



COMPTROLLER GENERAL OF THE UNITED STATES
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To the President of the Senate and the
Speaker of the House of Representatives

This report examines the analysis behind the currently planned size of the U.S. strategic petroleum reserve and discusses factors influencing the optimal size of the reserve. This report is one of a series of reports examining various aspects of the reserve program.

Copies of this report are being sent today to the Director, Office of Management and Budget; the Secretaries of Energy and State; and to interested congressional committees.

James A. Stairs
Comptroller General
of the United States

D I G E S T

The potential value of the strategic petroleum reserve as a national security measure in diminishing U.S. vulnerability to the effects of interruptions in imported petroleum supplies, and in carrying out U.S. international energy commitments, is unquestionable. The law creating the reserve, however, allows considerable discretion in deciding how the reserve can most effectively be established. Determining the optimal size of the reserve is extremely difficult given the many unknowns, assumptions, variables, and political factors.

In considering requests to fully fund the reserve, the Congress might be guided by the following factors.

- No study has shown what the optimal size should be. The June 1978 amended plan and subsequent Department of Energy analysis, although not designed to determine an optimally sized reserve, do project a range of supply interruptions that would require a billion-barrel reserve.
- The probability of a future supply disruption of the size and duration necessary to require a one billion barrel reserve is rated low in the Department of Energy supply-interruption assessment.
- Recent Department analyses indicate that the largest potential supply shortfalls under selected disruptions are considerably less than projections made at the time the amended plan was prepared.
- The one billion barrel reserve is sized to meet supply disruptions of far greater severity than ever experienced in the past.

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--Serious implementation problems and large cost increases have been experienced that were not anticipated at the time the billion-barrel decision was made.

The federally funded reserve does not have to be sized to meet supply shortfalls on a barrel-for-barrel basis but can be supplemented by such measures as

- existing industry capabilities, such as existing stocks and fuel switching;
- a mandatory industrial petroleum reserve of up to 205 million barrels, as authorized in the strategic petroleum reserve legislation;
- demand-constraint and supply-management measures, such as emergency conservation, allocation, or rationing; and
- political, military, and economic leverage available to affect the size and duration of shortfalls.

INTERNATIONAL EMERGENCY OIL
SHARING IS A CONSIDERATION

The Department of Energy assumption that the International Energy Program will be fully effective during supply interruptions directly affects the projected shortfalls the reserve is being sized to meet. Officials expressed doubts, however, about the functioning of this international program during severe supply interruptions, citing

- an inadequate definition of emergency reserve stocks, which results in overstated available reserves;
- the lack of a binding mechanism to settle price disputes; and
- insufficient mandatory reallocation procedures. (See pp. 29 to 31.)

GAO found that a large portion of projected shortfalls under the most severe interruptions could result from U.S. supply obligations to other nations. (See pp. 31 and 32.)

EMERGENCY RESERVE PROGRAMS
IN OTHER COUNTRIES WARRANT
CONSIDERATION

GAO's analysis of the reserve programs of International Energy Agency nations revealed that the one billion barrel U.S. reserve is disproportionately larger than that of any other nation. In most European nations, only an estimated 45 days of their required 90-day reserves represent stocks actually available for emergencies. In addition, of 20 nations, only 5 are building separate Government-owned reserves, and Germany's and Japan's--the largest outside the United States--will contain only about 25 and 13 days of stocks, respectively. The United States, on the other hand, will have 116 days of usable stocks in its one billion barrel Government-owned reserve alone--plus that portion of its 131 days of reported industry reserves that is available for emergencies. (See p. 33.)

The absence of mandatory industry involvement in the U.S. program distinguishes it from other emergency reserve programs. Other countries have had considerable experience with mandatory petroleum-reserve programs. GAO believes that the German and Japanese programs, which require industry and consumers to share reserve costs, warrant consideration by the United States. (See pp. 33 to 37.)

AGENCY COMMENTS

Executive agency officials who reviewed the draft report generally agreed with its accuracy. Their comments have been incorporated where appropriate. (See p. 6.)

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<u>ABBREVIATIONS</u>		
DOE	Department of Energy	
GAO	General Accounting Office	
IEA	International Energy Agency	
IEP	International Energy Program	
IPR	industrial petroleum reserve	
OAPEC	Organization of Arab Petroleum Exporting Countries	
OMB	Office of Management and Budget	
SPR	strategic petroleum reserve	

CHAPTER 1
DEVELOPMENT OF THE STRATEGIC PETROLEUM RESERVE,
ITS COST, AND STATUS OF FUNDING

The 1973-74 Arab oil embargo demonstrated U.S. vulnerability to interruptions in petroleum supplies and increased national concern for developing measures to reduce the effects of potential future import interruptions. Although the impacts of the 1973-74 crisis on the United States are extremely difficult to quantify, a recent economic analysis estimates that the embargo and its concurrent price increases reduced the gross national product by 3 percent, and increased unemployment by 1.7 percent and inflation by 1.8 percent. Since the embargo, U.S. dependence on foreign oil has risen sharply, with imports increasing from 6.2 million barrels a day in 1973--36 percent of U.S. oil consumption--to 8.1 million barrels a day in 1978--43 percent of U.S. oil consumption. The major action taken by the U.S. Government to provide protection against future oil embargoes has been the creation of a strategic petroleum reserve (SPR).

In his January 1975 State of the Union message, President Ford recommended a strategic storage program of 1 billion barrels of oil for domestic needs. During 1975, legislation concerning a reserve was considered and in December 1975, the Energy Policy and Conservation Act (Public Law 94-163) was enacted. The act provided that an SPR for the storage of up to 1 billion barrels of petroleum products 1/ would be created with the provision that 3 years after enactment, the SPR would contain not less than 150 million barrels.

The purpose of the SPR as stated in the act is to diminish U.S. vulnerability to the effects of interruptions in petroleum product supplies and to carry out U.S. obligations under the International Energy Program (IEP).

1/Petroleum products are defined in the legislation as crude oil, residual fuel oil, or any refined petroleum product--including any natural liquid and any natural gas liquid product.

The act required that by December 15, 1976, the Department of Energy (DOE) prepare and transmit to the Congress a plan for designing, constructing, and filling the storage and related reserve facilities. ^{1/} The act directed that, where practicable, the plan provide an SPR by December 1982 equal to the amount of crude oil imported into the United States during the three highest consecutive import months of 1974 and 1975--approximately 500 million barrels. The act also established procedures for amending the plan to change the SPR size if necessary.

On December 15, 1976, DOE submitted its SPR plan to the Congress where it was subsequently approved. The plan stated that an SPR will help stabilize the national and international petroleum situation by

- providing credible evidence that the United States has the will to insulate its energy economy from major supply disruptions;
- avoiding undue pressures on either our domestic or foreign policy, as well as contributing to international stability through the International Energy Agency (IEA); and
- reducing the economic impact of an interruption if one occurs.

The plan called for the reserve to reach 500 million barrels by 1982, and consist entirely of crude oil. The plan also projected potential supply disruptions based on estimated oil imports for 1980 and 1985 and two supply interruption scenarios. (See ch. 2.)

In announcing his National Energy Plan in April 1977, President Carter set a goal of attaining an SPR of 1 billion barrels by 1985. DOE transmitted an amendment to the SPR plan to the Congress in June 1978. The amendment doubled the planned size of the SPR to its maximum authorized level of 1 billion barrels by 1985. The Congress approved the SPR amendment by not passing a resolution disallowing it within

^{1/}Many of the statements and actions attributed to DOE in this report were actually stated and performed by the Federal Energy Administration. For simplicity, however, DOE is referred to throughout the report. The functions of the Federal Energy Administration were transferred to DOE on October 1, 1977.

the time limit of 15 days. The amendment reported that the SPR expansion was (1) an integral part of the President's April 1977 National Energy Plan and (2) a major national security measure to provide increased insurance against severe petroleum supply interruptions. The amendment identified three important reasons for expansion.

- Current and more realistic estimates of future import levels indicate a large reserve would be appropriate.
- The United States needs more protection while working to control the growth of import dependence.
- A large SPR is needed to provide increased flexibility for a variety of contingency situations.

In justifying the decision, the amendment stated the SPR expansion was essential to meet the President's objective of reducing U.S. vulnerability to potentially damaging petroleum supply interruptions, and that a large reserve, coupled with effective conservation measures to reduce demand levels during interruptions, would enable the United States to

- significantly reduce adverse economic, foreign policy, and national-security impacts of oil supply interruptions;
- reduce the probability of oil embargoes by forcing greater revenue losses on countries imposing effective embargoes;
- assist in protecting the overall interests of the United States and its partners under the IEP agreement; and
- ease the severe problems and impacts of a crash program to reduce energy-import dependence.

