

An hourglass-shaped graphic with a globe inside. The top bulb is dark blue, and the bottom bulb is light blue. The globe is a darker shade of blue. The hourglass is centered on the page.

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*Private Crude Oil Stocks and the Strategic Petroleum
Reserve Debate*

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Updated June 23, 2003

Abstract. Periodically, since the inception of the Strategic Petroleum Reserve (SPR) in 1975, debate has occurred concerning its optimal size. In the 108th Congress, the House has passed energy legislation (H.R. 6) which would require the SPR to be filled to its current capacity of approximately 700 million barrels and would authorize funds to further expand the capacity of the reserve to 1 billion barrels.

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June 23, 2003

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Private Crude Oils Stocks and the Strategic Petroleum Reserve Debate

Summary

Periodically, since the inception of the Strategic Petroleum Reserve (SPR) in 1975, debate has occurred concerning its optimal size. In the 108th Congress, the House has passed energy legislation (H.R. 6) which would require the SPR to be filled to its current capacity of approximately 700 million barrels and would authorize funds to further expand the capacity of the reserve to 1 billion barrels.

Analysis of the SPR issue has been carried out in a benefit/cost framework in which benefits, the avoided cost to the national economy of a supply disruption, are set against the real resource costs associated with investing in the SPR. The role of the privately held stock of crude oil has been largely static in these analyses. The data show, however, that private stock behavior has been changing. Industry holds less crude oil, and has less capacity to hold crude oil, than a decade ago. These changes reflect a decade long strategy of reducing operating costs to remain competitive. However, oil markets face greater exposure to supply disruption today because our dependence on imported crude oil has risen substantially since 1992. The effectiveness of the SPR in providing security from crude oil supply disruptions may be primarily a function of its size, but may also be dependent on the underlying stocks of crude oil held by the private sector.

The International Energy Agency (IEA) has studied the behavior of crude oil stocks in the U.S. since 1989. It finds that our total stocks, measured as days of net imports that can be replaced by stock draw-down, have been declining. This trend results from the interaction of increasing import dependency, the essentially constant size of the SPR over the period, and the declining size of privately held stocks. The IEA concludes that with no change in any of these factors, the U.S. will no longer be able to replace ninety days of net imports from domestic stocks in 2006.

Because the IEA focuses on total reserves, its analysis may overstate the ability of U.S. stocks to mitigate oil supply disruptions. This is because not all privately held oil stocks can be drawn upon without disrupting the functioning of the system itself. Once these lower operational inventory levels are considered, the thinness of privately held stocks is apparent. As a result, the ability of privately held stocks to provide a buffer to supply disruptions is reduced.

This report will be updated as events warrant.

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Private Crude Oil Stocks and the Strategic Petroleum Reserve Debate

Background

The Energy Policy and Conservation Act of 1975¹ authorized the creation of the Strategic Petroleum Reserve (SPR) for the storage of up to 1 billion barrels of crude oil. The federal government began filling the SPR in 1977, mostly with imported oil. By 1992, the SPR held 575 million barrels of crude oil, and in May 2003, over a decade later, holds approximately 600 million barrels in reserve. Since the creation of the SPR in 1975, debate has periodically focused on the optimal size of the SPR, specifically whether it should be expanded to 700 million or 1 billion barrels of oil. In the 108th Congress, legislation passed by the House (H.R. 6) would require the SPR to be filled to its current capacity of 700 million barrels of crude oil and provides funding of \$1.5 billion to expand the capacity of the SPR to 1 billion barrels.²

Worldwide concern over the unstable nature of the crude oil market has led other nations to establish emergency oil stocks as part of International Energy Administration (IEA) agreements to manage supply disruptions. For example, at the end of 1999 Japan held 315 million barrels of crude oil, OECD Europe held 325 million barrels, South Korea held 43 million barrels, and Taiwan held 13 million barrels. The U.S. is the only country in this group where security stocks are totally government owned. In Japan, South Korea, and OECD Europe, the total stock is divided between government and mandated private stocks. In Taiwan, the stock is completely mandated private.³

