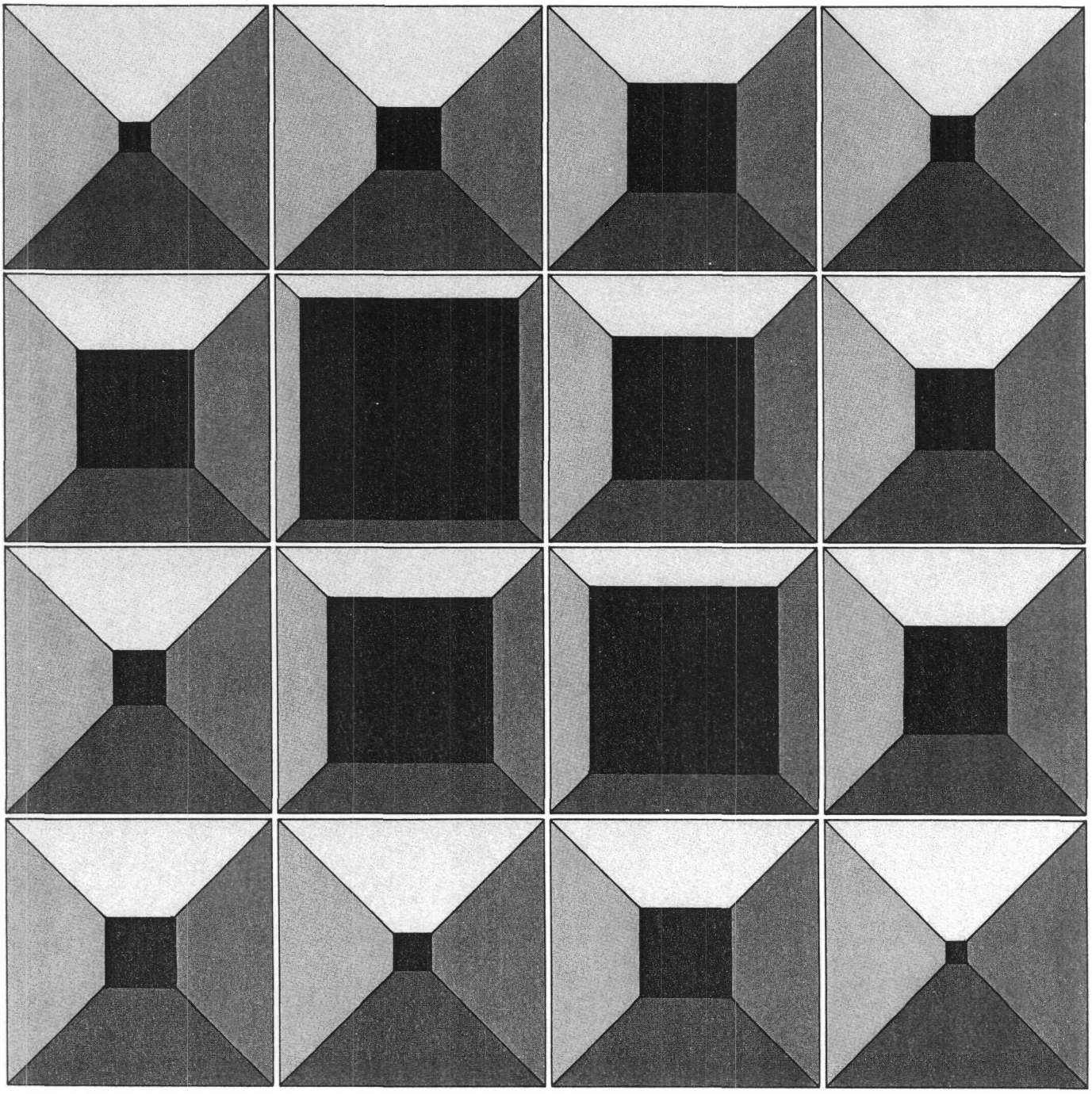
BACKGROUND
PAPER

The World Oil Market in the 1980s: Implications for the United States

May 1980

Congress of the United States
Congressional Budget Office



THE WORLD OIL MARKET IN THE 1980s:

IMPLICATIONS FOR THE UNITED STATES

The Congress of the United States
Congressional Budget Office

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Alice M. Rivlin
Director

ERRATA SHEET

THE WORLD OIL MARKET IN THE 1980s: IMPLICATIONS FOR THE UNITED STATES

Page xi: The last line of the second full paragraph should read: "total stocks over this period are assumed to be zero."

Page xv: The third paragraph should read: "Further conservation of gasoline could be achieved either through higher federal mileage standards or through larger penalties for violation of the standards. Gasoline prices have only now risen to the level at which the costs of new fuel-saving investments are outweighed by their benefits."

Subsequent to the preparation of this report, because of recent automotive fuel price increases, CBO reestimated the costs and benefits of fuel savings. The results of the updated analysis are presented in testimony by Alice M. Rivlin, Director, Congressional Budget Office, before the Subcommittee on Science, Technology and Space of the Senate Committee on Commerce, Science and Transportation, May 14, 1980.

Page 13: The tenth line of the third paragraph should read: "the world oil market will be forced to absorb an excess demand of 4.4 million barrels per day in 1985, and 10.6 million in 1990."

Page 59: Contrary to the first and second paragraphs, the estimates presented here of the economic effects of oil import disruptions do not assume price controls. Controls were dropped from this simulation in order to discern the full extent of oil price increases in the event of a disruption. In addition, it was found that controls accompanied by allocations exacerbated shortages of oil inputs to industry. Thus, the 20 percent constraint on domestic oil prices and the allocation regulations cited in the first paragraph were not in effect for this analysis. A more detailed analysis of the economic effects of oil supply disruptions is presented in a forthcoming CBO report, The Strategic Petroleum Reserve: An Analysis. The numbers in Chapter V (and specifically in Table 16 on page 60) reflect the case in which price controls are not imposed. These macroeconomic results were obtained directly from the Wharton Econometric Forecasting Associates Annual Model: The Energy Version.

PREFACE

Through a variety of legislation, the 95th and 96th Congresses have constructed the elements of a national energy policy. Common to this legislation has been the goal of reducing oil imports. Nevertheless, imports may increase over the coming decade, as demand for oil rises and domestic supplies decline. In addition, the costs of replacing oil imports may be exceptionally large. Thus, the United States may be forced to reassess its approaches to solving the energy problem and to reducing the risks inherent in dependence on foreign oil.

At the request of the Senate Energy and Natural Resources Committee, the Congressional Budget Office (CBO) has prepared this analysis of oil imports over the coming decade, and the possible policy responses to them. In keeping with CBO's mandate to provide objective analysis, this report contains no recommendations.

The report was prepared under the supervision of Raymond C. Scheppach, with the assistance of Everett M. Ehrlich, the principal author. Sections of the report were written by Robert F. Black, Barry J. Holt, John J. Korbel, and Lawrence Oppenheimer of the Natural Resources and Commerce Division; Mark P. Berkman of the Budget Analysis Division; and Jane D'Arista of the National Security and International Affairs Division. Beth Blattenberger, Richard D. Morgenstern, Craig R. Roach, James Sawyer, and Mark Sharefkin also participated in various phases of this report. The Congressional Budget Office is indebted to consultant geologist A.A. Meyerhoff for his assistance and review of the supply analyses herein.

Robert L. Faherty, Patricia H. Johnston, and Francis S. Pierce edited the manuscript, assisted by Mary A. Anders. Angela Evans, Phyllis Gustely, and Deborah Vogt typed the several drafts.

Alice M. Rivlin
Director

May 1980

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SUMMARY

The United States imported about 8 million barrels of oil per day in 1979--or about 42 percent of its total supply. This could increase to 52 percent by 1985 and 57 percent by 1990 if the present trend continues.

The thrust of U.S. energy policy since the early 1970s has been to reduce imports of oil by substituting domestic sources of energy. The real magnitude of the task is only now becoming apparent. U.S. oil production will inexorably decline during the 1980s as reserves are depleted, making it even more difficult to reduce the volume of oil imports. Moreover, the effort to substitute more expensive alternative fuels or energy sources for imported oil will impose an additional burden on the economy.

Policymakers are thus faced with a dilemma. The dependence on oil imports poses a distinct set of "risks" for the U.S. economy, which may be identified as economic losses or costs that are not included in the price of oil. If imports are not reduced, the U.S. economy will continue to be vulnerable to interruptions in the flow of foreign oil, as well as to rising prices and other risks. On the other hand, the costs of substituting domestic energy sources for foreign oil will be very high.

Other alternatives are, therefore, worth considering. For example, rather than reducing imports, policymakers might choose to accept the inherent risks imports pose, and prepare for their consequences through such means as the Strategic Petroleum Reserve or macroeconomic policies to bolster the dollar. Another kind of option would be to diversify oil sources so as to minimize the risk of a break in supply, or to link purchases of foreign oil to U.S. exports. To the extent that this latter effort succeeded, it would decrease the burden on the U.S. balance of payments. These alternatives to protect the United States from the effects of rising oil imports can be grouped under three general kinds of policies:

- Policies to reduce oil imports.
- Policies to offset the economic losses posed by imports when they occur.
- Policies to reduce the risks inherent in any level of oil imports.

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RISKS ASSOCIATED WITH OIL IMPORTS

To determine the proper combination of policy approaches, the risks of oil import dependence must be understood. They fall into four general categories:

- o Vulnerability to supply interruptions.
- o Long-term price increases.
- o Deterioration of the dollar.
- o Constraints in foreign relations.

Vulnerability to Interruption

Of the four kinds of risks, vulnerability to disruption in the flow of foreign oil is viewed as the most serious, and has the greatest potential consequences.

Disruptions can occur because of political instability in producing countries, as happened in Iran in 1978-1979. Since most OPEC oil is produced and controlled by state-run national oil companies, political upheavals may have unforeseeable effects. Disruptions can also occur because of logistical factors, such as the oil field fire in 1978 that reduced Saudi Arabian capacity by a million barrels per day. Such a disruption could have severe consequences if it occurred at one of the centralized points in the world oil delivery system--for example, Ras Tanura in Saudi Arabia or Kharg Island in Iran. Finally, disruptions can occur as a result of military action.

While there is no way of estimating the likelihood of disruptions, it is possible to estimate their consequences. If, for example, Saudi production were to be completely cut off in 1984, this would reduce available exports to the United States, Western Europe, and Japan by about 9 million barrels a day.

An interruption of this magnitude would cause rapid increases in world oil prices which would, in turn, reduce demand somewhat and bring additional supplies to the market, as has happened in the past. Countries belonging to the International Energy Agency would share their supplies, but the United States could still be left with a shortfall of 3.5 million barrels per day. It is estimated that, if the disruption continued for a year, the

gross national product (GNP) would be reduced by $272 billion, the unemployment rate increased by 2.1 percentage points, and the inflation rate increased by 20 percentage points. Thus, the costs associated with a major supply limitation of a year's duration would be large.

Long-Term Price Increases

The analysis of the world oil market presented in this paper assumes an average price of $30.00 per barrel in the fourth quarter of 1979, rising thereafter at an annual rate 2 percent greater than increases in the general price level. It also assumes that no major institutional changes occur in the oil market, that no import quotas are imposed, and that no production-sharing arrangements are made by OPEC.

Under these assumptions, total world demand outside of the Soviet bloc and China is projected to be 58.9 million barrels per day in 1985 and 66.4 million in 1990. Corresponding to these levels of world demand, world supply is projected to be 54.5 million barrels per day in 1985 and 55.8 million in 1990. U.S. imports are projected at 10.1 million barrels per day in 1985 and 11.3 million in 1990. OPEC production is estimated at 30.1 million barrels per day in 1985 and 31.3 million in 1990. Increases and decreases in total proved reserves over this period are assumed to be zero.

These projections depict a tight oil market in the later 1980s, with an excess demand of approximately 10.6 million barrels per day occurring in 1990 under the price assumption employed in this analysis. This suggests that prices higher than those assumed here are inevitable. Yet even if demand were restricted to levels within the bounds of the projected supply, this would not guarantee stable prices. For many producing countries, the price increases of 1979 have created a surfeit of revenues, and these governments have undertaken to set prices and output at levels that best serve their own development and investment needs rather than market demands. This raises the possibility that producers may set future price increases independent of the market and maintain them by proportionate production cutbacks.

Higher oil prices will affect the prospects for economic growth in the United States and other industrialized countries. Higher oil prices erode consumer purchasing power and business profits, lowering demand and investment, while at the same time increasing inflation. Moreover, the uncertainty created by the expectation of further oil price increases may induce a continuing shift from productive to speculative assets, thereby lowering the prospects for long-term growth of output, employment, and productivity.

Ultimately, of course, there are constraints on rising OPEC prices. Higher oil prices would make nonconventional liquid fuels, solar energy applications, and conservation measures more economic, and speed their development. But this would occur only in the long run. The short-term constraint on OPEC price increases is limited to the conservation brought about by a slowdown in economic growth.

Deterioration of the Dollar

As oil prices rise, the flow of dollars from the United States to oil producers increases. The ability of the producing countries to "recycle" their incomes through imports of capital and other goods from industrialized countries is decreasing, however, because of their limited capacity to absorb added investment revenues productively. Thus, higher oil prices will result in a growing glut of dollars abroad. This, in turn, will make continued downward movements of the dollar likely, and such movements have immediate inflationary effects on the U.S. economy. Hardest hit would be industries such as steel or automobiles, in which foreign competition now makes it difficult to raise domestic prices. Moreover, devaluation might further increase dollar outflows since it would require larger expenditures for the same volume of imports.

In the long run, continued dollar devaluations might result in an abandonment of the dollar as the world's reserve and transactions currency. Foreign holdings of dollars are estimated to be approaching $1 trillion. If the dollar were dropped by OPEC as the denominator of oil trade, world currency managers might take this as a signal that the dollar was no longer capable of performing its unique function. This would create added uncertainty and volatility in the world monetary system.

Oil imports are not the only source of the U.S. trade deficit. Deficits existed before the 1973-1974 oil price increases. Moreover, some countries that are far more dependent on oil imports than the United States have not experienced similar balance-of-payments problems. Other factors of major importance in the U.S. trade deficit are:

- Slow Economic Growth in Other Industrialized Countries. After the 1974-1975 recession, the U.S. economy recovered more rapidly than those of its European trading partners. In 1976 and 1977, this slower growth in Western Europe led to a decreased demand for U.S. exports, and exacerbated the U.S. trade deficit.

- o Changes in Relative Inflation and Interest Rates. In the short run, differences in relative rates of inflation and interest cause capital to move from one country to another. Such capital movements have a pronounced effect on the relative values of currencies. Until 1979, low U.S. interest rates kept short-term capital out of the country.

- o Deteriorating Trade with LDCs. Less developed countries (LDCs) are now the largest market for many exports from industrialized nations. The United States runs a deficit against these countries, while other major industrialized nations run surpluses by filling a larger share of Third World import orders. This is caused, in part, by greater orientation on the part of their governments and businesses toward exports to LDCs.

- o Technological Lag in U.S. Exports. The United States is lagging in the sale of some "high-technology" goods, and although measurement is difficult, some critics see the lag as increasing. The severity of this problem may grow as the composition of trade shifts from goods to technological transfers.

Thus, even if oil imports were to remain constant, other factors could worsen the U.S. balance-of-payments problem. Regardless of the U.S. payments position, an ever-increasing outflow of dollars for oil imports might of itself create enough pressure to force a replacement of the dollar as the world's reserve currency.

Relations with Other Countries

Reliance on foreign supplies of oil affects U.S. political relations with several blocs of countries. The effects of this reliance are most pronounced on U.S. policy toward the Middle East and, to a lesser degree, on U.S. relations with industrialized allies and the Soviet Union.

Increasingly tight oil supplies may lead to competition for access to oil supplies. While the creation of the International Energy Agency has eased tension somewhat, the use of state-managed national oil companies as a tool of foreign policy by the European community and Japan has encouraged this competition.

The Soviet Union is, at present, an energy exporter, and benefits greatly from its cash sales of oil and natural gas. This position should change as Soviet oil production declines in the early 1980s. If the Soviets

make the transition to energy imports an orderly one, buying at the world price in world markets, U.S.-Soviet relations may be unaffected. But if they attempt to create political blocs or to set up new governments in the producing nations in order to gain preferential access to oil, the impact on U.S.-Soviet relations could be significant.

In 1985, 40 percent of the world's oil will come from the Persian Gulf region. This may put pressure on the United States to give greater consideration to a Palestinian state and to a military presence in the Arabian Sea or Indian Ocean. While a politically imposed cutoff of Persian Gulf oil in support of the Palestinian cause seems unlikely at this time, the failure of moderate governments in producing countries to obtain a settlement may lead to instability in those countries.

POLICY RESPONSES TO RISING OIL IMPORTS

A response to the foregoing problems could invoke three types of energy policy. One set of measures would seek to reduce the level of oil imports, and their concomitant risks. Another set of measures would address the losses posed by oil imports once they occur. A third would reduce the level of risk associated with any given amount of imports. The use of one set of policies would not preclude the use of others.

Reducing Oil Imports

There are several available methods to reduce oil imports, including substitution of new energy sources, such as synthetic liquids or solar applications; conservation activities; and restrictive quotas, tariffs, and fees. Some of these policies are discussed below.

New Energy Sources. Shale oil, anticipated to carry a current resource cost of approximately $30 per barrel, provides a refinable substitute for crude oil. Environmental problems posed by shale oil production are yet to be resolved, however, including disposal of spent shale and possible damage to aquifers in shale-bearing regions.

Methanol production from coal is a mature technology common to the organic chemicals industry. Large-scale production of methanol from coal is expected to carry a resource cost of $30-$40 per barrel.

Solar heating and cooling are anticipated to carry a resource cost of $40 per barrel, although they pose smaller environmental costs than synthetic liquids. Solar applications, however, will first become economic in uses that replace electricity rather than oil, and in regions that now predominantly use gas, coal, or nuclear power rather than oil for heating and cooling.

Conservation. Additional incentives, particularly for weatherization, could be provided to encourage household conservation of oil and gas. The large aggregate energy savings that are possible in household uses depend on millions of household consumers correctly perceiving the economic signals to conserve, and having the wherewithal to make sizable front-end investments.

