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AN EVALUATION OF THE STRATEGIC PETROLEUM RESERVE

A REPORT

PREPARED AT THE REQUEST OF THE

SUBCOMMITTEE ON ENERGY AND POWER

COMMITTEE ON

INTERSTATE AND FOREIGN COMMERCE

UNITED STATES

HOUSE OF REPRESENTATIVES

BY THE

CONGRESSIONAL BUDGET OFFICE

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June 6, 1980

The Honorable Harley O. Staggers
Chairman
Committee on Interstate and Foreign Commerce
2125 Rayburn House Office Building
Washington, D. C. 20515

Dear Mr. Chairman:

The enclosed report "An Evaluation of the Strategic Petroleum Reserve" was prepared by the Congressional Budget Office for the Subcommittee on Energy and Power to evaluate the potential effectiveness of the SPR in time of crude oil import shortfall.

The report is quite specific in its conclusions. When a shortfall occurs, each barrel of crude oil in the Strategic Petroleum Reserve has the potential to prevent almost $200 in current dollars of GNP loss, along with the associated unemployment. Other Congressional sources now report that each point of unemployment above the expected base of 6.8 percent costs as much as $29 billion in lost revenues and higher unemployment compensation, food stamps and other costs. The cost of filling the reserve is estimated to be approximately $3 billion per year. The costs can be minimized in the long run by expediting the fill as soon as possible. Additionally, the Congressional Budget Office and other experts who testified before the Subcommittee indicate there is every likelihood that, during the period of dependence on imported oil, this country will again experience a substantial shortfall.

Currently, the Department of Energy is not purchasing oil for the Strategic Petroleum Reserve and has not done so since the start of the Iranian crisis. Early in 1979, the Administration announced that all new oil procurement would be postponed until after the June 1979 OPEC meeting to avoid price pressure on the world crude oil market. One year later, as OPEC is about to open its 1980 meeting, the same reason is being repeated by the Administration as an excuse for not filling the reserve. Additionally, there is speculation that budgetary reasons may also be influencing the decision not to fill the Reserve. This report indicates that the economic consequences of not filling the reserve are extremely severe.

The Subcommittee appreciates the excellent work performed by the Congressional Budget Office in preparing this outstanding report. Wide distribution will assist in making the logical decision concerning the future of the Strategic Petroleum Reserve, and I believe that this document merits publication as a Committee Print.

Sincerely,

John D. Dingell
Chairman

Enclosure

PREFACE

The Strategic Petroleum Reserve program has experienced numerous problems in both constructing storage capacity and purchasing oil to fill the existing capacity. These problems, as well as the current pressures to reduce the federal budget, have raised a number of questions regarding the appropriate size of the reserve and the timing of crude oil purchases. This paper, prepared by the Congressional Budget Office (CBO) at the request of the Energy and Power Subcommittee of the House Interstate and Foreign Commerce Committee, addresses these two major issues.

The report was prepared by Barry J. Holt of the Natural Resources and Commerce Division and Mark Berkman of the Budget Analysis Division, under the supervision of Raymond C. Scheppach and Robert A. Sunshine. Everett M. Ehrlich and Mark Steitz provided many valuable suggestions. Bill Finan of Wharton Econometrics Forecasting Associates provided technical support. Patricia H. Johnston edited the manuscript. The several drafts were typed by Dorleen Dove, Brice McDaniel, Kathryn Quattrone, and Deborah Vogt. In keeping with CBO's mandate to provide objective analysis, the report contains no recommendations.

Alice M. Rivlin
Director

June 1980

SUMMARY

The Strategic Petroleum Reserve program, which is administered by the Department of Energy, has experienced serious difficulties both in developing storage capacity and in acquiring oil. Although the Congress authorized a reserve of 1 billion barrels, only 248 million barrels of storage capacity have been completed, and only 92 million barrels of oil have been acquired, the last in August 1979. Furthermore, the President's revised budget for fiscal year 1981 reflects a decision not to resume oil purchases until June of that year.

The Congress is now considering legislation that would direct the Department of Energy to resume crude oil purchases. On the other hand, concern for a balanced budget in fiscal year 1981 and the possible effects of renewed purchases on the international oil market have focused Congressional attention on reevaluating the program to determine its size, rates of oil acquisition, and financing methods.

BENEFITS AND COSTS OF THE RESERVE

The Strategic Petroleum Reserve (SPR) is intended to mitigate the economic problems that would be caused by full or partial interruption of the flow of oil from abroad. During a supply interruption, the availability of the reserve oil would tend to reduce the upward pressure on oil prices and reduce potential losses in gross national product (GNP). For example, without a strategic reserve, a year-long shortfall of 2 million barrels per day in 1984--that is, about 21 percent of projected oil imports--would reduce GNP in that year by approximately $146 billion (3.6 percent of projected current dollar GNP); it would also increase the unemployment rate by about 1.1 percentage points and the inflation rate by 7 percentage points. This assumes that there would be no price controls or oil allocation regulations. Virtually the entire impact of such a shortfall on the GNP and unemployment, as well as a large portion of the inflationary effect, could be averted by a reserve of about 750 million barrels. Similarly, a reserve of 1 billion barrels could almost completely offset a year-long shortfall of 3 million barrels per day in 1984--about 31 percent of projected oil imports--which would otherwise cause about a $226 billion (5.5 percent) loss in current dollar GNP and increase the unemployment and inflation rates by about 1.8 percentage points and 15 percentage points, respectively. The 1 billion barrel reserve could also offset the economic effects of a cutoff of all imported oil for almost four months.

The costs of developing the SPR are not insignificant. Development of each 250 million barrel increment of storage over the current level would cost between $1 billion and $5 billion, depending upon the timing, the rate of construction, and the type of storage capacity. Total additional storage development costs to reach a 1 billion barrel reserve are estimated to range between $5 billion and $11 billion in current dollars over the next six to ten years. Filling the capacity with the purchase of 1 billion barrels of oil could be expected to cost approximately $50 billion, but these costs could be recovered, and probably with a profit, when the reserve was drawn down or the program terminated.

Each barrel of reserve oil, for which storage capacity costs between $3 and $20 to develop, would thus appear to have the potential to offset close to $200 in current dollar GNP losses. Further, although the timing, size, and duration of future interruptions are difficult to predict, the risk of interruption seems to be increasing. The level of imports is expected to rise from the 1979 level of 42 percent of total domestic petroleum consumption to about 57 percent in 1990, primarily because domestic production is declining and demand is not. In addition, the political stability of several key producing countries is increasingly uncertain, so that one or more oil supply interruptions in the next 20 years appear probable. The low cost of the oil reserve relative to the economic losses it could avert make the reserve a highly cost-effective federal program for protecting against the risks of growing dependence on imported oil. Indeed, it is the only program that could offset the short-term economic effects of oil supply interruptions.

OIL ACQUISITION STRATEGY

The program's large benefits relative to costs, as well as increasing U.S. dependence on imported oil, seem to bolster the arguments for acquiring the oil as rapidly as possible, subject to the constraints imposed by the federal budget and the international oil market.

Budget Constraints and Offsetting Options

Costs. At projected world oil prices, it would cost approximately $3.0 billion per year over the next few years to purchase oil at a rate of 200,000 barrels per day. At this rate, it would take approximately two years to fill the current storage capacity of 248 million barrels. If oil were purchased at a rate of 400,000 barrels per day, this capacity would be filled in 13 months, at a total cost over that period of approximately $5.6 billion. While this represents a sizable outlay, the money spent on purchasing oil is expected to be recouped when the oil is eventually sold. Moreover, because CBO expects continued real increases in the price of oil, the total budgetary cost of the program might be reduced by expanding capacity and purchasing more oil sooner, despite the premiums that would have to be paid for accelerating storage development.

Options to Reduce Budget Effects. Methods could be found to reduce the impact on the budget of spending for the SPR. One would be to impose an energy-related revenue measure such as the recently proposed oil import fee and dedicate the revenues to building the reserve. Such a fee could fund the reserve program while, at the same time, discourage consumption and reduce the level of imports. The Congress could lose flexibility in allocating budgetary resources, however, if this were accomplished through a trust fund.