Although decisions on the size of the SPR and private stocks are made through very different decision processes, they are linked by the fact that both may be useful in times of supply disruption. When supply is disrupted, prices rise quickly through active futures, spot, and product markets. Higher prices give businesses an incentive to bring product to market, which mitigates potential physical shortages, giving policy makers time to consider an SPR draw-down. If businesses have reduced

¹ P.L. 94-163

² A detailed analysis of the history of petroleum allocations to the SPR as well as current data and analysis of related policy issues can be found in CRS Issue Brief IB87050, *Strategic Petroleum Reserve*, by Robert Bamberger.

³ Paul N. Leiby and David Bowman, *The Value of Expanding the U.S. Strategic Petroleum Reserve*, ORNL/TM-2000/179, November 30, 2000, p. 20. The report is available at the Oak Ridge National Laboratory website, <http://pz11.ed.ornl.gov>

available inventories to cut costs, their ability to play this role is diminished. For this reason, the size and availability of private stocks of crude oil is relevant to debates over the optimal size of the SPR as well as when, and under what circumstances, to use the SPR.

Benefits/Costs of the SPR

The case for the existence of the SPR is usually framed in a benefit/cost framework.⁴ The benefits are typically defined as avoided costs which are then set against the real resource, or opportunity, costs of maintaining the reserve. The same approach is followed for considering marginal adjustments to the reserve, but with a focus on the additional value of avoided costs implied by a reserve expansion set against the marginal resource cost of expanding the reserve. Although debate on the size of the SPR is normally framed in terms of millions of barrels of crude oil held, another measure, consistent with International Energy Agency (IEA) measurement, is the number of days of net imports for which the reserve can substitute. Although the primary focus of SPR usage is concerned with international oil market disruptions, the SPR could also be used in times of emergency stemming from domestic supply disruption.

The benefit of maintaining the SPR lies in avoiding the effects of severe oil price spikes and shortages that might result from supply disruptions. Significant, rapid spikes in the price of crude oil and actual shortages can have damaging effects on the macroeconomic performance of the economy. Reduced economic output, leading to increased unemployment and a reduction in the rate of economic growth are possible consequences. In terms of the balance of payments, higher oil prices will mean a greater expense for oil imports, causing the balance of trade to deteriorate.

The costs of the SPR are much like those of other public investment projects. The capital cost of the reserve and/or expansion of the reserve, costs associated with providing for the draw of the reserve, the operations and management cost, and the cost of the oil stored in the reserve are all part of total cost. The cost of the stored oil is a real budget cost in the year of acquisition to be recouped later when, and if, the reserve is drawn down.

Proponents of the SPR see the existence, as well as the use, of the reserve contributing to stability in the oil market. The existence of the reserve could deter some politically or economically motivated disruptions. If the reserve is drawn upon, it might allow affected economies time to make other adjustments to the new market conditions, including diplomacy, which might remedy, or mitigate the underlying cause of the disruption. The existence and/or use of the reserve might calm uncertain oil markets and dampen the effect of underlying market imbalances leading to a moderated price spike.

Those opposed to market intervention see less benefit associated with the SPR and its use. They believe that the freely functioning market can mitigate most

⁴ Ibid.

disruptions and that government intervention in market processes is unlikely to enhance resource allocation. In this view, friendly suppliers might expand short term output in case of a disruption, and higher prices will allocate available supplies to their most pressing needs, minimizing the effect of the supply disruption.

The SPR is not a stand-alone policy for energy security. In the longer term, diversifying energy sources and improving energy efficiency, engaging in productive dialogue with oil producers and enhancing the price responsiveness of consumer demand are all important measures. In the shorter term, encouraging fuel switching capability and demand reduction can be useful energy security measures.