The amended plan projected potential supply shortages based on estimated oil imports for 1985, the two supply interruption scenarios used in the original plan, plus an additional--more severe--scenario. (See ch. 2.)

Although the amended plan called for attaining a level of 1 billion barrels by 1985, it contained development plans only for another 250 million barrels of the SPR for a total

of 750 million barrels. As of May 1979, no plan had yet been submitted for the final 250 million barrels.

COST OF THE RESERVE

In its December 1976 SPR plan, DOE estimated the 500 million barrel reserve would cost between \$7.5 and \$8.0 billion to design, construct, fill, and maintain through 1982. In the June 1978 plan amendment increasing the SPR to 1 billion barrels, DOE estimated the first 750 million barrels would cost \$14 billion, but did not estimate the full reserve cost because development plans had not been completed.

DOE's only cost estimate for a full billion barrel SPR program was made in December 1978 congressional testimony, when the cost was estimated at \$25.57 billion, as follows:

	<u>Cost</u> (billions)
Oil acquisition and transportation	\$22.00
Facilities development	3.50
Planning	<u>.07</u>
Total	<u>\$25.57</u>

The total cost per barrel of oil stored in the reserve has escalated from an original 1976 estimate of \$15 to the current estimate of more than \$25. The cost of storage facilities alone has risen from an original estimate of \$1.53 a barrel to a current estimate of about \$3.50.

STATUS OF APPROPRIATIONS TO FUND THE RESERVE

Through fiscal year 1979, funds totaling \$6.95 billion had been appropriated for the SPR as shown on the following page.

	<u>Appropriated</u> (billions)
Petroleum acquisition and transportation	\$6.029
Storage facility development	.867
Planning	.036
Personnel/administrative services	<u>.018</u>
Total	<u>\$6.95</u>

More than \$3 billion of this amount was not spent due to program delays; consequently, the administration requested only \$8.4 million for the reserve in its fiscal year 1980 budget. The administration stated in the budget request that it continues to believe that a 1 billion barrel SPR is needed. Funds were requested, however, for planning and development of only 750 million barrels of the reserve.

An Office of Management and Budget (OMB) official informed us that the original DOE budget request included funds for work on the final 250 million barrels of the SPR. OMB opposed this request, however, contending that the Nation can have a billion barrel reserve, even if the Government holds only 750 million barrels, because the equivalent of 250 million barrels of reserves is privately held by the oil industry and major consumers. An agreement was reached in the administration's final budget request in which DOE dropped its request for funding of the final 250 million barrels of the SPR, and the administration's formal commitment to a billion-barrel reserve was retained.

PURPOSE AND SCOPE

The Congress will be considering appropriations to implement the SPR. This report discusses factors bearing on the level of the reserve, and examines the rationale for the SPR's currently planned size. We also examined the IEP and determined how other major oil importing countries have prepared for potential oil supply interruptions.

We examined reports, studies, and other documents addressing the above issues; reviewed available executive branch files on pertinent subjects; and discussed relevant issues with a wide range of Government, contractor, and industry officials involved with the SPR.

Our draft report was provided to the Departments of Energy and State and to the Office of Management and Budget for review and comment. Their comments have been incorporated where appropriate.

CHAPTER 2

ANALYSES AND OTHER DATA

SUPPORTING THE SPR SIZE

Although the level of the SPR has been based on several interrelated economic, foreign policy, and national security considerations, DOE has also recognized the need to consider the cost effectiveness of various levels of the reserve. Beyond this, there are also other important factors affecting the SPR level which we discuss in this and later chapters.

As noted in chapter 1, both the original plan and amendment projected supply shortages based on estimated oil imports and supply-interruption scenarios. Since the original and amended plans were submitted, several basic assumptions have changed.

In assessing the following data and analyses, it should be noted that no precise criteria have been established to determine the appropriate reserve size other than the legislatively authorized maximum of 1 billion barrels. Many variables must be considered. For example:

- Future energy demand is uncertain and depends, in part, on the health of the economy, world oil prices, domestic energy-pricing policy, and on the success of energy conservation measures.
- Future domestic energy supply is also uncertain and depends on such factors as energy prices, possible Government incentives to energy production and development, and the results of alternative energy-source development. Therefore, future import levels, which represent the difference between demand and domestic supply, are also highly uncertain.
- The source of future imports for the United States and its allies and the resulting vulnerability to countries or groups depend on both import policies and the policies of the oil exporting countries toward resource development. Discoveries, such as those in the North Sea and Mexico, can reduce importing-country dependence on Arab oil sources.

- The likelihood and severity of potential interruptions depend on important political factors, including U.S. relations with key producing countries.
- The potential interruption to be coped with depends on several domestic considerations, including the availability of alternative measures, such as industry capabilities and demand constraint.
- Finally, the SPR deterrent value must be considered. U.S. officials stated that a larger reserve increases political flexibility and reduces the potential for political embargoes. A September 1976 DOE report assessing this subject, however, stated that analysts who have thoroughly explored this area believe the value of deterrence against embargoes peaks as the SPR size approaches 500 to 700 million barrels, and little is obtained beyond that point.

PETROLEUM IMPORT PROJECTIONS

A wide range of petroleum import projections have been used in SPR planning. We have estimated that U.S. oil imports are likely to be from 12 to 13 million barrels per day by 1985. 1/ The estimates of U.S. oil imports in 1985 which have been used for SPR planning are developed within DOE and are as follows.

1/Letter report to the Congress, EMD-78-5, October 14, 1977.

	<u>Barrels per day</u>	
	<u>Low estimate</u>	<u>High estimate</u>
	(millions)	
SPR plan December 1976	7.3	10.4
SPR plan amendment June 1978	7.0 <u>a/</u>	11.5 <u>b/</u>
Shortfall assessment <u>c/ d/</u> September 1978	9.8	9.9
DOE analysis December 1978	(e)	9.9
Shortfall assessment <u>d/</u> January 1979	9.9	13.3

a/ Estimate assumes National Energy Plan is fully effective.

b/ Estimate assumes National Energy Plan may not be fully effective.

c/ Estimates assume constrained world oil supplies.

d/ Estimates include U.S. territories and SPR purchases.

e/ Only single estimate used.

SUPPLY INTERRUPTION SCENARIOS

The supply interruptions used for SPR planning were based on scenarios DOE developed for an October 1976 report. We were told that the Departments of Defense and State, the National Security Council, and the Central Intelligence Agency reviewed the scenarios. The National Security Council again reviewed the scenarios in March 1978 and concluded that no revision or updating was necessary. In late 1978, DOE made slight modifications to the extreme scenarios.

The October 1976 report was intended to examine the types of threats which the United States should consider in planning and designing the SPR. The report actually identified eight situations that would result in U.S. supply interruptions. Of these eight scenarios, two used in the original plan and one added in the amended plan were considered by DOE to represent the most plausible range of potential supply interruptions. Under the original plan,

the reserve was designed primarily to protect against political embargoes; whereas, under the amended plan, the reserve was expanded to provide protection against greater disruptions which could result from military actions.

OAPEC embargo

The original SPR plan used two of the eight interruption scenarios to justify a 500-million barrel reserve. Both scenarios were political embargoes with production cuts by the Organization of Arab Petroleum Exporting Countries (OAPEC) ^{1/} and no oil shipments to the United States. U.S. imports from these countries totaled 3.7 million barrels a day in 1977--or 42 percent of imports. One scenario envisioned a 25-percent production cut, while the other assumed a 50-percent production cut. Embargoes lasting 6 and 9 months were considered in the plan and amendment, but in December 1978 DOE revised the 25-percent OAPEC scenario to include a 25-percent embargo for 9 months, followed 18 months later by an identical embargo. According to DOE, another Middle East war is considered the most probable event that could possibly result in embargoes of this magnitude.

The original SPR plan deferred answering the question of whether the reserve should be sized to respond to an extended wartime interruption of petroleum imports. The plan noted that in view of the high cost of developing a reserve that could adequately respond to such an interruption, further analysis was needed.