Another option would allow private investors to buy title to oil in the reserve, and buy and sell the titles speculatively. In the event of a drawdown of the reserves, the government, retaining control of oil, would pay titleholders for the quantity sold.

An additional alternative would be for the federal government to tax the subsidy received by refiners of Alaskan North Slope Oil. This subsidy results from a combination of the controlled price of the oil and its treatment under the entitlement program. While oil price decontrol will phase out this subsidy by October 1981, taxing it in the interim could result in revenues of about $1.6 billion by that time.

International Constraints

International considerations have played a major role in slowing the progress of the reserve program. Producing nations have opposed the program publicly, while agreements among consuming nations apparently limit the U.S. government's ability to purchase oil for the reserve in a tight market.

Producer Opposition. While the public opposition of the producer nations to the reserve program is clear, their response to renewed U.S. stockpiling is difficult to predict. The possibility of production cutbacks cannot be ignored, especially while countries such as Saudi Arabia are producing at higher levels than they would prefer. Producer opposition to renewed stockpiling might be minimized, however, if the United States dedicated some of the production from federally owned oil to the reserve. One option would be to dedicate the current 130,000 barrels per day federal share from the Naval Petroleum Reserve (NPR) or some of the royalty oil that is due the federal government for offshore leases. Although such dedication would force the refineries currently receiving this oil to replace

63-724 O - 80 - 2

it with purchases on the world market, the strategy might be more acceptable to producing nations.

Market Restraints. The countries belonging to the International Energy Agency (IEA) agreed in 1979 to consult with each other before resuming stockpiling. They further agreed that no country would resume stockpiling if that would result in pressure on world oil prices. Substantial oil purchases for the reserve in a tight oil market could result in increased prices that would be felt by all consumers. A high purchase rate of 400,000 barrels per day represents about 1 percent of the oil traded daily on the international oil market. In a tight, competitive oil market, this could raise prices as much as $4 per barrel. At lower, more likely purchase rates of 100,000 to 200,000 barrels per day, the effect would be only $1 to $2 per barrel. The oil market, however, does not always exhibit such sensitivity to demand. Prices are not set solely by market conditions. If any price increases resulted from SPR purchases, they would more likely stem from political rather than economic factors, and thus would be difficult to predict.

While critics of the reserve have cited tight oil market conditions as a reason for not purchasing oil, the oil market over the next 6 to 18 months is expected to be very favorable to reserve purchases. Softening spot market prices over recent months, together with the prospects of a continued recession, may be expected to curtail the rate at which crude oil prices rise over the next year or two.

If market concerns remain a constraint, the United States might wish to consider alternative policies that would have a neutral effect on the world oil market. For example, it might be possible to increase NPR production at Elk Hills by 30,000 to 50,000 barrels per day and dedicate this additional production to the reserve. Another alternative might be to find ways of reducing current domestic demand and use the resulting oil savings for the reserve.

CONCLUSION

The Strategic Petroleum Reserve is a highly cost-effective program for reducing the risks of high oil import levels and future interruptions of supply. To fill the remaining storage capacity of 156 million barrels would cost approximately $5.6 billion if it were accomplished in 13 months at a high acquisition rate of 400,000 barrels per day. Budget limitations and international oil market conditions are the two major constraints to current purchases of oil for the reserve. If budget limitations are severe, various alternatives are available--such as imposing an oil import fee or raising private financing. With respect to the international oil market, the constraints are twofold: the opposition of producing nations and possible upward pressure on oil prices resulting from the reserve purchases. Producer opposition might be minimized by dedicating federal oil from the Naval Petroleum Reserve or royalty oil from offshore leases. It is possible that the oil market will have a considerable amount of slack over the next 6 to 18 months, so that the economic climate for renewed purchases should be favorable. If market constraints are serious, however, alternative policies could be considered, such as increasing oil production from Elk Hills or reducing domestic demand and using the savings for the reserve.

CONTENTS

TABLES

APPENDIX TABLES

FIGURES

AN EVALUATION OF THE STRATEGIC PETROLEUM RESERVE

CHAPTER I. INTRODUCTION

The security of the U.S. oil supply has been a major goal of energy policy since the 1973-1974 embargo by the Organization of Petroleum Exporting Countries (OPEC). To protect the country from the consequences of future interruptions in the supply of imported oil, the Congress authorized a federal petroleum reserve in the Energy Policy and Conservation Act of 1975 (EPCA). In June 1978, the Congress approved plans for a Strategic Petroleum Reserve (SPR) of 1 billion barrels, the maximum amount authorized by the EPCA. The potential usefulness of this program has grown along with the rising level of imported oil--now about equal to domestic production--and increasing political instability in the oil-producing nations.

The SPR program, administered by the Department of Energy (DOE), has experienced serious difficulties both in developing storage capacity and in acquiring oil to meet the authorized level of 1 billion barrels. To date, storage capacity of only 248 million barrels has been completed, with another 290 million barrels of capacity now under construction. Development of the remaining 462 million barrels of capacity has been delayed until 1982, both because of oil supply uncertainty and because using private sector storage has proved to be very expensive. Furthermore, while most of the technical problems in preparing storage facilities have been solved, the reserve today contains only 92 million barrels. 1/ The reserve program has not contracted for more oil since February 1979 and has taken no deliveries since August 1979.

Thus, the completion of a 1 billion barrel reserve is by no means certain. The Energy Security Act of 1979 (now in conference) would direct DOE to resume the purchase of oil. On the other hand, concern for a balanced budget in fiscal year 1981 has also focused Congressional attention on reducing or eliminating the program. Of the $6.9 billion that was appropriated for the program between fiscal years 1976 and 1980, about

1/ To date all storage facilities are salt domes and mines. The program encountered a number of technical difficulties, including limited rates of leeching for brine removal, unanticipated environmental restrictions on brine disposal, and equipment failure.

63-724 O - 80 - 3

$4.1 billion will still be available at the beginning of fiscal year 1981. 2/ The President's January budget request for fiscal year 1981 devoted 16 percent of the outlays for energy (function 270) to the SPR, and called for the resumption of oil acquisition in June, 1980, at the rate of 3 million barrels per month, increasing to 7.5 million barrels per month in calendar year 1982. The revised budget request submitted in March, however, delays purchases until June 1981. Recent statements by DOE officials indicate that no final decision regarding oil purchase has been made at this time.

To resolve these issues, the Congress is again evaluating the reserve program to determine its size, rates of oil acquisition, and financing methods. Chapter II assesses the value of a strategic reserve in mitigating the effects of an oil supply interruption. The reserve's value is compared with its costs to evaluate various reserve sizes. Chapter III identifies those factors that constrain the rate at which storage capacity can be built and oil acquired. Policy options are suggested for reducing these constraints and allowing high rates of acquisition. Two appendixes provide additional information. The first is a detailed description of the model used to calculate the benefits of the reserve. The second compares the budget effects of alternative storage construction and oil acquisition strategies.

2/ Approximately $1.8 billion has been committed to the Department of Defense's Defense Fuel Supply Center, but DOE has not authorized the Center to purchase oil. The remaining $2.3 billion is presently unobligated and requires reappropriation by December 31, 1980.

CHAPTER II. EVALUATION OF ALTERNATIVE RESERVE SIZES

The United States imported about 42 percent (8.0 million barrels per day) of its total oil supplies in 1979. With relatively stable consumption levels and diminishing domestic production levels, this proportion is likely to increase to 57 percent by 1990.

The U.S. dependence on oil imports, which are vulnerable to supply interruptions, poses a distinct set of risks for the U.S. economy. These risks may be identified as economic losses or costs that are not included in the price of oil. They are of uncertain magnitude and related to events that may, but not necessarily will, occur. This reliance on uncertain imports constrains foreign relations and leaves the economy vulnerable to potentially significant disruptions. 1/

There are two basic ways to limit the possible effects of an oil supply interruption: reducing the dependence on foreign oil and preparing to mitigate the short term effects of an interruption. Imports can be reduced by substitution of alternative energy sources, by new domestic production or by conservation. Such policies, however, affect long-term production and consumption patterns and offer very little immediate protection. In the short term, the effects of a supply interruption can be alleviated by sufficient domestic petroleum reserves as well as by effective rationing and allocation programs. This chapter evaluates various oil reserve sizes designed to provide this short-term protection. Reserves ranging between 250 million barrels and 1 billion barrels are compared in terms of estimated benefits and costs.

