

GAO

Fact Sheet for the Honorable
Ted Stevens, U. S. Senate

September 1987

OIL RESERVES

An Analysis of Costs—Past, Present, and Future



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Resources, Community, and
Economic Development Division

B-208196

September 29, 1987

The Honorable Ted Stevens
United States Senate

Dear Senator Stevens:

This fact sheet responds to your June 16, 1987, request that we address several questions regarding the cost of the Strategic Petroleum Reserve (SPR). Specifically, you asked us to determine (1) the total federal expenditures to date on the SPR per barrel of crude oil stored, with costs allocated among operations, construction, and oil, (2) the estimated additional per-barrel expenditures of the federal government over the next 5, 10, and 15 years, allocated among the same cost categories and assuming no changes in existing federal policy on reserve levels, and (3) in the event of an SPR drawdown, the amount a purchaser of crude oil from the SPR would pay per barrel under existing federal policy.

In summary we found that

- the total cost of developing and filling the SPR through fiscal year 1987 will be about \$18 billion; the average per-barrel cost will be \$33.74. A breakdown by category is shown in table 3.1;
- based on a fill rate of 75,000 barrels per day, the cumulative incremental cost per barrel for oil-fill activities for the periods requested will be: 1988-1992, \$23.00; 1988-1997, \$25.85; 1988-2002, \$25.85. The breakdowns by individual 5-year period is shown in tables 4.1, 5.2, and 6.1; and
- under DOE's SPR sales plan, SPR oil would be auctioned only after a Presidential determination that an energy emergency exists, or that the drawdown was necessary to fulfill U.S. obligations under the International Energy Program. Economic theory suggests that bids for SPR oil would closely approximate bids for other oil sold on the open market, but, as discussed below and in section 7 of the fact sheet, there is little agreement on what the market price would be under conditions which might lead to an SPR drawdown.

With regard to the incremental costs per barrel of oil added to the SPR, our calculations reflect the fact that, at a 75,000 barrel-per-day fill rate, the SPR will reach its targeted capacity of 750 million barrels in 1995. Costs associated with continued fill will cease at that time, and all subsequent expenditures will be those associated with maintaining the SPR oil inventory in a standby condition.

Regarding your last question, even in the absence of an energy emergency, there is little consistency among forecasters as to what the market price for crude oil would be in any year, and the disparities between forecasts increase further in the future. It is almost certain that an energy emergency resulting from a disruption of oil supplies would raise oil prices above the market price levels that would be in effect immediately preceding the disruption. However, the Department of Energy (DOE) believes an early release of SPR oil would dampen the expected market price increases.

In developing the per-barrel costs used in this fact sheet, we obtained past and current SPR cost data from DOE's Office of Fossil Energy based on actual expenditures for the SPR and DOE's fiscal year 1988 budget request. Estimates of future costs were taken from our May 1987 report that analyzed several oil-fill alternatives.¹ This fact sheet utilizes oil price forecasts from the Data Resources, Inc., Spring 1987, base case (oil refiners acquisition cost for imported oil), in determining future oil costs. Budget authority estimates for operations and construction for fiscal years 1988 through 1992 were obtained from DOE. We estimated costs for fiscal years 1993 through 2002 based on discussions with DOE officials as to likely cost patterns, including oil fill, and with sites in standby condition. In responding to the question on the future selling price of SPR oil, we used information we developed in two other reports--a May 20, 1983, report on oil prices in an oil supply disruption and a June 5, 1985, report evaluating DOE's plans to sell oil from the SPR. (A summary of the reports we used is given in appendix I.)

¹Oil Reserves: An Analysis of Oil Fill Alternatives
(GAO/RCED-87-145BR, May 1987).

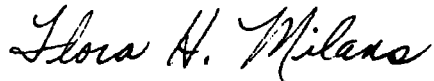
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We discussed the accuracy and reasonableness of the information in this fact sheet with responsible agency officials and have incorporated their views where appropriate.

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As arranged with your office, unless you publicly announce its contents earlier, we plan no further distribution of this fact sheet until 10 days after the date of this letter. At that time we will provide copies to the Secretary of Energy and other interested parties and make copies available to others upon request. If you would like further information, please contact me on (202) 275-8545. Major contributors to this fact sheet are listed in appendix II.