Persian Gulf closure

The June 1978 amendment to increase the SPR to 1 billion barrels included the above 25- and 50-percent OAPEC embargoes and added a third scenario--a 100-percent loss of all petroleum exports from the Persian Gulf. This scenario was among the original scenarios developed by DOE, but was not included in the original SPR plan. Subsequent to the use of this worst-case scenario in the amendment to justify a billion-barrel reserve, DOE has significantly reduced its potential severity and now plans for possible Persian Gulf supply losses of only 75 percent for 6 months, followed by 50 percent for the succeeding 6 months.

With the exception of limited pipeline availability to the Mediterranean, Saudi Arabia, Iran, Iraq, Kuwait,

^{1/}Saudi Arabia, Iraq, Kuwait, Qatar, United Arab Emirates, Libya, Syria, Algeria, Abu Dhabi, Egypt, and Bahrain.

Qatar, United Arab Emirates, and Bahrain export exclusively through the Persian Gulf. These countries exported an average of about 20 million barrels of petroleum a day during 1977.

For SPR planning purposes, loss of oil exports from the Persian Gulf is considered the most severe situation. The DOE October 1976 report states that such a loss would be so severe in its impact on producers and consumers that a prolonged interruption is considered highly unlikely. Although a number of events, such as terrorist activities or local wars, could reduce the flow of oil from this source, U.S. officials acknowledged that a severe cutoff for longer than a few months presupposes a general war.

The prediction of possible oil-supply interruptions is a highly uncertain and speculative process. The probability of a cutoff of oil shipments from the Persian Gulf or a 50-percent cut in OPEC oil exports is rated low in the DOE report, but most officials we contacted felt the consequences would be so severe that they must be considered. DOE officials compared SPR expenditures with the Department of Defense budget--both provide deterrent and national-security benefits which are not readily quantifiable. These officials believe that the probability of the Persian Gulf situation occurring compares to that of a Soviet attack on Western Europe, which the United States has decided is probable enough to prepare for.

Prior supply disruption

From October 1973 to March 1974, the United States experienced an oil embargo by the Arab oil exporting countries. This was the first time the United States did not have spare production capacity to adequately offset a supply interruption. The Arab production cuts averaged about 15 percent over the 5-month embargo. The long supply lines from the Middle East provided considerable lag time between the initiation of the embargo and the onset of significant shortages in the United States. The maximum crude oil shortfall in the United States during the embargo reached about 2 million barrels a day--or about 15 percent of the petroleum available to the United States. Accompanying the embargo was a quadrupling of oil prices which had a severe impact on the free world economies and greatly magnified the impact of the embargo.

POSSIBLE SUPPLY SHORTFALLS

Using the petroleum-import projections and supply-interruption scenarios previously discussed, DOE officials

have developed a range of possible U.S. petroleum-supply shortfalls. The highest projected 1985 oil-supply shortfalls contained in the original SPR plan are compared with the highest subsequent shortfall projections in the following table.

<u>Scenario</u>	December 1976	June 1978	September 1978	December 1978	January 1979
	<u>SPR plan</u>	<u>SPR plan amendment</u>	<u>shortfall assessment</u>	<u>DOE analysis</u>	<u>shortfall assessment</u>
	----- (millions barrels/day) -----				
25-percent OAPC embargo	2.7	3.9	1.8	2.8	3.9
50-percent OAPC embargo	4.6	7.7	3.2	5.1	7.4
Persian Gulf closure <u>a/</u>	(b)	10.9	6.6	5.9	8.5

a/The June and September 1978 shortfalls assume a 100-percent closure of the Gulf, while the December 1978 and January 1979 shortfalls assume a 75-percent closure.

b/The Persian Gulf scenario was not included in original SPR Plan.

Shortfall projections were contained in the original SPR plan and in the plan amendment increasing the reserve to 1 billion barrels. Although the shortfall figures in the amendment were used to support the SPR size increase, DOE officials informed us that no backup documentation on the development of these shortfall projections was retained by DOE.

Potential U.S. petroleum-supply shortfalls are currently developed by the DOE Energy Information Administration. This office uses a range of possible import projections based on internally developed supply and demand estimates. The results are used to estimate supply shortfalls under different interruption situations, using the DOE petroleum allocation model. This computer model estimates future sources of petroleum imports to the United States and calculates expected shortfalls in those imports that would result from supply interruptions of various sizes, types, and durations. The model simulates world trade in crude oil and refined products and, in the case of a given supply interruption, apportions available petroleum supplies among IEA countries as dictated by the IEP sharing agreement.

Supply shortfalls depend on many variables and assumptions. Changing the factors used in the forecast of predistruption world oil supply and demand, source and distribution of world oil consumption, U.S. share of imports, or any number of other factors would change the projected U.S.-supply shortfalls under each situation.

In June 1978, the Energy Information Administration was asked to reassess potential petroleum-supply shortfalls, using scenarios and assumptions provided to it by the SPR office. The results were contained in a September 15, 1978, report, "An Assessment of Potential U.S. Petroleum Supply Shortfalls 1978-1990." The most significant result of this analysis was a large reduction in projected oil shortfalls under the various interruption scenarios. Under the revised projection, the planned SPR is larger than the projected shortfall caused by a 50-percent OAPEC production cut for 9 months--the maximum duration considered for embargo-caused interruptions. Changes in DOE assumptions, which lowered the projected impact of potential future supply interruptions, included

- narrowing the range of future U.S. oil-import estimates (from an original 7.0 to 11.5 million barrels a day to 9.8 to 9.9 million);
- eliminating the premise that embargoes can be successfully targeted against selected countries;
- constraining the future availability of oil from OAPEC by assuming slower increases in production than previously expected;
- slowing the estimated growth rate of the world economy; and
- projecting real increases in oil prices, starting in 1982.

In October 1978, the SPR office again requested a reassessment of potential petroleum-supply shortfalls, resulting in a January 1979 Energy Information Administration report, "Petroleum Supply Vulnerability, 1985." The primary difference between this report and the earlier one is that the earlier report considered a chosen set of assumptions resulting in a narrow range of shortfalls for each situation, while the later report uses a wide range of assumptions that result in shortfalls of 2.6 to 8.5 million barrels a day. Other differences between the reports include the following.

- The previous study assumed that all importing countries would incur a supply shortfall under the OAPEC embargoes, but the latest analysis also considers the case in which only IEA nations suffer shortfalls.
- The previous study assumed a 100-percent loss of supplies from the Persian Gulf, but the current study considers only 50- and 75-percent losses.
- The previous study always assumed a low level of predisruption exports from the Organization of Petroleum Exporting Countries, but the current analysis addresses both high and low levels.

The latest supply-shortfall analysis is designed to illustrate the impact of changing assumptions on the levels of projected shortages, and does not highlight any of its assumptions as most probable. As a DOE official pointed out, the study can be used to support a wide range of reserve sizes.

OTHER STUDIES ASSESSING THE SPR SIZE

In addition to the supply-shortfall projections discussed in the preceding section, numerous other studies have been prepared that address the reserve size issue. As far as we could determine, no study has been completed that shows what the optimal size for the SPR should be. We examined numerous studies assessing the SPR size and found that (1) many different approaches, assumptions, and variables were used, (2) no single study addressed all of the many interrelated factors which must be considered, and (3) there was no consensus on the appropriate size. Estimates ranged from about 500 million to well over 1 billion barrels.

A March 1977 DOE study to determine supply interruption conditions that would justify reserve sizes greater than the originally planned 500 million barrels examined SPR sizes of 750 million and 1 billion barrels. The study concluded that a 750 million barrel reserve would provide cost effective coverage of all plausible political interruptions. The study further concluded that although a billion-barrel reserve would also provide insurance against all assumed political embargoes, the unlikely combination of events to generate an interruption large enough to make it cost effective makes this a questionable expansion.

In June 1977, President Carter directed an assessment of U.S. and allied vulnerability to oil-supply disruptions. The National Security Council headed the study with inter-agency coordination. One objective of the study was to identify oil-supply interruption and price-increase contingencies for which the United States should be prepared. The study, however, was not officially completed, inter-agency comments were not incorporated, and no conclusion was reached on the size of interruption for which the United States should prepare.

In December 1978, DOE completed an analysis of the need for the final 250 million barrels of the SPR. Using the import projections, embargo scenarios, and supply shortfalls cited earlier in this chapter, and after considering private-industry capabilities and conservation measures (see ch. 3), the analysis found that reserve sizes ranging from approximately 500 million to 1.5 billion barrels would be needed to replace lost imports without serious economic impacts under the postulated interruption scenarios. The analysis further concluded that

- no basis exists for justifying a reduction in the SPR-size goal of 1 billion barrels;

- a reduction in SPR size could reduce deterrent value, decrease response flexibility, increase vulnerability to military actions, and increase economic losses; and

- the net cost, on a present value basis, of the last 250 million barrel increment of the SPR could be very small.