Role of Private Stocks

The implicit assumption underlying the SPR debate appears to be that the stock of private oil reserves held by the U.S. petroleum industry is known, unchanging, and available to reach the market during a supply disruption. To put the SPR expansion issue in proper context, the optimal size of the SPR might be considered as *part* of the total stock of reserves the nation has to draw upon in times of emergency.⁵ Consider the following extreme, hypothetical cases. If the private sector were able, technically and economically, to run the oil production system with zero inventories, or reserve stocks, every world oil market supply disruption would be quickly transmitted to the domestic consumer market, leading to immediate shortages and price spikes. In this case, a large reserve, coupled with quick response usage rules might be required for market stability. At the other extreme, if the oil industry found it either technologically or economically useful to hold a year's worth of supply in reserve which it was willing to draw down as needed, there might be little need for any government reserve. If, in reality, we are somewhere between these extremes, so might be the requirement for the SPR, and, as a corollary, if the capability of privately held stocks varies, so must the capability of the SPR if our overall ability to meet market challenges is to remain constant.

⁵ Care must be exercised in evaluating private stocks of crude oil. The Energy Information Administration, in the June 13, 2003 Weekly Petroleum Status Report, Figure 2, page 7, reports that although the five year, average monthly holdings of crude oil in 2002 and 2003 in the private sector are between 280 and 350 million barrels, it would be incorrect to assume that at any time there was that much oil available for draw-down. The system has a lower operational inventory level of 270 million barrels. This value represents the oil that is being held or in transit to refineries and bulk terminals as well as oil in pipelines. This oil cannot be accessed for emergency use; it represents a kind of fill in the system, which must be present for the continuous operation of the production process from well head to consumption. Private stocks available for emergency draw-down should be considered to be the total stocks held *net* of the lower operational inventory levels. Reserves held in the SPR are, in principle, fully available for extraction and use. Therefore, stocks of crude oil held in the SPR are not directly comparable to total stocks held in the private sector. The correct comparison is between barrels of crude oil held in the SPR and the *net* level of private stocks. This observation substantially reduces the effective private reserve stock levels in the U.S. in terms of their ability to replace net imports.

In fact, the behavior of private levels of crude oil stocks have not been constant, they have been declining. Crude oil stocks, excluding the SPR, stood at 285.1 million barrels on May 16, 2003. One year ago the stock stood at 325.6 million barrels, which implies a reduction of 12.4 percent in stocks held by the nation's oil industry.⁶ **Figure 1**, computed by the IEA, shows the behavior of total U.S. oil stocks, measured as days of net imports.⁷