Sincerely yours,



Flora H. Milans
Associate Director

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ABBREVIATIONS

DOE	Department of Energy
EPCA	Energy Policy and Conservation Act
FY	fiscal year
GAO	General Accounting Office
IEA	International Energy Agency
MMBD	million barrels per day
SPR	Strategic Petroleum Reserve

SECTION 1

BACKGROUND

Oil supply disruptions in the 1970s dramatically increased oil prices and damaged the economies of the United States and other oil-consuming nations. Oil prices nearly tripled during the 1973-74 Arab oil embargo and increased 150 percent during the 1979 Iranian oil cutoff. These price increases resulted in loss of economic output, inflation, unemployment, and balance of payment problems in the United States that lasted long after the supply disruptions ended.

The federal government responded to these impacts with several new energy programs and policies designed to reduce the nation's vulnerability to future oil shortages. One of these responses was the creation of the Strategic Petroleum Reserve (SPR), authorized in the Energy Policy and Conservation Act (EPCA) (Public Law 94-163, December 22, 1975). Under EPCA, the U.S. government was authorized to store up to 1 billion barrels of oil for use during an oil supply disruption.

To meet this objective, the Department of Energy (DOE) established a three-phase plan to store 750 million barrels of crude oil in the SPR by 1989. The completion date has been extended, but the 750-million-barrel objective still has congressional and administration support. DOE is planning to fill the SPR at a 75,000-barrel-per-day rate in fiscal year (FY) 1987. The SPR now contains over 530 million barrels of oil and would contain 534 million barrels by the end of fiscal year 1987 based on this fill rate.

DOE's proposed budget for fiscal year 1988 requests funds to continue filling the SPR at 35,000 barrels per day. Although final congressional action has not been taken on the budget, the House passed H. R. 2712, a bill making appropriations for the Department of the Interior and related agencies for fiscal year 1988, on June 25, 1987. According to DOE officials, this bill establishes funding levels commensurate with filling the SPR at 75,000 barrels per day, thus continuing the fiscal year 1987 fill rate. This fill rate also meets the requirements in EPCA as amended by the Omnibus Budget Reconciliation Act of 1986 (Public Law 99-509) that requires either having 750 million barrels of oil stored in the SPR or maintaining an average fill rate of 75,000 barrels per day as a condition for selling oil from the Naval Petroleum Reserve. We have assumed that the SPR will continue to be filled at 75,000 barrels per day until the 750-million-barrel inventory level is reached in 1995.

For the purposes of this fact sheet, SPR costs have been divided into three categories: operations, construction, and oil.

