imply that only 32–40 years of oil remain. Instead, since proven reserve quantities and reserves/production (R/P) ratios are based on current technology and prices, these numbers represent a lower bound—even if exploration, technical improvements, and development of oil fields ceased from this day forward, more than enough oil would be available to cover the cumulative demand of the next 25 years.

Table 1. Proven Reserves estimates by country / region
(Source: "Quantifying Energy: BP Statistical Review of Energy.")

Country	B-bbl
Total North America	**59.5**
Total South and Central America	**103.5**
Total Europe and Eurasia	**140.5**
Total Middle East	**742.7**
Total Africa	**114.3**
Total Asia Pacific	**40.2**
Total World	**1200.7**
Saudi Arabia	264.2
United States	29.3

Proven reserves are not static, however. Although annual production of oil depletes the amount of oil in reserves, the quantity in reserves has nonetheless historically *increased* (see Figures 2a and 2b). Despite a production increase of near 30% from 1980 to 2005, growth in reserves more than kept pace as R/P increased from about 30 years to 40 years over the same period. Growth in reserves is generally attributable to two factors: new discoveries and so-called field growth. Whereas new discoveries through exploration increase reserves by adding to the inventory of oil fields available for production, field growth represents the upward revision of estimates of economically recoverable oil in fields already discovered. Field growth occurs because of technology advances and increased prices, which make more oil in the same field economically recoverable and hence classifiable as proven reserves. The ultimate ceiling on how far proven reserves can climb is called the ultimately recoverable resource (URR), and it is the more important figure for long-term forecasts. Because the URR includes discoveries that have not yet occurred and technology that is not yet developed, estimates of its value vary much more widely than estimates of proven reserves. The U.S. Geological Survey (USGS) reported with a 50% probability that at the beginning of 1996, total world URR of oil was at least 3,345 billion barrels, of which 717 billion barrels had been produced, leaving 2,628 billion barrels remaining [3]. Since 1996, 275 billion barrels have been produced, which would leave 2,353 billion barrels, assuming the USGS estimate is correct. If, instead, the low reserves estimate of USGS is taken (95% confidence), then URR is at least 2,453 billion barrels (instead of 3,345 billion barrels), which would leave, at the very least, 1,460 billion barrels of conventional oil URR remaining. Using average production rates close to the projection for the coming decades, the USGS estimates of remaining conventional URR would last, at the very least, another 40 years (95% confidence) and probably another 65 years (50% confidence). All these preceding estimates only account for conventional oil. They do not account for the contributions that nonconventional hydrocarbon resources are expected to make in the coming decades.

In particular, up to 2,000 billion barrels of heavy oil, bitumen, and shale oil are estimated to be recoverable for between $20/barrel and $70/barrel, along with possibly 600 billion barrels of enhanced oil recovery and deep-water accessible oil at $20–$60/barrel [4]. Based on these data we conclude that oil is more than sufficiently abundant for the next 20 to 30 years and may last well beyond that. By extension, there is enough recoverable oil in place to meet the cumulative needs of the United States and DoD over this time period. The next question is whether the *rate of production* of this oil can keep up with the projected demand increases.

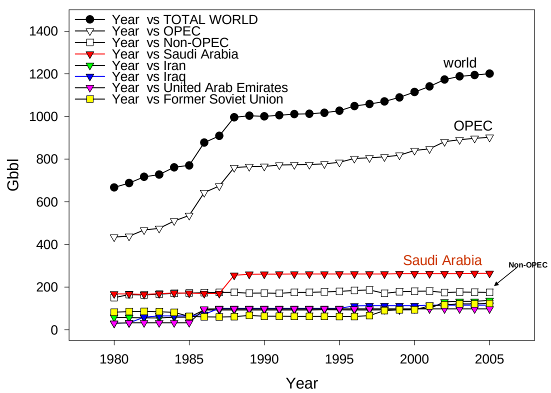


Figure 2a. Historical growth of proven reserves for the world and selected countries and groups as reported in "Quantifying Energy: BP Statistical Review of Energy."