Further conservation of gasoline could be achieved either through higher federal mileage standards or through larger penalties for violation of the standards. In the absence of these standards, gasoline prices will have to rise further before the costs of new fuel-saving investments are outweighed by their benefits.

Import Fees and Quotas. If the risks associated with oil imports become so severe that an immediate reduction in imports is warranted, either fees or quotas could be applied to them. Doing so, however, would either raise consumer prices or call for the reinstitution of some form of price controls. Alternatively, taxes could be placed on individual products such as gasoline, although consumption has in the past shown only slight responsiveness to higher gasoline prices.

Offsetting the Losses Created by Oil Imports

While reducing imports may be economically effective, it may not be possible to reduce them to levels at which some of the concomitant risks become tolerable. Disruptions in supply, for example, can occur at any level of imports. Another group of policies would seek to address the losses posed by continued oil imports, rather than reducing the imports themselves. The following policy options are among those that serve this end.

Strategic Petroleum Reserve. The Strategic Petroleum Reserve (SPR) could be highly effective in mitigating the effects of oil import disruptions. In the event of an import disruption of 3.5 million barrels per day in 1984, each barrel of a 500 million barrel SPR might result in GNP savings of $72 to $334. Coupled with the likely appreciation of the reserve over time, the SPR emerges as a cost-effective policy.

Rationing. In the event of a supply disruption, rationing could allocate shortages of up to 1 million barrels per day with minimum GNP losses. Rationing would, however, take several weeks to put into place, and could not allocate larger shortages without heavy GNP losses.

Macroeconomic Policy. Conventional macroeconomic and international trade policy might help correct for import-related losses. Expanding the money supply in line with oil price increases might reduce their recessionary impact. Similarly, manipulation of interest rates and exchange rates might induce recycling of petrodollars, but at the potential cost of a recession.

Reducing the Risks Associated with Oil Imports

Whether or not oil imports are directly reduced through quotas or through subsidization of alternatives, it might be desirable to enact measures aimed at reducing the risks associated with any given level of imports. This type of policy is concerned with securing oil imports on the best possible terms. If effective, it would enable the United States to tolerate a higher level of imports and to pay a smaller "premium" for alternative domestic energy. The primary thrusts of the policy would be to encourage imports less vulnerable to disruption, promote the recycling of petrodollars, and establish better relations with countries that produce or import oil. It might also seek to induce expansion of output from existing producers. It would include the following measures.

A Strategy for Oil Proliferation. An effort could be made to finance oil and gas exploration in Third World countries outside OPEC. Some countries and international institutions have pursued the equivalent of this strategy by opening "lending windows" for this purpose, or by directing state-owned oil companies to work toward it. If the policy succeeded, supplies from non-OPEC countries would grow, lessening U.S. vulnerability to disruption, and reducing price increases in the long run.

Heavy Oil. The underdeveloped deposits of heavy oil along Venezuela's Orinoco River are potentially larger than the world's reserve of conventional crude oil. The United States could help to develop them through financing, technology transfer, and marketing guarantees.

New Assets for OPEC. Several proposals have been made to create a special asset to pay for oil whose return would be linked to inflation and the value of the dollar. This would protect producing countries from erosion in the value of their petrodollars, and encourage them to expand their

investment in oil production. A variant of this proposal, put forward by former Venezuelan President Carlos Andres Perez, would use surplus petrodollars, matched by funds from the Organization for Economic Cooperation and Development, as the basis for a "Marshall Plan" for the world's underdeveloped countries.

Bilateral Trade. A bilateral agreement to exchange oil for development-oriented goods and technological transfers could, in principle, benefit both parties. Japan now imports approximately 1 million barrels per day (20 percent of its imports) under various state-to-state deals. A failure to adopt a policy of this type might be disadvantageous to the United States, if other oil importing countries secured preferential access to crude oil through this method.

Dialogue Between OPEC and Industrialized Countries. Many believe that formal talks between the oil producing and oil consuming states are inevitable. Such a conference could go beyond the questions of oil price and availability, and address issues such as the role of the dollar in oil payment, technological transfer to the OPEC countries, implementation of the UN's New International Economic Order, and political issues that influence the oil market, such as the Palestinian question. Such a dialogue might be an inevitable precondition to long-term stability in the oil market. As Alberto Quros, president of Venezuela's state-owned oil company, Maraven, has stated:

> Interdependence is the only way out, but only the developed nations can really take the steps leading to partnership with the developing world . . . . What is needed is a long-term understanding under which OPEC would now supply the volumes the world needs at prices that consumers can afford, in exchange for future considerations, financial assets, market prices, technology transfer and trade, in which the OPEC producers can have some confidence.

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CHAPTER I. INTRODUCTION

In response to sharply increased world oil prices and the instability of oil imports, the 95th and 96th Congresses passed several pieces of crucial energy legislation, putting a national energy policy into place. Natural gas and petroleum product fuel prices will now more accurately reflect their market levels. A program to develop synthetic liquid fuels and gas, financed in part by the federal government, has been started, and firms engaged in this development may be given expedited regulatory treatment through an Energy Mobilization Board. Tax credits and grants are being used to subsidize conservation of energy, and low-income families are being offered assistance adjusting to higher energy prices. A program for gasoline rationing is under development for use in the event of emergencies, and the Strategic Petroleum Reserve may resume purchases. Revenues from a "windfall profits" tax may be available for many of these projects.

Despite these actions, the oil import problem remains unsolved, partly because of declining domestic production and a persistent demand for oil. Barring significant price increases or new policy decisions, another decade of oil imports lies ahead. By the end of the 1980s, the United States may be importing more oil than it did at the beginning.

The U.S. dependence on oil imports 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. The extent of the risks is governed by both the level of imports and the state of the world oil market. The flow of imports, for example, can be disrupted for both political and logistical reasons, and disruptions larger than those experienced in 1973 and 1979 are possible. These disruptions would depress the growth of the gross national product (GNP) and lower the U.S. standard of living. The price of imports may continually rise, dampening the long-term prospects for economic growth and increasing inflation. Imports create dollar outflows unmatched by the demand for U.S. goods, services, and assets. These depress the value of the dollar and may jeopardize the world monetary system. U.S. relations with other countries may be affected by the nation's linkage to foreign oil.

While policies to reduce oil imports may be successful, lower import levels will probably not be realized until the 1990s. Moreover, regardless of their success, import reduction policies do not confront directly the risks that oil imports will pose, even at reduced levels.

The Congress will, therefore, have to decide if a "second round" of energy policy is necessary, and if so, what form it should take. Making these judgments will require an appraisal of the oil import problem over the next decade--an appraisal not only of the future level of imports, but also of the risks these imports will present for the United States.

This paper analyzes each of these risks individually, and discusses the array of possible policy responses to them. Chapter II of this report presents projections of U.S. supply and demand for oil in the coming decade. Chapter III incorporates these projections into a broader analysis of the world oil market in the coming decade, and examines the prospects for higher oil prices and their effect on the U.S. economy. Chapter IV analyzes the potential impact of the projected oil import levels on the U.S. balance of payments and the future of the dollar. Chapter V discusses the security of future oil supplies and the possible effects of sustained oil imports on U.S. relations with critical groups of nations. Chapter VI describes the policy responses to these risks that are available to the Congress.

CHAPTER II. PROJECTIONS OF U.S. SUPPLY AND DEMAND FOR OIL

U.S. imports of crude oil and refined products increased dramatically in the last decade, and they are projected to continue to rise in the coming decade although at a more moderate rate. From 3 million barrels per day in 1969, imports grew to 6 million barrels per day in 1973 and 7.8 million in 1979. Assuming that oil prices rise by 2 percent annually in real terms and that current federal policy remains unchanged, the level of oil imports is estimated to reach 10.1 million barrels per day in 1985. By 1990, this level may reach 11.3 million barrels per day. The projected import levels represent the difference between estimates of future demand for oil in the United States and estimates of the supply of domestic oil. These estimates are developed in this chapter.

DOMESTIC OIL DEMAND

The Demand for Energy: An Overview

The U.S. demand for energy from all sources will continue to grow during the 1980s, reaching the equivalent of 47.8 million barrels of oil per day by 1990, a 22 percent increase over total energy demanded in 1979 (see Table 1). This is an average annual increase of 1.8 percent a year, as compared with the higher rate of 3.7 percent a year for the postwar period.

The domestic demand for oil will also continue to grow gradually during the next decade, rising from 18.5 million barrels per day in 1979 to 19.5 million in 1985 and 19.9 million in 1990. But the share of oil as a source of primary energy is projected to decline substantially, from 47.6 percent of the total in 1979 to 41.6 percent in 1990.

This slowdown in the rate of growth of domestic demand for energy and the decline in the share of oil as a primary energy source can be attributed to several factors. First, demographic trends suggest slower increases in the labor force, in persons of driving age, and in new households. Second, the 1980s are likely to see a slower rate of growth in the gross national product (GNP), and this will dampen domestic demand for energy. Third, structural shifts now underway in the composition of the economy, stressing less energy-intensive processes and new technologies, suggest that the demand for energy will grow at a slower rate than output, and that this gap will increase over time. Fourth, price increases, especially

TABLE 1. U.S. ENERGY DEMAND BY PRIMARY ENERGY SOURCE IN 1979, 1985, AND 1990 (In millions of barrels per day of oil equivalent)

Energy Source	1979 (Estimated)	1985 (Projected)	1990 (Projected)
		Amount	
Oil	18.7	19.5	19.9
Natural Gas	9.8	9.5	9.7
Coal	7.6	10.0	12.2
Nuclear Energy	1.5	2.6	3.9
Hydropower	1.5	1.5	1.5
Other a/	0.2	0.3	0.6
Total	39.3	43.4	47.8
		Percent Distribution	
Oil	47.6	44.9	41.6
Natural Gas	24.9	21.9	20.3
Coal	19.3	23.0	25.5
Nuclear Energy	3.8	6.0	8.2
Hydropower	3.8	3.5	3.1
Other a/	0.5	0.7	1.3
Total	100.0	100.0	100.0

SOURCE: CBO, using Data Resources, Inc. (DRI), energy model, December 19, 1979.

a/ Includes solar and other renewable resources.

for oil, will provide an incentive for both households and businesses to conserve oil. Finally, recent and future energy price increases may make unconventional sources of energy economically viable, thereby encouraging their development and use. The following section on methodology discusses these factors in greater detail.

Methodology

Forecasts of future energy consumption, and in particular the consumption of oil, cannot be made with certainty. The level and mix of future energy demand will depend upon general economic activity and changes in energy prices. Estimates presented in this section are based on a detailed model of the U.S. economy that specifies energy consumption by sector. 1/ The projections assume a 3 percent annual growth in real GNP and a 2 percent real annual increase over a base of $30 per barrel in the fourth quarter of 1979.

Growth in the national economy will entail a rising demand for energy. If GNP grows at 3 percent a year (which is slightly less than the 3.5 percent average rate for the postwar period), energy demand may be projected to grow at 1.8 percent a year. Energy demand grows at a slower rate than the economy generally because changes in the structure of the economy, together with the development of new production processes and technologies, lead to reduced energy needs. The tendency of industrialized societies to use relatively less energy over time per unit of output can be measured by an energy/GNP growth coefficient, representing the change in energy demand associated with a change in GNP. Thus, an energy/GNP growth coefficient of 0.8 implies that energy demand grows at 80 percent of the rate of change in GNP. With GNP growth of 3.0 percent a year and an energy/GNP growth coefficient of 0.8, energy demand would grow at 2.4 percent per year. The U.S. energy/GNP growth coefficient for the postwar period has been about 0.83. However, it is expected to decline over the next decade to an average of 0.6.

The change in the energy coefficient reflects changes in the structure of the economy: a shift to less energy-intensive activities such as services, and a substitution of labor for capital. In addition, more efficient use of existing energy resources enables a reduction in the use of energy for a given level of output. Furthermore, there may be natural limits to the use of energy for such purposes as heating, cooling, and transportation, so that continued growth in these uses will reflect primarily demographic changes. The postwar period has seen a rapid expansion of energy for cooling purposes, while growth of the suburbs has stimulated the demand for gasoline. One might reasonably expect that the economy is approaching a saturation point, and that postwar rates of growth in such energy uses will not continue in the future.

Price increases will most likely encourage households and businesses to conserve energy. Although energy prices increased in the 1974-1978 period,

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1/ Data Resources, Inc. (DRI), energy model.

they did not increase as fast as other prices for U.S. consumers, so that the real price of energy--in particular, of oil--actually declined. Conservation measures do not make economic sense if they cost more than the energy saved. Now, when real energy prices are rising, conservation is rapidly becoming a sound investment with payback periods of a few years. Despite this inducement, a number of constraints still limit household conservation under current policy. Many of the activities that would conserve heating uses of oil are small and produce a less tangible return (through lower fuel bills) than cash rewards. Large aggregate energy savings depend on many millions of industrial and household consumers correctly perceiving economic signals and being able to respond to them. While conservation of home heating fuel can be justified on purely economic grounds, conservation of oil in automotive uses may not currently be cost-effective. Most of the conservation that has been experienced in gasoline consumption has been the result of federal fuel-efficiency standards rather than of market incentives. Gasoline prices have only recently risen to the level at which the costs of fuel-saving innovations will be outweighed by the dollar value of the fuel that is saved.

Sectoral Demand for Energy and Oil

While the demand for oil is projected to increase gradually over the 1979-1990 period, the share of oil as a source of energy is projected to decrease. At the same time, demand for coal is projected to grow from 7.6 million barrels per day of oil equivalent in 1979 to 12.2 million in 1990, an annual rate of increase of 4 percent. Demand for nuclear power is projected to increase from 1.5 million barrels per day of oil equivalent in 1979 to 3.9 million in 1990 as existing projects are completed, an annual rate of increase of 9.1 percent (see Table 2).

The rates of growth in energy demand, and in demand for oil in particular, are projected to vary in different sectors of the economy. In transportation, conservation efforts will slow the growth of oil consumption. In the residential and commercial sectors, the substitution of electricity and natural gas will reduce the growth in oil consumption between now and 1990. Electric utilities will also reduce their use of oil as nuclear energy and coal become more important sources of primary energy. Consumption of energy in manufacturing will remain relatively constant, as will the sector's relative emphasis on oil as a primary energy source. Over the next decade, other fuels will be increasingly substituted for oil--first coal and nuclear energy. In the longer run, solar energy and some synthetic fuels will become viable economic alternatives. It should be noted, however, that opposition to nuclear power and coal burning will limit their use. In the absence of this opposition, these two sources could replace an additional 1.0 million barrels per day of oil in 1990.

TABLE 2. TOTAL U.S. ENERGY DEMAND AND OIL DEMAND BY SECTOR OF THE ECONOMY IN 1979, 1985, AND 1990 (In millions of barrels per day of oil equivalent)

	1979 (Estimated)	1985 (Projected)	1990 (Projected)
Total Energy Demand			
Residential and commercial	7.5	8.6	9.2
Industrial	9.8	10.6	11.1
Transportation	9.8	9.9	10.3
Electric utility	12.1	14.3	17.4
Total	39.2	43.4	47.8
Oil Demand			
Residential and commercial	3.5	4.1	4.2
Industrial	3.7	3.9	4.2
Transportation	9.8	9.9	10.3
Electric utility	1.7	1.6	1.0
Total	18.7	19.5	19.9
Oil as a Percent of Total Energy			
Residential and commercial	46.7	47.7	45.7
Industrial	37.8	36.8	37.8
Transportation	100.0	100.0	100.0
Electric utility	14.0	11.2	5.7
Total	47.7	44.9	41.6

SOURCE: CBO, using DRI energy model, December 19, 1979.

Residential and Commercial Use. Residential and commercial primary energy consumption is projected to grow from 7.5 million barrels per day of oil equivalent in 1979 to 9.2 million in 1990, an average rate of 1.9 percent a year. Oil consumption will rise from 3.5 million barrels per day to 4.2 million barrels per day during this period. The leveling off in oil consumption will be the result of conservation measures in space heating and

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cooling, increased use of electricity, development of more efficient electrical systems, and a decline in the rate of new household formation.

Industry. The industrial sector will show only moderate growth in energy consumption--from 9.8 million barrels per day of oil equivalent in 1979 to 11.1 million in 1990--and the share of oil in total energy consumption will remain roughly constant at 37.8 percent. The most important factor in industrial energy demand is overall economic activity as reflected in the GNP. Substitution of other fuels has not been extensive in the past for a number of reasons. Curtailments in the supply of natural gas for industry have forced some substitution to oil. Moreover, until recently, energy from synthetic fuels has not been an economic alternative. As the real price of oil continues to rise, however, synthetic fuels may be utilized. Coal is growing in importance to the industrial sector despite obstacles to more rapid growth, such as lack of available land for coal storage, the requirement of clean burning in some industrial processes, and air pollution standards.

Transportation. The transportation sector currently accounts for more than one-half of U.S. oil consumption and one-quarter of all energy consumption. Oil use in transportation is projected to grow only slightly, from 9.8 million barrels per day in 1979 to 10.3 million in 1990. This slower growth will be mainly a reflection of conservation as the fuel economy standards for autos of the Energy Production and Conservation Act (EPCA) take effect. EPCA efficiency gains may be less than anticipated, however, if consumers continue to shift to the less energy-efficient portion of the new transportation fleet--light trucks and vans. Moreover, gasoline prices will have to rise further before many gasoline-saving innovations become cost-effective. Since the transportation sector is almost exclusively dependent on petroleum, little substitution of other fuels may be expected in the short run. Technological innovation will be required before electric vehicles make significant inroads in the automobile market.

Electric Utilities. Electric utilities will continue to be the fastest growing energy sector of the economy. Energy consumption by utilities will grow from 12.1 million barrels per day of oil equivalent in 1979 to 17.4 million in 1990, an average rate of 3.4 percent a year. Since fuel is their main cost, electric utilities have always had an incentive to improve energy efficiency, although some rate-setting procedures may work against this. New technologies, combined with conservation measures to utilize waste heat, promise some energy savings in this sector. Oil is expected to continue to decline in its importance as an energy source, from 14.0 percent of fuel used in electric utilities in 1979 to 5.7 percent in 1990. On the other hand, coal and nuclear energy will become increasingly important.