The primary reason that this analysis supports large reserve sizes, despite the fact that the import projections and supply shortfalls which it uses are smaller than those of most other studies, is the use of a ceiling on the SPR daily drawdown rate. Under this ceiling, no more than 2 percent of the remaining reserve can be used during each day of an interruption, thus providing for a contingency reserve should an interruption last longer than its postulated length. These contingency reserves range from 53 million barrels for the least severe scenario to 218 million barrels for the 50-percent OAPEC embargo, and require SPR sizes about 19 percent larger than the actual shortfalls projected under the interruption scenarios used in the analysis.

The Congressional Budget Office issued a study in December 1978, "The Economic Impact of Oil Import Reductions," which analyzed the macroeconomic effects of year-long supply interruptions of 3 and 4 million barrels a day in 1982. The study also examined the effectiveness of 250 and 500 million barrel reserves in mitigating those effects. The effectiveness of larger reserve sizes was not assessed. The report concluded that the SPR (1) is an effective policy option for mitigating losses in the gross national product and increases in unemployment during supply interruptions, (2) appears to be more useful in reducing output losses at higher levels of oil shortages, and (3) has significant marginal benefits, as demonstrated by the additional \$20 billion loss in real output averted by a 500 million--as opposed to 250 million--barrel reserve during a 3 million barrel a day supply shortfall in 1982. The study notes, however, that these benefits must be balanced against both the SPR cost and the probability of another oil-supply interruption and price increase occurring, which the report says cannot be determined. The report also notes that its conclusions must be viewed in the perspective of its many assumptions, including its projections of

- the size and duration of supply interruptions;
- future U.S.-energy supply and demand;
- increases in the real world price of oil;
and
- the effects of oil-allocation regulations
and price controls.

IMPLEMENTATION PROBLEMS

A December 1978 hearing before the House Subcommittee on Energy and Power disclosed that (1) the SPR program is suffering from major cost overruns (see ch. 1), (2) the reserve's actual fill rate is so seriously behind schedule that only about 70 of the planned 250 million barrels of oil were scheduled to be in storage at the end of 1978, and (3) equipment to withdraw what oil is in storage will not be operational until late 1979. As of early May 1979, about 83 million barrels were in storage. DOE officials have attributed the cost escalations and delays to unforeseen implementation difficulties and insufficient feasibility studies. Poor program management and planning were cited in the hearing. DOE has taken steps to reorganize its SPR office and has begun a major reassessment of the entire SPR program.

CHAPTER 3

OTHER MEASURES AVAILABLE TO MEET

OIL-SUPPLY INTERRUPTIONS

If an oil-supply interruption occurs, other measures in addition to a federally funded reserve could be used to counteract its effects. The degree that the United States depends on the SPR can be reduced depending on how effective these measures are. During this review, we looked into the potential for (1) using private industry capabilities, (2) establishing an industrial petroleum reserve as part of the SPR, and (3) using demand-constraint and supply-management measures. In addition, the United States would likely have political, military, and economic options available to reduce the size and duration of supply interruptions.

PRIVATE INDUSTRY CAPABILITIES

DOE estimates that by the mid-1980s about 440,000 barrels of oil equivalent a day, or about 163 million barrels over 1 year, could be made available by private industry during petroleum-supply interruptions. This industry capability is available through existing oil-industry and major consumer inventories, alternative fuels, and transfers of generated power. An emergency increase in the production of domestic oil was also examined by DOE, but discounted as unavailable by the mid-1980s.

Oil-industry inventories

Refineries, major bulk terminals, and major pipelines maintain stocks above the minimum essential levels required to continue normal operations. A portion of these stocks presumably could be used in the event of severe supply interruptions. For example, safety stocks are maintained for protection against such contingencies as late resupply, random surges in demand, exchange requests, and seasonal variations. Since industry routinely uses these stocks to meet the above contingencies, however, the amount available at any given time to meet emergency-supply interruptions is uncertain.

In July 1976, the American Petroleum Institute issued a report entitled, "An Assessment of Changes in Petroleum Stocks and Storage Capacity Since the 1973 Arab Oil Embargo." The study found that less than 3 years after the embargo, about 300 million barrels of petroleum-storage capacity had been added by petroleum companies and major consumers. The increase in capacity marked a sharp rise from pre-embargo trends and occurred in spite of a downturn in demand. The study

concluded that the perception of reduced security of foreign-oil supplies has increased the incentives to hold petroleum.

The study noted that lack of data is a severe constraint, however, in making a comprehensive assessment of changes in petroleum stocks and storage capacity. Even when data is available, it is collected and reported infrequently. An American Petroleum Institute official advised us in November 1978 that no subsequent analysis had been done on this subject. The official said the Institute had not determined if this was only a temporary buildup in reaction to the embargo, as DOE officials believe, or a permanent change in storage trends.

In its January 1977 SPR plan, DOE estimated that petroleum industry stocks at the primary level totaled about 820 million barrels, comprising about 280 million barrels of crude oil and 540 million barrels of products. A few hundred million more barrels of refined products are stored by secondary distributors and major users. The plan estimated that only about 50 to 60 million barrels of crude oil inventories could substitute for SPR storage and that, pending further analysis, none of the product inventories should be considered available to reduce the crude oil level in the SPR.

We previously reported that the extent to which industry inventories can be used to satisfy the SPR objectives should be determined, and we pointed out that DOE may need authority to enable the Government to use these stocks during emergency shortfalls. ^{1/} DOE agreed that further analysis was needed, and in May 1977 contracted for a study of the availability of industry's petroleum and product inventory as temporary emergency stock for use in conjunction with the Government SPR. The study results were contained in a June 1978 report, "Inventory Management in the Petroleum Industry." The overall conclusion was that the American petroleum industry management process is so efficient for normal operations that there is little excess industry stock which could be relied on to tide the country over a supply interruption. The study included safety stocks in its definition of normal operating inventories, however, and considered only those inventories beyond safety stocks to be excess.

The DOE December 1978 analysis estimates that industry inventories of crude oil and refined products total about

^{1/}"Issues Needing Attention in Developing the Strategic Petroleum Reserve," (EMD-77-20, February 16, 1977).

1.1 billion barrels. The majority of these stocks, however, are working inventories required for normal operations. The current DOE estimate is that about 207,000 barrels a day of industry inventories--up to a total of 75 million barrels--could be available in the event of emergency supply shortfalls, without causing serious shortages in the oil-distribution system. The analysis does not differentiate between crude oil and refined products.

Industry-oil inventories are being used to help meet the current Iranian supply crisis. DOE expects that this action will assist them in better determining the exact availability of these stocks to meet future supply interruptions. We believe that such a determination is necessary. Industry stocks should not be disregarded in planning for future supply interruptions as they might be used as a basis for justifying adjustments in the federally funded SPR size requirement.

Major consumer inventories

DOE currently estimates that, nationally, utilities hold about 87 million barrels of petroleum inventories, of which about 60,000 barrels a day--up to a total of 23 million barrels--could be relied upon as being available for use during supply interruptions. Although little data is regularly collected on the petroleum inventories held by other industrial end users, DOE estimates that they could supply about 9,000 barrels a day of reserve stocks--up to a total of 3 million barrels. It should be noted that the wide regional differences in these inventories may limit their availability in some areas during emergency interruptions.

Alternative fuels

Presently, industry's capabilities for fuel switching are primarily limited to substituting natural gas for fuel oil. Although DOE expects that by the mid-1980s little excess natural gas will be available for such switching, recent developments in supplies from non-OAPEC nations and domestic-price deregulation may change this outlook. Assuming that the United States can only realistically rely on switching from oil to fuels other than natural gas, however, DOE predicts that by the mid-1980s, industry capabilities for fuel switching during petroleum-supply interruptions will reach about 94,000 barrels a day.

Power transfers

The use of interconnected transmission facilities to move power from surplus areas to shortage areas, or power-wheeling, is a common practice among utilities. Although

its usefulness during supply interruptions may be limited by generation and transmission capacities, seasonal demand factors, and regulatory impediments, DOE estimates that by the mid-1980s, powerwheeling could replace about 68,000 barrels of fuel oil a day.