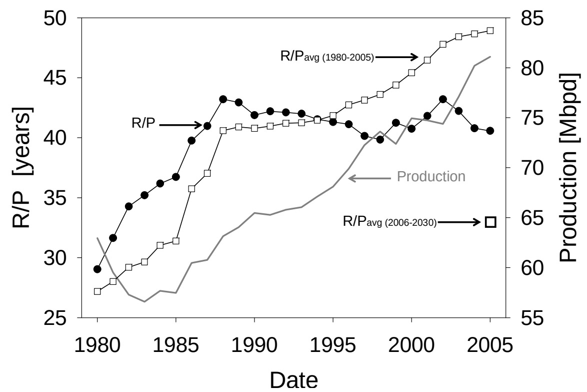
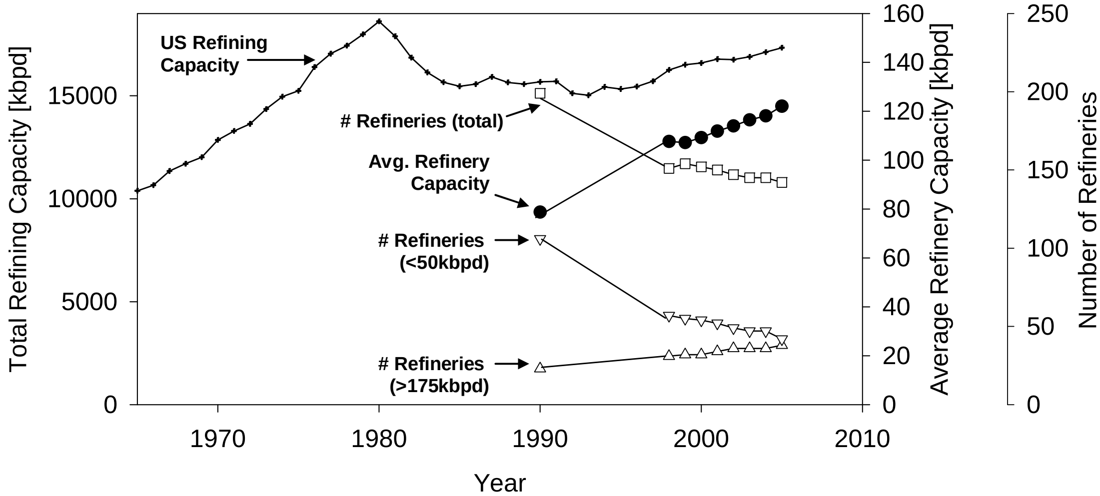


Figure 2b. Historical R/P ratios relative to then-year production levels (black circles) and relative to the 1980–2005 average production (open squares). Actual production levels are shown (gray line) as well as current R/P relative to projected average production over the next 25 years (lone square).

Production Capacity

While we are convinced that economically recoverable oil reserves are sufficient for many decades' worth of oil at current production rates, it is not clear that global production capacity (i.e., the current rate of production) will be comfortably ahead of demand as it has been in decades past when Saudi Arabia played the role of swing producer. As such, the United States must reckon with the possibility of transient global oil supply shortages. Examples of potential causes of such short-term shortages are easy to enumerate because there are many. Destruction of infrastructure by natural disasters like Hurricane Katrina is only one example. Concentration of domestic refining capacity onto the shoulders of fewer than 150 refineries (a more than 25% drop since 1990), as shown in Figure 3, amplifies such concerns because the impact on the supply chain would be greater and the speed of its response would be slower in the event of any infrastructure loss.