DOMESTIC OIL SUPPLY

Domestic crude oil production is projected at 8.0 million barrels per day in 1985 and 7.4 million in 1990. It will decline despite the strong incentives provided by the decontrol of crude oil prices, because of limited geological prospects and a continuing fall in the rate at which exploration actually results in new reserves.

Methodology

For the purposes of this analysis, domestic crude production is separated into four categories:

- o Conventional production from proved reserves;
- o Conventional production from resources not yet discovered;
- o Production from the Alaskan North Slope; and
- o Enhanced recovery from proved reserves (including heavy oil).

Each of these four categories is analyzed below. Using drilling and exploration data supplied by the American Petroleum Institute and estimates of internal capital availability, as projected by CBO's model of the windfall profits tax, future reserves and production were projected for each of these categories. 2/ For current proved reserves, historical decline rates were extrapolated. The analysis presumes that decontrol of crude oil prices continues on schedule accompanied by a windfall profits tax of $227 billion over this decade. As is the case in all of the analyses presented in this paper, a price of $30 per barrel in the fourth quarter of 1979 is assumed, rising at a rate of 2 percent above the rate of inflation annually. In addition, it is assumed that a pipeline is constructed to transport Alaskan oil from the West Coast to the midcontinent, and that an Alaskan gas pipeline begins operation by 1987.

Proved Reserves

Production from proved reserves will constitute the bulk of production from the lower-48 states until the late 1980s. At present, two-thirds of it

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2/ Congressional Budget Office, The Windfall Profits Tax: A Comparative Analysis of Two Bills (November 1979).

comes from 200 relatively large fields, most of which have been producing for 10 years or more, and half for 25 years or more. Conventional primary and secondary recovery methods have been used on almost all of these fields, and production levels are declining because of depletion. In the absence of new reserve discoveries, these fields have averaged production declines of 12.7 percent per year under EPCA controls. Decontrol will arrest the decline somewhat by encouraging investments that accelerate production from these known reserves. Primary and secondary production from known reserves outside Alaska is projected to be 3.2 million barrels per day in 1985 and 1.2 million in 1990.

New Discoveries

This report uses two techniques to estimate discoveries of new or additional reserves. First, additions to existing reserves, such as revisions of estimates of proved reserves, extensions to known fields, and new pool discoveries are individually projected using historical trends during periods when real prices increased. Second, discoveries of new fields are estimated by combining projected finding rates with estimates of future exploratory drilling rates which, in turn, are directly influenced by prices. Discoveries of new reserves in "frontier areas" are projected by synthesizing estimates from individual firms, trade organizations, and government agencies. Once new reserves are established, a conventional production profile over time is assigned to them.

Domestic production will be influenced more by the decline in production from known fields than by new discoveries until the late 1980s. With the exception of the discovery of Prudhoe Bay, aggregate withdrawals from production have exceeded new discoveries for each of the past 10 years. Although exploratory and drilling activities have increased greatly in recent years and discoveries have increased in number, they have not been large enough to compensate for the depletion of older, larger fields. Unless an exceptional new discovery is made on the North Alaskan Outer Continental Shelf (OCS) or on some OCS areas in the lower-48 states, this trend is expected to continue through the next decade. Production from new reserves is estimated at 2.3 million barrels per day in 1985, and 3.5 million in 1990.

Alaskan North Slope

Alaskan North Slope oil is estimated separately because of its distinct geology and its singular importance in U.S. supply. The producers of

Alaskan oil are somewhat unsure of the production profile from the existing Prudhoe Bay fields because of changing economic conditions and because of unanticipated changes in the behavior of the main reservoir. Other North Alaskan fields are not likely to produce more than 300,000 barrels per day until the late 1980s. The Kuparuk reservoir is expected to be the most important of those now known to the public. Total Alaskan production is estimated at 1.6 million barrels per day in 1985, and 1.4 million in 1990.

Heavy Oil and Tertiary Recovery

Heavy oil is defined in this paper as oil with an American Petroleum Institute viscosity measurement (API^{o}) of 16^{o} or less. This measurement defines a specific gravity of oil that usually renders it less mobile than lighter crude oil. Heavy oil production usually employs a variety of thermal techniques designed to increase mobility so that it will flow when pumped. In some cases, the oil is combusted in the ground to build pressure and heat. Usually, however, oil is burned at the production site in order to generate the steam heat needed to inject into the heavy oil formation. This, in turn, can create significant air quality problems. Most heavy oil reserves are found in California, where stringent environmental standards must be met before production can begin. The decontrol of heavy oil will probably raise the rate of return on production from new fields to the point at which it will be profitable to control emissions and meet state environmental standards. Heavy oil production is estimated at 500,000 barrels per day in 1985 and 600,000 barrels in 1990.

Enhanced, or tertiary, production will also be facilitated by the 1979 OPEC price increases. With the limited prospects for significant additions to new reserves, extensions of existing reserves through enhanced production will be important in defining the future U.S. reserve base. Chemical injection into formations, previously prohibited by the expense of the chemicals, is now a realistic possibility. Carbon dioxide injection will also become a more feasible technology, given recent price increases. Enhanced production is expected to rise over its current levels by 365,000 barrels per day in 1985 and 690,000 barrels in 1990. Existing enhanced production is counted in production from existing reserves in this analysis.

PROJECTED OIL IMPORTS

In 1985, the U.S. oil demand is projected to be 19.5 million barrels per day, rising to 19.9 million in 1990 (see Table 3). The U.S. oil supply in 1985 will total only 8.0 million barrels per day, and will decrease to 7.4 million in

TABLE 3. PROJECTED U.S. OIL IMPORTS, 1985 AND 1990 (In millions of barrels per day)

	1985	1990
Projected Oil Demand a/	19.5	19.9
Minus Projected Domestic Oil Supply	8.0	7.4
(Proved reserves)	(3.2)	(1.2)
(New discoveries)	(2.3)	(3.5)
(Alaskan North Slope)	(1.6)	(1.4)
(Heavy oil)	(0.5)	(0.6)
(Future tertiary)	(0.4)	(0.7)
Minus Projected Supply of Natural Gas Liquids	1.4	1.2
Projected Oil Imports	10.1	11.3

a/ Crude equivalent of demand for refined products--corrects for increased volume resulting from refining.

1990. In addition, production of natural gas liquids will total 1.4 million barrels per day in 1985 and 1.2 million in 1990. 3/ If the United States is to meet the projected demand, then oil imports will have to equal the amount over the supply of domestic oil and natural gas liquids, or 10.1 million barrels per day in 1985 and 11.3 million in 1990. These levels assume a price of $30 per barrel in the fourth quarter of 1979, rising at an annual rate 2 percent faster than the general price level. They also assume that there is no change in existing energy policy.

These projected higher oil imports will pose serious economic and security risks to the United States. The risks are analyzed in the remainder of this paper. In Chapter III, the likelihood of higher oil prices is analyzed. Chapter IV discusses the impact of projected import levels on the dollar. Chapter V examines the effects of higher import levels on the security of supply, and the economic effects of potential interruptions of supply. In Chapter VI, policy responses to these risks are discussed.

3/ Natural gas liquids are natural gas that occurs in liquid form, and are produced in conjunction with natural gas. They are incorporated into the refining process along with crude oil.

CHAPTER III. THE WORLD OIL MARKET AND OIL PRICES IN THE 1980s

Prices in the world oil market are likely to continue rising in the next decade. In the past, such increases have led to increases in domestic energy prices, and in the costs of a wide variety of goods and services that require energy inputs. Higher costs dampen consumer demand and may cause a slackening of economic activity, economic growth, and employment, while also increasing the rate of inflation. The ensuing losses of consumer income are multiplied thoughout the economy. In the long run, rising energy prices pose a major uncertainty for investors, and inhibit the process of capital formation. To assess the likelihood of these prospects, one must analyze the supply and demand trends for oil. This chapter presents such an analysis.

Projections of world oil prices based on supply and demand contain both economic and political uncertainties that make precise estimates unreliable. But supply and demand forecasts imply the likelihood of higher prices, if not their extent. Specifically, these forecasts describe the magnitude of the risk of higher oil prices in this decade, should the world economy achieve moderate growth.

Total world demand for oil (outside of the Soviet bloc and the People's Republic of China) is projected to be 58.9 million barrels per day in 1985 and 66.4 million in 1990. The oil available to meet this demand is estimated at 54.5 million barrels per day in 1985 and 55.8 million in 1990. This equals the total supply of oil from the industrialized nations, including the United States; from OPEC; from less developed countries outside OPEC; and from the net exports of the Soviet Union, Eastern Europe, and the People's Republic of China. These projections assume a fourth-quarter 1979 price of $30 per barrel in the United States, rising at 2 percent above the inflation rate annually. Should they prove correct, the world market will be forced to absorb an excess demand of 4.4 million barrels per day in 1985, and 10.4 million in 1990. Thus, a tight market and rising oil prices, with their potential dampening effect on economic growth, seem likely in the next decade.

WORLD OIL DEMAND

World oil demand, excluding the Soviet bloc and China, is projected to increase at an average annual rate of 2.2 percent over the 1978-1990 period.

The largest absolute increases and the fastest rates of growth will be seen in OPEC nations and in the other less developed countries (LDCs). These estimates are presented in Table 4.

TABLE 4. WORLD CRUDE OIL DEMAND, 1978, 1985, AND 1990 (In millions of barrels per day)

Area	1978	1985 (Projected)	1990 (Projected)	Average Annual Rate of Change (Percent) 1978-1985	1985-1990
Industrialized Countries					
United States	18.3	19.5	19.9	0.9	0.4
Western Europe	14.6	15.9	17.3	1.2	2.0
Japan	5.4	6.5	7.4	2.7	2.6
Canada	1.8	2.0	2.2	1.5	1.5
OPEC	2.5	4.3	6.3	8.0	8.0
Non-OPEC LDCs	8.5	10.7	13.3	3.3	4.4
Total	51.1	58.9	66.4	2.1	2.4

Methodology

The world demand for energy is largely a function of world economic growth. In the developed nations, this relationship has been gradually changing, as progressively less and less energy is required relative to the expansion of GNP--a response to higher energy prices. In the less developed countries (LDCs), where the shift to a manufacturing economy increases energy use, the potential for conservation savings is uncertain. Yet throughout the world, it is evident that oil will claim a smaller share of energy demand than in the past as it is replaced by natural gas, coal, nuclear energy, and hydropower.

World demand for oil is dependent not only on economic growth but also on the price of oil relative to other energy sources. For LDCs, the availability of foreign exchange with which to make oil payments is also an

important determinant both of the demand for oil and of the rate of economic growth. In estimating the future demand for oil in this report, rates of real GNP growth were taken from projections by the Department of Energy, the Organization for Economic Cooperation and Development (OECD), the World Bank, and other sources. Increases in energy demand were then calculated, and apportioned among oil and other fuels. These were compared to other estimates of growth in oil demand for consistency.

Demand in the Industrialized Countries

Demand for oil within the industrialized countries of Western Europe, North America, and Japan is projected to rise from its 1978 level of 40.1 million barrels per day to 43.9 million barrels per day in 1985 and 46.8 million in 1990. This reflects an average annual rate of increase of 1.3 percent between 1978 and 1990. An assumption of approximately 3 percent rate of economic growth for the group as a whole was made for this time period, and the demand for all energy was projected to increase by an average of about 2.4 percent annually. Thus, the projections assume a shift away from oil toward nuclear power, coal, and increased conservation.

Higher energy prices are promoting a shift in energy demand in both Japan and Western Europe, similar to that in the United States. In Western Europe, oil demand is projected to increase at an annual rate of 1.4 percent over the period 1978-1990. This is lower than the general rate of energy demand growth, largely because of the development of alternative energy sources. Between now and 1985, many of the nuclear projects undertaken since 1973 in Western Europe will be completed, taking pressure off oil demand. In addition, new imports of natural gas from a Libyan pipeline under the Mediterranean, and perhaps from the Soviet Union, will further reduce the demand for oil. On the other hand, it is unlikely that new conservation efforts will affect demand growth significantly. Since the OPEC price increases of 1973-1974, Western Europe has, by and large, already undergone a transformation to greater energy efficiency in transportation, space heating, and use of waste heat in industry and utilities.

Japanese oil demand is projected to grow more rapidly than European or U.S. demand, because of Japan's anticipated higher rates of real economic growth (4 percent annually, contrasted to the 3 percent assumption made for the United States and Western Europe). This is also true because of Japan's long-term policy of tying oil imports to reciprocal

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commodity and capital exports, which serves to increase both economic activity and the availability of oil. It will also serve to increase Japanese imports of liquefied natural gas. But Japan's export-oriented economy may not grow as rapidly as was anticipated before the 1979 price increases, because of slower economic growth worldwide. Evidence of such a slippage is already appearing in Japan's foreign trade position. To the extent that Japan is forced to import a world-wide recession, its demand for oil will increase less rapidly. Demand levels of 6.5 million barrels per day in 1985 and 7.4 million in 1990 are projected for Japan, reflecting an average annual increase of 2.7 percent over the 1978 level of 5.4 million barrels per day.

Demand in OPEC Countries

OPEC countries experienced an increase in oil demand of 12.8 percent annually over the 1967-1978 period, as they used oil as a fuel for industrial development, and as personal incomes in the OPEC countries rose. While strong future demand increases are projected for OPEC, there is reason to believe that rates will not reach those of the past decade. First, many gas utilization projects have been brought on line that will allow economic use of natural gas which until now has been burned off. Second, the commitment to develop petrochemicals and refining capacity appears to be easing in favor of purchasing participation in existing Western projects instead. Demand within OPEC seems likely to grow at a rate slightly less than that of general economic growth. In addition, the overthrow of the Pahlavi regime in Iran has led to an abandonment of the Shah's industrial plans, which were slated to increase Iranian oil demand by 1.5 million barrels per day by 1990. An increase of half as much is now more likely. These factors suggest a long-term growth rate of 8 percent for OPEC oil consumption, raising it from 2.5 million barrels per day in 1978 to 4.3 million in 1985 and 6.3 million in 1990.

Demand in Non-OPEC Less Developed Countries (LDCs)

Until the 1979 oil price increases, less developed countries outside of OPEC had been projected to increase their oil demand at an average annual rate of 6 percent or more. The current price of oil has reduced this prospect considerably, because of the scarcity of foreign exchange with which to pay for oil imports.

LDCs demonstrated high rates of oil demand increase in the recent past--about the same as general economic growth--primarily because industrial development brought with it new uses of energy. In addition, the migration of workers into metropolitan areas from rural areas meant that their consumption of energy was transferred from indigenous sources used in the country (such as wood, peat, or other natural fuels) to fuels provided by the market. Thus, oil demand probably increased at a higher rate than the total energy demand. This "migration" component of energy demand growth will probably taper off in the 1980s.

In one subgroup of LDCs, rising incomes have created an increased consumer demand for oil. In this subgroup, often referred to as "newly industrialized countries," oil demand is projected to grow at more than 5 percent per year, slightly less than the projected 6 percent rate of economic growth estimated for this group. The largest increases will be seen in Mexico and Taiwan. Australia is included in the group because of its location rather than its level of development. Lesser increases are projected for India and South Korea. Demand may not grow in Brazil, the other member of the group, where 60 percent of foreign exchange earnings are now being returned as debt service to public and private international lenders. Yet all of these countries have export-led economies that are capable of generating foreign exchange.

For LDCs outside this subgroup, demand is projected to increase in proportion to economic growth, at an annual rate of approximately 2.5 percent. Many of those outside the industrializing group may be unable to meet oil payments should demand or prices increase considerably. Moreover, slower economic growth in the industrialized community will mean a smaller export market for LDCs, diminishing their prospects for economic growth. Total LDC demand is projected to grow from the 1978 level of 8.5 million barrels per day to 10.7 million in 1985 and 13.3 million in 1990, reflecting a long-term rate of increase of 3.8 percent.

WORLD OIL SUPPLY

The available world supply of crude oil is estimated at 54.5 million barrels per day in 1985 and 55.8 million in 1990. More than one-half will come from the OPEC countries, and the remainder from the United States and Canada, the North Sea, and non-OPEC less developed countries (see Table 5). The methodology used to make these estimates is discussed below, and regional production trends are described in the following pages.

TABLE 5. WORLD CRUDE OIL SUPPLY, 1978, 1985, AND 1990 (In millions of barrels per day)

	1978	1985 (Projected)	1990 (Projected)
Industrialized Countries			
United States	10.3	9.4	8.5
North Sea (Britain and Norway)	1.5	3.7	3.7
Canada	1.6	1.5	1.9
Other	0.4	0.5	0.5
OPEC Countries			
Saudi Arabia	8.3	8.5	8.5
Other OPEC	22.0	21.6	22.8
Non-OPEC LDCs			
Mexico	1.3	4.5	5.5
Other Latin America	1.2	1.4	1.2
Africa	1.0	1.8	2.3
Asia	0.9	1.8	1.9
Non-OPEC Middle East	0.6	0.8	0.8
Soviet Bloc and China, Net Exports a/	2.0	-1.0	-1.8
Total	51.1	54.5	55.8

a/ Includes natural gas.

Methodology

The existence of large world oil reserves (defined as that amount of oil that has been identified in the ground and is economic to extract) does not, in and of itself, guarantee ample oil production. Actual production is governed by three factors: the geological characteristics of reserves, the availability of the necessary infrastructure, and the revenue needs of the producers.

The basic data for proved crude oil reserves and their concentration into fields were taken from the 1978 Rand publication, Giant Oil Fields and World Oil Resources, compiled by Richard Nehring. This information was updated with reports of new discoveries and field extensions, primarily in American Association of Petroleum Geologists Bulletin, Oil and Gas Journal, Petroleum Economist, Petroleum Intelligence Weekly, and World Oil. Table 6 summarizes reserve data. Production rates for individual fields were obtained by determining how long these fields could produce at their present levels of production. For mature fields that are expected to continue producing for more than 15 years, existing production rates were carried forward. Fields now approaching maturity were assigned rates predicted either by Rand or by industry resources and periodicals. Fields that are now scheduled to begin production were assigned production rates estimated by industry sources (notably in Oil and Gas Journal), or by analogy to fields of comparable size and geology. For the purposes of this study, oil recovery technology is held constant unless otherwise stated.