INDUSTRIAL PETROLEUM RESERVE

The Energy Policy and Conservation Act authorized (but does not require) the creation of an Industrial Petroleum Reserve (IPR) by directing petroleum refiners and importers to store up to 3 percent of the amount they refined or imported during the previous calendar year in readily available inventories. This inventory would be part of the SPR in addition to normal industry inventories. The 3-percent maximum IPR would amount to an estimated 205 million barrels based on 1978 consumption levels. The current administration position is that an IPR should not be established. The IPR remains an available option, however, if a decision is made to (1) reduce the Federal cost of the SPR yet (2) maintain the total size at 1 billion barrels.

The act provides that if an IPR is established, it must be done in a manner which maintains an economically sound and competitive petroleum industry. Relief may be granted to refiners or importers who would otherwise incur special hardship, inequity, or unfair distribution of burdens resulting from this section of the act.

During 1976, DOE assessed whether to exercise its discretionary authority to create an IPR and decided not to establish one. Of the 11 headquarters offices and 9 regions within DOE that reached a conclusion on this issue, 6 offices favored some form of IPR and 14 opposed creation of an IPR. As part of its assessment, DOE requested written comments from interested parties on the feasibility of establishing an IPR and held public hearings in July 1976. The oil industry was strongly opposed to an IPR. Of the 44 organizations responding, 41 expressed opposition.

Arguments for an IPR

The primary advantage of establishing an IPR, if it is substituted for a portion of the federally funded SPR, could be a reduction in the Federal budget. Other possible advantages which surfaced during the DOE assessment included the following.

- Industry would be able to use existing storage capacity for some of the stocks, thus reducing facility acquisition costs.
- The reserve would include some finished products.
- The IPR would accomplish some of the objectives of regional storage by having some emergency stocks at refining, importing, and marketing locations throughout the country. This would reduce logistical requirements and distribution problems, and would provide more flexible drawdown options. Under the present plan, most stocks will be stored in the Gulf Coast region.
- The IPR would result in a conservation measure because costs are passed on to consumers. DOE estimated petroleum demand would be reduced by about 3.2 million barrels a year by 1983 if all costs of the IPR are passed on to consumers.
- If an IPR is established, additional reporting requirements imposed on industry would provide the Government more detailed information on industry inventories.

Arguments against an IPR

The major arguments against an IPR which surfaced during the DOE assessment are listed here.

- The SPR is essentially a national security program and since it will benefit the entire Nation and its economy, one industry or sector of the economy alone should not be forced to bear a share of the cost.
- Because of the large potential capital requirement, an IPR would probably divert industry capital from other, more productive investments, such as exploration and production, energy-resource development, and refinery expansion and modernization.

Although industry estimates of the total capital requirement for an IPR varied widely, most estimates were between \$2.7 and \$5.0 billion. DOE estimated that the industry capital investment to develop a 185 million barrel IPR by the end of 1982 would be \$2.3 billion.

- Most firms would have difficulty recovering the cost of implementing an IPR in a competitive marketplace. The difficulty in passing through the cost of required environmental control equipment was cited as an example.
- Because of the differing structures of various companies (size, type of business, location, and financial structure), there would be an unequal ability to bear the IPR cost. These differences could lead to competitive distortions.
- Firms would seek exemptions or exceptions from an IPR requirement or use litigation to delay compliance.
- An IPR would require another regulatory staff, and additional funding would be necessary to deal with compliance, exceptions, and appeals.

Depending upon the type of IPR established, some of the above advantages and disadvantages would be reduced or eliminated.

An IPR remains a possible option

Whether or not an IPR should be created is a policy decision. Examples of the options available for establishing an IPR considered by DOE during its 1976 assessment are to (1) require refiners and importers to store required quantities of oil in their storage facilities, (2) allow industry refiners and importers to participate in consortiums to acquire centralized industry-owned facilities to store the oil, or (3) have the Government provide the storage facilities in conjunction with other SPR facilities and require refiners and importers to provide oil or pay fees to finance their portion of the oil procurement.

DEMAND CONSTRAINT AND SUPPLY MANAGEMENT MEASURES

To the extent that emergency conservation measures can constrain demand, and emergency allocation or rationing measures can effectively manage available supplies, the adverse impacts of a petroleum-supply interruption can be lessened. The SPR does not have to be sized to meet a supply shortfall on a barrel-for-barrel basis but can be supplemented by an integrated package of demand-constraint and supply-management measures. DOE has considered some of these measures in its planning process.

Demand constraint measures

In March 1979, DOE transmitted three standby energy-conservation plans to the Congress for its approval which were developed according to the requirements of the December 1975 Energy Policy and Conservation Act. Although the act does not set any required levels of demand constraint, the IEP requires the United States to be prepared to reduce petroleum consumption during emergencies by 7 to 10 percent. At 1978 levels, DOE estimates that its plans would reduce U.S. demand for petroleum products by about 3 percent--or by 610,400 barrels a day. The three energy-conservation plans submitted by DOE follow.

Emergency weekend gasoline sales restrictions

This plan would prohibit owners of retail gasoline stations from selling gasoline or diesel fuel during specified weekend hours except to certain emergency, commercial, and Government vehicles. Estimated fuel savings would be 246,000 barrels of oil a day.

Emergency building temperature restrictions

This plan would require that owners of most nonresidential buildings maintain thermostat settings at no higher than 65 degrees F. for heating and no lower than 80 degrees F. for cooling and maintain water temperature settings at no higher than 105 degrees F. The plan's requirements would reduce petroleum demand by an estimated 360,000 barrels a day.

Emergency advertising lighting restrictions

This plan prohibits the illumination of all nonessential advertising signs and window displays. The plan would reduce energy demand by an estimated 4,400 barrels a day.

Each plan had to be approved by resolution by each House of Congress within 60 days from the date of submission. Only the plan for emergency building temperature restrictions received the necessary congressional approvals. Accordingly, DOE has no standby authority to implement the other two plans.

Supply management measures

The Government has the authority to allocate and ration supplies during emergencies, including the powers to

- reimpose price and allocation controls on residual fuel oil, middle distillates, naptha-based jet fuel, and certain minor products;
- continue price and allocation controls on motor gasoline;
- order refinery-yield adjustments;
- implement a crude oil allocation program; and
- equalize the cost of imported products.

Under this authority, DOE has developed several programs designed to alleviate the impact of emergency-supply shortfalls, including the Standby Product Allocation and Pricing Program and the Standby Crude Oil Allocation and Pricing Program. The product program empowers DOE to allocate and price refined-petroleum products during a supply shortfall to ensure equitable distribution of available supplies to all consumers. The crude oil program allows DOE to allocate and price supplies of crude oil available during shortfalls so that all refiners would share in shortages. Regulations establishing both programs in a standby status were published in January 1979.

In addition to the above programs, DOE has also developed a Standby Gasoline Rationing Plan as required by the Energy Policy and Conservation Act. Under this plan, DOE would print and mail gasoline-ration checks quarterly to owners of registered vehicles, who would then exchange them at local financial institutions and other organizations for coupons redeemable at gasoline stations. Allotments would be computed on the basis of motor vehicle registrations and available supplies, with supplemental allotments made for priority users. This rationing plan is designed to be implemented as a last resort during severe petroleum-supply interruptions, and could be put into effect in 90 days or less.

Like the standby conservation plans, the gasoline-rationing plan was transmitted to the Congress in March 1979 and had to be approved by resolution by each House of Congress within 60 days of its transmittal. Although a modification of the plan was approved by the Senate, it was rejected by the House.

OTHER OPTIONS

If a large oil-supply disruption of the type used to justify a billion barrel SPR occurred, the United States would not be impotent, and the severity of the ensuing crisis would force consideration of potential political, military, or economic measures to counteract the disruption. For example, in the event of political embargoes, the United States could suspend all military support and assistance, embargo all trade, seize assets in the United States, or eliminate technical assistance for the embargoing nations. Although these are drastic actions that would only be undertaken after careful deliberation, they are possible options. To be effective, the support and cooperation of other major IEA countries would be required. We did not attempt to examine political, military, and economic options in this review.