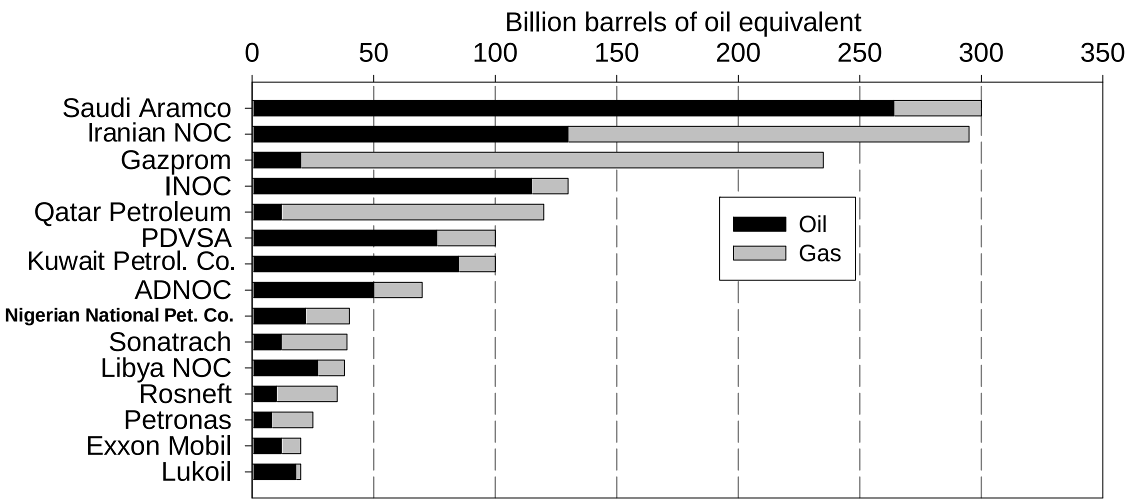


Figure 3. TOP: U.S. refining capacity data (from BP Statistical Review 2006) and historical count of U.S. refineries by size and in total (from Defense Energy Support Center, FY05 Factbook). These data allowed calculation of average capacity of U.S. refineries since 1990 (solid circles). Note that total domestic refining capacity has stagnated since 1980 and that refining capacity has become concentrated in fewer, larger refineries. BOTTOM: Ranking of oil and gas reserves by company (from *The Economist,* 10 August 2006). All but Exxon and Lukoil are national oil companies.

The growing dominance of global oil reserves by national oil companies (NOCs), which are often poorly managed and are also subject to the direct political influence of foreign governments [5], constitutes yet another cause for concern over transient fuel supply shortages to the United States. Figure 3 shows that the overwhelming majority of global reserves are controlled by NOCs, with the largest U.S. petroleum company, Exxon Mobil, only 14th on the list of global reserves [6]. Looming behind all this is concern that Saudi Arabia no longer can play the stabilizing role it once did as the world's swing producer. Despite its claims of enormous proved reserves (>260 billion barrels), it is not clear that Saudi Arabia can safely increase the *rate* at which it produces from these reserves to arbitrarily high levels, for sustained periods, without causing serious damage to reservoirs. Saudi Arabia currently produces at a rate of almost 11 million barrels/day,[2] but to meet the predicted demand growth its production will have to increase enormously, practically doubling production rates to levels near 20 million barrels/day [2]. On top of these unprecedented production levels, Saudi Arabia must still maintain a 2 million barrels/day spare capacity if it is to remain a credible swing producer. If for any reason Saudi Arabia can no longer easily fulfill its historic role as the world's swing producer—filling in supply when shortages elsewhere arise—then the risks mentioned previously will be amplified further still.

An obvious way to mitigate some of these risks is simply to invest in more production capacity—more wells, platforms, and refineries. Such expansions of production capacity would enable quicker recovery of the oil that we already know is sufficiently available in proven reserves. However, investment to adequately expand capacity is not a given. Insufficient investment in capacity expansion is among the top concerns of most industry analysts ([2], [7]). The IEA estimates that nearly $3 trillion must be invested in capacity expansion over the next 25 years ($120 billion/year) to meet expected demand [2]. Meanwhile, the EIA's International Energy Outlook for 2006 has revised its projection of OPEC capacity expansions downward by more than a factor of 2 compared to previous years' estimates because of lower than expected investment by oil-producing nations [7]. Whether increased investment would even yield meaningful production capacity gains is another question entirely, and the answer depends on whether the world has actually reached so-called peak oil. Contrary to widespread perception, the concept of peak oil does not mean running out of oil (the previous section explained that there is indeed a lot left to be produced). *Peak oil means that production capacity no longer can grow because of geologic scarcity*, and it is a harbinger of a production decline. Recent examples of strained production rates would seem to give credence to this view, and we do not absolutely discount it. However, because the timing of such a production peak should correspond to cumulative production of half the volume