Figure 1. U.S. Oil Stocks, 1989-2002

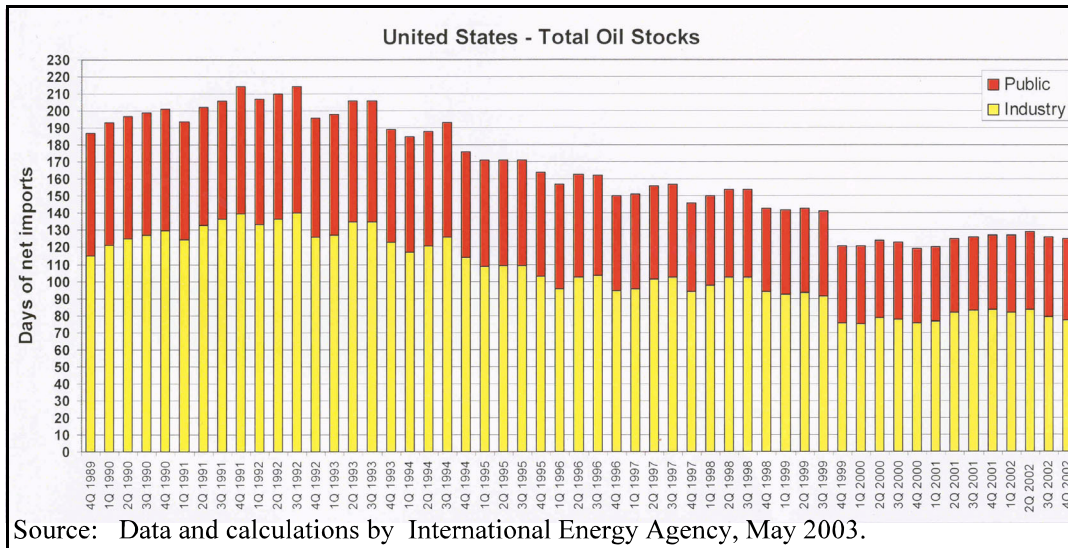


Figure 1 shows a decade long decline in the ability of industry stocks, along with the SPR, to replace imported oil. Several forces are at work in **Figure 1**. First, the increasing dependence of the U.S. on imported oil makes a stock of any size less capable of replacing imports. Even if the actual stocks shown in the figure were constant, days of imports would decline if the quantity of oil we import rises. Table 1 shows that net imports of crude oil have increased from approximately 5.7 million barrels per day on average in 1989 to approximately 9.0 million barrels per day on average in 2002.⁸ This increased dependency has contributed to the downward trend of **Figure 1**.

⁶ Stocks of refined petroleum products were also lower than the previous year by margins ranging from 2 percent to 30 percent. Up to date information on petroleum stocks is published in the Weekly Petroleum Status Reports available at www.eia.doe.gov.

⁷ IEA data provided by William C. Ramsay, Deputy Executive Director, IEA, *A Fossil Fuel Future*, presentation at CRS, May 22, 2003.

⁸ Table 1 also shows that the U.S. has increased its imports of petroleum products, mostly gasoline. Depending on the nature of future market disruptions, the U.S. could import more petroleum products in lieu of importing crude oil.

Table 1. Net Imports of Petroleum, 1989-2002
(in thousands of barrels per day)

Yearly average	Crude Oil	Petroleum Products	Net Imports
1989	5,701	1,500	7,202
1990	5,785	1,375	7,161
1991	5,666	959	6,626
1992	5,994	944	6,938
1993	6,689	929	7,618
1994	6,964	1,090	8,054
1995	7,135	750	7,886
1996	7,398	1,100	8,498
1997	8,117	1,040	9,158
1998	8,596	1,167	9,764
1999	8,613	1,300	9,912
2000	9,021	1,399	10,419
2001	9,308	1,592	10,900
2002	9,038	1,340	10,378

Source: U.S. Energy Information Administration. *Monthly Energy Review*, March 2003, p. 43.

Secondly, as noted above, in the short term, stocks of privately held oil have declined. **Figure 2** shows the behavior of U.S. stocks, measured in billions of barrels, in the longer term, from 1973-2002. The figure shows that non-SPR crude oil stocks have experienced a long term decline since their peak in the mid 1970's, even though in the last two decades imports and consumption have risen. Figure 2 also suggests some increased volatility in the level of privately held stocks since the mid 1990's. This behavior might be expected if firms were optimizing their inventory holdings. Additions to stock when prices of crude oil are low and draw downs from inventory when prices are high enhance profit opportunities.⁹