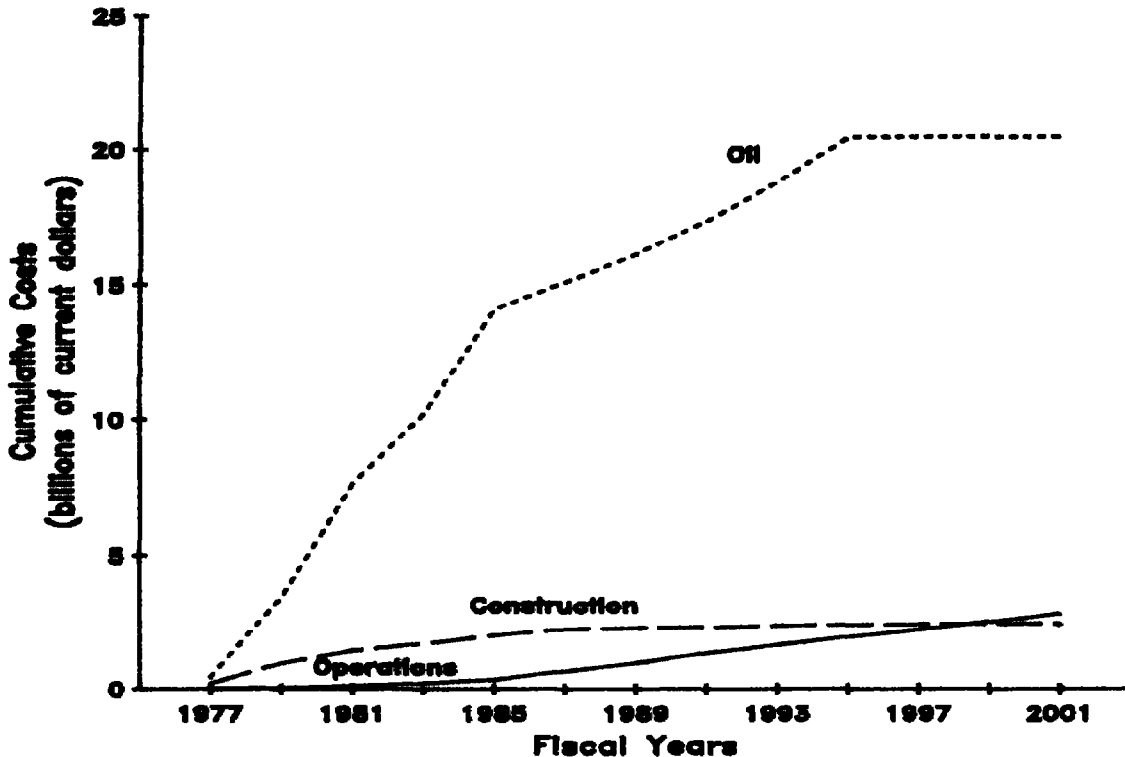
The operations cost category comprises management, planning, and facilities operations costs. The construction category consists of storage development costs, as well as facilities costs related to development. All costs relating to oil acquisition and transportation constitute the oil cost category.

SECTION 2

THE RELATIONSHIP AMONG SPR OIL, CONSTRUCTION,
AND OPERATIONS COSTS: 1977 THROUGH 2002

As the development of the SPR progresses, the relationship among oil, construction, and operations costs changes, as illustrated by figure 2.1.

Figure 2.1: Cumulative costs of the SPR



Oil represents an overwhelming proportion of the overall cost of the SPR and has been the fastest growing cost category. Construction costs accumulated rapidly between 1977 and 1987 as the major construction costs for the SPR occurred in that time period. Operational costs, however, remained low and grew slowly. In the years between 1988 and 1995, oil will still represent the largest part of the total cost, but it will accumulate at a less rapid pace. Increases in construction costs will be relatively small as major construction will end in 1987. After 1995, when the SPR reaches 750 million barrels, oil purchases will cease, construction costs will remain insignificant, and operations will consist of the

remaining standby costs, which are costs that will be incurred while maintaining the SPR for use after the oil fill has been discontinued.

SECTION 3

SPR EXPENDITURES THROUGH SEPTEMBER 30, 1987

Table 3.1 shows the actual and estimated costs of operations, construction, and oil acquisition for the SPR through the end of fiscal year 1987.

Table 3.1: Expenditures for the SPR: Fiscal Years 1976-1987

	Actual cost through <u>FY 1986</u>	Estimated costs <u>FY 1987^a</u>	Total cost	Cost per barrel ^b	Percent of <u>total cost</u>
	- - - - (millions) - - - -				
Operations	\$ 524	\$148	\$ 672	\$ 1.26	4
Construction	2,135	89	2,224	4.16	12
Oil	<u>14,595</u>	<u>526</u>	<u>15,121</u>	<u>28.32</u>	<u>84</u>
Total	<u>\$17,254</u>	<u>\$763</u>	<u>\$18,017</u>	<u>\$33.74</u>	<u>100</u>

^aPlanned fiscal year 1987 obligations based on DOE's fiscal year 1988 congressional budget request.

^bThe cost per barrel was calculated by dividing the total cost of each cost category by the total 534-million-barrel SPR inventory expected at the end of fiscal year 1987.

SECTION 4

ESTIMATED COSTS FOR

CONTINUED OIL FILL: 1988-1992

Assuming an oil-fill rate of 75,000 barrels per day and estimated costs for operations, construction, and oil purchases, we developed a per-barrel cost of filling the SPR during the fiscal year period 1988-1992. The results of our analysis are shown in table 4.1.