[2] This is an all-time high and is around 40% greater than Saudi Arabia's average production rate of the last 30 years, during which 10 million barrels/day was achieved in only 5 of the years: 1980, 1981, 2003, 2004, 2005.

that will ultimately be recovered,[3] subscribing to the hypothesis of the imminent arrival of peak oil is an implicit statement that the cumulative amount of oil the world will ultimately produce (the URR) is only about 2 trillion barrels (2 × current global cumulative production of 1 trillion barrels), a figure that is far lower than the majority of previously cited estimates, especially if nonconventional oil is included.

What does all this mean for DoD? In light of the small fraction of U.S. demand that DoD constitutes (1%–2%), the *availability* of supplies to meet DoD demand should *not* be a problem in the next few decades, even in the face of possible transient shortages for the world as a whole. Current estimates of U.S. proven reserves (29.3 billion barrels) [1] could supply current DoD demand of 140 million barrels/year for well over 150 years. A recent Jason study pointed out that production from just two domestic offshore platforms could meet current DoD demand and that just five domestic sources—North Slope Alaska, California, Thunderhorse and Atlantis offshore platforms, and New Mexico—currently produce more than 800 million barrels per year, more than 4½ times all DoD demand [8]. The total U.S. production of 6.83 million barrels/day (2.5 billion barrels/year) covers more than 10 times the DoD annual consumption. So while transient supply shortages to aggregate U.S. demand are likely to occur in the coming few decades, these shortages should not affect DoD's ability to obtain the fuel it needs, although they may affect the price it pays, as discussed below.

Sustained High Prices and Price Instability

Oil price movements are extremely complex, being driven by numerous factors (e.g., market perceptions, political stability, etc.), but we assume to a first order that oil prices will be driven by the actual balance of global supply and demand. On that basis we believe that tight supply conditions in the coming decades will result in generally high oil prices, which will have an important impact on the nation. EIA's *International Energy Outlook* for 2006 estimates a price range of $34/barrel to $96/barrel in 2030 (in current dollars) [7], and we expect that the upper end of that range is more likely. *We do not view these high oil prices to be a serious concern for DoD, however*. The 2005 DoD bill for mobility fuels was about $8 billion and may have reached $12 billion in 2006, a figure

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[3] If the global oil production profile follows the model developed by M. King Hubbert, which correctly predicted the U.S. production peak, then the timing of maximum oil production coincides roughly with production of one-half of the URR.

that, while large, is still less than 3% of the total DoD annual budget for those years [9]. Furthermore, on the basis of current DoD consumption rates, a $10/barrel increase in the price of crude oil would correspond roughly to about a $1.5 billion increase in the total DoD fuel cost ($10/barrel × ~150 million barrels/year = $1.5 billion). This means that even if oil prices reached $200/barrel, the total increase in DoD's fuel bill would be around $20 billion, for a total of about $30 billion, which would still be less than 5% of its annual budget. We do not believe that a 3% to 10% component of the budget will be prohibitively expensive. For these reasons we do not view the *absolute* cost of fuel to be the highest priority energy concern of DoD.

The *instability* of fuel prices, on the other hand, should be cause for serious concern within DoD over the coming decades. The previous section on the potential for transient shortages in the global oil supply mentioned some of the many indications that the oil market will remain tight for the foreseeable future unless significant production capacity is added (a development that is far from certain). Even more than inflated prices, it is the instability of prices that can characterize a tight market. Erratic, unstable behavior is generally found in systems operating near capacity, so the wild price swings in oil during recent years have been interpreted by some observers as an indication that the global market is indeed strained [10]. The reason that DoD should be concerned about instability of the price more than the (high) absolute value of the price itself is that unstable prices are unpredictable, and therefore they severely compromise the ability of DoD to budget and plan for the future. The deleterious effects of unpredictability in budget costs are hard to quantify but should not be underestimated. For instance, if fuel costs exceed the amount budgeted for them, then they are financed by taking money from the budgets of other programs. This can severely affect other DoD programs, if not cancel them entirely. The dollar and opportunity costs of cutting programs in this way can be severe, especially considering that each program may represent many years of prior investment.