The projection does not assume unanticipated discoveries in unexplored areas after 1979. New oil reserves will certainly be found--for example, discoveries are expected in Argentina, the Sudan, and Vietnam. The location and extent of future discoveries cannot, however, be estimated with any certainty. Recent discoveries for which a consensus reserve estimate exists, such as those in Mexico and China, are included even though the new fields are not yet incorporated into formal reserve estimates.

Estimates of the investments in pipelines, port facilities, and refineries that are necessary to allow oil production from known reserves were taken from oil industry periodicals, notably Oil and Gas Journal, Petroleum Economist, and Petroleum Intelligence Weekly. Such estimates are particularly important in the cases of expanding producers. Refining capacity is not a necessary precondition for oil production, but it sometimes indicates a producer's intention to expand production of a certain type of crude, as is the case in Iraq and Venezuela.

Producer nations now make production decisions as part of a larger strategy aimed at economic development. Oil revenues have become the lever of development for most of the important oil-producing countries. The development plans instituted by most OPEC countries have added a degree of certainty to their production schedules by creating a "revenue requirement" that must be met if they are to make good on their plans and on the implicit promises they contain of a growing standard of living.

Even in the absence of formal development plans, every producer nation has a pattern of expenditures that can be extrapolated into the future. A good economic model of these expenditure commitments is in Theodore Moran's Oil Prices and the Future of OPEC. 1/ Moran's calculations have been amended, when appropriate, with supplemental data from the news media and from regional economic journals such as the Middle East Economic Digest and the Far East Economic Report.

Supply in the Industrialized Countries

The future supply of U.S. crude oil and natural gas liquids was estimated in Chapter II as 9.4 million barrels per day in 1985 and 8.6 million in 1990. Production of industrialized countries other than the United States is estimated at 5.7 million barrels per day in 1985 and 6.1 million in 1990, with the bulk of this from the North Sea fields and Canada (see Table 5).

The North Sea reserves are estimated at between 20 billion and 30 billion barrels, depending on the presumed efficiency with which the oil is recovered (see Table 6). Expansion of production facilities in the North Sea was temporarily slowed in the late 1970s because of private sector concern with the leasing terms desired by the British government. The North Sea fields are capable of producing 4.5 million barrels per day by 1985 (3.3 million barrels per day from the British tracts, 1.2 million barrels from the Norwegian). The British government, however, will probably put a ceiling on production designed to meet their domestic needs and allow only a minimum for export. A production level of 2.5 million barrels per day has been discussed. This would allow total North Sea output of 3.7 million barrels per day in both 1985 and 1990.

Canada's reserves are set at 6 billion barrels, but are growing because of new discoveries in Alberta. Moreover, the possibility of large new discoveries is high, both in the Arctic Islands and in the Mackenzie Delta (near Prudhoe Bay). The Grand Banks area off Newfoundland is thought to have significant potential as well. Canada is also beginning to develop its heavy oil resources; if a recovery technology proves economic, which is now thought to be the case, significant quantities of oil will be available. Canadian heavy oil reserves could total 950 billion barrels. Under favorable conditions, 140 billion barrels out of the 950 billion can ultimately be recovered. Total Canadian production is seen as 1.5 million barrels per day in 1985 and 1.9 million in 1990.

1/ Theodore Moran, Oil Prices and the Future of OPEC (Washington, D.C.: Resources for the Future, 1978).

TABLE 6. PROVED OIL RESERVES, JANUARY 1, 1980

	Proved Reserves (In millions of barrels)	Reserve Life (In years) a/
Industrialized Countries		
Canada	6,800	12.58
Norway	5,750	40.39
United Kingdom	15,400	26.87
United States	26,500	8.39
Other	2,401	26.96
Subtotal	56,851	12.57
OPEC Countries		
Algeria	8,440	18.65
Ecuador	1,100	13.70
Gabon	500	7.13
Indonesia	9,600	16.44
Iran	58,000	54.79
Iraq	31,000	25.20
Kuwait b/	68,530	75.40
Libya	23,500	31.41
Nigeria	17,400	20.11
Qatar	3,760	21.46
Saudi Arabia b/	166,480	47.86
United Arab Emirates	29,411	44.15
Venezuela	17,870	21.01
Subtotal	435,591	39.00
Non-OPEC LDCs		
Angola	1,200	22.99
Argentina	2,400	13.99
Australia	2,130	13.26
Brazil	1,220	20.26
Brunei	1,800	19.34
Egypt	3,100	16.99
India	2,600	29.68
Malaysia	2,800	28.41
Mexico	31,250	57.46
Oman	2,400	22.67
Tunisia	2,250	58.71
Other	4,562	12.11
Subtotal	57,712	41.51
Soviet Bloc and China		
Soviet Union	67,000	15.73
China	20,000	26.09
Other	3,000	22.21
Subtotal	90,000	17.44
Total	641,624 c/	28.09

SOURCE: Oil and Gas Journal, December 31, 1980.

a/ Number of years that existing production levels can be maintained, given reserve levels.

b/ Includes share of "Neutral Zone," an area whose production is divided between Saudi Arabia and Kuwait.

c/ Details may not add to totals because of rounding.

Outside of the United States, the North Sea, and Canada, reserves and production of other industrialized nations are minimal. Production of 0.5 million barrels per day in 1985 and 1990 is seen for the rest of Western Europe, coming from Austria, Denmark, France, Greece, Italy, the Netherlands, Spain, and West Germany. Ireland has the geological potential for large, new fields, but these have not yet been explored.

Supply in OPEC Countries

The OPEC countries will produce more than half of the world's oil for the balance of this century. OPEC production is projected to be 30.1 million barrels per day in 1985 and 31.3 million in 1990 (see Table 7).

TABLE 7. OPEC CRUDE OIL SUPPLY, 1978, 1985, AND 1990 (In millions of barrels per day)

Country	1978	1985 (Projected)	1990 (Projected)
Algeria	1.2	1.0	1.0
Ecuador	0.2	0.3	0.3
Gabon	0.2	0.3	0.2
Indonesia	1.6	1.7	1.7
Iran	5.1	3.5	4.0
Iraq	2.6	4.0	5.0
Kuwait	2.1	1.6	1.6
Libya	2.0	2.0	2.0
Nigeria	1.9	2.5	2.0
Qatar	0.5	0.5	0.5
Saudi Arabia	8.4	8.5	8.5
United Arab Emirates	1.8	2.0	2.0
Venezuela	2.2	2.2	2.5
Total	29.8	30.1	31.3

The distribution of output among the members of OPEC should remain roughly constant over this period. Saudi Arabia, which increased its output after the Iranian revolution, should return to its desired level of 8.5 million barrels per day throughout the 1980s. Although capacity increases could

bring output to 12.0 million in 1990--presuming a continuation of the existing relationship between the United States and Saudi Arabia--growing conservationist sentiment within Saudi Arabia could limit actual production increases.

Some members of OPEC will have to contend with depletion problems. Algeria, Indonesia, Nigeria, and Venezuela all face diminishing production from known reserves, but, with the possible exception of Nigeria, each has a good chance of discovering new resources. Venezuela, with a promising continental shelf and its heavy oil belt around the Orinoco River, is notable in this regard; it should be able to expand production both through these resources and through enhanced recovery in old fields. Iran faces problems of pressure maintenance in older fields, although a gas injection program could maintain its production level; also, good prospects exist for discoveries in the Persian Gulf.

Iraq could be the fastest growing producer in OPEC in the 1980s, increasing output to 5.0 million barrels per day by 1990. Libya also has the resources to increase output significantly, but may not need the resulting revenue. Algeria, Kuwait, and the small Persian Gulf states should be able to maintain constant output without difficulty, but may also elect to conserve reserves by further limiting production.

Ironically, higher oil prices actually may discourage higher OPEC production levels. The recent doubling of oil prices has brought the revenues of most producing nations to levels that cannot be efficiently absorbed by economic development. Rather than produce for a surplus of foreign exchange, many producers may seize higher prices as an opportunity to leave their depleting oil resources in the ground.

High-Absorber Nations. The "high-absorber" OPEC countries--so named because they are able to absorb relatively high amounts of petro-revenues through investment and economic development--are Algeria, Ecuador, Gabon, Indonesia, Iran, Iraq, Libya, Nigeria, and Venezuela. These countries as a group should provide 17.5 million barrels per day in 1985 and 18.7 million in 1990.

Iran and Iraq are the two largest producers in this group. Iran's reserves of 58 billion barrels are estimated on the basis of a 15 percent recovery rate applied to an estimated 375 billion barrels of oil in place.

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(Only a percentage of actual oil-in-place is ever recovered. 2/ Reserve estimates are usually made by applying an estimated recovery rate to the estimated amount of oil in the ground.) If pressure maintenance and other enhanced recovery operations are successful, these reserves could be ultimately extended up to 100 billion barrels. Pressure to avoid mounting debts and to fulfill expectations of improved standards of living may induce Iran to produce at close to full capacity over the next decade. This could translate to 4.0 million barrels per day in 1985 and 1990. This level, however, presumes that the Iranian government reestablishes control over its oil fields and has access to spare parts, now denied by the U.S. embargo. While Iranian reserves suggest a higher production figure, the current government may not be willing to invest in the pressure maintenance and exploration necessary to increase capacity to levels reached under the Pahlavi regime.

Iraq's situation is similar to that of Iran, but it has a reserve base that is expected to grow rapidly. The present figure of 31 billion barrels will probably double in the 1980s. Iraq's significant underdevelopment as a producer is explained both by the physical characteristics of its oil (which is heavy, with relatively high concentrations of sulfur and corrosive metals) and by politics. Iraq has had a radical government that antagonized many firms. In 1960 it found only one out of every 200 acres leased for oil exploration was actually being worked, and confiscated unworked leases as a response. This has strained its relations with the international oil industry. Iraqi production should reach 4.0 million barrels per day in 1985 and 5.0 million in 1990.

The second tier of this high-absorber group is composed of Algeria, Indonesia, Libya, Nigeria, and Venezuela. Algeria and Indonesia both face depletion of known reserves, but should be able to sustain production levels of 1.0 and 1.7 million barrels per day, respectively, until 1990. Nigeria faces a similar problem, complicated by the fact that its reserves lie in a large number of small deposits, which makes enhanced recovery operations less profitable. Nigerian production should peak at 2.5 million barrels per day in 1985 and decline to 2.0 million in 1990, unless unanticipated discoveries are made.

2/ Oil in the ground, or oil in place, includes the total known amount, including that which cannot be recovered economically by today's technology.

Libya currently produces 2.0 million barrels per day and may have the physical resources to produce more. The Libyan National Oil Company had projected 2.4 million barrels per day of production in 1980. Libya's light, low-sulfur oil is contained in highly porous reef-like structures, and is therefore both high quality and easy to produce. Yet the price increases of the past year may make the revenues resulting from production increases unnecessary. Production of 2.0 million barrels per day in 1985 and 1990 is anticipated.

Venezuela is undergoing a transition as an oil producer. Large thermal recovery projects are being introduced to its large fields to prevent production declines. These projects will allow continuous production of 2.2 million barrels per day from old fields. Additions will be made to Venezuelan production for its continental shelf, where exploration is underway. Initial production from this source should be available by 1985, and significant contributions can be expected by 1990, yielding production estimates of 2.2 and 2.5 million barrels per day in these two years. Venezuela's significant heavy oil resources probably will not produce more than 150,000 barrels per day by 1990, owing to national policy decisions.

Low-Absorber Nations. Four OPEC countries--Kuwait, Qatar, Saudi Arabia, and the United Arab Emirates (UAE)--are designated as "low absorber" because their capacity to absorb oil revenues in productive investment is low. Qatar is the smallest, with production held to a government-imposed level of 500,000 barrels per day. While production could be higher, especially since onshore reserve estimates are expected to increase, government-imposed ceilings are likely to continue.

The UAE and Kuwait are mid-sized producers in this group, and both constrain production because of limited needs for revenues. The UAE is a coalition of several states, among them the producing regions of Abu Dhabi, Dubai, and Sharjah. The bulk of UAE production comes from Abu Dhabi, which has reserves of 30 to 40 billion barrels and current production of 1.5 million barrels per day. Some estimates of future Abu Dhabi production reach 3.0 million barrels per day, but at present the Abu Dhabi government is presumed to prefer conservation to more revenues than it can expend productively. Minimum estimates of production are 1.5 million barrels per day in 1985 and 1990. Total UAE production is projected to be 2.0 million barrels per day in 1985 and 1990.

Kuwait reserves of 69 billion barrels could support the existing production capacity of 3.0 million barrels per day. A country with a larger population and equivalent resources would probably produce 6.0 to 7.0 million barrels per day, but for Kuwait production at this level would result

in revenues for which no productive domestic use exists. Low revenue requirements should constrain Kuwaiti production to 1.6 million barrels per day through the 1980s, sufficient to finance the real equivalent of Kuwait's present budget, and extend its reserves for 100 years, a government goal.

Saudi Arabia. Saudi Arabian production is estimated at 8.5 million barrels per day in 1985 and 1990. Larger levels are sustainable, given the extent of Saudi reserves and a feasible rate of infrastructural development (including desalinization projects for pressure maintenance). However, the revenue requirements of the Saudi regime and the socially destabilizing consequences of rapid economic growth should prohibit an expansion of output from this desired level.

Saudi reserves are immense--the official figure of 166 billion barrels may understate their ultimate production. The largest fields are being produced conservatively, and the significant offshore potential in the Persian Gulf is still to be developed. Disallowing time constraints, the maximum feasible production from known Saudi fields (some of which are not in production at present) appears to be 18.0 to 22.0 million barrels per day. A plan submitted to the Saudis by Aramco (the foreign managers of Saudi reserves) for modest capacity expansions in the early 1980s conforms to capacity of 12.0 million barrels per day in 1985. Yet it is doubtful that this level will be approved by the Saudis.

The Saudis will have goals other than revenues when deciding how much oil to produce. Over the past several years, they have repeatedly made clear the following goals:

- A resolution to the Arab-Israel conflict that allows the Palestinians self-determination;
- A program to implement the goal of Third World economic development as presented in the United Nations' New International Economic Order; and
- A workable solution to the problem of investing surplus oil revenues over the long term.

The likelihood is low that the Saudis would set a production level that would be crippling to the Western economy. Saudi oil sales and much of their investment portfolio are tied to the dollar, so that economic injury to the United States would be felt directly by the Saudis. Furthermore, a weakened economy would compromise the West's ability or will to defend the Saudi government from either an internal or a Soviet threat. On the

other hand, the Saudis have economic leverage and will probably use it to pursue the larger political goals listed above, particularly with regard to the Middle East. King Khalid and Crown Prince Fahd have stated their willingness, once a Palestinian solution is found, to produce "any level that is feasibly possible." While reports from Saudi Arabia depict a growing belief by technical experts that production should be curtailed, to do so would force major changes in the economic and political linkages between Saudi Arabia and the West. Barring unforeseen circumstances, this remains unlikely.

Domestic political considerations will also enter into the Saudi production decision. For example, expansion of oil-producing capacity would call for the introduction of more foreign workers, since the Saudi workforce is not large enough to perform all the necessary labor itself. Such "guest workers," mostly from Yemen, Egypt, and the dispersed Palestinian community, are seen as a destabilizing force in Saudi society. Similarly, many Saudi technical experts, disgruntled with alleged corruption in the extensive royal family and with production levels in excess of Saudi Arabia's strictly defined current revenue needs, are said to be arguing within the government for lower production levels. Finally, oil production is centered in the Shiite region of Saudi Arabia, a predominantly Sunni nation, leaving the oil fields a potential hostage in the event of domestic instability.

Yet political considerations argue for higher production levels as well. Reducing production would not lower revenues to producers, since oil prices probably would rise more than proportionately. Reduced production levels, moreover, could undermine the West economically, and damage the premise of the Western military umbrella. Many feel that as long as the Saudi royal family is in power, production below the current desired level of 8.5 million barrels per day is unlikely.

Supply in Non-OPEC Less Developed Countries

Third World nations outside of OPEC are projected to produce 10.3 million barrels per day in 1985 and 11.7 million in 1990. Country-by-country production estimates are given in Table 8. Outstanding among this group is Mexico, where production is estimated at 4.5 million barrels per day in 1985 and 5.5 million in 1990. Outside of Mexico, and perhaps Egypt, no country in this group can count on being a major long-term producer unless significant new discoveries occur. Argentina, the Sudan, and Vietnam are frequently cited as candidates for large new fields in virgin areas, but realistic estimates of their future production cannot include possible undiscovered resources.

TABLE 8. CRUDE OIL SUPPLY IN NON-OPEC LESS DEVELOPED COUNTRIES, 1978, 1985, AND 1990 (In millions of barrels per day)

Area	1978	1985 (Projected)	1990 (Projected)
Africa			
Angola	0.1	0.3	0.3
Egypt	0.5	1.0	1.0
Tunisia	0.1	0.1	0.2
Other	0.1	0.4	0.8
Subtotal	0.8	1.8	2.3
Asia			
Australia	0.4	0.5	0.5
Brunei	0.2	0.3	0.3
India	0.2	0.4	0.4
Malaysia	0.2	0.4	0.3
Other	0.1	0.2	0.4
Subtotal	1.1	1.8	1.9
Latin America			
Argentina	0.4	0.5	0.6
Brazil	0.2	0.3	0.2
Mexico	1.2	4.5	5.5
Other	0.6	0.6	0.4
Subtotal	2.4	5.9	6.7
Middle East			
Oman	0.3	0.4	0.4
Syria	0.2	0.3	0.3
Other	0.1	0.1	0.1
Subtotal	0.6	0.8	0.8
Total, Non-OPEC LDCs	4.9	10.3	11.7

Mexico's oil in the ground is given as 200 to 300 billion barrels, and the now official proved reserve estimate of 31 billion barrels is an understatement. Mexican planners are said to work with the figure of 60 to 80 billion barrels in ultimate production. Mexico is currently building pipelines for

possible oil exports to Japan and an offshore mooring buoy for ultra-large crude carriers in the Atlantic. Both will be completed in a few years, giving Mexico the infrastructural capability to export its production.