Table 4.1: Estimated Expenditures for the SPR: Fiscal Years 1988-1992

<u>Cost category</u>	<u>Cost for maintaining oil inventory</u>	<u>Cost for oil fill</u>	<u>Total cost</u>	<u>Cost per incremental barrel^a</u>
	- - - - - (millions) - - - - -			
Operations and construction	\$758	\$ 181	\$ 939	\$ 1.32
Oil	<u>0</u>	<u>2,970</u>	<u>2,970</u>	<u>21.68</u>
Total	<u>\$758</u>	<u>\$3,151</u>	<u>\$3,909</u>	<u>\$23.00</u>

^aIncremental cost for 137 million barrels.

The \$758 million attributed to the existing inventory reflects the cost that would be incurred to manage and maintain the SPR storage sites regardless of any oil-fill activities. The \$181 million of incremental costs that would be incurred in the process of adding an additional 137 million barrels of oil to the September 30, 1987, inventory of 534 million barrels is composed of several elements. These include additional electric power and maintenance costs for the crude oil and brine pumping systems, leaching the required cavern storage space at SPR sites, and additional facilities development and distribution improvements to accommodate the additional oil inventory. The cost of oil fill, \$2,970 million, represents 137 million barrels at an average price of \$21.68. Oil price forecasts for the period 1988-1992 are lower than the average price during the preceding 11 years, and they vary between \$17.62 and \$24.00.¹

According to DOE, the additional electric power for injecting the oil into storage caverns is about 10 cents per barrel. Since the oil displaces the brine in the caverns on a 1:1 basis, an additional 10 cents per barrel is required to cover electric power

¹Data Resources, Inc., Spring 1987, base case.

costs for the brine pumps. DOE also expects that the oil-fill operation will require extra equipment maintenance. A DOE official estimated that a reasonable estimate for the additional maintenance would be about 5 cents for each barrel of oil and 5 cents for each barrel of brine. The additional electric power and maintenance for the 137 million barrels of oil added during the fiscal year period 1988-1992 will cost approximately \$41 million.

An ongoing oil-fill program requires that DOE continue cavern leaching programs at three of its sites. DOE also needs to complete ongoing programs for facilities development and distribution improvements so that the increased oil inventory can be appropriately protected, managed, and distributed if needed. DOE has estimated that it will cost about \$140 million over the next 5 years to accomplish these tasks. Since these costs would probably not be incurred if oil fill were discontinued, we have included them as incremental for oil fill.

To provide an overall perspective on SPR costs, we have developed an average cost per barrel for the SPR inventory as it is expected to be in fiscal year 1992. (See table 4.2.)

Table 4.2: Estimated Total Expenditures for the SPR:
Fiscal Years 1976-1992

<u>Cost category</u>	<u>Total cost</u> (millions)	<u>Average cost per barrel^a</u>	<u>Percent of total cost</u>
Operations and construction	\$ 3,835	\$ 5.72	17
Oil	<u>18,091</u>	<u>26.96</u>	<u>83</u>
Total	<u>\$21,926</u>	<u>\$32.68</u>	<u>100</u>

^aBased on 671 million barrels of oil in inventory.

SECTION 5

ESTIMATED COSTS FOR

CONTINUED SPR OIL FILL: 1988-1997

The assumed oil-fill rate of 75,000 barrels per day will fill the SPR to the 750-million-barrel level in fiscal year 1995. The estimated costs for completing the oil-fill program in fiscal years 1993-1995 and then maintaining the entire SPR in standby status during fiscal years 1996-1997 are shown in table 5.1.

Table 5.1: Estimated Expenditures on the SPR: Fiscal Years 1993-1997

<u>Cost category</u>	<u>Cost for maintaining oil inventory^a</u>	<u>Cost for oil fill</u>	<u>Total cost</u>	<u>Cost per incremental barrel^b</u>
	- - - - - (millions) - - - - -			
Operations and construction	\$760	\$ 24	\$ 784	\$ 0.30
Oil	<u>0</u>	<u>2,408</u>	<u>2,408</u>	<u>30.48</u>
Total	<u>\$760</u>	<u>\$2,432</u>	<u>\$3,192</u>	<u>\$30.78</u>

^aIncludes standby costs for 1996 and 1997.