Logistics Cost of Fuel Delivery

In addition to fuel price instability, the overhead logistics cost of delivering fuel to the battlefield is a second fuel issue that deserves the focused attention of DoD. Numerous studies (e.g., [8], [11]) already have described and analyzed some of the high costs of infrastructure and logistical forces needed to deliver fuel to tactical forces. We agree with these concerns about tactical platforms' dependence on fuels, but we view the issue to be addressable by end-use conservation alone—which would result in delivering less fuel. The costs associated with this issue depend only on the amount of fuel that is used and are completely decoupled from the original wholesale cost of the fuel and its availability. These problems, therefore, cannot be addressed by alternative fuel sources or lowered wholesale fuel prices and will not be considered further in this work.

CONCLUSION

In summary, while assurance of petroleum resources may be a transient problem for the United States over the next 20 years, it will not be a problem for DoD. Both the United States as a whole *and DoD* are at significant risk through exposure to oil price instabilities, however. Table 1 summarizes these views. We include in the table (with less confidence) a far-term look for DoD, noting that DoD has a unique need to look further into the future than normal commercial enterprises because of the long development times, acquisition times, and life spans of defense platforms—all measured in decades.

Table 1. Summary of petroleum supply challenges for the United States and DoD in both near and far term. The primary concern we see for DoD in the coming decades is the stability of the cost of the fuel it requires. DoD should begin, however, to think about long-term (>30 years away) challenges, which could include unsupportable, high prices and perhaps production supply shortages.

	U.S. (<20–30 yrs)	**DoD (<20–30 yrs)**	**DoD (far term)**
Are petroleum *reserves* sufficient?	yes	yes	yes
Will production (*supply rate*) meet demand?	Transient shortages are likely (e.g. Katrina, H. Chavez)	**Shortages highly improbable** (Domestic production capacity >> DoD demand)	Supply shortages possible
Will *price levels* have significant impact?	Economic impact of sustained high prices is likely	Fuel bill will remain small fraction of DoD budget (<3% in 2006; expect <10% thru 2025)	Possibility of unsustainable petroleum fuel costs
Expected impact of *price instability*?	Economic vulnerability is significant	**Significant vulnerability of DoD budget**	Significant vulnerability of DoD budget

II. HEDGING RISK AND PREPARING FOR THE FAR TERM

GENERAL STRATEGIES FOR DoD

Part I established our view that the availability of fuel to DoD is not a concern over the next two to three decades. Instead, the question DoD faces is what can be done about potential *price instability* in the coming few decades, and how can it prepare for unforeseeable sustained petroleum shortages beyond that time frame. Much effort has been expended by other researchers to address the issue of oil price instabilities in the global market, and it is not our intention to reproduce or survey that work here. Suffice it to say, however, that DoD should consider and employ all traditional means of hedging against unforeseeable price swings. Examples of such hedges include long-term, fixed-price contracts with petroleum suppliers in politically stable regions with sufficient assured capacity; seasonal timing of fuel purchases; and the buildup of fuel storage capacity within DoD (the Defense Energy Support Center storage capacity of fuel products is about 10.3 million barrels outside the continental United States and 9.7 million barrels inside the continental United States [9]). All these efforts are currently being employed to some degree, but they should be pursued further, especially the long-term contracts.

Description of Proposal

A more aggressive hedge against price fluctuations that we propose for consideration by DoD is to establish a *long-term supply contract* for military-grade fuel from a *nonpetroleum*-based production capacity (preferably domestic) to stabilize DoD's fuel costs during non-crisis conditions, while creating investment opportunities for private industry to develop alternative fuel technologies. The concept is for DoD to provide a guaranteed market volume to an alternative fuel producer during weak oil market conditions (low oil prices), while the alternative fuel producer guarantees sale of fuel product to DoD during a strong oil market (high oil prices). To implement this concept we envision DoD releasing a request for proposals or request for information to industry offering to purchase a fixed amount of fuel at a predetermined price so long as the fuel meets a set of criteria, the distinguishing one being that its production feedstock is not liquid petroleum based and hence is decoupled from the global oil and gas markets. Candidate alternative fuels may include Fischer-Tropsch processes based on domestic coal or biomass, biodiesel based fuels, etc., but DoD should specify as little as possible what technological process is used to produce the fuel so that industry is afforded as much creative flexibility as possible.