Pemex, the Mexican state-owned monopoly, has discussed plans for expanding output to 4.0 million barrels per day in 1982, and this could be fulfilled with little difficulty. Mexican officials are planning to drill 3,000 new wells by 1985. This would imply rapidly expanding production and dramatic increases in revenues; 4.5 million barrels per day in 1985 and 5.5 million in 1990 are anticipated. For this expansion to occur, however, infusions of foreign capital are needed, calling for additional borrowing by Mexico, a nation with significant foreign debts. Yet such borrowing may be allowed because Mexico's balance-of-payments deficit and unemployed population are growing at alarming rates.

Egypt is the second largest producer in this group. Egypt's reserves are currently appraised at only 3 billion barrels, but a promising exploration program is underway in the Gulf of Suez and the Mediterranean off the Nile delta. Egypt also has reserves on the Sinai peninsula. Egyptian production will reach a level of 1.0 million barrels per day in 1985 and 1990.

The eastern continental shelf of South America has traditionally been considered a promising geological region, particularly offshore Argentina. Several onshore producing areas in Argentina are found in sedimentary basins that extend onto the shelf. The Argentinian national oil company is for the first time inviting foreign firms onto the shelf for joint exploration. Discoveries thought possible by some geologists could bring Argentinian production to over 1.0 million barrels per day by the late 1980s; in their absence, however, onshore production will sustain a level of 0.5 million barrels per day in 1985 and 0.6 million in 1990.

Similar optimism was held for the Brazilian shelf, but except for the Campos Basin it has not proved out. Petrobras, the state-owned company, is conducting a last sweep of the shelf and will finish its preliminary exploration in the early 1980s. Future discoveries are thought possible in the western Amazon region, but logistical difficulties may make production extremely difficult.

India has also had recent discoveries, and new fields are thought possible in the Bay of Bengal. Australia is conducting an exploratory program that is thought likely to be successful. Tunisia and Malaysia are likely to expand production and are seen as promising areas for exploration.

Finally, some areas are viewed as being exceptionally promising, but have not been explored adequately and are not yet producing. Most notable are the Sudan and Vietnam, where political constraints have limited activity. Cameroon, Chad, Guatemala, and Pakistan are also cited as prospective producers.

Supply in the Soviet Bloc and China

While Chinese oil production is projected to expand in this decade, declines in Soviet production should move the Soviet bloc into a net importer position by 1985. The Soviet bloc may draw almost 2.0 million barrels per day from the world market by 1990. Table 9 presents estimates of the net energy balance for the Soviet bloc and China in 1985 and 1990, respectively. Production and reserve data for the Soviet Union, Eastern Europe, and China are relatively difficult to obtain and are not always consistent, but suffice to allow estimates of future production. For the purposes of projecting the state of the international oil market, however, the net oil exports of these countries must be estimated. Soviet bloc exports are currently positive, and should remain so through the early 1980s, when production from Soviet fields will decline from a peak expected in 1980-1982. Expansion of Chinese oil supply, however, will compensate for some of the decline in Soviet and Eastern European net exports.

Soviet Union. Soviet crude oil reserves are now set at 71 billion barrels, although some estimates of Soviet ultimate production exceed 125 billion. This is the world's second largest proved reserve. Soviet gas deposits are even larger. The Soviet Union's 910 trillion cubic feet of gas exceed the gas reserves of the entire Middle East.

Several critical questions dominate analysis of Soviet production. The first is the status of Samotlor, the largest Soviet field. Samotlor is said to be experiencing declining production and to be headed toward depletion, making it reasonable to predict that Soviet production is nearing a peak. A second question concerns reservoir mismanagement, specifically improper waterflooding leading to losses in ultimate recovery. Older Soviet fields in the Ural-Volga region are reported to be pumping 50 to 60 percent water. Newer fields in the western Siberian region, however, apparently do not have this problem.

The Soviets appear to be concentrating on drilling more wells in the already producing western Siberian fields, choosing the more certain activity of extending known reserves over exploration in the Kara Sea and Caspian Sea although the rate of discovery there is high. Thus, the long-term prospects for Soviet production could be good. Despite predictions to

TABLE 9. PROJECTED OIL AND GAS BALANCE IN THE SOVIET BLOC AND CHINA, 1985 AND 1990

Area	1985 Oil a/	1985 Gas b/	1985 Total Oil Equivalent c/	1990 Oil a/	1990 Gas b/	1990 Total Oil Equivalent c/
Soviet Union						
Production	10.1	51.6	19.4	9.6	65.9	21.5
Consumption	10.1	44.0	18.0	11.7	53.5	21.4
Net exports (+), imports (-)	+0.0	+7.6	+1.4	-2.1	+12.4	+0.1
Eastern Europe						
Production	0.4	6.7	1.6	0.5	6.7	1.7
Consumption	3.1	10.6	5.0	3.8	12.9	6.1
Net exports (+), Imports (-)	-2.7	-3.9	-3.4	-3.3	-6.2	-4.4
Total Soviet Bloc Net Exports (+), Imports (-)	-2.7	+3.7	-2.0	-5.4	+6.2	-4.3
People's Republic of China, Net Exports (+)	+1.0	0.0	+1.0	+2.5	0.0	+2.5
Total, Soviet Bloc and China			-1.0			-1.8

a/ Millions of barrels per day.

b/ Billions of cubic feet per day. A billion cubic feet is equivalent to 180,000 barrels of oil.

c/ Millions of barrels per day.

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the contrary, and difficult drilling conditions, the Soviet Union has been able to continue increasing production and has pledged to deliver oil and gas to their export customers in the 1980s.

The withdrawal of Western technology following the Soviet invasion of Afghanistan may make it difficult for the Soviets to fulfill production plans, at least in the near term. Because their drilling capabilities are behind those of the West, the Soviets had sought an infusion of Western know-how in this area. Since many of the new oil and gas fields are in inhospitable areas inside the Arctic Circle or in Siberia, and are also at great depths, this technological assistance was considered critical in maintaining Soviet production. In its absence, there is little doubt that production will fall in a few years.

How the Soviet shortfall will be distributed is unclear. On the one hand, reduced gas deliveries to Eastern Europe would threaten the political unity of the Soviet bloc. On the other hand, gas would be an important source of cash for the Soviet Union if it was sold in increasing amounts to Western Europe. Pipelines have already been built toward this goal. Moreover, if a period of political tension between the United States and the Soviet Union is at hand, the Soviets may seek to build stronger economic ties to Western Europe to weaken its alliance with the United States. Thus, much of the shortfall of oil and gas production may be absorbed inside the Soviet bloc through reduced consumption and slower economic growth, rather than by the world market. Because the Soviet Union's economy is centrally planned, the government can specify energy use. The 1976-1980 economic plan curtailed auto production dramatically, and the government is expanding electrification through nuclear power.

Eastern Europe. Eastern European countries have traditionally relied on the Soviet Union for energy imports. Soviet pipelines to Eastern Europe have already been constructed to carry future imports of Soviet natural gas. These countries are, however, negotiating with Middle Eastern and North African producers for crude oil, and are building refineries that will handle the specific characteristics of these crudes. Eastern European oil production is limited to Romania and Yugoslavia, and prospects for its expansion are limited. Some natural gas is being found, and its production will probably increase. Total required Eastern European oil imports will rise, however, from their current 2.0 million barrels per day to 3.3 million barrels per day in 1990 (see Table 9).

People's Republic of China. Over the past few years, Chinese reserve figures have escalated substantially. China's onshore resources are said to be 40 billion barrels, and its offshore potential is possibly as large, in contrast to the government estimate of 20 billion barrels.

Given China's new plans for development and its new access to Western technology, energy consumption and production should both increase rapidly. Estimates of 1985 Chinese oil production have been in the range of 4.1 to 6.1 million barrels per day. The upper end of this range will be difficult to achieve, however, because of an absence of infrastructure such as port facilities. Production of about 4.0 million barrels per day is more likely, including about 2.0 million barrels per day from the large northeastern fields, 1.0 to 2.0 million barrels per day from the western fields where development is now planned, and about 0.5 million barrels per day from offshore Po Hai Bay. Other offshore formations, such as the Taiwan Straits and South China Sea, may be in production by 1985, and will probably be producing significant quantities by 1990.

Production of 4.0 million barrels per day in 1985 and 6.5 million in 1990 would create an exportable surplus of 1.0 million barrels per day in 1985 and 2.5 million in 1990. But these export levels would not balance the net imports of the Soviet Union and Eastern Europe.

OIL PRICES IN THE 1980s

World demand for oil, including U.S. net demand for imports, will exceed available supply by 4.4 million barrels per day in 1985 and by 10.6 million barrels in 1990 at the level of prices used for this analysis (see Table 10). Thus, it is probable that the world oil market will remain tight through the next decade, and that there will be increases in the price of oil. The implications of a continuing tight market are discussed in this section.

The Likelihood of Higher Prices

Should the conditions described in this chapter prevail, excess demand will probably bring price increases for oil greater than used for these projections by the mid-1980s. Theoretically, price increases should ultimately cease when oil prices become equal to the prices of synthetic substitutes. This is true only for the long run, however; the time required to bring about the production of synthetic substitutes makes this constraint ineffective in the short run. Moreover, price increases tend to be reinforced by the willingness of consumers and refiners to pay them, up to the point at which the high prices have negative effects on the economies of industrialized countries. By slowing down economic growth and reducing consumers' disposable income, higher prices ultimately soften the demand for oil and restabilize the market. This happened to some extent in 1975, and may happen again in 1980.

TABLE 10. PROJECTED WORLD OIL BALANCE, 1985 AND 1990 (In millions of barrels per day)

	1985			1990		
	Production	Consumption	Imports (-) Exports (+)	Production	Consumption	Imports (-) Exports (+)
Industrialized Countries						
United States	9.4	19.5	-10.1	8.5	19.9	-11.4
Canada	1.5	2.0	-0.5	1.9	2.2	-0.3
Japan	---	6.5	-6.5	---	7.4	-7.4
Western Europe	4.2	15.9	-11.7	4.2	17.3	-13.1
Subtotal, Industrialized						
Less Developed Countries	15.1	43.9	-28.8	14.6	46.8	-32.2
Less Developed Countries						
OPEC	30.1	4.3	+25.8	31.3	6.3	+25.0
Non-OPEC	10.3	10.7	-0.4	11.7	13.3	-1.6
Subtotal, LDCs	40.4	15.0	+25.4	43.0	19.6	+23.4
Subtotal, Non-Communist World	55.5	58.9	-3.4	57.6	66.4	-8.8
Soviet Bloc and China, Net Imports			-1.0			-1.8
Total Imports (-)			-4.4			-10.6

SOURCE: Projected by the Congressional Budget Office, using price assumption of $30 per barrel in the fourth quarter of 1979, rising at an annual rate 2 percent greater than the general price level.

Even if supply and demand were projected to be in balance throughout the coming decade, higher oil prices would remain a possibility. This could happen if producers decided to restrict supply and raise prices. Many producing countries perceive that their rate of economic growth has reached a practical limit, because of the inflationary or socially destabilizing effects faster growth would have. They may conclude that, if revenues cannot be translated effectively into growth, oil is best left in the ground. When market prices are rising, a producer in this situation may choose to reduce output rather than increase it, thus earning the same revenue on less production. Here again, the effects of higher prices on the economies of the industrialized countries would act ultimately to restrain such increases. Before that point is reached, however, price increases are possible even in the face of stable demand.

Price increases might take a hidden form. If OPEC decided to denominate oil rates in currencies other than the dollar, this would raise the price of oil paid by many other industrialized countries in the future since their currencies tend to appreciate relative to the dollar. In addition, U.S. import prices would rise by the extent to which the dollar fell in value relative to the currency in which oil was priced. Hidden price increases might also occur if oil were transferred away from contract sales to spot sales. Spot prices will remain higher than contract prices as long as availability is considered uncertain. In such a situation, refiners would pay a premium that reflects the cost of closing their refineries.

Finally, hidden price increases could take the form of economic concessions to producers. Many producing nations are building refining and petrochemical facilities that will come on line in the mid-1980s. Because of the difference in transportation costs in shipping crude and refined products (crude, being denser, is cheaper to ship), and because of projected excess capacity, these refining and petrochemical facilities may not be economically viable in a conventional market. Thus, producers may tie sales of these products to purchases of crude oil. Such "tie-in" sales would involve an additional transfer of resources to OPEC countries, and would amount to a de facto price increase. A similar disguised resource transfer might occur in the form of trade concessions offered to producing countries by consumer countries competing for access to oil. Bilateral agreements between producing and consuming countries are becoming increasingly common as consumers seek to secure oil deliveries and promote reciprocal trade with producers. These agreements not only often raise prices directly through "goodwill payments" and the like, but may also involve financial or trade concessions to producers. This type of hidden price increase is often in the interest of both parties since it can lead to more certain deliveries and better trade balances.

Effects of Higher Prices on U.S. Economy

The likelihood of higher oil prices in the coming decade raises the question of how these price increases will affect the U.S. economy. Higher oil prices in the 1970s contributed to the simultaneous existence of inflation and unemployment.

The effects of higher oil prices on inflation are obvious. In 1980, the United States will consume approximately 6.5 billion barrels of oil. A price increase of $4 per barrel would raise the rate of inflation by one percentage point. Price increases in substitutable fuels, such as coal and natural gas, would exacerbate this inflationary effect.

On the basis of the price assumption made for this analysis ($30 per barrel in the fourth quarter of 1979, increasing at 2 percent annually in real terms), oil prices may rise to $52 per barrel by 1985. This may, as already noted, be a minimum figure, since an excess demand for oil of approximately 4.4 million barrels per day is projected for that year. Assuming that oil prices rise by a minimum of $20 per barrel over the six-year period and projecting oil consumption in 1985 at 7.1 billion barrels (19.5 million barrels per day), price increases between now and 1985 could cost consumers $142 billion dollars in that year. This would amount to a cumulative increase in the general price level of 3 percent annually between 1980 and 1985, not taking account of price increases in other fuels, cost-of-living wage increases, and other costs related to the price of oil.

Rising oil prices not only increase the rate of inflation; they also dampen economic growth. Accompanied by higher prices for other sources of energy, they reduce the disposable income of consumers and hence the aggregate demand for goods and services. This demand reduction has a depressing effect on the national economy. Higher energy prices also lower business profits, reducing the volume of new investment. The inflationary effects of higher energy prices serve to lower the real interest rate, making saving less attractive. The expectation of continued increases in energy prices may further reduce incentives for investment, causing investors to turn to speculative assets such as gold. All of these effects diminish capital formation, and thus economic growth and productivity.

Major Sources of Uncertainty

Any estimate of future energy supply and demand is subject to major uncertainties, which are discussed below.

Levels of Economic Growth. The levels of crude oil demand presented in this chapter are highly sensitive to changes in economic growth. A one percentage point annual increase in the worldwide rate of economic growth would increase crude oil demand by 4 to 5 million barrels per day in 1990. A comparable decrease would lower demand by the same amount. It may be that the rates of growth assumed here are optimistic. This would close the gap between projected demand and supply, but at the cost of protracted slow growth. Shifts in demand may occur among the less developed countries, in which the greatest uncertainty as to future growth levels exists. This relationship suggests that surges in economic growth in the coming decade will be self-adjusting; as higher worldwide economic growth leads to higher oil prices, the higher prices in turn will inhibit that growth.

Disruption of Supply. The supply estimates presented in this chapter presume that no political or logistical event interrupts supplies from producing nations. Recent experience, however, shows that oil supplies can be disrupted either intentionally or accidentally in a number of ways (see Chapter V for an analysis of supply disruptions). Future disruptions, beyond limiting available supplies, would serve to reallocate supply within the OPEC cartel. In the past, supply disruptions have often served as the starting point for price increases.

Production Sharing. While OPEC has never formally allocated world production among its members, the possibility cannot be overruled. It would be most likely at a time of slack demand and falling oil prices. The cartel might then seek to restrict production to predetermined levels.

Efficiencies in Utilization. The main uses of oil are in transportation and space heating. The demand projections presented here assume that there will be no unforeseen technological innovations in those fields. Significant advances in automotive engineering, architectural design, or industrial process design would fundamentally change the outlook for the world oil market. As the time horizon of these estimates recedes, energy use patterns become an increasingly important source of uncertainty. Demand by the industrial nations is projected to reach 46.8 million barrels per day in 1990 (see Table 4). Thus, a 20 percent increase in the overall energy efficiency of the industrial economies over what is assumed in the forecasts would eliminate the excess demand for oil projected for that year. Such an increase cannot be anticipated, but neither can it be ruled out.

Production from Non-OPEC Sources. Uncertainties also exist as to levels of future production in many non-OPEC countries and the Soviet Union. While there is reason to believe that nearly all of the world's giant oil fields have been discovered, many less developed countries have hydro-

carbon prospects that are underexplored. Recent exploratory successes in India, Pakistan, and Vietnam, for example, suggest potential additions to world reserves. Given the low level of geological knowledge in many of these areas, unforeseen discoveries are possible. Nevertheless, the time necessary to bring these discoveries to production would rule out a contribution from this source until the late 1980s. Moreover, many LDCs that discover oil would increase their domestic consumption rather than export any new production.

Information on Soviet production is often contradictory. Most analyses depict Soviet production as approaching a peak in the early 1980s. Some observers, however, believe that Soviet resources are currently underproduced, and that the reserve base will be expanded. This uncertainty is compounded by the uncertainties of U.S.-Soviet relations and how they will affect Soviet oil and gas production.

Alternative Fuels or Energy Sources. The demand for oil could conceivably be reduced by an accelerated development of alternative fuels. Most notably, increases in the availability of natural gas might occur, partly as a result of the decontrol of the U.S. gas market. The development of alternative energy sources, particularly of solar energy or synthetic liquid fuels, might erode the demand for oil by the late 1980s. The future of nuclear power is also uncertain. Accelerated nuclear programs, including greatly expedited licensing procedures, could erode world oil demand by approximately 2.0 million barrels per day by 1990.