BENEFITS OF A STRATEGIC RESERVE

The most significant measurable benefits of a strategic reserve are the adverse macroeconomic effects that it would mitigate in the event of an oil supply interruption. Drawing oil from a strategic reserve during supply interruptions would allow continued production of many goods and services that would otherwise be curtailed, and would reduce surges in prices and unemployment. The value of the strategic reserve--that is, the expected

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1/ For additional information, see Congressional Budget Office, The World Oil Market in the 1980s: Implications for the United States, Background Paper (May 1980).

benefits to be derived from the reserve--depends on the probability, size, duration, and timing of future supply interruptions. While there is much uncertainty in any estimates of such probability, the value of a reserve can be estimated under a number of scenarios. In the analysis presented here, the macroeconomic effects of an oil supply interruption are explored. The degree to which a reserve could offset these effects determines the value of the reserve.

Methodology for Calculation of Benefits

The economic impact of an oil supply interruption was calculated in terms of its effect on aggregate national output (as measured by the gross national product), inflation, and unemployment. Estimates were developed using the Wharton Annual Energy Model, which combines input-output analysis with macroeconomic analysis.

This model utilizes input-output tables that relate oil consumption and industrial output to calculate the effects of oil supply interruptions. By comparing the constrained feasible outputs with those required by the new demand composition, allocation adjustments are determined. This procedure is repeated until the final demands are consistent with the constrained output, resulting in new values for expected gross national product (GNP) and the level of prices and employment. The model allows inflationary surges from excess demand to be passed through to the general price level or to be suppressed by modelling the policy device of price controls. The model and the assumptions concerning GNP growth, oil prices, demand, and conservation are discussed in more detail in Appendix A.

Estimated Benefits

Scenarios were designed with varying levels of oil supply interruptions and policy responses, and used in the model. In all cases, the interruption was assumed to occur in 1984 and to last for one year. The year 1984 was selected because it appeared to be the first year when a reserve of significant size (between 250 and 700 million barrels) could reasonably be expected to exist. This analysis indicates that each barrel of oil provided by the reserve would avert about $200 of the 1984 GNP loss resulting from an interruption. In addition, the reserve would suppress surges in the rates of inflation and unemployment.

Table 1 summarizes the results of the simulations. 2/ In all cases, real output would decline and unemployment and inflation rates increase as a result of oil supply interruptions. 3/ Higher prices would reduce both real income and real wealth of households, further reducing purchases and slowing real economic growth. In the years following the oil supply interruption, the economy would rebound but would not recover entirely to the level it would have reached without an interruption. The economic effects of an oil supply interruption would be severe. In the range of shortfalls considered here, from 1 to 5 million barrels per day, GNP loss would be slightly greater than proportional to the shortfall. For example, a year-long, 2 million barrel per day shortfall would result in a GNP loss of about $146 billion (3.6 percent of 1984 GNP), and a 3 million barrel per day shortfall, $226 billion (5.5 percent).

In this analysis, a petroleum reserve would simply reduce the daily shortfall and thus reduce the economic effects of the interruption. 4/ For example, in the absence of a reserve, the year-long supply interruption of 3 million barrels per day would result in the GNP loss of $226 billion, and increase inflation and unemployment by 15 and 1.8 percentage points, respectively. A 750 million barrel reserve would effectively reduce the shortfall to about 1 million barrels per day, and reduce the impacts accordingly. In this case the reserve would avert $160 billion of the GNP

2/ The macroeconomic impact estimates of an interruption presented in this paper assume no price controls and an allocation of petroleum that minimizes GNP losses. This method of allocation differs from that provided for by the Energy Policy and Conservation Act (EPCA) of 1975. The EPCA rules allocate supplies in a way which would minimize GNP losses only after the demands of public safety, health, farms, transportation, and utilities are met. The economic losses associated with the EPCA allocation rules are high, resulting in a value of the reserve oil considerably higher than those presented in the text. For example, a year-long, 3 million barrel per day shortfall would result in a 1984 GNP loss of about $400 billion, as compared to the $226 billion loss under the efficient allocation assumed for the analysis.

3/ The analysis does not specifically account for the costs to the federal government associated with the high rates of inflation and unemployment that would prevail during an oil supply interruptions.

4/ The simplifying assumption that results in total drawdown of the reserve does not recognize the possiblity of a more cautious drawdown plan reflecting the uncertain duration of supply interruptions. Analysis of alternative drawdown strategies is beyond the scope of this paper.

TABLE 1. MACROECONOMIC INDICATORS DURING A FULL YEAR OF OIL SUPPLY INTERRUPTION IN 1984

Daily Shortfall (million barrels per day)	Percent of Projected Imports	GNP as a Loss: In Billions of Dollars	GNP as a Loss: Percent of Projected GNP	Increase in Projected Inflation Rate (percentage points)	Increase in Projected Unemployment Rate (percentage points)	Minimum Reserve Required to Offset Entire Interruption (millions of barrels)
1	10.5	66	1.6	3	0.5	365
2	21.1	146	3.6	7	1.1	730
3	31.6	226	5.5	15	1.8	1,095
4	42.1	306	7.5	25	2.2	1,460
5	52.6	387	9.4	31	2.8	1,825

loss, and reduce inflation and unemployment by 12 and 1.3 percentage points, respectively.

It is possible that not all of these benefits would be realized. Foreign countries might capture many of the benefits of a drawdown of the Strategic Petroleum Reserve. While coordinated stockpiling and drawdown among consumer nations would lead to large benefits for all consuming nations, it is possible that certain countries could benefit directly from the reserves of another.

The IEA Agreements that allow for the allocation of supplies during interruptions would not be triggered unless there were a 7 percent disruption in the supply for member countries. 5/ In a smaller disruption, without coordinated drawdown, oil drawn from any member's stockpile would be considered an increase in world supply and, in principle, would be distributed accordingly. Although the oil from the reserve would physically remain in the country, it would to some degree displace oil that would have been imported. If oil from the Strategic Petroleum Reserve were distributed throughout the world market in this way, as much as two-thirds could "leak" to other countries. Consequently, if there were no coordination of reserve drawdown among consumer nations, larger SPR size and faster drawdawn rates would be needed to achieve the same results.

5/ Such a disruption would leave the United States facing a shortfall of 1.0 to 1.5 million barrels per day.

STRATEGIC RESERVE COSTS

Although the budgetary impact of the reserve program includes both the costs of storage facility development and oil acquisition, only development costs are compared here to the benefits identified in the previous section. While oil acquisition costs account for over 80 percent of the budgetary costs, the oil should maintain its value or, in all likelihood, increase before it is used. Consequently, in this analysis, the purchase of oil is not considered a cost, because the expenditures will be recovered upon reserve drawdown.

The costs to complete 1 billion barrels of capacity range from $5 billion to $11 billion over the next ten years, depending on the type of storage capacity used and when the capacity is developed. The program now relies upon salt domes and, in one case, a salt mine to store oil. All of the first 538 million barrels will be stored in this fashion. Additional storage could be developed through a variety of methods, including additional salt domes and mines as well as above-ground steel tanks.

The Department of Energy currently estimates that the first 538 million barrels of capacity will cost approximately $3 per barrel or $1.6 billion. The Department estimates that the next addition of 190 million barrels of capacity will cost approximately $5 per barrel or $1 billion. No DOE estimate is available for the costs of completing the last 272 million barrels of capacity. Assuming costs for this increment are similar to those of earlier increments, storage costs would total $5 billion for the 1 billion barrel reserve. Reliance on private sector storage, however, could result in significantly higher costs. Initial bids from the private sector ranged from $4 to $15 per barrel. 6/ Total development costs thus could be as high as $11 billion if the upper bound of this range is assumed for the 462 million barrels of capacity not already under construction.