Of course, DoD needs to provide some end-product specifications, including fuel-quality specifications, predetermined price, and the volume of which it is willing to guarantee purchase. These specifications should encompass national environmental priorities as well. DoD may elect to invest directly into the enterprise, but the essence of the concept is that *direct financial support of the venture by DoD is not required*. We propose that merely by guaranteeing a market at a negotiated price (for example capped at $40 to $60/barrel), private industry may be persuaded to invest in and develop this alternative fuel production capacity by itself. The foundational assumption of this proposal is that a number of viable alternative fuel technologies already exist that could be produced at a cost of only $40 to $60/barrel and that the only reason that they have not been developed commercially thus far is the risk of oil prices returning to levels below these production costs in the future. For instance, IEA reports that most oil companies make long-term investment decisions based on an assumed price of oil between $20 and $25/barrel [3]. Our concept aims to enable a long-term alternative fuels investment based on $40 to $60/barrel. Since long-term investment generally means at least decades (e.g., 20–30 years) to recoup the value of the investment, this is the time scale we envision for such a concept. Finally, the scale of the concept that we propose would be limited to only a fraction of DoD supplies. We do not see such a source ever covering all DoD needs—for instance, to meet DoD fuel demands outside the continental United States, logistics requirements may make it favorable to purchase fuel from local suppliers.

Obviously, DoD needs to study the economic aspects and technical details of this concept in much more detail than we present here. Such studies should not aim to identify the final technical solution, but rather to understand the fundamental scientific limitations of some of the various technologies available and to solidify the technical requirements of such a fuel. A follow-on appendix to this report will give a very brief overview of some technologies that may be able to meet these requirements (e.g., Sasol in South Africa produces 150,000 barrels/day of diesel and naphtha using a coal-to-liquids process at a cost of about $50 to $60/barrel of product [12]), but the best way to determine whether such processes exist may be through experiment—actually issuing a request for information and seeing what industry can develop.

CORE BENEFIT

The immediate benefit of our proposal hinges simply on its potential to dampen the impact of large, unpredictable swings in oil prices that we expect DoD may face in coming decades. Figure 4 is a general illustration of how long-term supply contracts can buffer DoD against price swings in the global market. In this diagram the more short-term a transaction is, the more the transaction price is set by the global oil market. As discussed earlier, the vast majority of oil traded has its price closely linked to global market reference prices (even though most of it is not literally traded on the spot market), and hence most trade follows a route through the center box on the diagram.