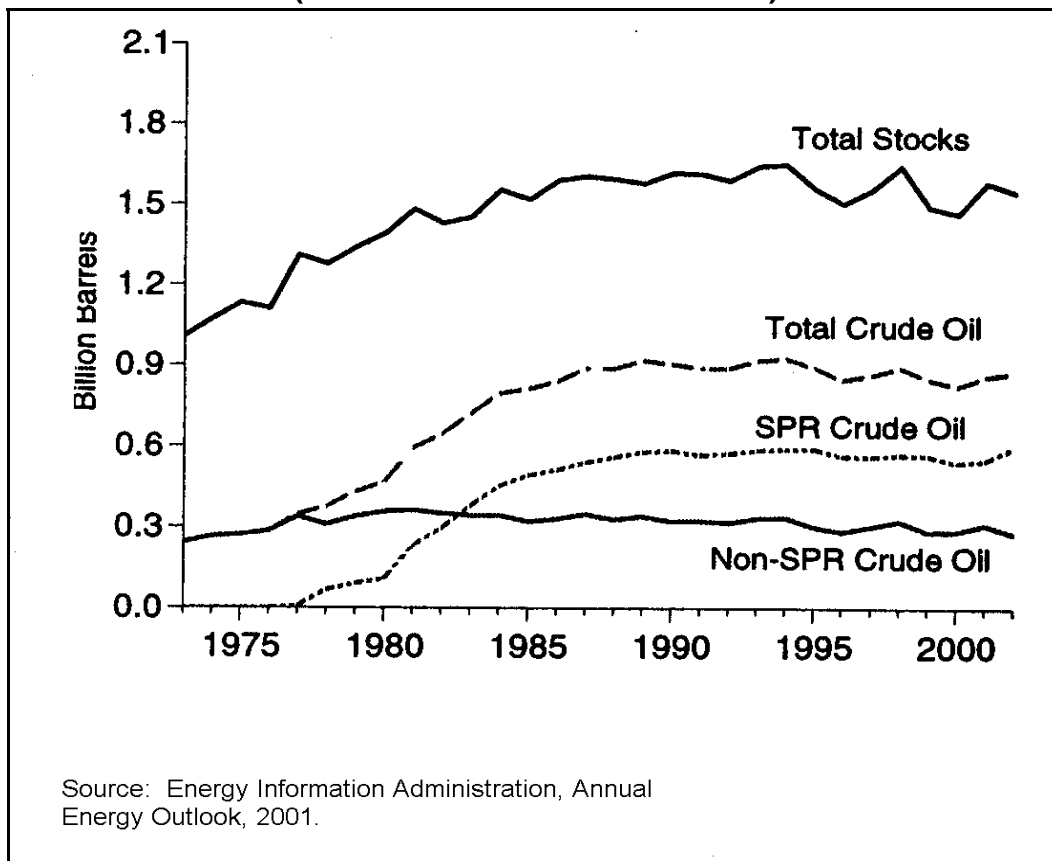
Trends similar to those observed in crude oil have also occurred in petroleum products. The Petroleum Industry Research Foundation, Inc. calculates that finished gasoline stocks fell from a 30 day stock in 1985 to an 18-19 day stock in 2001. This translated into a 41 million barrel decline in gasoline stocks over the period. An additional complication is that gasoline is not as fungible as it once was. Different

⁹ Production is also price sensitive. Marginal production can be brought to market with the incentive of higher prices.

blends of gasoline to satisfy differing air pollution standards in various parts of the country put further strain on a system that is reducing stocks.¹⁰

Finally, not only privately held stocks have declined, but the privately held capacity to hold stocks has also declined. In 1990, the capacity of refineries in the U.S. to hold stocks of crude oil was 204 million barrels; by 2002 this capacity had declined to 183.3 million barrels, a reduction of over 10 percent.¹¹ This decline in capacity, coupled with the decline in held stocks, suggests that the industry might be attempting to reduce the level of inventory as a way of managing cost. Much of U.S. industry has adopted “just in time” inventory techniques as a way to lower costs and enhance efficiency. It would be consistent with this trend for the petroleum sector

Figure 2. Behavior of U.S. Stocks, 1973-2002
(measured in billions of barrels)



to follow a similar strategy.