Withdrawal costs are estimated to be between $20 million and $100 million. This cost will depend on the level of withdrawal and could be borne by the purchasers of the oil.

EVALUATION OF COSTS AND BENEFITS

A direct comparison of development costs to the benefits of a strategic reserve must be made carefully. The costs represent federal

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6/ These were for 20-year leases of salt domes, mines, and steel tanks.

outlays over a short period of time for a program that could provide security for many years. The quantifiable benefits of the reserve are measured in terms of offsetting economic losses in the event of future supply interruptions. As shown in Table 2, expected economic loss offsets are exceedingly large. For example, if the country were to face a single year-long supply interruption of 3 million barrels per day, a reserve of 1 billion barrels would avert about $205 billion of GNP loss, compared to development costs of between $5 and $11 billion. 7/

A cost-benefit evaluation of the reserve is difficult without knowing the likelihood of future oil supply interruptions. The probability of future supply interruptions is, however, difficult to estimate. The oil distribution system can be disrupted by logistical problems, political instability, or military action. Historical evidence suggests that the probability of interruptions is not low. Since 1973, when OPEC first began to restrict output, there have been two supply interruptions, the political embargo of 1973-1974 and the interruption resulting from the Iranian revolution beginning late in 1978. Since the UN resolution establishing Israel in 1947, there have been at least four other interruptions of various sizes, including two blockades of the Suez Canal, a bombing of a pipeline in Iraq, and a fire at an oil field in Saudi Arabia. While these interruptions have not all had serious worldwide consequences, they have occurred with an average frequency of once every five to six years since 1947.

There are many situations today that could result in the United States facing shortfalls of up to 5 million barrels per day. Political instability and the possibility of military activity continue to pose a threat to oil market stability. Strained relations between Iran and Iraq, or the United States and Iran, could escalate and result in severe market disruptions. An abrupt, uncompensated export cutback by either Nigeria or Libya, for example, could result in a shortfall to the United States of about 1 million barrels per day. A general OPEC cutback of about 20 percent would cause a 2 million barrel per day shortfall to the United States. Logistical problems or military action at one of the centralized points in the world oil delivery system could result in much larger disruptions. For example, if the Strait of Hormuz were closed, the United States could face

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7/ Because the program benefits are measured in dollars of GNP and the program costs are measured in dollars of federal expenditure, they may not be directly comparable on a net basis. This is because one dollar of federal expenditure may result in an increase of more than one dollar in GNP. This makes the value of net benefits somewhat uncertain. Given the magnitude of the difference between costs and benefits, however, this does not appear to significantly change the results.

TABLE 2. DEVELOPMENT COSTS AND EXPECTED BENEFITS OF A STRATEGIC PETROLEUM RESERVE

SPR Size (millions of barrels)	Development Costs a/ (billions of dollars)	Benefits a/ (billions of dollars)
250	1 b/	45
500	2-3	95
750	3-7	150
1,000	5-11	205

a/ Benefits are measured in terms of averted GNP loss in the event of a shortfall that would require drawdown of the entire reserve in 1984 and are in 1984 dollars. The costs are in current dollars, incurred both before and after 1984. Adjusted to 1984 dollars, the costs of smaller reserve sizes would increase slightly while costs for the larger reserve would decrease. This does not significantly change the results.

b/ At the end of fiscal year 1980, approximately $0.9 billion will have been spent for the first 248 million barrels of storage capacity.

a shortfall of 5 million barrels per day or more. These situations and historical evidence, then, suggest that the United States is likely to face one or more supply interruptions during the next two decades.

Table 2 shows that the probability of an interruption need not be large to make expected benefits of the 1 billion barrel reserve greater than projected costs. The net benefits expected from the reserve increase with the size of the reserve with any fixed probability of total drawdown. Further, using the high end of the cost range, the ratio of benefits to costs of the 1 billion barrel reserve indicates that it would be economic if the probabilities of an interruption were such that complete drawdown is expected during the next 19 years.

CHAPTER III. ALTERNATIVE PURCHASE STRATEGIES

Chapter II indicates that the reserve program, with the Congressionally approved 1 billion barrel goal, would be cost effective. The sooner the reserve is operational, the more protection it will provide. Budget constraints and international oil market conditions, however, restrain the rate at which storage capacity can be built and oil acquired. These factors are discussed here, along with policy options for addressing them.

BUDGET CONSTRAINTS

Budget Effects

The Congress has appropriated $6.9 billion for the SPR to date. At the end of fiscal year 1979, approximately $2.1 billion had been spent, leaving $4.8 billion unexpended ($2.3 billion will require reappropriation by the end of calendar year 1980). An additional appropriation of at least $1.5 billion would be required to complete a 250 million barrel reserve and $55 billion or more would be necessary to complete a 1 billion barrel reserve. Outlays for the reserve would also be a significant portion of annual federal energy expenditures. In the President's January budget for fiscal year 1981, SPR outlays accounted for 16 percent of budget outlays for energy. The SPR outlays would grow to 35 percent by 1984 under the Department of Energy's January budget plan. 1/ This percentage could be even higher should a more aggressive development and oil acquisition schedule be undertaken.

Timing is a critical factor in determining the ultimate budget impact of the reserve program. Generally, the federal government could minimize budget costs by buying oil as soon as possible. CBO currently assumes oil prices will increase in real terms by 2 to 3 percent annually over the next ten years. Savings of this kind, however, might be at least partially offset if a premium would have to be paid in order to accelerate the development of storage capacity. Four development and oil acquisition scenarios were developed to demonstrate the budget impact of alternative completion schedules and the trade off between oil acquisition savings and development cost increases. The scenarios, discussed in detail in Appendix B, include the

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1/ The President's March update to the fiscal year 1981 budget calls for a one-year delay in oil purchases, from June 1980 to June 1981.

DOE schedule as presented in the January Budget request (Case One); a schedule filling existing capacity as quickly as possible (Case Two); a schedule accelerating storage capacity development as well as oil acquisition (Case Three); and a schedule linking oil fill to production levels of federally owned oil reserves (Case Four).

This comparison indicates that the use of more expensive facilities to accelerate the program does not necessarily increase total program costs. The premium that must be paid for more rapid development of facilities may be more than offset by savings realized from the earlier purchase of oil.

The Department of Energy schedule, defined in its fiscal year 1981 budget request submitted in January, calls for resumption of oil acquisition in June 1980 at a rate of 100,000 barrels per day. The rate of acquisition is to remain at this level until the beginning of calendar year 1982, when it is increased to 250,000 barrels per day. This is not the maximum rate of fill that could be accomplished. The maximum rate of fill at existing SPR sites is approximately 400,000 barrels per day. At this rate, existing remaining capacity of 156 million barrels would be filled within 13 months after the resumption of oil acquisition.

Construction of additional storage of 290 million barrels is scheduled to continue through fiscal year 1981 by expanding existing sites. No decision regarding the next expansion has been made. The January budget request, however, includes planning funds for further expansion, including regional storage of 24 million barrels, primarily for the Northeast and Hawaii. Storage capacity of 728 million barrels is projected by 1990. It may be possible, though, to accelerate development in order to take advantage of oil market conditions and to maximize reserve benefits, in spite of the higher development costs.

To expand capacity more rapidly, the government would have to intensify federal efforts or increase the use of the private sector. One of the approaches DOE has considered, the "turnkey" approach, calls for the lease of storage capacity, above or below ground, from private firms. The Department has not proceeded with this approach for two reasons. First because of uncertainty of oil availability, the long-term leases required were not thought advisable. Second, initial contract bids were higher than DOE anticipated and significantly higher than estimated costs of government facility expansion. A willingness to pay a premium for accelerated development would allow greater private sector involvement or more costly above ground storage. Such a policy could result in additional capacity leading to a total of 450 million barrels in 1982 and 1 billion in 1986. The

January DOE plan calls for only 300 million barrels of capacity in 1982 and 560 million by 1987. 2/

Policy Options to Reduce Budget Effects

Options to reduce the net budget impacts of the Strategic Petroleum Reserve include:

- Dedication of a portion of the revenues from a new, energy-related revenue source to the reserve.
- Private financing through a mechanism that allows the speculative trading of titles to reserve oil.
- Reallocation of the subsidy provided by the entitlement treatment of Alaskan North Slope oil.