CHAPTER 4

THE INTERNATIONAL ENERGY PROGRAM

The 1973 oil embargo and simultaneous sharp rise in world oil prices disrupted the economies and strained the political, strategic, and economic relationships of many oil-importing countries. The embargo resulted in inadequate cooperation among the industrialized nations and competitive unilateral efforts to secure oil supplies. In response to the 1973-74 oil crisis, the United States held a Washington Energy Conference which led to the signing of the agreement on an International Energy Program in November 1974. One of the major purposes of the agreement was to establish effective procedures to meet future oil-supply emergencies so that burdens are shared equitably among the 20 member countries.^{1/} To provide a mechanism for international cooperation, the agreement created IEP and established IEA to administer it.

One of the objectives cited in the legislation for creating the SPP was to fulfill U.S. reserve obligations under the IEP. The United States meets its IEP emergency-reserve commitment, however, solely by reporting oil-industry stocks. DOE officials stressed that the reserve is a domestic program which does not increase U.S. oil-sharing obligations or reserve commitments under the IEP, and that no reserve oil will ever leave the United States. Although the United States does not plan to use SPR stocks for international oil sharing, the SPR could be used to help U.S. allies. A State Department official told us that if the United States had a billion-barrel oil reserve, the Government would be under intense political pressure to use the reserve and allow allies with shortages to use a portion of the oil supplies allocated to the United States under the IEP oil-sharing system. As the SPR increases in size, its potential as a tool to help U.S. allies increases.

Because the IEP is assumed to be 100-percent effective in SPR planning, the program's ability to operate effectively in event of a major oil-supply disruption and its potential impact on U.S. supply shortfalls should be important considerations for U.S. decisionmakers. The IEP has several potential weaknesses, and the U.S. oil-supply shortfall under the largest disruption scenario used in the latest DOE

^{1/}Australia, Austria, Belgium, Canada, Denmark, Germany, Greece, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, Turkey, the United Kingdom, and the United States.

shortfall assessment will be increased by nearly one-third over its preallocation level if the IEP functions as planned.

EMERGENCY OIL-SHARING PROCEDURES

The IEP system for dealing with oil-supply emergencies has three main components:

- Emergency self-sufficiency. Each participating country is required to maintain emergency reserves sufficient to sustain consumption for at least 70 days with no net oil imports. This requirement increases to 90 days in 1980. The emergency reserve commitment may be satisfied by oil stocks, fuel switching capacity, or standby-oil production.

- Demand restraint. Participating countries must, at all times, have ready a program of contingent oil-demand restraint measures enabling them to reduce final consumption by 7 to 10 percent, depending on the size of the oil-supply reduction. For demand restraint measures, countries may substitute the use of emergency reserves held in excess of the IEP reserve commitment. We were told that European member countries have already taken extensive conservation measures so that meeting the IEP demand-restraint requirement would be extremely difficult. Some countries might have to use emergency reserve stocks to meet demand-restraint requirements.

- Emergency oil-sharing allocation. The emergency oil-sharing system is designed to ensure that available supplies are equitably distributed among member countries. The system is triggered by the Governing Board of the IEA when a participating country or the IEA nations as a whole sustain reductions in daily rates of oil supplies which exceed 7 percent of the daily rate of consumption during the previous calendar year. Integral parts of IEP include an emergency management organization and an information system, including a mechanism for dealing with participating nations and oil companies to obtain needed information and redistribute

supplies. Although the formulas for allocation are complex, the underlying principles are simple. If oil supplies to all participating countries are reduced or embargoed beyond the 7-percent trigger for emergency sharing, each participant must reduce consumption by the same percentage, and the remaining world supplies are distributed based on an oil-sharing formula. If oil supplies to a selected participant fall below the trigger level, only that country is required to restrain demand. It then becomes entitled to pro-rata allocations from other member nations.

COMPARABILITY OF REPORTED EMERGENCY RESERVES

IEP defines emergency reserves as including total oil stocks (crude oil, major refined products, unfinished oils) held in refinery tanks, bulk terminals, pipeline tankage, barges, intercoastal tankers, oil tankers in port, inland ship bunkers, and storage tank bottoms. Working stocks and stocks held by large consumers as required by law or otherwise controlled by governments are also included in total oil stocks. In an attempt to include only the stocks which can be completely withdrawn if necessary, total oil stocks reported under IEP are reduced by 5 to 10 percent in measuring emergency reserves. The oil industry, however, has advised IEA officials that the minimum working inventories needed to sustain an efficient logistical system during and after a crisis are much higher than the 5 to 10 percent defined as absolutely unavailable by IEP.

IEA officials examined various national laws on stock reporting requirements and compared them with its own reserve stock definitions. They found some minor differences, but concluded that for practical purposes the reserve levels reported by member countries are comparable. Most IEA members require their oil industry to hold stocks above the level they would normally maintain. The requirement imposed on the oil industry varies by country. The United States, however, imposes no such requirement and the reserves it reports to IEA are stocks voluntarily owned and held by industry. IEA officials said they view the reserves reported by the United States as complying with the IEP stock definition and consistent with those reported by other countries. Therefore, none of the SPR stocks are currently required to meet IEP emergency-reserve requirements.

POTENTIAL IEP WEAKNESSES

The success in managing an oil crisis ultimately depends on the degree of solidarity among the importing countries. In the event of a severe oil shortage or prolonged disruption, the divergent interests of the IEA members could put increasing strain on their common commitment. The IEP agreement contains no mechanism to force compliance.

The U.S. Government position is that the IEP oil-sharing system will work as planned in the event of future oil-supply disruptions. A State Department official pointed out that the member nations presumably understood the IEP terms when they signed the agreement, and that their actions thus far have indicated a willingness to comply with the terms. Further, there was general consensus among U.S. officials we interviewed that the IEP would function effectively during a limited, political supply disruption. These officials expressed concern, however, about what would happen in event of severe or military supply disruptions. The pessimism they expressed was based on the belief that such a supply disruption would likely lead to large price increases and concern about the willingness of oil companies to allocate available world supplies based on the established sharing formula. Moreover, individual countries might begin competing with each other for available supplies, especially countries whose usable reserves were substantially less than being reported.

Weaknesses in the IEP which may cause problems during supply disruptions include the questionable definition of emergency reserves, inadequate pricing mechanisms, and insufficient mandatory-reallocation procedures.

Questionable definition of emergency reserves

U.S. Government officials recognize that emergency reserves being reported by IEA-member countries do not constitute true reserves, but the definition agreed to was a political compromise between the 20 member countries. The definition of emergency reserves is considered weak and U.S. officials have attempted, without success, to have IEA adopt a more stringent definition as a signal of collective intentions to reduce vulnerability. Other IEA-member countries apparently have rejected changing the definition because of the (1) high cost to increase real reserves, (2) lack of a perceived near-term oil crisis, and (3) political liability in attempting to fund or force the oil industry to finance additional stocks.

IEA officials attempted in 1975 to determine minimum working stock levels for industry, defined as those stocks necessary to insure normal refinery operations and product distribution. Responses from member countries were inconclusive--estimates ranged from 6 to 90 days. Working stocks were generally estimated to be about 45 days for European industry. Only stocks above this level are considered pure reserves that would be fully usable without any effects on industry operations. Officials conceded that reserves reported by all countries are overstated.

An IEA official estimated that of the 148 days of net-oil imports the United States reported to IEA as emergency reserves in 1977, 58 days were pure reserves. The U.S. National Petroleum Council studied existing industry stocks in the United States and concluded that of the 153 days of imports the United States reported to IEA in 1976, only 23 days represented pure reserves.

Inadequate pricing mechanism

A serious potential problem in successful voluntary allocation of available oil supplies concerns price agreement. If some countries allowed price increases during emergencies and others did not, allocation from one country with higher prices to another country with fixed prices would result in an economic loss by the company(ies) involved. Oil companies voluntarily distributing supplies under the allocation process will likely want the best possible prices.

The IEP agreement contains no binding mechanism to settle price disputes. U.S. officials consider this a weakness that needs to be overcome. According to one DOE official, the lack of a pricing mechanism is "the Achilles heel of the IEP," and represents its most serious problem. A State Department official said that IEP does have voluntary pricing guidelines and arbitration procedures. IEA is developing a mandatory system to resolve price disputes, but the completion date for the system is uncertain.

Insufficient mandatory-reallocation procedures

The IEP emergency oil-sharing system could not be implemented without detailed information from, and active cooperation of, the oil companies which control the worldwide logistical network. Although procedures for oil company cooperation have been worked out in advance, oil company behavior in actual supply emergencies will be influenced by the exporters as well as the importers.