^bIncremental cost for 79 million barrels.

The \$2,408 million cost of oil fill reflects the addition of 79 million barrels of oil at an average price of \$30.48. For this period, Data Resources, Inc., forecasted the price of oil to rise above that of the preceding 5-year period, ranging from \$26.00 in 1993 to \$32.50 in 1995 when oil purchases will be completed. The incremental operating and construction costs for the fiscal year period 1993-1997 consist of the additional electric power and maintenance costs of 30 cents per barrel--or a total of about \$24 million--for the 79 million barrels of oil added during the period.

Table 5.2 combines the expenditures for the 5-year periods shown on tables 4.1 and 5.1 and shows cumulative expenditures over the 10-year period 1988-1997.

Table 5.2: Estimated Expenditures for the SPR: Fiscal Years 1988-1997

<u>Cost category</u>	<u>Cost for maintaining oil inventory^a</u>	<u>Cost for oil fill</u>	<u>Total cost</u>	<u>Cost per incremental barrel^b</u>
	- - - - - (millions) - - - - -			
Operations and construction	\$1,518	\$ 205	\$1,723	\$ 0.95
Oil	<u>0</u>	<u>5,378</u>	<u>5,378</u>	<u>24.90</u>
Total	<u>\$1,518</u>	<u>\$5,583</u>	<u>\$7,101</u>	<u>\$25.85</u>

^aIncludes standby costs for 1996 and 1997.

^bIncremental cost for 216 million barrels.

The total cost and the average expenditure per barrel of the SPR by 1997, when filled to its 750-million-barrel maximum and maintained in standby for 2 years, is shown in table 5.3.

Table 5.3: Estimated Total Expenditures for the SPR: Fiscal Years 1976-1997

<u>Cost category</u>	<u>Total cost</u>	<u>Average cost per barrel</u>	<u>Percent of total cost</u>
	(millions)		
Operation and construction	\$ 4,619	\$ 6.16	18
Oil	<u>20,499</u>	<u>27.33</u>	<u>82</u>
Total	<u>\$25,118</u>	<u>\$33.49</u>	<u>100</u>

SECTION 6

ESTIMATED COSTS FOR

CONTINUED OIL FILL: 1988-2002

The incremental costs of adding oil to the SPR end in fiscal year 1995 when DOE reaches its goal of filling the SPR to its design capacity of 750 million barrels. As a result, the incremental costs specifically associated with filling the SPR for this 15-year period are the same as would be incurred at the end of the 10-year period. However, the costs of maintaining the SPR oil inventory continue, with about \$801 million expected to be needed during fiscal years 1998-2002 to cover the costs of maintaining the SPR sites in standby status. This additional cost is reflected in the increased costs for maintaining oil inventory as shown in table 6.1.

Table 6.1: Estimated Expenditures for the SPR: Fiscal Years 1988-2002

<u>Cost category</u>	<u>Cost for maintaining oil inventory^a</u>	<u>Cost for oil fill</u>	<u>Total cost</u>	<u>Cost per incremental barrel^b</u>
	- - - - - (millions) - - - - -			
Operations and construction	\$2,319	\$ 205	\$2,524	\$ 0.95
Oil	<u>0</u>	<u>5,379</u>	<u>5,379</u>	<u>24.90</u>
Total	<u>\$2,319</u>	<u>\$5,584</u>	<u>\$7,903</u>	<u>\$25.85</u>

^aIncludes standby costs from 1996 through 2002.

^bIncremental cost for 216 million barrels.

The average cost per barrel for filling and maintaining the SPR at the end of fiscal year 2002 is shown in table 6.2.