New Revenue Sources. There are a number of options that the federal government could employ to raise revenues for the reserve program and minimize the net budget impact. The recently proposed oil import fee and the excise tax that was to replace it represent efforts to discourage consumption and to reduce the long-term risks associated with high levels of imports. It might be possible to impose such a fee for the purpose of funding the reserve program. Any formal creation of such a trust fund, however, could reduce Congressional flexibility in allocating budgetary resources.

Private Financing of the Strategic Reserve. If budgetary constraints inhibit the filling of the Strategic Reserve, private financing might be sought. This could be accomplished by allowing investors to purchase a transferable title to reserve oil. The federal government would retain control of the oil but allow the speculative trading of the titles.

In the event of a drawdown of the reserve, the federal government could prorate receipts among all titleholders. In order to prevent price manipulations at the time of sale, the government could agree to charge the price quoted for a reserve barrel title on the day that the President decided to draw down the reserve. A consequent refilling of the reserve could be accomplished by issuing a new set of titles on the open market.

2/ No change in the development schedule was made in the March 1980 revision to the fiscal year 1981 budget request.

Alaskan North Slope Entitlements. Another source of funds might be found in the treatment of Alaskan North Slope (ANS) oil in the entitlements program. 3/ Refiners of Alaskan crude have been provided a subsidy, at the expense of refiners and consumers of other domestic oil, because of ANS oil's unique regulatory position prior to the OPEC price increases of 1979. At that time, refiners were granted entitlements for ANS oil because the sum of wellhead price and transportation costs were higher than the world price for oil. The controlled wellhead price of North Slope oil, plus transportation costs, is now below the world price. The refiners of ANS oil, however, still do not have to buy the right to refine the oil. This implicit subsidy is currently valued at about $5 per barrel, which will be reduced through 1980 and 1981 as the wellhead price is decontrolled. If the federal government were to tax away the subsidy, approximately $1.6 billion could be realized between now and October 1981. This money could then be dedicated to the reserve. DOE is currently exploring alternatives to remove the advantage that refiners of ANS oil receive from its entitlements-free treatment.

WORLD OIL MARKET CONDITIONS

International considerations have played a major role in slowing the progress of the reserve program. Agreements with other members of the International Energy Agency, based on tight market conditions, apparently limit the government purchases of oil for the reserve. In addition, the producing nations have opposed the program publicly.

Relations with Other Nations

Consuming Nations. The IEA member countries agreed in 1979 to consult with each other prior to continued stockpiling. They further agreed

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3/ The entitlements program equalizes the cost of crude oil for all domestic refiners, through the buying and selling of entitlements (defined as the right to refine a barrel of controlled domestic oil). When a refiner refines a barrel of imported oil, he is allowed to sell an entitlement to an entitlements pool. When refining a barrel of controlled domestic oil, he is compelled to buy an entitlement. The value of these entitlements is continually adjusted so that the buying and selling leaves the entitlements pool with a final value of zero. By forcing refiners of less expensive domestic oil to buy the right to refine it, and by allowing refiners of more expensive imported oil to sell their unused entitlements, the system equalizes the average cost of crude oil for each refiner.

that no country would resume stockpiling efforts, if such efforts would result in pressure on the world oil market.

High rates of oil purchase for the reserve in a tight oil market could result in increased prices that would not be limited to SPR oil, but would be felt by all consumers. A high purchase rate of 400,000 barrels per day represents about 1 percent of the oil traded daily on the international oil market. If the oil market were tight and truly competitive, such a purchase rate could increase prices as much as $4 per barrel. 4/ The world oil market does not always exhibit such sensitivity, however, and prices are not set solely by market conditions. Price increases, if any, resulting from SPR purchases are more likely to be politically motivated and, consequently, impossible to predict.

The world situation may never be completely favorable to the federal stockpiling of oil. Current market conditions and the quantities of oil required for the reserve program, however, suggest that resumed stockpiling might not have adverse effects on the market. Moreover, softening spot market prices over recent months and the prospects of a continued recession that would suppress demand indicate that the next 6 to 18 months may present a relatively good opportunity to acquire substantial quantities of oil without significantly increasing oil prices.

Producing Nations. While the position of those producer nations publicly opposing the reserve program is clear, their response to renewed stockpiling is difficult to predict. The possibility of production cutbacks cannot be ignored, especially while countries such as Saudi Arabia are producing at levels above their stated preferences. At the same time, however, some of the smaller producers that rely on spot markets which have been weakening might be willing to negotiate contracts to supply oil to the reserve. After the OPEC meeting in June 1980, however, certain producers, including Saudi Arabia, may reduce production levels regardless of the status of the SPR program.

Policy Options to Minimize Political and Supply Constraints

The above factors notwithstanding, there are policy options that might minimize the political and supply constraints on the SPR. The options to minimize political constraints include the use of federally owned oil and diplomatic or trade agreements. Implementing demand reducing policies or

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4/ The price of oil is assumed to be $40.00 per barrel. The price elasticity assumed is -0.1.

increasing production of federally owned oil could ease the constraints posed by a tight oil market.

Policies to Reduce International Political Constraints. International constraints, caused by producer opposition to the reserve and consumer fears of tight markets and higher prices, might be reduced through the use of federally owned oil to fill the reserve. Cutting off the sale of this oil and earmarking it for the strategic reserve would force its present customers to the world market, however, and thus have the same net effect on oil supplies as open federal purchases. Nevertheless, such policies obviate the need for the government to enter directly into the international oil market.

The federal government currently sells about 130,000 barrels per day from the Naval Petroleum Reserve (NPR), some of which could be traded for oil to be placed in the Strategic Petroleum Reserve. Adverse public reaction to the recent sales at high market prices as well as efforts by purchasers to renege on their contracts provide incentives to use NPR oil for the strategic reserve. There are, however, a number of West Coast refiners that would have trouble replacing this high quality oil or adapting to heavier grades. Although using NPR oil has been cited as a means of reducing the budgetary cost of the SPR, such use would not accomplish this. While SPR outlays would be reduced by the oil transfer, the loss of NPR receipts would offset this outlay reduction.

A second major source of federally owned oil exists in the Gulf of Mexico, in the form of royalty oil due the federal government for offshore leases. This royalty oil is now sold back to the producers or, in some cases, distributed to other refiners. There is approximately 100,000 barrels per day of new production each year, of which about 15,000 barrels per day is owed the government. Policies could be implemented to accept all new royalty oil in kind rather than cash, and dedicate it to the strategic reserve. This would result in an incremental acquisition of 15,000 barrels per day each year. In addition, natural gas leases in the Gulf produce about 3.6 trillion cubic feet per year, yielding the equivalent of about 30,000 barrels of oil per day in royalty gas. Some portion of this gas could be traded for oil to be placed in the SPR.

International political constraints might also be reduced through special trade agreements with oil-producing nations. Oil in exchange for U.S. technology might prove a highly effective form of trade. 5/ Saudi Arabia, for example, might be willing to assure the supply of oil to the

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5/ Congressional Budget Office, The World Oil Market in the 1980s: Implications for the United States, Background Paper (May 1980).

United States in exchange for stronger military support. Less developed oil-producing nations might prefer other types of trade agreements. Some of these agreements, however, might address the long-term problem of oil security more effectively than solving the short-term needs of the reserve program.

Policies to Minimize Oil Supply Constraints. While utilizing federal sources of oil for the reserve might be politically more acceptable to producing and consuming nations, it would still result in additional demand for oil. It might be possible, however, to increase production from these federally owned sources and dedicate the increment to the reserve. For example, the NPR reserve at Elk Hills, California, could produce an additional 30,000 to 50,000 barrels per day and stay within the estimated maximum efficient rate.