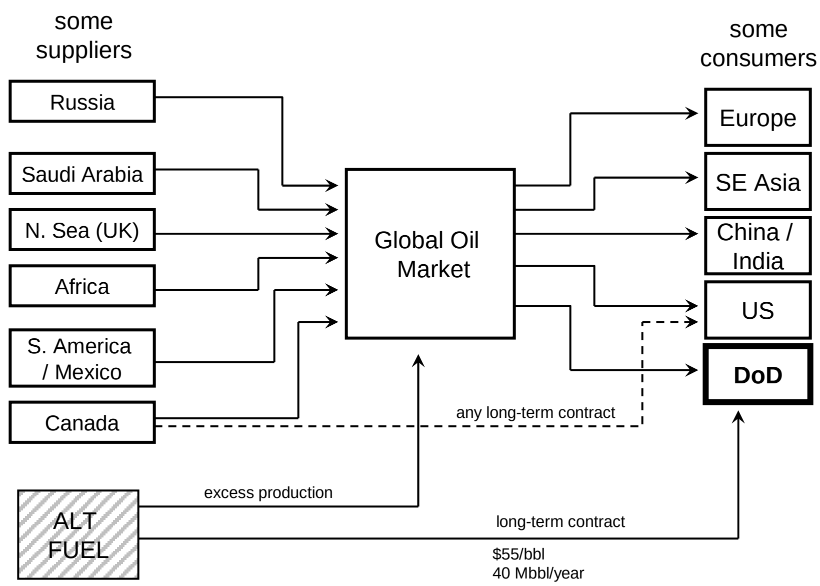

Figure 4. Illustration of the flow of *access* to a fungible commodity (oil) on an open, global market with the role of a conceptual alternative fuel producer for DoD included. Direct lines between producer and consumers illustrate the nature of the long-term contract and its independence from the open market price fluctuations. The alternative fuel-supply concept insulates the DoD from price fluctuations by exactly the same means as any long-term contract between a supplier and consumer, as illustrated, for example, by the dashed line between Canada and the U.S. DoD is listed separately from the United States in this figure to emphasize the fact that it obtains its oil through Defense Energy Support Center independently of the rest of U.S. consumers.

The longer term an oil supply contract is, however, the more the transaction circumvents the global oil market, since its price is predetermined. So in this sense the essential characteristic of our proposal, with respect to DoD fuel cost stability, is simply establishing a fuel supplier for DoD whose supply is available to DoD first before being made available on the world market.

Unique Benefits

It is easy to infer from Figure 4 that the goal of price stabilization could be met by establishing a long-term supply contract (i.e., a direct line from supplier to consumer) with any of the suppliers on the left-hand side. The reason our proposal focuses on a *non-petroleum*, alternative-fuel supplier is that we believe this approach may offer some unique, ancillary benefits in both the coming few decades and beyond:

- Securing a favorable, very long-term contract with any regular petroleum supplier may be prohibitively difficult, but DoD would have more bargaining power to negotiate such an agreement with a supplier who would otherwise have trouble competing in the open market. The inhibitor to investment in ventures with higher costs than competitors' is risk that market prices will fall below the production costs for the venture. The offer of a guaranteed market may prove highly persuasive to such a venture.
- Developing a stable market would help catalyze the development of a new alternative (non-petroleum-based) fuels industry in the United States. Greater and greater cost reductions may be realized as the industry progresses along a learning curve with greater cumulative production. This may not guarantee cost competitiveness with inexpensive petroleum (less than $30/barrel), but it would help accelerate the industry toward its potential.
- Because swings in futures and spot oil prices depend not only on physical supply and demand constraints but also on trader perceptions of future risk, etc., demonstrating a viable, scalable alternative fuel source may have a significant dampening effect on instabilities in the open global market itself. Oil exporters' capacity to gouge importers may be reduced if they respect the capability of importers to effectively develop alternatives (i.e., the "appearance" of alternative fuel success may be enough to quell the fear premium placed on oil futures prices)
- The proposed concept offers an opportunity to diversify DoD fuel supplies beyond the global oil markets. In doing so DoD can withdraw some of its cash flow from world oil markets, where many oil-producing countries are increasingly becoming the object of military concern.

WHY DoD?

A legitimate question to answer is whether the development of an alternative fuels industry is the role of DoD at all. DoD, despite its size, is not large enough to drive national or global oil markets, and perhaps the effort is better left to industry on its own. A few factors speak in favor of DoD's active involvement, however. The foremost argument, perhaps, is that DoD has a unique need among nearly all other fuel consumers to plan far into the future. DoD weapons systems and platforms, which are dependent on hydrocarbon fuels, have life spans of many decades and can take 10 to 20 years to develop and acquire. It is precisely these long lead times that demand that DoD plan early. Another reason for DoD's involvement is that DoD is the largest single consumer of fuel in the United State. Finally, among federal agencies, DoD has by far the greatest financial resources and is in the best position to offer a guaranteed market to prospective alternative fuels ventures. Taken together, these facts make DoD the single largest stakeholder in the development of new fuel resources, but this does not mean no others exist. Within private industry there is interest in efforts to maintain stability in fuel costs and to develop petroleum alternatives, the most obvious being in the airline industry. Also, within the federal government, the Department of Energy, which has the most experience in this field, is another key stakeholder. In carrying out the concept that we propose, DoD is a necessary player because of its unique size and need for price stability, but this should not preclude including other stakeholders as well.