Table 6.2: Estimated Total Expenditures for the SPR: Fiscal Years 1976-2002

<u>Cost category</u>	<u>Total cost</u> (millions)	<u>Average cost</u> <u>per barrel</u>	<u>Percent of</u> <u>total cost</u>
Operations and construction	\$ 5,420	\$ 7.23	21
Oil	<u>20,499</u>	<u>27.33</u>	<u>79</u>
Total	<u>\$25,919</u>	<u>\$34.56</u>	<u>100</u>

We also analyzed the estimated costs to maintain the 750-million-barrel SPR in a standby status. Our analysis shows that for the fiscal year period 1996-2002, it will cost about \$0.21 per barrel annually to keep the SPR sites ready in the event of a drawdown. We obtained this annual \$0.21-per-barrel cost by dividing the \$801 million standby costs for the period by the total 750-million-barrel inventory and dividing again by the 5 years in the period. This figure does not include any cost, such as interest. Imputed interest represents the implicit cost of money and is a concept used to make government cost of money comparable to that which a private entity would incur in carrying out the same activity.

SECTION 7

FACTORS AFFECTING SPR OIL SALES PRICE

When DOE is ordered to draw down the SPR to meet an oil supply shortage, it plans to auction the oil to prospective purchasers. The sales price for the oil is generally expected to parallel spot market prices. However, the number of variables that will influence the market price makes any estimate of SPR prices highly uncertain. A discussion of several of the key variables affecting oil prices is given below.

PRESENT SPR SALES POLICY AND EXPECTED OIL PRICES

The Energy Policy and Conservation Act requires that an SPR drawdown occur only after the President declares that a "severe energy supply interruption" exists or if it is necessary to fulfill U.S. obligations under the International Energy Program, which, under many oil disruption scenarios, means sharing oil with other International Energy Agency (IEA) members.¹ In the case of a drawdown, the current DOE sales plan is to auction the SPR oil. Sales contracts would be awarded to the highest bidders. The only form of nonmarket allocation in the plan is an option for the Secretary of Energy to direct, as he sees fit, the sale of up to 10 percent of the volume of SPR oil sold in a given month. The price of this oil would be set at the average price SPR oil sold for at the most recent competitive sale. According to the plan, directed-sales oil would be used only "under the most extreme of circumstances."

Economic theory suggests that bids for SPR oil would closely approximate bids for other oil sold on the spot market (the prices paid for oil exchanged on a day-to-day basis). Bidders vying for SPR oil would likely avoid bidding below spot levels, expecting that many of their competitors would be willing to pay market-clearing prices. The bidders would also avoid bidding well above spot market levels, since they would be paying more than the price for which they could get oil elsewhere. A Harvard University study published in 1983 cites some historical precedent for spot market bids, noting that "when world oil supplies were tight in 1979, prices for decontrolled domestic crude approximated the delivery

¹IEA, established in 1974 and composed of 21 oil-consuming countries, including the United States, serves as an energy policy coordinating forum. Under most supply disruptions involving the IEA Emergency Sharing System, the United States will have an obligation to provide oil to other IEA countries.

cost of foreign crude purchased at spot prices."² Even in the absence of an energy emergency, there is little consistency among forecasters as to what the market price for crude oil would be in any year, and the disparities between forecasts increase further in the future. Oil security analysts and industry representatives that we interviewed generally concurred with the theoretical conclusion that bidding would approximate spot prices.

OIL PRICES IN A DISRUPTION

Future market prices for oil even under normal market conditions are difficult to predict, and any number of estimates are available. While these estimates generally show a gradually rising trend in prices, market price changes could occur rapidly if normal oil supply channels are disrupted. The degree of change will be influenced by factors such as size of the disruption, tightness of the market, and the behavior of companies holding oil stocks.

Oil prices increase in a disruption because supplies are reduced, allowing producers to charge more for their oil. A disruption would raise oil prices regardless of market conditions at its outset. Prices could rise even if the market has enough excess capacity to replace most of its lost production. Past research on disruptions shows that oil prices spiral up in a process often referred to as price ratcheting. Disruptions tighten the oil market, raising spot market prices. Expectations of rising prices induce inventory buildup, further tightening the market and raising spot prices. If oil prices happen to be falling before that disruption, they would rise or at least fall less rapidly.