Another way to obtain additional oil for the reserve without disturbing the world oil market would be to offset the additional demand by reducing consumption for other uses. Thus the reserve could be filled without increasing the present level of imports. Current and proposed policies, such as utility coal conversion directives and conservation incentives, are aimed primarily at reducing the demand for oil over the next decade and beyond. To make oil available for the SPR, more immediate demand restraint would be needed. This restraint could be achieved by stringent policies, such as gasoline rationing or mandated conservation, or by increased economic incentives for rapid fuel switching, increased energy production, and conservation.

CONCLUSION

This chapter indicates that there are constraints on the rate at which the Strategic Petroleum Reserve can be developed. While these constraints could be reduced or eliminated, there are tradeoffs that must be considered. Total long-term budget effects could be reduced by accelerated storage construction and oil acquisition, though short-term budget effects would be increased. Short-term budget effects could be addressed through the use of private sector funds, the dedication of new energy-related revenues, or changing the entitlement treatment of Alaskan oil.

Earlier reserve completion would provide greater program benefits through earlier protection against supply interruptions, although the more rapid oil purchases might create international tension. Current market conditions and the relatively small levels of oil purchases required by the program suggest that these international concerns might not present a serious constraint, however. Finally, changes in domestic and foreign energy policy might provide additional oil supplies that could be dedicated to the reserve.

APPENDIXES

APPENDIX A. DESCRIPTION OF THE WHARTON ANNUAL ENERGY MODEL

Introduction

Input-output analysis offers an effective technique for studying the relationship between the size of an oil supply interruption and aggregate economic activity. This type of analysis captures both the direct and indirect effects of an oil shortfall.

In this application, however, conventional input-output analysis has some disadvantages. First, conventional input-output analysis assumes fixed technologies and prices--that is, no input substitution is allowed. Second, while permitting the determination of industrial deliveries to final demand, it does not determine the distribution of these deliveries by GNP component. Third, input-output analysis does not recognize inherent output restrictions that exist in such industries as oil and gas.

These problems can be resolved by combining conventional input-output analysis with a framework that permits input substitution, distributes industrial deliveries to final demand across GNP components, and restrains oil and gas output. The energy version of the Wharton Annual Model combines input-output analysis with a macroeconomic model, eliminating many of the problems inherent in conventional input-output analysis.

To determine the impact of petroleum import shortfalls, the Wharton Annual Energy Model (WAEM) is "solved backwards." Restrictions on industrial output restrain the gross output of the model's 63 industrial sectors. The assignment of priorities to each industry in WAEM is based on studies done for the Federal Energy Administration by Resource Planning Associates (RPA) of Cambridge, Massachusetts. The input-output table is then used to determine the feasible set of deliveries to final demand. By comparing the feasible set of deliveries to final demand with the set required by the existing final demand composition, necessary allocation adjustments to final demand are determined. The purpose of these adjustments is to eliminate excess demand for the output of each industrial sector. This procedure is repeated until the final demands are consistent with the constrained output.

The presence of excess demand in the system is an obvious source of inflation during an oil production cutback. The model is structured to allow these inflationary surges either to be passed through to the general price level and wages or, alternatively, to be suppressed. The latter option posits the existence of price restraints, such as controls, to prevent primary prices from adjusting because of excess demand.

Input-Output Analysis of a Foreign Oil Production Cutback

Consider an input-output model of a fictitious three-industry economy consisting of agriculture, steel, and oil. In Table A-1 each column provides a list of the inputs needed for the production of an industrial good. For example, for each $100 of oil output, $25 of input is required from the steel industry, and $65 in labor and capital inputs. Each row gives the distribution of an industry's output. Again, for the oil industry, $25 is delivered to the agricultural industry, $50 to steel, $10 to oil, and $15 to final demand. For each industry, the row and column sums equal the total gross value of output for that sector.

TABLE A-1. SIMPLE INPUT-OUTPUT ACCOUNTING EXAMPLE (In dollars)

	Agriculture	Steel	Oil	Industrial Deliveries to Final Demand	Gross Output
Agriculture	50	0	0	100	150
Steel	25	100	25	50	200
Oil	25	50	10	15	100
Value Added a/	50	50	65	165	---
Gross Output	150	200	100	---	450

NOTE: GNP = $\sum$ value added = $\sum$ industrial deliveries to final demand = 165.

a/ Labor and capital inputs.

Now, consider the same example, with the exception that the single final demand category is broken down into three categories: consumption, net exports, and other final demands (see Table A-2). In this case, both the summation of the value added and the summation of the GNP components yield GNP of $165.

TABLE A-2. SIMPLE INPUT-OUTPUT ACCOUNTING EXAMPLE WITH EXPANDED FINAL DEMAND (In dollars)

	Intermediate Inputs			Industrial Deliveries to Final Demand			
	Agriculture	Steel	Oil	Consumption	Net Exports	Other	Gross Output
Agriculture	50	0	0	80	10	10	150
Steel	25	100	25	0	50	0	200
Oil	25	50	10	10	5	0	100
Value Added a/	50	50	65	---	---	---	---
GNP Components	---	---	---	90	65	10	---
Gross Output	150	200	100	---	---	---	450

NOTE: GNP = $\sum$ value added = $\sum$ GNP components = 165.

a/ Labor and capital inputs.

If the intermediate sector column entries are divided by the gross output of the sector, the proportions for $1 of gross output are obtained (see Table A-3). Similarly, if each component of final demand is divided by its column total, the industrial distribution of $1 of each category of final expenditure is obtained, which yields Table A-3.

Figure A-1 shows the basic structural elements of the simple tables in this appendix. In solving the Wharton Annual Model, a vector of GNP components is first determined (the G vector). The H matrix (or bridge matrix) translates the final demands by GNP component into final demands by the industrial sector (the F vector). The technology matrix (the A matrix) then translates the F vector into gross output by industry (the X vector). Value added is determined by fractioning the gross output into intermediate and primary inputs.

TABLE A-3. SIMPLE INPUT-OUTPUT TABLE IN COEFFICIENT FORM

	Agriculture	Steel	Oil	Consumption	Net Exports	Other
Agriculture	0.33	0	0	0.89	0.15	1.00
Steel	.17	.50	.25	---	.77	---
Oil	.17	.25	.10	.11	.08	---
Value Added a/	.33	.25	.65	---	---	---
GNP Components	---	--	---	1.00	1.00	1.00
Gross Output	1.00	1.00	1.00	---	---	---

a/ Labor and capital inputs.

Figure A-2 shows the direction of solving the input-output relationship, translating final demands into industry output requirements. The difficulty with solving the model using this standard procedure to study the impact of an oil production cutback is that restrictions will be applied to industrial outputs. This means that, rather than using the composition of final demand to determine the composition of industrial output, industrial outputs are predetermined to some degree by the RPA petroleum allocation regulations. Defining XE to be the vector of constrained gross outputs induced by the oil production cutback, Figure A-2 must then be solved "backwards." Thus, a new set of final demands must be derived, given XE. Although the industrial deliveries to final demand can be determined in a rather straightforward manner, given the technology, a difficulty implementing this step arises because no unique relation exists between the industrial deliveries vector (F) and the vector of GNP components (G).