CHAPTER IV. OIL AND THE VALUE OF THE DOLLAR

The increased dependence of the United States on oil imports, coupled with rising oil prices since 1973, have resulted in increased dollar outflows for oil payments. Given the projected decline in U.S. oil production during the coming decade and the projected increase in U.S. oil demand, the outflows will continue to grow. How will this affect the dollar?

As will be seen in the remainder of this chapter, oil is only one of a number of factors contributing to the decline in the dollar's value. It is critical enough so that rising oil imports will cause a further deterioration of the dollar in international exchange and losses to the U.S. economy as a whole. (The secondary effects on the national economy may, however, be larger than the direct effects of higher oil prices. For example, the rise in interest rates needed to recycle petrodollar outflows in the past year may have been worse than the direct effects of those outflows on the exchange rate and, in turn, the price of imports.) Other factors in U.S. balance-of-payments deficits are: slow economic growth among major U.S. trading partners; tariff and nontariff barriers on U.S. exports; a technological lag in U.S. industries; and anticipated changes in the institutional role of the dollar. In the long run, oil-related deterioration of the dollar might contribute to a reduction in the reliance on the dollar as the world's reserve and transactions currency. This would be followed by an oversupply of dollars in world trade and a severe increase in the price of U.S. imports.

BACKGROUND

Throughout the post-World War II period, until the 1970s, the United States ran a positive trade balance. The pattern changed in 1971 and 1972, when the United States imported more goods than it exported. Merchandise trade deficits were again experienced in 1974, 1976, 1977, 1978, and--according to preliminary statistics--1979. The magnitude of the deficits increased significantly, from approximately $9 billion in 1976 to over $30 billion in 1977 and 1978, and an expected $28 billion in 1979. The merchandise trade deficit has been offset, to some extent, by surpluses in the balance of services. Nevertheless, the balance of the U.S. current

TABLE 11. U.S. BALANCE OF PAYMENTS, 1973-1979 (By calendar year, millions of dollars)

	1973	1974	1975	1976	1977	1978	1979 (Estimated)
Current Account							
Merchandise trade exports	71,400	98,300	107,100	114,700	120,800	141,900	168,300
Minus non-oil imports	62,900	79,400	73,300	92,300	110,200	137,000	140,600
Minus oil imports	7,600	24,300	24,800	31,800	41,500	39,100	55,300
Balance of trade	911	-5,369	9,047	-9,306	-30,873	-34,187	-27,680
Balance of services	2,993	8,956	14,014	18,909	21,451	25,378	31,960
Unilateral transfers	-3,883	-7,185	-4,615	-4,997	-4,670	-5,086	-5,400
Total, Current Account Balance	22	-3,598	18,445	4,605	-14,092	-13,895	-1,100
Capital Account							
Net private capital flows	-1,778	-10,871	-26,725	-25,672	-17,558	-27,077	14,060
Net foreign official flows	5,145	10,981	6,907	17,573	36,656	33,758	-37,812
Change in U.S. current assets	-1,283	-1,069	-4,076	-6,772	-4,068	-3,924	-8,594
Total, Capital Account Balance	2,084	-959	-23,894	5,660	13,175	2,756	-31,044
Statistical Discrepancy a/	-2,107	4,557	5,449	-10,265	937	11,139	32,244

SOURCE: Bureau of Economic Analysis, Survey of Current Business (U.S. Department of Commerce). Projections for 1979 made by Congressional Budget Office based on data for the first six months.

a/ By definition, the net flow of capital and the net flow of trade must sum to zero, yet capital flows rarely balance trade flows with precision. The differences are usually ascribed to reporting errors, omissions, internal transfers of transnational corporations, and leads and lags in the payments for imports and exports. The statistical discrepancy line captures these effects.

account--that is, the total measure of the flow of goods and services in and out of the country--was negative in 1977 and 1978, and is expected to be negative in 1979. These data are presented in Table 11. 1/

Significant outflows of dollars have also resulted from U.S. direct investment abroad, increases in U.S. banks' foreign lending, and transfers of funds by private holders of dollars from U.S. financial markets to the Eurodollar market. Since 1973 there has been a net outflow of capital from the United States, causing greater additions to the supplies of dollars in foreign countries in most years than have U.S. trade deficits.

Other factors also influence the willingness of foreigners to hold and invest dollars in U.S. or international financial markets, such as short-term differences in inflation and interest rates here and abroad and concern about the effects of U.S. economic policies on the dollar's future. The magnitude of the dollar outflow in 1977 and 1978 that resulted both from trade deficits and from private capital outflows may have contributed to the fall in the dollar's value. As the dollar's value falls, private holders of dollars convert their assets into other, stronger currencies, contributing to a further erosion in its value.

In balance-of-payments accounts, dollar outflows are offset by official transfers. Throughout the decade, central banks abroad bought dollars when they were in surplus, in order to prevent further declines in the dollar's value and prevent appreciations in their own currencies (which would increase prices of their exports and have a negative influence on their trade balances). When foreign central banks buy dollars in exchange for their own currencies, they increase their dollar reserves. Unlike private foreign dollar holdings, which tend to be invested in the Eurodollar market and do not appear in U.S. balance-of-payments accounts, these new reserve funds are invested (in the United States) in U.S. Treasury securities and thus serve to "balance" U.S. international accounts. Such support for the dollar has been seen as critical in maintaining its role as an international reserve and transactions currency. Providing this support for the dollar is made more difficult, however, by the existence of an external dollar market--the Eurodollar market--which provides foreign dollar holders with the option of holding assets outside the United States, where they do not assist in offsetting U.S. payments deficits.

1/ For a discussion of balance of payments statistics and of recent trends in the U.S. trade balance, see Congressional Budget Office, The U.S. Balance of International Payments and the U.S. Economy: Developments in 1978 and Early 1979 (November 1979).

In the postwar era, the dollar gained greatly in value while the exchange rate was fixed against other currencies. By the late 1960s, however, the fixed exchange rate became unrealistically high and the dollar overvalued. To correct this, in 1971 the Nixon Administration stopped maintaining the value of the dollar vis-a-vis gold, and allowed it to "float" against foreign market currencies. As a result, the value of the dollar was allowed to fall toward its level between 1970 and 1973, before the OPEC price increases. It fluctuated at this lower level from 1973 through 1975, then rose, largely in response to a domestic recession in 1975 and 1976, the two years since the OPEC price increases in which the United States registered a trade surplus. In 1977, the dollar resumed its decline, continuing until the Administration put into effect a support package on November 1, 1978. Thereafter it rose until June 1979, and has fluctuated since.

OIL IMPORTS AND THE DOLLAR: THREE EFFECTS

Oil imports affect the dollar in three ways:

- Most directly, they result in an outflow of dollars for oil payments.
- The outflow is, to some extent, offset by an inflow, when the oil-producing countries "recycle" their earnings by purchasing goods and assets in the United States.
- The institutional role of the dollar as the world's reserve and transactions currency may be altered by oil-related outflows.

The Outflow: Payments for Oil

In 1973, the United States imported 5.87 million barrels per day, net, of oil and oil products at a total cost of $8.3 billion. In 1978, net imports had reached the level of 7.87 million barrels per day, at a total cost of $42.2 billion. Imports in 1979 were approximately 7.8 million barrels per day, at a total cost of $60.0 billion. Thus, even if U.S. oil imports had not increased over this period, the total payment for foreign oil would have risen by $46 billion in 1979. The United States would have achieved a positive merchandise trade balance in 1979 had the price of oil remained at its 1973 level. Clearly, higher oil prices have worsened the merchandise trade balance.

But oil imports are only part of the trade picture. While the value of oil imports rose by $33.9 billion between 1973 and 1978, the value of all other imports rose by $90.3 billion. Thus, oil imports were responsible for only 27 percent of the general increase in U.S. merchandise imports over this period. In 1978, oil imports dropped in value by $2.8 billion, yet imports of metals, machinery, and automobiles alone increased by $14.2 billion.

The significance of this can be seen by comparing the U.S. experience with that of other industrialized countries that are even more dependent on imported oil. Oil imports accounted for about 15 percent of the growth in West Germany's imports over the 1973-1978 period, and for 40 percent of the growth in Japan's imports during the same period. Yet West Germany has had a trade surplus in every year since 1973, and Japan since 1976. Thus, it is clear that oil imports are not the sole factor in U.S. trade deficits.

The Inflow: Recycling Petrodollars

Many of the dollars spent on imported oil flow back to the United States in two ways: as payment for imports from the United States by OPEC countries, usually of capital goods or food; and as investment of OPEC surpluses in the United States or in dollar-denominated assets abroad.

Exports to OPEC. If all dollars sent to OPEC by the United States for oil payment were returned to the United States in payment for goods or assets, oil imports would not pose a threat to the value of the dollar. But the United States does not export enough goods and services to OPEC to balance trade between the two. West Germany now has a trade surplus with OPEC, and Japan and the European Economic Community, outside of Germany, have managed to decrease their deficits (see Table 12). A variety of factors explain their superior performance. It is partly attributable to efforts by these governments, particularly that of Japan, to secure markets in OPEC countries for their capital goods and manufactured products. Often these include pipelines and other infrastructural equipment for the oil industry, or assistance in constructing refineries or petrochemical plants. These are often provided in "barter" deals in exchange for access to OPEC oil. Other reasons for their superior trade performance may be their long experience as exporting countries, the technological superiority of their products, and the poor price competitiveness of U.S. exports because of domestic inflation and efforts to maintain the dollar above its apparent market value.

TABLE 12. MERCHANDISE TRADE BALANCE BETWEEN SELECTED INDUSTRIALIZED COUNTRIES AND OPEC, 1970-1979 (By calendar year, in billions of dollars)

	United States			Japan		
	Exports	Imports	Net	Exports	Imports	Net
1970	2.1	1.8	0.3	0.9	2.9	-2.0
1971	2.3	2.2	0.1	1.4	3.7	-2.3
1972	2.8	2.9	-0.1	1.9	4.6	-2.7
1973	3.6	4.9	-1.3	2.7	7.0	-4.3
1974	6.7	16.8	-10.1	5.4	20.0	-14.6
1975	10.8	18.7	-7.9	8.4	19.4	-11.0
1976	12.6	27.2	-14.6	9.3	21.9	-12.6
1977	14.0	35.6	-21.6	12.0	24.3	-12.3
1978	16.7	33.0	-16.3	14.2	24.7	-10.5
1979 b/	3.6	9.1	-5.5	2.6	7.4	-4.8

(Continued)

SOURCE: International Monetary Fund, Direction of Trade (March 1980).

OPEC Assets. As a whole, the OPEC countries import less than they export, leaving them with surpluses derived from oil sales. These surpluses are invested in a variety of assets, among them government and private securities here and abroad (including the Eurodollar market), loans to less developed countries, and gold. Policies of industrialized countries toward OPEC investments vary, as they do toward foreign investments in general. The United States, like Germany and Switzerland, restricts access to some portions of its domestic capital market, although more through political means than legal. In some countries, OPEC capital is sought actively, as in Kuwait's purchase of a significant interest in the Japanese Mitsubishi Corporation.

The ways in which the OPEC countries dispose of their surpluses are determined by their economic goals. In the past few years, they appear to have sought to diversify their portfolios, which had been disproportionately channelled into dollar-denominated assets in the United States and the Eurodollar market. While direct purchases of U.S. securities, both public and private, rose from 22 percent of the total allocated surpluses in 1974 to 33 percent in 1976, they fell back to 12 percent in 1978 as OPEC countries

TABLE 12. (Continued)

	West Germany			European Economic Community a/		
	Exports	Imports	Net	Exports	Imports	Net
1970	1.0	1.8	-0.8	2.9	7.3	-4.4
1971	1.2	2.4	-1.2	3.4	9.1	-5.7
1972	1.5	2.6	-1.1	4.3	10.7	-6.4
1973	2.3	3.9	-1.6	6.0	15.0	-9.0
1974	4.1	9.2	-5.1	9.6	36.7	-27.1
1975	6.8	8.2	-1.4	16.1	32.4	-16.3
1976	8.2	9.7	-1.5	18.1	36.6	-18.5
1977	10.8	10.1	0.7	23.1	38.3	-15.2
1978	12.3	9.7	2.6	27.4	38.6	-11.2
1979 b/	2.6	2.9	-0.3	c/	c/	c/

a/ Excluding West Germany.
b/ First quarter data.
c/ Data not yet available.

sought nondollar assets (see Table 13). The desire to diversify assets stems, in part, from current and expected declines in the dollar's value. OPEC investors also perceive that oil in the ground gains from inflation, while paper assets lose from inflation. This leads them not only to reduce oil production levels, but to shift into more speculative assets such as gold. Finally, since OPEC members generally seek industrial diversification and development, their capital is often directed to available manufacturing assets, such as the Iranian acquisition of a 25 percent share of West Germany's Krupp conglomerate or the Libyan acquisition of 10 percent of Fiat.

Oil and the Institutional Role of the Dollar

A final consideration in the relationship between oil imports and the dollar concerns the use of the dollar as the medium of oil payments, and, in turn, the dollar's status as the world's reserve and transactions currency. Because of this status, oil is bought and sold in dollars, since more goods and assets can be purchased with dollars than with any other single currency.

TABLE 13. ESTIMATED DISPOSITION OF OPEC INVESTABLE SURPLUS, 1974-1978 (By calendar year, in billions of dollars)

	1974	1975	1976	1977	1978
United States	13.00	9.50	12.00	9.25	1.75
Treasury securities					
Bills	5.30	0.50	-1.00	-0.90	-1.00
Bonds and notes	0.20	2.00	4.20	4.30	-1.50
Other marketable U.S bonds	0.90	1.60	1.20	1.70	0.80
U.S. stocks	0.60	1.70	1.80	1.40	0.80
Commercial bank liabilities	4.20	0.60	1.90	0.40	0.70
Subtotal (banking and portfolio placements)	11.20	6.30	8.10	7.00	-0.20
Other (including direct investment, prepayments on U.S. exports, debt amortization, etc.)	1.70	3.20	4.20	2.30	2.00
Eurodollar Market	22.50	8.00	11.00	12.00	2.50
United Kingdom	7.50	0.25	-1.00	0.75	-0.25
Other Developed Countries	6.00	7.75	8.00	8.00	6.00
Less Developed Countries a/	6.00	7.25	7.50	8.50	4.25
Soviet Bloc	0.50	2.00	1.25	1.25	0.50
International Financial Institutions (including IMF oil facility)	3.75	4.25	1.75	0.50	-0.50
Total Allocated Surplus	59.25	39.00	40.50	40.50	14.25
Estimated Current Account Surplus	71.00	35.50	39.50	35.50	5.00
Adjustment for Lag in Receipt of Oil Revenues	-11.25	1.00	-4.50	3.00	1.00
Estimated Gross Borrowings	0.50	4.00	8.00	10.00	15.00
Estimated Cash Surplus, plus Borrowings	60.25	40.50	43.00	48.50	21.00
Minus Total Allocated Surplus	-59.25	-39.00	-40.50	-40.50	-14.75
Discrepancy in Estimates	1.00	1.50	2.50	8.00	6.75

SOURCE: Department of the Treasury, Office of International Banking and Portfolio Investment.

a/ Includes grants, debt amortization, and prepayments for imports.

The decline in the dollar's value has eroded some of the faith in its ability to perform this central function. Some OPEC members have called for pricing oil in terms of a "basket of currencies" instead of dollars, because of the decreases they experience in the real price of oil as the dollar loses value.

Dollar pricing of oil poses both advantages and disadvantages for the U.S. economy. Foreign oil consumers generally pay for oil by purchasing dollars on the Eurodollar market and sending them to OPEC members. In the short term, this absorbs dollar liquidity. Yet the dollars accumulated by OPEC members in this way generally are not returned through purchases of U.S. goods and services (see Table 12) or of U.S. assets (see Table 13). Most of these accumulated dollars return to the Eurodollar market, the global pool of liquid dollars. Thus, some dollars are continually being borrowed in the short term to transact oil purchases.

Dollar pricing of oil also creates advantages for other industrialized countries. For example, spot prices in 1979 were driven up, for the most part, by foreign buyers who paid in devalued dollars, perceiving the spot price of oil as being lower than U.S. buyers did. (It has even been suggested that foreign governments have been slow to support the dollar because lower dollar values mean lower real oil prices. Yet any government pursuing such a policy would be penalizing its exporters for the sake of modest reductions in the price of imported oil.) On the other hand, the United States would probably not benefit from adoption of an oil price expressed in terms of a "basket of currencies." Since most of these currencies have appreciated relative to the dollar, pricing oil in terms of yen, marks, or francs would make it more expensive for U.S. purchasers.

Continued declines in the dollar's value may ultimately induce OPEC to abandon the dollar as the medium for oil payments. World money managers in both the public and private sectors would see such a move as a signal that the dollar was no longer tenable as a world reserve currency. Unless it was phased out in an orderly fashion, the change could precipitate a rush against the dollar. Portfolio managers would seek to rid themselves of dollars because of the reduced world need for them, resulting in a further drop in the dollar's value that would continue the spiral. For U.S. consumers, this would mean higher prices for oil and all other imports, with heavy losses for the economy. There is no reason to suppose that such a collapse of the dollar would be welcomed either by OPEC, a large dollar holder, or by other foreign governments, but OPEC's actions are capable of sending out the economic signals that could lead to such a collapse.

OTHER CAUSES OF THE DOLLAR'S DECLINE

Slow Economic Growth in Major U.S. Trading Partners

U.S. exports are dependent on the economic growth of U.S. trading partners, since such growth increases their demand for imports from the United States. The recession of the mid-1970s slowed demand for U.S. goods by other industrialized countries. During the same period, many less developed countries also reduced their imports from the United States and other industrialized countries because of the lack of foreign exchange (see Table 14). In 1977, growth in the European Economic Community was slow at a time when the United States was experiencing a recovery, so that increased demand for imports by the United States was not offset by external demand for U.S. exports. (In 1978, it should be noted, the pattern was reversed but the trade deficit did not close.) These data are presented in Table 15.

Decreased Competitiveness of U.S. Exports

U.S. exports may also be faltering for technological reasons. Between 1970 and 1979, the U.S. share of world manufactured exports fell from 21 to 17 percent. This occurred despite the fact that prices were shifting in favor of the United States. U.S. relative unit labor costs fell by over 30 percent, relative industrial wholesale prices by over 10 percent, and relative export prices by 5 to 10 percent.