The disruption size and the degree of market tightness³ are important factors in determining the increase in spot market prices. According to a model used in 1983 GAO study,⁴ disruptions of 3, 10, and 19 million barrels per day (MMBD) could increase prices as much as 23, 119, and 345 percent, respectively, in a "slack" market, and 35, 171, and 497 percent, respectively, in a "tight" market. These figures assume a \$31 base price, no SPR drawdown in the 3 MMBD disruption, and maximum drawdown in the 10 and 19 MMBD disruptions. The slack market was defined as production at 65 percent of capacity, while a tight market was

²Thomas Dreves, "Legal Constraints on the Allocation of Oil During Supply Disruptions," Crude Oil Access in Disruptions in the 1980s: Analysis of Public Policy Implications, Harvard Energy Security Program, H-83-03, May 1983, p. 141.

³Market tightness is defined as the percent of available production capacity in use.

⁴Oil Supply Disruptions: Their Price and Economic Effects (GAO/RCED-83-135, May 20, 1983).

production at the disruption's outset of about 75 percent capacity. Model authors did not place much confidence in the model's ability to measure the effects of a 19 MMBD disruption because basic oil market relationships may break down.

Oil inventory behavior can greatly influence prices in a disruption. In future disruptions, the expectation of continuing oil shortages and riding oil prices by a nervous oil market could well play a greater role in oil inventory behavior and escalating oil prices than the size of the actual shortage. Private stock buildup can intensify the price shock, whereas SPR or private stock drawdown can help moderate the increase.

TIMELINESS OF SPR DISTRIBUTION

One effect of the SPR is to dampen price increases during an oil supply disruption. Effective use of the SPR has the potential to mitigate price increases during a disruption. Much of SPR's success in mitigating price increases will depend on DOE's success in discouraging stock building. DOE's current policy is to sell the SPR oil as early as possible during a disruption, largely for the purpose of discouraging stock building.

However, there are many obstacles to an early SPR drawdown. Oil security analysts have noted that a President might be inhibited from declaring an energy emergency for fear of increasing public anxiety about the shortage. Since such a Presidential declaration is required by law for an SPR drawdown, an early drawdown could be delayed because of this factor.

Another potential obstacle to an early drawdown is a possible conflict between civilian and national security demands. During sustained military activity, the military's petroleum requirements can increase up to five times over its peacetime requirements. Military concerns over a possible worsening of an oil disruption could lead to pressure not to use the SPR early, or at least not until possible military oil requirements from the SPR are clarified. Although the Department of Defense could bid like anyone else for the oil, there may be pressure not to use the SPR oil until the Department defines its needs. For example, a major war in the Middle East could both cause a major oil supply disruption and increase the need for military preparedness, leading to a potential conflict of military and civilian interests regarding SPR oil.

SUMMARIES OF RECENT GAO REPORTS RELATED TO SPR COSTOil Supply Disruptions: Their Price and Economic Effects
(GAO/RCED-83-135, May 20, 1983).

This report describes how oil prices increase during oil supply disruptions. It specifically describes various factors which can affect the severity of such price increases. Chapter 2 up through page 27 outlines these factors and demonstrates their impact with four different disruption scenarios and three market models.

Evaluation of the Department of Energy's Plan to Sell Oil From the Strategic Petroleum Reserve (GAO/RCED-85-80, June 5, 1985).

This report refers more specifically to SPR sales prices during a drawdown. The first two pages describe the SPR sales plan and the circumstances under which the SPR will be drawn down. Pages 7 and 8 explain the potential impact of a SPR drawdown on the world oil market, illustrating the point with three econometric models. Pages 8 through 12 illustrate the significance of an early drawdown of the SPR. Pages 18 and 19 relate why SPR selling prices during a drawdown would imitate spot market prices and support this theory.

Oil Reserves: An Analysis of Oil Fill Alternatives
(GAO/RCED-87-145BR, May 1987).

This report analyzes possible oil fill rate options for the SPR. These rates include the current Department of Energy proposal of 35,000 barrels a day, the current required rate of 75,000 barrels a day, 100,000 barrels a day, and the maximum fill rate. A table of cost comparisons of the different fill rates can be found on page 40. Section 4 describes the various alternatives, and section 5 compares the costs of the fill rates. Section 6 reviews the benefits of the various fill rates.

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