There are several ways to circumvent the indeterminancy problem of directly translating the industrial deliveries vector into the final demand components. One way, used in several earlier studies of oil production cutbacks, is to reduce final demand through some ad hoc procedure until the output constraints are satisfied. An alternative methodology, however, was developed for this study. The basis for the methodology can be summarized by examining Figure A-3, which shows the direction of price conversion in the model. Prices are built up from both unit labor and capital costs, which

Figure A-1.
Basic Input-Output Structure

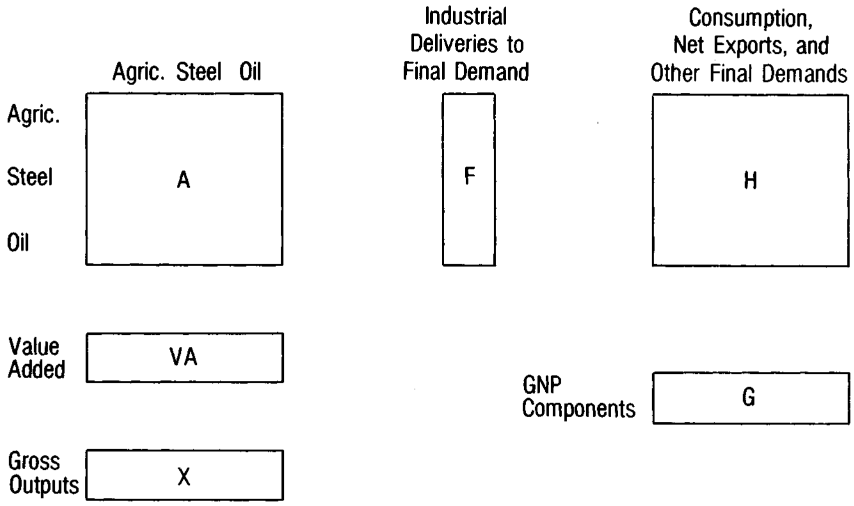


Figure A-2.
Direction of Solution of Input-Output Relationships

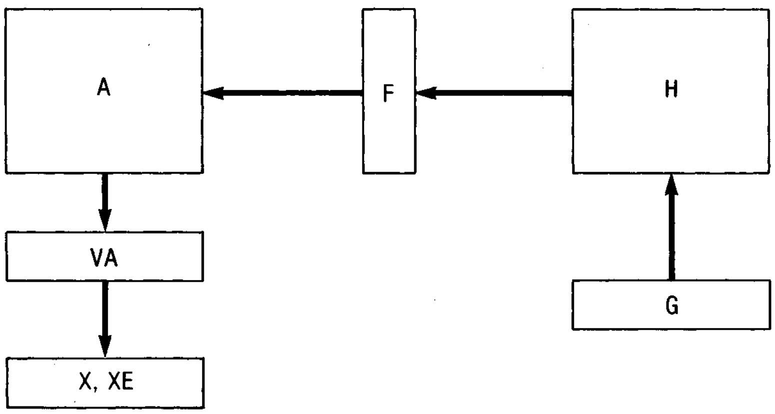
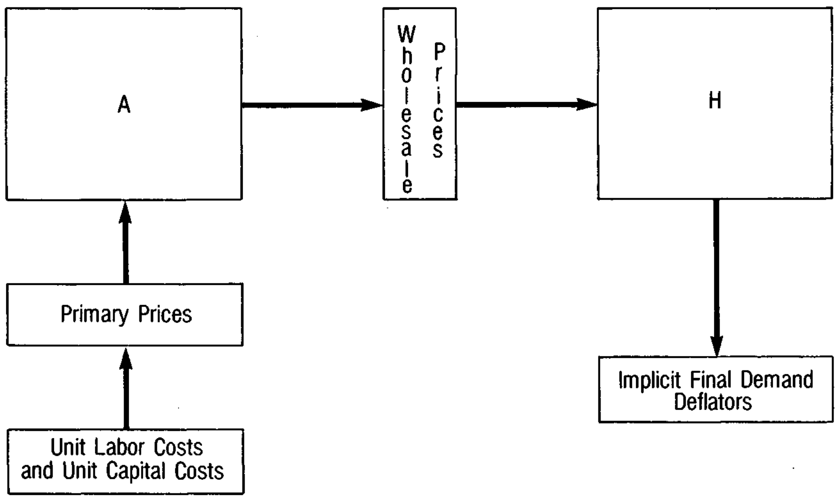


Figure A-3.
Direction of Solution of Price Relationships



in turn determine gross output prices. The gross output prices are then used to determine the implicit final demand deflators. The direction of price conversion in the model parallels the direction of the oil production cutback solution--from the output side, back to final demand.

Price adjustment because of excess demand can be treated in two ways. The methodology can best be explained by writing out the basic relationship for determining gross output prices:

$$P_i^w = B_i P_i^{va} + \sum_k a_{ki} P_k^w \qquad i = 1,\ldots,63;\quad k = 1,\ldots,63;\quad k \neq i$$

where

P_i^w = output wholesale price index for the i^{th} sector,

P_i^{va} = value added deflator of the i^{th} sector,

$\sum_k a_{ki} P_k^w$ = column weighted sum of the input wholesale prices, and

B_i = the ratio of value added to the gross output for the i^{th} sector.

This relation states that the weighted sum of the primary input price for an industrial sector plus the material input prices yields the gross output price for a sector. This relation is modified in the production cutback period to account for excess demand for the sector's output. The revised specification reads:

$$P_i^w = B_i P_i^{va} + \sum a_{ki} P_k^w + J$$

where the additional term J represents the adjustment to prices because of the reduction in deliveries to final demand. J is determined by the fraction of the percentage shortfall that is passed into gross output prices.

Alternatively, the J term can be suppressed. The argument is that price controls permit price increases only sufficient to compensate for increased costs of production, but a mechanism is required to adjust the allocation of final demand. The methodological approach is to bypass the model's normal price channels and transmit the allocational information to final demands by way of "shadow prices"--that is, although the aggregate price level is not affected, relative prices are. The final demands (FDj) are adjusted by the relation:

$$FD_j^* = FD_j \left[\frac{P\ (\text{embargo})}{P\ (\text{preembargo})} \right]^{ej}$$

where FDj*, is the final demand for category j after adjustment for changes in relative prices because of the production cutback. The ej term is an elasticity parameter. These terms are assumed for each component of final demand.

This description has greatly simplified the price-income effects, but the main thrust of the argument is that the proposed methodology systematically solves for a feasible final demand set. The RPA allocation plan determines XE, the constrained set of gross outputs. Given XE, a vector of industrial deliveries to final demand (FE) can be determined. 1/ Using an initial estimate for final demand (G), a corresponding required deliveries vector (F) can be obtained. By comparing the two vectors--FE and F--on a sector-by-sector basis, an excess demand vector is derived. This is used to revise the gross output prices for each industrial sector. In turn, the revised gross output prices adjust final demand prices. For each final demand category, then, a revised estimate is obtained by comparing the constrained and unconstrained final demand prices. This methodology permits either the passthrough of excess demand inflationary shocks or the suppression of those shocks by some form of price controls.

Model Assumptions

Scenarios were designed with varying levels of oil supply interruptions and policy responses and applied to the model. The assumptions made for the simulations used in the analysis are summarized below.

Base Case GNP Growth. The GNP projection is a real annual growth rate averaging 2.7 percent through 1987. The 1984 GNP is projected to be $4.1 trillion in current dollars.

Oil Prices. Decontrol of domestic oil prices by 1982 is assumed. Imported oil prices are projected to increase at an average annual compound rate of 11 percent between 1980 and 1984 and 8.5 percent between 1984 and 1987. The price of imported oil during an interruption is calculated by using a price elasticity with respect to demand of approximately -0.1. After the interruption, the price level is assumed to drop to a level 30 percent above the price at the start of the interruption.

Demand. Total U.S. petroleum consumption is projected to remain relatively stable between 1980 and 1987, at about 18.3 million barrels per day. Domestic production is projected to decline from 8.5 million barrels per day in 1980 to 7.4 million barrels per day in 1987.

Conservation. The degree to which various industries can absorb supply cutbacks without reductions in output differs. In this analysis the average assumed input cutback that could be absorbed is about 7 percent.

1/ See discussion of Figures A-1 and A-2 for definitions of XE and G.

Allocation Policies. The allocation rules used to produce the results presented in the text are intended to minimize GNP losses. Supplies are distributed to demands depending on the degree to which output is affected by input constraints. A second set of allocation rules was incorporated to model those provided by the Energy Policy and Conservation Act (EPCA) of 1975. These rules allocate supplies efficiently only after the demands of public health, safety, farms, transportation, and utilities are met.

APPENDIX B. FOUR RESERVE COMPLETION CASES

Four cases were developed to explore the significance of different oil acquisition and storage construction schedules for the Strategic Petroleum Reserve (SPR). Case One reflects the Department of Energy (DOE) schedule as defined in the fiscal year 1981 budget request made in January 1980. Case Two assumes the highest rate of fill possible of existing storage capacity. Case Three is an accelerated case. In addition to the high fill rate assumed for Case Two, expansion of storage capacity is increased over the current DOE schedule. Case Four is based on linking the reserve schedule to the production levels of federally owned oil reserves.