This suggests that factors other than price competitiveness are responsible for recent U.S. trade declines. Technological lags have been cited in a number of established industries currently encountering strong foreign competition, such as steel, shoes, and autos. The United States also lags in some specific products involving new technologies. U.S. spending on research and development (R&D), both public and private, has decreased steadily as a percentage of GNP since the mid-1960s (when it was probably stimulated by the demands of the Vietnam War). Among the major industrialized nations, only the United Kingdom has shared this decline in R&D spending. On the other hand, U.S. expenditures on R&D are still as large as those of all other countries combined, as shown by such indicators of scientific progress as patents granted and numbers of scientists employed.

TABLE 14. MERCHANDISE TRADE BALANCE BETWEEN SELECTED INDUSTRIALIZED COUNTRIES AND NON-OPEC LDCs, 1970-1979 (By calendar year, in billions of dollars)

	United States			Japan			West Germany			European Economic Community a/		
	Exports	Imports	Net	Exports	Imports	Net	Exports	Imports	Net	Exports	Imports	Net
1970	11.1	9.4	1.7	6.1	4.6	1.5	3.1	3.0	0.1	9.2	9.5	-0.3
1971	11.2	10.1	1.1	7.3	4.6	2.7	3.5	3.0	0.5	10.5	9.3	1.2
1972	11.7	12.3	-0.6	8.3	5.4	2.9	3.7	3.6	0.1	11.8	10.7	1.1
1973	17.3	16.7	0.6	11.4	9.1	2.3	5.4	5.1	0.3	14.7	15.9	-1.2
1974	26.0	25.5	0.5	17.1	12.7	4.4	8.2	6.3	1.9	20.0	20.9	-0.9
1975	28.4	23.9	4.5	16.1	11.2	4.9	7.8	6.7	1.1	23.5	19.8	3.7
1976	27.8	29.7	-1.9	18.4	14.0	4.4	8.3	8.3	-1.0	22.8	22.9	-0.1
1977	29.3	36.9	-7.6	22.8	16.0	6.8	9.3	10.5	-1.2	28.3	25.2	3.1
1978	36.1	42.3	-6.2	29.4	17.9	11.5	11.3	12.0	-0.7	34.7	31.3	3.4
1979 b/	10.2	11.8	-1.6	7.2	5.2	2.0	3.3	3.4	-0.1	c/	c/	c/

SOURCE: International Monetary Fund, Direction of Trade.

a/ Excluding West Germany.
b/ First quarter data.
c/ Data not yet available.

TABLE 15. MERCHANDISE TRADE BALANCE BETWEEN SELECTED INDUSTRIALIZED COUNTRIES AND ALL INDUSTRIALIZED COUNTRIES, 1970-1979 (By calendar year, in billions of dollars)

	United States			Japan			West Germany			European Economic Community a/		
	Exports	Imports	Net	Exports	Imports	Net	Exports	Imports	Net	Exports	Imports	Net
1970	26.4	28.9	-2.5	8.9	8.4	0.5	25.2	22.0	3.2	54.4	59.8	-5.4
1971	26.8	33.4	-6.6	11.4	7.9	3.5	28.7	25.5	3.2	62.5	66.1	-3.6
1972	30.6	40.2	-9.6	14.3	9.5	4.8	34.5	29.9	4.6	77.6	79.9	-2.3
1973	41.9	47.5	-5.6	16.0	15.1	0.9	49.1	39.6	9.5	103.8	113.1	-9.3
1974	55.2	60.1	-4.9	21.7	20.2	1.5	61.0	46.3	14.7	129.9	146.4	-16.5
1975	56.8	55.2	1.6	19.4	18.2	1.2	58.7	51.4	7.3	136.9	151.2	-14.3
1976	62.3	66.3	-4.0	26.5	19.1	7.4	68.7	59.8	7.9	154.4	170.6	-16.2
1977	66.7	77.9	-11.2	32.7	20.6	12.1	79.9	69.0	10.9	177.7	191.8	-14.1
1978	76.4	96.7	-20.3	40.3	25.7	14.6	97.5	85.6	11.9	217.4	236.6	-19.2
1979 b/	23.2	24.8	-1.6	9.8	7.6	2.2	28.5	25.5	3.0	c/	c/	c/

SOURCE: International Monetary Fund, Direction of Trade.

a/ Excluding West Germany.
b/ First quarter data.
c/ Data not yet available.

Tariff and Nontariff Barriers to Trade

Obstacles to free trade exist in most countries, including the United States. They include tariffs on imports and anticompetitive measures such as quotas. Such barriers are said to be pronounced in Japan, where they weaken the U.S. trade position. Many U.S. firms in industries threatened by foreign competition claim that foreign governments have tacitly encouraged their exporters to sell goods in the United States below cost, and that such dumping or otherwise subsidized exports accounts for much of the rise in manufactured imports.

Some foreign governments, notably Japan, actively pursue foreign trade through such means as export financing and "packaging," state-to-state trade negotiations, and export subsidies. This reflects the historical importance of exports in many industrialized economies, as well as the fact that other governments use trade as a deliberate tool of foreign policy.

Capital Flows

The importance of the dollar in international finance makes it sensitive to developments in the money market. A major portion of world trade is denominated in dollars--as much as 80 percent for Japan, less for European countries, and probably even more for developing countries. Much of this trade is financed by borrowings of dollars in financial centers outside the United States. These centers are referred to as the Eurodollar market.

The rise of the Eurodollar market has linked the world's money markets into one. The ability of money managers to move quickly from currency to currency on a round-the-clock global basis has made short-term currency values instantly responsive to changes in interest rates in individual countries. For example, if U.S. interest rates lag behind those on Eurodollar deposits, this will draw dollars into the Eurodollar market, lowering their value and making the dollar a less attractive asset for foreign investors. The consequence will be shifts of funds into other currencies. Such a chain of events occurred in 1978. Data published by the Bank for International Settlements reveal that in 1978 Eurobanks received, net, more dollars from U.S. residents than from OPEC countries. Thus, more dollars left the United States in 1978 than left OPEC. Japan and Germany, the two major surplus countries, were net borrowers of dollars in Eurocurrency markets. These developments prompted the Federal Reserve to take countermeasures in October 1978 to slow the outflow of U.S. dollars.

In summary, the role of the United States as international banker must be weighed in considering the various factors that contribute to the deterioration of the dollar. While the trade deficit undoubtedly has increased the supply of dollars held by foreigners, and especially those held by OPEC countries, it was not as important as net private capital outflows until 1977 and 1978. (In the first quarter of 1979, private capital flows reversed direction for the first time since the OPEC price increases of 1973-1974.) But rising oil imports will deepen trade deficits in coming years, adding to the downward pressure on the dollar.

CHAPTER V. SECURITY OF SUPPLY

The security of the U.S. oil supply has been a major concern of energy policy since the OPEC embargo of 1973-1974. In 1979, the Iranian revolution interrupted the flow of oil from that country. The possibility of another oil supply interruption has been a major impetus behind a wide range of domestic energy legislation. This chapter surveys the issues arising from OPEC control of Middle Eastern oil, and how this may affect U.S. relations with both allies and adversaries throughout the world.

BACKGROUND

The OPEC embargo and price increases of 1973-1974 threatened Western and Japanese security of access to a critical source of energy. Despite the risks associated with importing foreign oil, particularly from the Middle East, total U.S. oil imports, as well as imports from the Middle East, have increased significantly since then.

During this period, however, certain measures have been taken that could deter another supply interruption or reduce its impact. The International Energy Agency (IEA), founded at the initiative of the United States following the 1973-1974 oil crisis, is intended to handle such a supply interruption. Through the IEA, an oil-sharing mechanism has been worked out among the member countries. In the event of an interruption, members will undertake predetermined emergency conservation measures, and available oil supplies will be allocated among them. Every IEA participant is to set aside an emergency reserve equal to 60 days of oil imports.

The Strategic Petroleum Reserve

In the Energy Policy and Conservation Act of December 1975 (EPCA), the Congress mandated the development of a Strategic Petroleum Reserve aimed specifically at offsetting the likely output losses from a foreign oil supply interruption. To expedite the development of the reserve, the legislation provided for an early storage reserve of at least 150 million barrels. It also required the Federal Energy Administration to submit a plan for designing, constructing, and filling the Strategic Petroleum Reserve. The plan was submitted to the Congress in February 1977 and became effective in April. It superseded the Early Storage Reserve plan but retained the goal of storing 150 million barrels of oil by December 1978.

In May 1977, the plan was amended to accelerate the Strategic Petroleum Reserve by placing 250 million barrels in storage by December 1978, another 250 million by December 1980, and an additional 500 million barrels by 1985. This would bring the total crude in storage to 1 billion barrels--the maximum amount authorized by EPCA. Currently about 92 million barrels are in storage, with capacity for an additional 156 million barrels available. Construction of an additional 290 million barrels of storage capacity, which would bring total capacity to 538 million barrels, is scheduled for completion in 1982. No specific plans have been developed to bring capacity up to the 1 billion barrel goal. No oil purchases have been made since the spring of 1979. The Department of Energy's plans for oil purchase are presently unclear. The fiscal year 1981 budget request 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 1982. The revised budget request submitted in March 1980, however, delays purchases until June 1981. Recent statements of DOE officials indicate that no final decision regarding purchase has been made at this time.

Emergency Distribution Measures

During the 1973-1974 crisis, the Congress passed the Emergency Petroleum Allocation Act of 1973, providing for a system of petroleum allocation regulations. Essentially, the allocation system gave priority to the protection of public health, safety, and welfare and to national defense, mineral production, and agriculture. Since then, the Federal Energy Administration and the Department of Energy have conducted a careful review of the policies pursued during the 1973 oil embargo. The department has funded a number of studies to evaluate the existing priority classification system, and has continually updated the allocation system used during the Iranian disruption of 1979, even though the effectiveness of that system was questionable.

In 1979, the Emergency Energy Conservation Act authorized the President to develop a standby gasoline rationing plan to be implemented at his discretion when there is a 20 percent drop in gasoline availability. The rationing plan would be subject to Congressional approval, and either House could veto a presidential decision to implement it. The act also mandated a gasoline energy conservation plan, to be implemented by the federal government and the states, although many states have not yet developed their parts of the plan as required by the act.

FACTORS AFFECTING THE SECURITY OF SUPPLY

The security of the U.S. oil supply is dependent upon a number of political and economic factors. These include the size and sources of U.S. imports, the tightness of the world oil market, the size of the OPEC surplus, and the political stability of the oil exporting countries and of U.S. relations with them.

Size and Geographical Concentration of Oil Imports

Since the 1973 oil embargo, the United States has dramatically increased its oil imports. Net refined and crude imports rose from about 6.0 million barrels a day in 1973--representing 36 percent of U.S. oil consumption--to about 8.0 million barrels a day in 1979--approximately 44 percent of U.S. oil consumption.

The countries responsible for the 1973 oil supply interruption now provide a much larger share of U.S. petroleum imports. In January-September 1973, the Organization of Arab Petroleum Exporting Countries (OAPEC) provided 23.6 percent of total U.S. imports. By 1978 its share had risen to 39 percent, or 17 percent of U.S. domestic demand. The states belonging to the larger Organization of Petroleum Exporting Countries (OPEC) increased their share of U.S. oil imports over the same period from 70 to 80 percent.

The size and importance of U.S. imports, as was seen in Chapter II, will continue to increase over the coming decade. From 44 percent of U.S. demand in 1979, oil imports are projected to rise to 52 percent of demand in 1985, and 57 percent in 1990. The U.S. economy will thus become increasingly dependent on foreign oil.

Since the 1973 quadrupling of oil prices, exploration and development have been intensified in various parts of the globe, such as the North Sea, Mexico, China, and West Africa. This should lead to a greater diversification of import sources. If Mexico, for example, has the proved reserves indicated in Chapter III, the U.S. dependence on OPEC could be somewhat reduced in the near future. An oil supply interruption is much less likely in Mexico than in the Persian Gulf. Yet, the supply projections in Chapter III indicate that new producers such as Mexico will not bring a significant change in the geographical distribution of U.S. imports. The bulk of U.S. oil imports will continue to come from Persian Gulf and North African sources.

Tightness of World Oil Supplies

Security of supply is also dependent on the conditions of world oil supply and demand. As world oil markets tighten, the industrial oil-importing countries become more vulnerable to a supply interruption, and oil exporters have more leverage. If an embargo were to occur when world oil supplies were tight, exporters not involved would not be likely to have much excess capacity. In 1973-1974, the United States was able to pick up enough excess supplies to mitigate the effects of the interruption. In the early 1980s, the world oil market could have some slack, in the absence of a crisis similar to that of Iran. But this slack should disappear by 1985, along with the development of strong upward price pressures, as discussed in Chapter III. Tight markets appear likely throughout the second half of the decade, and few countries would be capable of providing short-term production increases if a disruption occurred.

The OPEC Capital Surplus

The financial reserves of many OPEC countries skyrocketed during the 1970s. Many of them have engaged in ambitious development plans, and have made large spending commitments. An interruption of any length in oil shipments could disrupt or suspend these development plans, with adverse domestic political consequences. For this reason, the potential participants in a new interruption would be among the low-absorbing nations--those countries that have difficulty finding economic uses for all of their oil revenues. 1/ Libya, Saudi Arabia, and Kuwait are typical low-absorbing countries. Nigeria, on the other hand, is an example of a high-absorbing country that needs oil revenues to sustain its development plans. While the Iranian revolution of 1979 may cause some OPEC countries to reevaluate their development plans in the short run, most of the high absorbers are likely to continue to spend the bulk of their oil revenues.

Some of the OPEC countries not only have heavy domestic investments but have also acquired extensive dollar-denominated assets abroad. A crippling of the Western economy would clearly be disadvantageous for

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1/ For more detail on the concept of high- and low-absorbing countries, see Dankwart A. Rustow, "Political Factors Affecting the Price and Availability of Oil in the 1980s." (Petroleum Industry Research Foundation, Inc., 1978).

them. The Western industrial countries also provide the market for new exports sought by OPEC members as part of their industrial diversification programs.

The OPEC surplus, which had been declining in 1977 and 1978, was dramatically increased by the price rises of 1979. These new revenues may be so large that they cannot be absorbed efficiently into OPEC economies. The OPEC countries lack a developed commercial infrastructure; there is a limit to the amount of new investment that can be accommodated, given the existing transportation system, limited supplies of skilled labor, and the small potential of the domestic market. There are also drawbacks to the investment of OPEC's surplus abroad. Purchases of many assets in industrial countries are restricted, and the U.S. seizure of Iranian assets in 1979 may provide an additional incentive to hold the surplus in more liquid form in the future. OPEC purchases of gold may have been an important factor in the upsurge of gold prices in early 1980. On the other hand, even the most liquid assets cannot always be converted into real purchasing power in time of crisis. If a situation like that of 1973-1974 were to recur, the nature of the emergency would be likely to prevent the OPEC countries from converting their assets into goods. The international gold market, for example, might be severely restricted under such circumstances.

Political and Logistical Factors

Continuity of oil supplies also depends upon political factors. World political conditions change rapidly, making it difficult to assess the likelihood of another supply interruption. A serious interruption could occur in the event of civil war, revolution, or serious domestic strife in a major oil exporting country. A prime example is the Iranian revolution. While other producers offset somewhat the slackening of Iranian supply in 1979, they would be less likely to make up the difference in the 1980s when significant excess capacity will not exist.

International tensions could also lead to an interruption, even at some sacrifice to the producers involved. A radical government might be willing to absorb economic losses to achieve ideological goals. Perhaps the most likely cause of such a supply interruption would be another Arab-Israeli war. Each of the four episodes of open warfare between Arabs and Israelis has led to some disruption in the world oil trade. The 1948 confrontation led to the permanent closing of the Iraq Petroleum Company's pipeline to Haifa. In

1956 the passage through Suez was interrupted--the major oil route at that time from the Middle East to the West. From the 1967 Yom Kippur War until 1975, the Suez Canal remained closed. The 1973 crisis led to the OPEC embargo. While the initiatives of the Carter Administration in the late 1970s seemed to have reduced the prospects for warfare in the Middle East, the Soviet invasion of Afghanistan in 1980 has once again raised the specter of a break in supplies from this region.

An interruption could be caused by logistical breakdown. Logistical breakdowns include explosions in oil pipelines and oil field fires. Iraq experienced a pipeline explosion (possibly caused by terrorists) in 1978. A fire in eastern Turkey knocked out Mediterranean delivery of Iraqi oil blend for two weeks in 1978, amounting to 500,000 barrels a day. Similarly, a 1977 fire at a Saudi Arabian producing facility resulted in a loss of world oil supplies equivalent to a shutdown of the Trans-Alaskan Pipeline (1.5 million barrels per day).

A number of factors work against another interruption in the near future. These include the development plans of many OPEC countries, their heavy investment in the United States, the chance that the United States could switch to non-OPEC oil for the short run, and the difficulties in effectively implementing an interruption. Nonetheless, as long as the United States remains heavily dependent on foreign oil, particularly from the Middle East, the security of its oil supply is an appropriate concern of U.S. energy policy. The impact that another interruption would have on the U.S. economy, as well as the political problems associated with dependence on foreign oil, are examined more closely in the next sections of this chapter.

ECONOMIC EFFECTS OF AN OIL INTERRUPTION

If another interruption in the supply of oil were to occur, what would be its consequences for the United States? The following section gives estimates of the impact on the U.S. economy of a one-year interruption in 1984 and 1990. 2/

2/ See Congressional Budget Office, The Economic Impact of Oil Import Reductions (December 1978) and Strategic Petroleum Reserve: An Analysis (forthcoming 1980).

Impact of a 3.5 Million Barrel per Day Interruption in 1984

While the 1973-1974 oil crisis lasted for about five months, in this analysis the interruption is assumed to last one year. This assumption makes it possible to estimate the maximum impact the interruption would have on the economy. The petroleum shortfall is assumed to be 3.5 million barrels a day, representing approximately 8 percent of projected energy consumption in 1984. The size of the shortfall is aimed to fit a wide range of possible events likely to lead to a supply interruption, such as an Arab-Israeli war or a shutdown of a major producer because of internal political problems. Oil prices are assumed to increase by 20 percent from their pre-interruption levels. The U.S. Strategic Petroleum Reserve is assumed to contain 500 million barrels and to be depleted after one year. Oil allocation regulations are also assumed to be in effect, and are maintained throughout the one-year period.