WHY NOT RELY ON THE DEPARTMENT OF ENERGY STRATEGIC RESERVE?

A final word must be given to explain how the concept that we propose offers benefits that are not available through the Department of Energy's strategic petroleum reserve (SPR). First, access to SPR resources is restricted to Presidential directive, and second, the primary mission of the SPR is not to supply the military in the event of an oil shortage, but rather to supply essential national industries. Its maximum drawdown rate (i.e., rate that oil can be pumped out and delivered for use) is 4.4 million barrels/day—less than 20% of the U.S. demand rate [5]. This does not mean that the military would be denied access, but the resources are not under DoD's direct control, and it is not guaranteed that the amount rationed to DoD would be sufficient in crisis circumstances. A third point is that the SPR is only used under dire circumstances, not merely to buffer price swings. Fourth, the SPR is not a source of fuel production as provided in our concept, but rather an underground holding tank of crude oil. Last, and perhaps most important, DoD reliance on the SPR does nothing to catalyze development of alternative fuel supply options and enable all the ancillary benefits associated with such an industry as described in our proposal.

AFTERWORD

This white paper outlines a concept for DoD to consider for stimulating development of mobility fuel supply alternatives. In addition to the nascent study of this concept, IDA was already engaged in a small, internal study of the so-called "peak oil" debate and of various technologies available to provide fuel alternatives. Two appendixes will be provided soon to supplement this white paper by outlining some of the early results of our internal studies.

PROPOSED FOLLOW–ON STUDIES

We propose further work to develop the efforts we have begun in both of these appendixes. The aim of the technologies portion of the study (Appendix #1, in preparation) would be to develop the minimum requirements that alternative fuel technologies and the enterprises that they represent must meet to be of significant value to DoD and the nation as a whole. In addition, such a study would be useful for helping decision-makers find deficiencies in technical proposals, evaluate technical risks, and define the ultimate potential offered by many of these technologies. The goal of the peak-oil inquiry (Appendix #2, in preparation) would be to offer DoD decision-makers an independent, coherent picture of the arguments made by both optimists and pessimists in this debate. The time scale on which DoD must plan with respect to weapons systems development etc. (beyond 20–30 years) requires that it have a decisive, clear view of what it expects in the long-term future, and why. Most of the studies with which we are familiar, however, (including our own white paper here) are limited to using the same statistics and figures that are published by only a few primary sources (*Oil and Gas Journal, World Oil,* IHS, and USGS are the primary sources from which IEA, EIA, BP etc. compile their statistics). Such studies do not have the scope to investigate in detail the probable validity of these figures and projections themselves. An independent broker's analysis of this debate may help establish a clear understanding of the situation for DoD.

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14. ABSTRACT

This whitepaper addresses the issue of energy supply challenges for DoD within the context of the greater national energy issues, and proposes a strategy that DoD might consider in order to hedge against future energy supply and cost uncertainties, while helping to drive the market development of select energy alternatives for the nation as a whole. The first part of this work provides a brief assessment of the energy (oil) challenges facing the United States and DoD with the aim of distinguishing the genuine problems from issues that are either not new or are outright red herrings. We argue that while the oft-professed goals of DoD energy security—"independence from the Middle East," "assured fuel access" and "protection against high fuel costs"—are not worthwhile endeavors, DoD does face two urgent concerns over its fuel supply costs. The first is DoD's exposure to unpredictable price swings, and the second is DoD's ignorance of the overhead logistics costs associated with fuel use. Conservation and efficiency are the only means of addressing the latter concern, whereas development of alternative fuel sources, among other strategies, may be useful for addressing the former. The second part of this work outlines our proposal for mitigating DoD's exposure to oil price instability, which has the potential for severe impact on DoD's ability to budget and plan. Moreover, development of an alternative fuel supply would represent a long term investment for which DoD has a unique need, on account of the long lead times required for development and acquisition of weapons systems that themselves have long lifetimes.

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