Case One

Case One is the Department of Energy plan as described in the January version of the fiscal year 1981 budget request to the Congress. This plan calls for the resumption of oil acquisition in June 1980 at a rate of 100,000 barrels per day (3 million barrels per month). The rate of acquisition is to remain at this level until the second quarter of fiscal year 1981 (beginning of calendar year 1982) when the rate would increase to 250,000 barrels per day (7.5 million barrels per month). Construction of additional storage of 290 million barrels is scheduled to continue through fiscal year 1981. This additional storage is the result of expansion of existing sites. No decision regarding the next expansion has been made. The budget request, however, does include planning funds for further expansion, including regional storage (24 million barrels). Storage of 728 million barrels is projected by 1989, assuming the completion of an additional 190 million barrels of capacity (see Table B-1). 1/

1/ The President's revised budget, as announced in March 1980, calls for the delay of oil purchases from June 1980 until June 1981. No changes in the development schedule were planned. This delay in oil purchase would increase the cost of completing the reserve by approximately $0.5 billion.

TABLE B-1. CASE ONE--DOE SCHEDULE (By calendar year, in millions of barrels)

	Storage Capacity Available	Oil Acquisition	Total Oil Stored
1980	250	20	113
1981	250	36	149
1982	308	90	239
1983	385	90	329
1984	406	77	406
1985	461	55	461
1986	562	101	562
1987	617	55	617
1988	677	60	677
1989	728	51	726

Case Two

Case Two assumes the highest rate of oil acquisition to fill existing capacity, or approximately 400,000 barrels per day (12 million barrels per month). This rate would fill the existing sites within 13 months (by July 1981 assuming that acquisition begins in June 1980). The Department's January budget plan is followed over the remaining period (see Table B-2).

TABLE B-2. CASE TWO--ACCELERATED OIL ACQUISITION (By calendar year, in millions of barrels)

	Storage Capacity Available	Oil Acquisition	Total Oil Stored
1980	248	72	164
1981	250	86	248
1982	308	58	308
1983	385	77	385
1984	406	21	406
1985	461	55	461
1986	562	101	562
1987	617	55	617
1988	677	60	677
1989	728	51	728

Case Three

Case Three is an accelerated scenario. The highest rate of fill possible is assumed for existing capacity, as in Case Two, along with an acceleration in the expansion of storage capacity. This could be accomplished by using the "turnkey" approach originally planned by DOE. The turnkey approach called for the lease of storage capacity developed by private firms. The Department has not proceeded with this approach for two reasons. First, because of the uncertainty of oil availability, the long-term leases required were not thought advisable. Second, initial contract bids were higher than DOE anticipated and significantly higher than projected costs of government facility expansion. While resulting in higher costs for storage capacity, this case would result in the storage of 728 millions of barrels by 1986, compared to 562 million in Cases One and Two and 482 million in Case Four (see Table B-3)

TABLE B-3. CASE THREE--ACCELERATED STORAGE DEVELOPMENT AND OIL ACQUSITION (By calendar year, in millions of barrels)

	Storage Capacity Available	Oil Acquisition	Total Oil Stored
1980	248	72	164
1981	250	84	248
1982	408	160	408
1983	585	177	585
1984	706	121	706
1985	861	155	861
1986	1,000	141	1,000
1987	1,000	---	1,000
1988	1,000	---	1,000
1989	1,000	---	1,000

Case Four

The fourth case assumes the slowest fill rate, matching the rate of oil acquisition with the rate of production of the Naval Petroleum Reserve (NPR), thus maintaining the NPR as a national reserve. The production level is projected to be 165,000 barrels per day, or 5 million barrels per month (see Tabel B-4). This scenario could be accomplished by using the NPR oil for the SPR or by requiring SPR purchases to match the NPR production level.

TABLE B-4. CASE FOUR--RELIANCE ON FEDERALLY OWNED OIL (By calendar year, in millions of barrels)

	Storage Capacity Available	Oil Acquisition	Total Oil Stored
1980	250	30	122
1981	250	60	182
1982	308	60	242
1983	385	60	302
1984	406	60	362
1985	461	60	422
1986	562	60	482
1987	617	60	542
1988	677	60	602
1989	728	60	662
1990	728	60	722
1991	728	60	728

Basic Cost Assumptions

Development costs for storage averaged about $3 per barrel for the first 248 million barrels and are expected to reach about $5 per barrel for the next 290 million barrels by the expansion of existing sites. The third increment of capacity (250 million barrels) is projected to cost up to $9 per barrel. These estimates are based on the proposed storage costs made by the private sector during preliminary turnkey negotiations. For Case Three, an average cost of about $20 per barrel was assumed for all storage beyond the first 538 million barrels. This assumption was made to reflect the premium that might be required to accelerate development.

Oil acquisition costs are based on CBO's projections of oil prices (refiner acquisition costs) over the relevant period. Although the SPR pays domestic refiner acquisition prices, it also must pay a higher transportation cost because of required adherence to the cargo preference law and pipeline costs. This projection is based on an annual inflation rate of 8 percent and an annual real price increase of 2 percent for oil.

Estimated Reserve Costs by Case. The January DOE plan (Case One), calls for 300 million barrels of capacity in 1982, 560 million barrels by 1987, and a 728 million barrel reserve by 1990. Based on CBO assumptions, this plan results in a total project cost of $42.7 billion.

Case Two--filling existing capacity as quickly as possible--would save about $1 billion of the $43 billion that would be spent for a 728 million reserve under the DOE schedule (see Table B-5). 2/ This would result in a reserve of 248 million barrels by July of 1981.

TABLE B-5. SUMMARY OF COSTS FOR A 728 MILLION BARREL RESERVE (In billions of dollars) a/

	Case One	Case Two	Case Three	Case Four
Storage Development	2.8	2.8	6.3	2.8
Oil Acquisition	39.9	38.7	31.7	42.6
Total	42.7	41.5	38.0	45.4

a/ This excludes expenditures through fiscal year 1980, which total $0.9 billion for development and $1.3 billion for oil acquisition in previous years.

The accelerated scenario (Case Three) shows that, for a 728 million barrel reserve, about $4.7 billion could be saved from the DOE schedule, despite the higher development costs necessary to maintain sufficient storage capacity to meet an aggressive fill schedule. A total of 728 million barrels would be stored by 1986 under this scenario, compared to same level in 1989 under DOE's current plan. A 1 billion barrel reserve could be completed by 1987 under the accelerated schedule at a total cost of approximately $62 billion. A slower development schedule would result in even higher costs. Whether such a schedule could be achieved would depend on both the availability of oil and how quickly storage capacity could be completed.

2/ The savings would be as much as $1.5 billion when compared to the additional purchase delay called for in the President's March update to the fiscal year 1981 budget request.

Case Four--linking oil fill to production from federally owned oil reserves--is the slowest of the cases and would cost the most. The 728 million barrel reserve would not be completed until 1991, at a cost of more than $45 billion--almost $3 billion more than DOE's plan.

Estimated Reserve Costs by Size. The costs of a number of reserve sizes were estimated assuming the varying schedules of the four cases. To complete a 248 million barrel reserve would cost between $6 and $7 billion in addition to about $770 million for development and $1.3 billion for oil spent prior to fiscal year 1980, depending on which case is assumed.

The cost of a 538 million barrel reserve is estimated to be between $25 billion and $27 billion in addition to the funds spent through fiscal year 1979, the lower cost resulting from an accelerated schedule. The costs to complete a 728 million barrel reserve also depend on the schedule assumed. As indicated in the discussion of the various cases, costs for a reserve of this size range from approximately $41 billion to $45 billion, the lower cost again resulting from an accelerated schedule. The final goal of 1 billion barrels will cost at least $62 billion based on these estimates. The accelerated schedule reaches this goal by 1986; no other schedule reaches a billion barrels until after 1990. Later achievement of this goal will likely cost more than the accelerated case.

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