If voluntary redistribution by the oil industry cannot be accomplished, in some instances procedures exist for participating nations to order their oil companies to mandatorially comply. Section 251 of the December 1975 Energy Policy and Conservation Act contains authority for requiring mandatory compliance by U.S. industry. As of May 1979, however, the United States still did not have regulations to implement this authority. DOE officials told us that mandatory compliance regulations have been drafted, and public hearings were held in July 1978. No date has been set for regulation completion.

IEP ALLOCATION TEST RESULTS

Two tests of the IEP allocation system have been conducted. Each test simulated oil-supply crises using both Government and oil industry data. Using computer simulation, the exercises were designed to test such factors as data requirements and definitions, communications, general procedures, and oil-industry participation.

The first test, held in October 1976, was generally successful. It was not fully realistic, however, because the national emergency-sharing organizations from each participating country--groups established to insure that national needs are met within the terms of IEP--were not included. The need for fair sharing of the allocation burden by the participating oil companies was identified as a serious potential problem.

The second test, conducted in the spring of 1978, simulated an oil crisis somewhat worse than the one in 1973-74, and included participation by the national emergency-sharing organization of each IEA country. A DOE official told us IEA officials estimated the test cost at \$10 million, including \$8 million in costs incurred by industry. The test was considered an overall success by IEA, even though it did not address prices to be received for oil transferred between companies--a critical factor in voluntary compliance by the oil industry. DOE used the IEA exercise to simultaneously test its standby domestic allocation programs, and viewed the test as a successful problem-detection and solving mechanism.

U.S. SHORTFALL PROJECTIONS AFFECTED BY IEP SHARING

The June 1978 SPR plan amendment contains projections of U.S.-supply shortfalls under various oil-disruption situations. The projections assume the IEA oil-sharing system will be fully effective. Under the least severe

embargo scenario, the U.S.-supply shortfall is reduced by oil reallocation from other countries. Under the most severe disruption situation, however, a large portion of the U.S. shortfall is a direct result of U.S. oil-sharing obligations under IEP. Although DOE did not retain documentation on the impact of IEP sharing on shortfalls shown in the amendment, a similar DOE projection prepared in December 1978 indicated that under the 50-percent Persian Gulf closure situation, the U.S. crude oil shortfall would be increased by nearly one-third over its preallocation level if IEP functions as planned. Consequently, U.S. participation in IEP seems important in justifying a billion-barrel SPR.

DOE and State Department officials believe that international oil companies would most likely allocate those oil supplies available during petroleum-supply interruptions voluntarily in a manner very similar to the IEP sharing system. These officials maintain that activating the IEP sharing system would reallocate only 5 to 10 percent of the supplies voluntarily allocated by oil companies. However, it was the unilateral competition for supplies and inequitable voluntary allocations of the 1973-74 oil crisis which led to the creation of IEP.

A senior IEA official stated that the United States seemed willing to share its relative oil wealth with other IEP members in return for the agreement that member countries would act together and cooperate in any future crises. The IEA official stated that the United States did not want a recurrence of the competitiveness that occurred during the earlier embargo, and that the United States has a strategic responsibility far greater than other IEP members.

CHAPTER 5

EMERGENCY PETROLEUM RESERVE PROGRAMS

IN OTHER COUNTRIES

Although nearly all the world's industrialized, import-dependent countries have established mandatory, emergency petroleum-reserve programs, the relative reserve-stock levels that will be available to meet supply shortages differ substantially, depending on the size requirements, method of ownership and control, and storage procedures. The absence of mandatory industry involvement distinguishes the U.S. program from emergency reserve programs of other IEA countries. Moreover, the planned level of segregated, Government-owned stocks in the U.S. reserve will make it by far the largest Government-owned program. Despite the relatively greater dependence of most other IEA nations on imported oil (see app. II), only 5 of the 20 IEA countries are establishing segregated, government-owned reserves in addition to their industry reserves. Further, their relatively small sizes, which will range from about 5 to 25 days of net oil imports based on 1977 import levels, are dwarfed by the U.S. Government's planned 116-day SPR at 1977 import levels.

Other countries have had considerable experience with compulsory oil-storage programs. In 1968, the European Economic Community established a petroleum reserve requirement for its member countries, requiring them to maintain stocks equivalent to at least 65 days of their previous year's domestic consumption. The requirement was subsequently increased to 90 days. Under IEP, all participating countries are required to have oil-reserve stocks equivalent to 90 days of net oil imports by 1980. Reserves reported for each country to meet IEP requirements are shown in appendix III.

The methods the various IEA nations used in establishing their emergency oil reserves have varied widely, but most rely exclusively on industry to satisfy reserve requirements. IEA petroleum reserves, which are industry-owned, are amalgamated with--and indistinguishable from--regular working stocks. Such storage arrangements can have serious implications for the availability of these reserves during emergency supply shortfalls. Generally, the governments require industry to hold inventories above normal, economically efficient operating levels, but allow industry to recoup a portion of the excess inventory costs through subsidies and higher consumer prices. The United States also satisfies its IEA reserve requirement entirely with industry-owned stocks, but does not require the U.S. petroleum industry to maintain excess inventories.

Due to their oil-import vulnerability, highly industrialized oil-dependent economies, and use of both industry and Government-owned reserves, the German and Japanese emergency oil reserve experience warrants consideration in planning for the U.S. program.

GERMAN EMERGENCY RESERVE PROGRAM

Germany, which imports about 96 percent of its crude oil requirements, has established an emergency petroleum-reserve program consisting of: (1) compulsory industry reserves, (2) Government-owned reserves, and (3) voluntary consumer-owned reserves.

Germany first imposed storage obligations on oil refiners and importers in 1965. In 1975, German law was revised to comply with European Economic Community and IEA requirements. The German Government hoped to preserve the competitive nature of its domestic oil market by imposing different storage obligations on different sectors of the oil industry. The Government ordered that

- refiners maintain 90 days of average production from imported crude;
- dependent importers, having long-term supply agreements with major oil companies, maintain 70 days of imports; and
- independent importers, dealing in small quantities and responding to spot demands, maintain 25 days of imports (increasing to 40 days in 1980).

Recognizing the considerable financial burdens these requirements imposed on the petroleum industry, the Government provided industry with tax exemptions and loan guarantees to alleviate a portion of the costs.

Germany's compulsory industry-owned reserves law has been continually attacked by the petroleum industry as inequitable, and was the subject of lawsuits before the German courts. These suits charged that (1) reserve requirements were tying up large amounts of capital badly needed to keep the German petroleum industry competitive, (2) the costs of the reserves were difficult to recover in the free market which exists in Germany, and (3) the lesser reserve requirements for independent importers gave them an unfair competitive advantage.

A key industry concern was financing the storage obligation. Because the many kinds of companies in the complex German market had varying financial positions, interest rates on loans necessary for financing storage obligations varied, resulting in unequal compliance costs. In addition, some companies had stiffer competition in particular geographic regions and product markets, and less success in passing storage costs through to consumers. Finally, the debt and the interest payments were difficult for some small companies to bear. In view of the similar U.S. market system, these are the same types of problems that might be experienced in the United States if an industrial petroleum reserve was established.

After protracted debate and litigation, Government and industry officials began to discuss ways to overcome the problems. A possible solution emerged in 1978 in the form of a proposed central storage corporation. The principal purpose of this corporation is to own the required reserve stocks which are in excess of industry's working stock needs. The corporation will (1) borrow money to buy the oil, using the stocks themselves as collateral; (2) buy or lease the storage facilities; and (3) administer the stocks. The corporation will pay the loan interest with compulsory fees collected from oil companies, and the oil companies will be allowed to pass the cost of the fees on to the consumers. After resolving various technical issues, the corporation was expected to begin purchasing or leasing company's obligatory stocks in late 1978, and will eventually acquire 65 of the 90 days of refiners' and all of the importers' obligatory stocks. Such an arrangement releases the capital of the oil companies and removes competitive disparities, but retains the concept of requiring the oil industry and customers to finance part of the reserve's cost.

To supplement its industry reserves, Germany created a Government-owned Federal Reserve in 1970. The Government has total ownership and control over this reserve, which will ultimately contain 60 million barrels of crude oil by 1980-- or about 25 days of oil imports. The estimated cost to the German Government will be about \$1.25 billion. A public corporation has been established to administer the program.

The German program's final element consists of voluntary consumer reserves. The Government recommends, but does not require, that certain large petroleum consumers maintain reserves equivalent to at least 14 days of consumption. This recommendation is enforced through promises of unfavorable consideration in the Government emergency petroleum-allocation program to consumers not meeting the 14-day guideline.