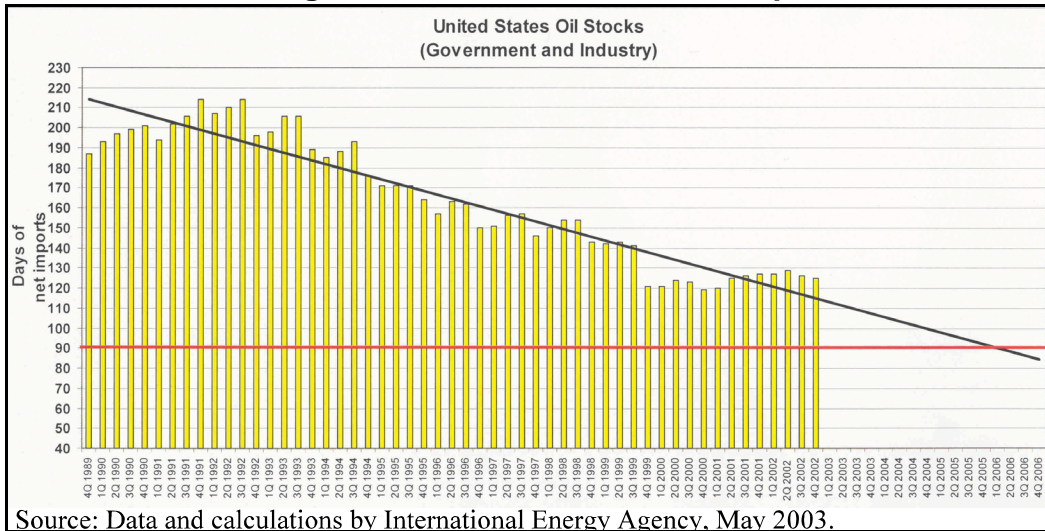
¹⁰ *Refining Concentration and Industry Dynamics*, Petroleum Industry Research Foundation, Inc., April, 2002, available at the web site, www.pirinc.org.

¹¹ Storage at refineries is not the only location for stocks of crude oil. Additional stocks might be engaged in the transportation and distribution process at any of several levels.

Implications of Current Stock Status

Figure 3 represents a “break even” analysis of the relationship between total stocks of U.S. crude oil and time, assuming that the nation has a security target of ninety days of import substitution, consistent with IEA targets. The IEA data are based on total stocks of crude oil which ignores the lower operational inventory constraint for industry and, therefore, may overstate the ability of combined stocks to actually meet emergency needs.

Figure 3. Break Even Relationship



Analysis by the IEA offers the tentative conclusion that U.S. ability to maintain a target of ninety days of import replacement with current trends continuing, and no change in current government policy, will end in 2006. An increase in the SPR would push this date further into the future, while an acceleration of private sector stock draw down would bring the date closer to the present time. Additionally, the figure also implies that if the SPR fill were expanded to 700 million barrels, or even 1 billion barrels, the increase in security that we might receive from enhanced levels of import replacement could be only temporary. The underlying decline of private sector stocks and increasing dependence on imported oil will also influence our susceptibility to supply disruptions in the future.

Although the IEA analysis suggests a developing problem for the U.S. in terms of replacing imported oil in times of emergency, the real situation may be even more challenging than the IEA analysis suggests. Energy Information Administration data shows that in the fall of 2002 and again in early 2003 private stocks of crude oil were reduced to the lower operational inventory levels discussed earlier. At those times there were no additional crude oil reserves in the private sector in a practical sense.¹² The more the private sector economizes on crude oil stock holdings, the more likely

¹² Data included in the Weekly Petroleum Status Report for the week ending May 30, 2003. Available at the Energy Information Administration website, www.eia.doe.gov.

it is that the lower operational inventory constraint will become effective during a market disruption, limiting the ability of industry to meet consumer demand.

Conclusion

While private sector stocks exist primarily because of the economic and technological requirements of the oil industry, they have also served a public purpose. Private stocks have at least partially played the role of a public good. They have provided benefits to the domestic oil market as a whole, as well as to policy makers as they faced difficult decisions about when, and if, to draw on the SPR. Private sector stocks are usually drawn down first, with market forces guiding the decision. Decisions on the optimal size of the SPR may need to take into account changes in industry practices which might affect the ability of private stocks of crude oil to play this role in the future.

Net stocks of privately held crude oil, in many ways the first buffer between an international oil supply disruption and U.S. consumer markets, were reduced to very low levels during the recent disruptions to the oil markets. Industry holds less stock in 2003 than it did a decade ago, even though U.S. dependence on crude oil imports has risen. The SPR currently holds approximately 600 million barrels of crude oil which could be used in a supply emergency. The effect of the rising dependence on imports and the reduced availability of private stocks implies that 600 million barrels of crude oil translates into fewer days of replaced reserves.