JAPANESE EMERGENCY RESERVE PROGRAM

Japan has the highest dependence on imported energy of any major industrial nation, with about 73 percent of its primary energy requirements supplied by imported oil. Over 99 percent of Japan's oil needs are met by imports, about 80 percent of which are obtained from Middle East countries. To minimize this extreme vulnerability, Japan plans to establish petroleum reserves equal to about 103 days of domestic consumption by 1982, consisting of 90 days of industry-owned stocks and about 13 days of Government-owned stocks.

The Japanese oil reserve program began in 1972 with a Government-controlled and industry-owned 60-day oil stockpile requirement by March 1975. The IEP 90-day requirement was officially adopted by the Petroleum Stockpiling Law of 1975. Because Japanese oil companies held an average of only 45 days of stocks at the time stockpiling requirements were first established in 1972, large expenditures were necessary. The Japanese Government estimated that costs in excess of \$3 billion would be incurred during the 5 years ended March 1979. At an expected demand level of 4.7 million barrels a day, the Japanese Government estimates that the 90-day industry stockpile will total about 425 million barrels by 1980.

The Japanese Government is assisting the oil industry in financing and administering the reserve burden. Rather than establishing a single central storage organization similar to Germany's, the Government is taking a decentralized approach. The stockpiling law requires oil companies to strictly record and report on their inventories but allows them to stockpile and report in groups. The reserve commitment is allocated within the groups in any manner the member companies desire. The Government grants stockpiling companies tax exemptions and low interest loans, offers local communities subsidies to accept new storage facilities, and forms joint companies with industry to purchase land for storage sites. Companies submit proposals for joint ventures, Government subsidies, or tax relief, and each case is judged individually by responsible Government organizations.

Despite the governmental assistance, the Japanese petroleum industry still opposes mandatory-stockpiling requirements. Industry blames its low investment return on the financial burden of the reserve requirements. It also complains that only about 20 percent of the substantial costs of the excess inventories required for the reserve are recoverable through Government financial incentives, and that costs are difficult to pass on to consumers.

In addition to the 90-day stockpile in the private sector, the Japanese Government created the state-owned Japan Petroleum Development Corporation in 1978 to establish a 13-day, Government-owned reserve by 1982. Approximately 63 million barrels of oil will eventually be purchased and stored by the corporation.

CHAPTER 6

CONCLUSIONS AND OBSERVATIONS

The SPR potential value as a major national security measure in diminishing U.S. vulnerability to interruptions in imported-petroleum supplies and in carrying out U.S. international energy commitments is unquestionable. The law creating the reserve, however, allows considerable discretion in deciding how the reserve can most effectively be established.

We found that determining the optimal SPR size is extremely difficult because of the many unknowns, assumptions, variables, and political factors which must be considered, and because there is no realistic way to assign quantitative probabilities to possible supply interruptions. Nevertheless, in considering requests to fully fund the billion-barrel reserve, the Congress might be guided by the following factors.

- No study has shown how large the optimally sized SPR should be. The June 1978 amended plan and subsequent DOE analysis, although not designed to determine an optimally sized reserve, do project a range of supply interruptions that would require a billion-barrel SPR.
- The probability of a future supply disruption of the size and duration necessary to require a billion-barrel SPR is rated low in the DOE supply-interruption assessment.
- Recent analyses done by DOE indicate that the largest potential supply shortfalls under selected disruption situations are considerably less than projections made at the time the amended plan was prepared.
- The one billion barrel SPR is sized to meet a supply disruption of far greater severity than ever experienced.
- Serious implementation problems and large cost increases have been experienced that were not anticipated at the time the billion-barrel decision was made.

The Federally funded SPR does not have to be sized to meet a supply shortfall on a barrel-for-barrel basis but can be supplemented by such measures as

- existing industry capabilities, such as existing stocks and fuel switching;
- a mandatory industrial petroleum reserve as authorized in the SPR legislation;
- demand-constraint and supply-management measures, such as emergency conservation, allocation, or rationing; and
- political, military, and economic leverage available to affect the size and duration of shortfalls.

In projecting U.S. oil-supply shortfalls under the various interruption scenarios used to justify a billion-barrel reserve, DOE assumes that the IEP will be fully effective. We found that under the more severe of these situations, the size of the U.S.-supply shortfalls, and thus the required size of the SPR, is increased significantly by the operation of the IEP sharing system. Further, the ability of the program to operate effectively during severe or extended supply interruptions was questioned by most of the U.S. officials contacted during our review. Weaknesses in reserve-stock definitions, pricing mechanisms, and reallocation procedures were cited as potential problems.

Among the IEA nations, the United States will have by far the largest reserve program, and the only one without some type of industry involvement. Although Government officials stressed that no SPR oil will ever leave the United States, they admitted that with a billion-barrel reserve the United States would be under considerable pressure to draw on its SPR and to permit allies use of some of its allocated shares of world oil supplies available during severe interruptions. Further, as the reserve increases in size, the potential for using it to help U.S. allies increases.

Our draft report was provided to the Departments of Energy and State and the Office of Management and Budget for review and comment. Their comments are reflected in the report where appropriate.

PRIOR GAO REPORTS EXAMINING THE
STRATEGIC PETROLEUM RESERVE

Letter report to the Secretary of Energy on management controls in the strategic petroleum reserve, (EMD-79-42, March 27, 1979)

"Information on the Department of Energy's Management of the Strategic Petroleum Reserve," (EMD-79-49, March 22, 1979)

Letter report to the Secretary of Energy on the need for regional petroleum reserves, (EMD-79-14, March 20, 1979)

"Transportation Planning for the Strategic Petroleum Reserve Should Be Improved," (LCD-78-211, October 18, 1978)

Letter report to the Secretary of Energy on the purchase of royalty oil for use in the strategic petroleum reserve, (EMD-79-1, October 6, 1978)

"Questionable Suitability of Certain Salt Caverns and Mines for the Strategic Petroleum Reserve," (EMD-78-65, August 14, 1978)

"Need to Minimize Risks of Using Salt Caverns for the Strategic Petroleum Reserve," (EMD-78-25, January 9, 1978)

"Issues Needing Attention in Developing the Strategic Petroleum Reserve," (EMD-77-20, February 16, 1977)

1976 IMPORT AND DEMAND LEVELS FOR
INTERNATIONAL ENERGY AGENCY MEMBERS

<u>Country</u>	<u>Imports</u> Crude oil and <u>refined products</u>	<u>Demand</u> Total <u>domestic demand</u>
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	(000 barrels per day)	
Australia	71	226
Austria	203	242
Belgium & Luxembourg	791	543
Canada	580	1,748
Denmark	377	335
West Germany	2,818	2,716
Greece	268	207
Ireland	114	106
Italy	2,219	1,806
Japan	5,428	4,784
Netherlands	1,477	684
New Zealand	79	96
Norway	227	173
Spain	1,008	983
Sweden	617	593
Switzerland	274	290
Turkey	263	299
United Kingdom	2,122	1,861
United States	7,333	17,509

Note: Imports may exceed demand due to re-exports, stock changes, and other losses.

EMERGENCY OIL RESERVES REPORTED FOR
INTERNATIONAL ENERGY AGENCY MEMBERS

<u>Country</u>	<u>July 1977</u>		<u>July 1978</u>	
	<u>Oil stocks</u> (000 tons)	<u>Days of</u> <u>imports</u>	<u>Oil stocks</u> (000 tons)	<u>Days of</u> <u>imports</u>
Austria	1,302	50	1,815	72
Belgium	7,129	115	(a)	(a)
Canada	19,423	667	18,161	601
Denmark	5,517	126	5,930	137
Germany	33,965	100	35,463	107
Greece	2,841	122	2,278	86
Ireland	1,332	94	1,337	90
Italy	23,094	100	20,595	93
Japan	45,173	81	44,785	77
Luxembourg	298	72	307	74
Netherlands	9,591	187	7,621	170
New Zealand	933	96	837	95
Norway	1,930	(b)	1,930	(b)
Spain	9,770	80	8,770	76
Sweden	6,143	87	6,070	90
Switzerland	4,486	123	4,496	122
Turkey	1,436	44	(a)	(a)
United Kingdom	18,664	95	16,807	127
United States <u>c/</u>	140,169	148	136,094	131

a/Not available.

b/Norway is net oil exporter.

c/Does not include strategic petroleum reserve.

Note: Australia, which joined IEA in early 1979, is excluded from the table.