Price controls on oil and oil-related products are assumed to be in effect throughout the crisis. It is quite clear that without controls oil price increases combined with shortages in those industries that use petroleum as inputs could lead to short-run economic problems. Consequently, it is assumed that, during an emergency, the U.S. government would implement some form of price controls. Finally, the analysis also assumes that conservation measures as well as fuel switching are implemented as far as possible.

A 3.5 million barrel per day interruption (which represents a 9 percent petroleum shortfall) would have a significant impact on the American economy (see Table 16). Real output would decline by 6.6 percent (a drop of $272 billion in 1984), while the unemployment and inflation rates would increase by 2.1 and 20.0 percentage points, respectively. 3/ These price

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3/ The results of the analysis are presented in annual terms because it is difficult to estimate precisely the impact of a shorter supply interruption. There is too much uncertainty as to how conservation measures, fuel switching, the drawdown of the Strategic Petroleum Reserve, and the level and drawdown of oil pipeline inventories would combine to mitigate the effect of the production limitation. For an oil production limitation of less than a year, the impact on real output (as well as prices and unemployment) is assumed to be linearly related to the annual results. For example, a $22.5 billion loss to the economy would result from a six month supply interruption, compared to a $45 billion loss during a year-long cutback.

TABLE 16. IMPACT OF A YEAR-LONG OIL SUPPLY INTERRUPTION AMOUNTING TO 3.5 MILLION BARRELS PER DAY IN 1984 ON GNP, UNEMPLOYMENT, AND INFLATION IN 1984 AND 1987

	1984	1987
Change in Real GNP (in billions of 1984 dollars)	-272	-100
Change in Real GNP (percent)	-6.6	-2.2
Change in Unemployment Rate (percentage points)	2.1	1.2
Change in Inflation Rate (percentage points)	20.0	2.5

NOTE. The effects are compared with CBO's economic projection without a supply interruption.

increases would also have an impact on GNP: higher prices reduce both real income and real wealth, causing households to reduce their purchases of goods and services, thereby slowing economic growth. 4/ A number of additional simulations were also calculated, which indicated that larger petroleum shortfalls would lead to proportionately larger output losses, greater unemployment, and more rapidly rising prices.

4/ The price controls assumed in this analysis permit price increases sufficient to compensate for increased costs of production resulting from bottlenecks and inefficiencies in producing goods and services. The inefficiencies are obviously greater at higher levels of oil shortfall, leading in turn to more rapid increases in prices. Finally, it should be noted that a fuller discussion of the interaction between oil prices and GNP can be found in a number of CBO publications. See for example, President Carter's Energy Proposals: A Perspective (June 1977), Chapter II and Recovery: How Fast and How Far? (September 1975), Chapter 5.

In the three-year period following the oil production limitation, the economy would rebound substantially as real output increased, unemployment declined, and prices subsided. But real GNP would still be below the baseline forecast, and the unemployment and inflation rates would be higher.

Impact of a 4 Million Barrel per Day Interruption in 1990

CBO projects U.S. imports to grow from 10.1 million barrels per day in 1985 to 11.3 million barrels per day in 1990 if oil prices increase at 2 percent annually in real terms. Imports will thus become a more significant percentage of U.S. oil and energy consumption. Growing U.S. dependence on foreign oil will obviously increase U.S. vulnerability to supply interruptions. The world oil market is expected to tighten in the late 1980s and early 1990s. Should an interruption occur during this period, the United States would not be able to obtain significant oil supplies from countries not involved in the supply interruption as it did during 1973-1974. On the other hand, U.S. oil supplies may become more diversified in the late 1980s when Mexico, China, and possibly other new producers may become alternative sources of oil.

In an attempt to make some quantitative assessments of the effects of a supply interruption in 1990, the results of the 1984 simulation were extrapolated. The 1984 interruption of 3.5 million barrels per day, or approximately 35 percent of U.S. oil imports, is equivalent to about 4 million barrels per day in 1990. A supply interruption of this size lasting for one year would cause real GNP in 1990 to drop about 7.3 percent below the projection, and unemployment and inflation to rise by 2.4 and 22.4 percentage points, respectively. The Strategic Petroleum Reserve required to prevent the GNP losses would be approximately 1.5 billion barrels. Thus, over the long term, the vulnerability of the United States to another supply interruption would grow with increasing import levels.

SECURITY OF SUPPLY AND U.S. FOREIGN POLICY

The Arab oil supply interruption in the fall of 1973 signaled that the United States had entered a new era of economic interdependence with other countries. This meant that the United States would, in the future, be increasingly vulnerable to foreign attempts to use economic leverage for

political purposes. The insecurity of oil supply has had important implications for national security and U.S. foreign policy. 5/ Numerous instances could be cited to show how concern over the security of the oil supply has affected U.S. foreign policy, but this section concentrates on three: the relations between the United States and its post-World War II allies, Western Europe and Japan; U.S.-Soviet relations; and U.S. policies in the Middle East. 6/

Oil and the Western Alliance

The months following the Arab oil supply interruption were among the most turbulent in the 25-year history of the alliance between the United States and Western Europe and Japan, the nadir being the denial of U.S. access to European bases during the 1973 Arab-Israeli War. At the commencement of the 1973 embargo, U.S. strategy assumed that a unified opposition of oil-consuming countries, coupled with the threat of economic or military retaliation, would undermine the solidarity of the OPEC countries. At the Washington Energy Conference in February 1974, however, the major consuming countries failed to develop a common strategy. Despite repeated attempts by the United States to reach a compromise, the Europeans, led by France, resisted bloc strategies and sought instead to make bilateral political and economic arrangements with OPEC countries. By late 1975, at the Conference on International Economics, the United States was forced to accept that its policy was a failure and that OPEC could not be undermined. Some analysts attributed the failure to inevitable differences between the United States, an international power with global responsibilities and commitments, and the Europeans and the Japanese with their more regional orientation. For the United States, energy was not a prime factor in foreign policy, while the freedom to act in foreign affairs was clearly such. The Japanese and Europeans, on the other hand, were quite willing to merge their foreign policies and their energy policies.

5/ For more details on U.S. economic interdependence with other countries see Klaus Knorr and Frank W. Trager, eds., Economic Issues and National Security (Regents Press of Kansas, 1977).

6/ Another important area not discussed here is U.S. oil supply and the Third World. It should be noted that the U.S. Middle Eastern foreign policy is intertwined with U.S. foreign policy towards the Third World. Moreover, since the supply interruption, the United States has spent much more time developing a coherent policy for dealing with the Third World.

Other strains have developed from international competition for oil in a tight market. Competition has been spurred by the ventures of national oil companies and the willingness of their governments to encourage and often subsidize direct state-to-state deals with OPEC members. By the end of 1979, for example, Japan had agreed to purchase oil from Iran at $40 per barrel, $17 above the world price, at a time of considerable tension between the United States and Iran. Such actions lead to increased costs for all oil consumers, and are a divisive force within the Western alliance.

Oil and the Soviet Union

The impact of the energy crisis on American-Soviet relations is a controversial topic. In one view, the U.S. oil crisis has until now only marginally or indirectly affected American-Soviet relations. 7/ Yet, this view also holds that, if the United States cannot solve its long-run energy problems, or if there is a return to the cold war, the Soviet Union may be able to exploit this dependency. A second school of thought maintains that the energy crisis has already led to a decline in U.S. power and influence vis-a-vis the Soviets. 8/ This group of analysts believes that, because the Soviet Union is currently self-sufficient in oil, it has an "extra card to play" in the world power struggle.

7/ For more background, see Aaron Wildavsky, ed., Energy and World Politics, (New York: Macmillan, 1975); and Edward N. Krapels, "Oil and Security Problems and Prospects of Importing Countries," Adelphi Papers #136 (London: The International Institute for Strategic Studies). See also Szyliowicz and O'Neill, The Energy Crisis and U.S. Foreign Policy (New York: Praeger, 1975); Yager and Steinberg, Energy and U.S. Foreign Policy (Cambridge, Massachusetts: Ballinger Publishing Company, 1974).

8/ The leading exposition of this school of thought can be found in Edward Friedland, Paul Seabury, and Aaron Wildavsky, "Oil and the Decline of Western Power," Political Science Quarterly, vol. 90 (Fall 1975). The same authors have also published The Great Detente Disaster: Oil and the Decline of American Foreign Policy (New York: Basic Books, 1975).

The First View. In the short run, according to the first school of thought, U.S. dependency on foreign oil is not likely to be one of the major factors determining the future course of Soviet-American relations. These analysts perceive the major U.S.-Soviet concerns as: (1) the avoidance of armed conflict through the Strategic Arms Limitation Talks and detente; (2) relations between China and the Soviet Union; (3) the future of the U.S.-Japanese mutual security treaty; (4) the prevention of Soviet hegemony over Western Europe; (5) and the Middle East conflict between Israel and the Arabs. In the latter area, there is a possibility of confrontation between the United States and the USSR, a confrontation that could be linked to the problem of energy. The intrusion of the Soviet Union into the area adjacent to the Persian Gulf has made the Persian Gulf a scene of potential U.S.-Soviet conflict. Yet many believe that the Soviet Union would gain little from a military intervention that closed oil supply lines.

If the United States continues to remain dependent on oil imports from the Middle East, the Soviet Union may come to view the U.S. oil dependency as something it can exploit in two ways. First, the USSR could play a more active role in supporting OPEC by providing more political, military, and economic support to the oil-producing countries. Second, it could sponsor political movement aimed at replacing the conservative monarchies of the Persian Gulf with more radical governments hostile to the West, although existing radical governments, such as those of Iran and Iraq, have not appeared to be avowedly pro-Soviet. Alternatively, it could exploit ethnic or religious division in Iran or Saudi Arabia.

The Second View. Other writers holds that, as a result of the OPEC price hike and the continued dependence on foreign oil, the West, particularly the United States, has suffered a decline in economic and political power relative to the Soviet Union. Since the Soviet Union is still self-sufficient in energy, it now has an extra card to play in the East-West struggle. This self-sufficiency, however, is projected to erode in the early 1980s, as Soviet production declines from its peak levels. 9/

9/ It should be noted that U.S. analysts believe that the Soviet bloc will become a net importer of oil in the 1980s. CBO believes that the Eastern European countries will also become net importers in the 1980s. See Central Intelligence Agency, Prospects for Soviet Oil Production (April 1977). The CBO estimates are discussed in Chapter IV of this report.

Oil and the Middle East

The changes that have occurred in U.S. policy in the Middle East since 1973 are rather clear. Prior to the 1970s, the oil-consuming countries dominated the oil-producing countries of the Middle East. This domination rested on the major oil companies and on British or American influence in the oil-producing countries. It enabled the consuming nations to bring the producing countries into the world economy at terms highly favorable to the former. This domination was gradually eroded by the rise of Arab nationalism, the growth of Soviet power and influence, and the West's support of Israel. Simultaneously, most Western countries, such as the United States, became increasingly dependent on supplies of Middle Eastern oil. 10/

During this period, the United States has sought to keep the issues of the Arab-Israeli conflict isolated from its relations with the key oil-producing countries in the Persian Gulf (for example, Saudi Arabia). It is not certain, however, that these issues can be separated. Lasting emnity between Israel and the Arab states has created obvious liabilities for the United States. Radical political movements in oil-producing nations are given political capital by the failure of Israel and its neighbors to reach agreement. This jeopardizes the stability of both these nations and their oil exports. Moreover, the regional response to the Soviet invasion of Afghanistan may have been tempered by Islamic nations' desires to distance themselves from the United States because of its support for Israel. This conflict between the commitment to Israel and its desire to stabilize its relations with oil producers reflects the impact of oil import dependence on U.S. foreign policy.

10/ Knorr and Trager, Economic Issues and National Security.

CHAPTER VI. POLICY OPTIONS

This chapter first summarizes the risks accompanying U.S. dependence on imported oil, which were presented in previous sections of this report. It then discusses the policy options available to reduce the risks.

OIL IMPORTS IN THE 1980s

Because of anticipated declines in domestic production and moderate increases in demand over the next decade, U.S. oil imports are projected to grow from their current level of approximately 8.0 million barrels per day to 11.3 million barrels per day in 1990--barring policy changes or higher prices than those used for this analysis. The increasing imports will pose four distinct economic and political risks for the United States.

First, the geographical location of the oil supplies will make them vulnerable to disruption. Although new supplies will be forthcoming from countries such as Mexico and China in the next decade, more than half of the world's oil will still come from the Middle East and North Africa. It will be vulnerable to the same types of political and logistical disruptions that have been experienced over the past six years. Moreover, increased revenues in the Persian Gulf states may strain the social and political stability of those countries. In addition, anticipated declines in Soviet oil production raise the question whether the Persian Gulf may become an arena of conflict between the Soviet Union and the United States.

Second, in the coming decade, oil price increases above those assumed in these projections appear inevitable. A recession in the industrialized countries over the next several years may soften the oil market in the short term. Yet, presuming an economic recovery by 1985, this slack will disappear, and price increases seem likely. By 1990, with only the price increases assumed in this analysis (2 percent in real terms annually), an excess demand of slightly over 10.0 million barrels per day will develop. The price increases of 1979 were caused, in large part, by a temporary excess demand far less than this amount.

Third, larger import volumes and higher oil prices will mean larger dollar outflows to producing nations. The capability of producing nations to absorb these revenues through development expenditures will be taxed severely, resulting in a larger "petrodollar surplus." This suggests that a

smaller proportion of petrodollars will be recycled through U.S. exports to producing nations than at present, and that a larger share will seek assets in the Eurodollar market, in other consuming nations, or in speculative investments such as gold. The larger surplus may add to the volatility of the world monetary system, and induce producers to seek a currency or group of currencies other than the dollar in which to price oil. If OPEC were to abandon the dollar, it might signal the end of the dollar's use as an international reserve and transactions currency, and result in heavy losses to the U.S. economy.

Finally, an inexorably tightening oil market may have a profound effect on international relations. Competition within the industrialized countries for scarce supplies could lead to the acceptance of "hidden" price increases in the form of trade, aid, or other concessions made to producing countries on a state-to-state basis. Further declines in the value of the dollar, fueled in part by oil imports, could create tensions between the United States and its major trading partners. If, as seems likely, the Soviet Union becomes a net oil importer by 1985, it may participate in the competition for access to oil.

POLICY RESPONSES TO RISING OIL IMPORTS

Each of the foregoing risks involves potential economic costs. They include losses to the national economy caused by supply disruptions, recessions brought on by rising oil prices, dollar devaluations necessitated by payments for foreign oil, and the costs of competing with other countries for access to oil. These potential costs constitute the "oil import problem." Solving it will entail minimizing the costs created by oil imports.

The thrust of energy policy since 1974 has been to reduce the costs of imports by reducing imports themselves. Yet the real magnitude of this task is only now becoming apparent. Achieving the Administration's suggested 1990 import goal of 4.0 million barrels per day would require a reduction of 7.3 million barrels per day in oil demand, approximately as much as current imports. A reduction of this size would entail a massive conversion to new sources of energy and a recycling of the nation's capital devoted to energy, entailing large, and often uncertain, economic and environmental costs.

The costs of the policy will be large because imported oil is now cheaper than its potential alternatives, and may continue to be so if the costs of those alternatives rise. The extra costs of the alternatives will be paid either by consumers, in higher prices, or through governmental subsidies requiring higher deficits or higher taxes. The premium may be worth

paying, however, since oil imports pose risks. The costs of those risks may not be apparent to consumers, since the economy as a whole pays for them. Disruptions in supply, or a weakening of the dollar, or the military defense of the Persian Gulf are not immediately visible at the gasoline pump or in household fuel bills. It may, therefore, be sensible to allow some subsidization of alternatives to imported oil.

Yet if the oil import problem is defined as the risks posed by imports, rather than the imports themselves, policy need not be confined to import reduction. An alternative goal might be to address the risks by preparing for disruptions in foreign supplies, or taking measures to offset the effects on the economy of higher oil prices or of a devalued dollar. This type of policy would serve the same purpose as import reduction, by protecting the economy and society from the inherent risks of imports.

In addition, some policies might be able to reduce the risks associated with any level of oil imports. This type of policy would be concerned with obtaining imports on the best possible terms, as opposed to reducing them. If such a policy could be made effective, it might be desirable to tolerate a higher level of imports and to pay a smaller premium for alternatives to imports. For example, a barrel of oil received in direct exchange for U.S. goods does not pose a serious risk to the dollar. Similarly, diversifying U.S. sources of foreign oil might reduce the risk of a disruption in supply. Thus, policy options can be grouped into three kinds:

- Policies that reduce oil imports;
- Policies that offset losses associated with oil imports; and
- Policies that reduce the risks inherent in oil imports.

The rest of this chapter discusses the three groups of policy options.

REDUCING OIL IMPORTS

Reducing oil imports would reduce the risk they pose to the economy. Policies to this end involve substituting alternative energy sources, such as solar or renewable energy forms or synthetic fuel, or reducing demand through conservation or by means of restrictive quotas or fees. With the exception of restrictive policies that enforce import reductions, these policies would provide only long-term relief and would not have significant effects until the end of the decade. Moreover, reducing imports would not eliminate many of the risks they pose. Even at lower levels, imports might still be vulnerable to supply interruptions.

The bulk of the oil used in the United States is employed either in transportation or in space heating. Alternatives to oil can perform these functions. Among these alternatives are synthetic fuels made from coal, grain, or shale.

The latest series of OPEC price increases has given more urgency to the production of synthetics, but significant problems remain. The most promising synthetic is methanol, based on a technology that is generally understood and has been in use, on a small scale, for several decades. Methanol can be used as a liquid motor fuel. It is relatively easy to transport, burns cleanly, is compatible with gasoline, and costs $30-$40 per barrel. This cost will increase, however, as fuel prices increase with the price of oil. In addition, higher interest rates will increase the financing costs of capital-intensive synfuel plants. Investment in commercial-scale methanol plants, however, has been inhibited by uncertainty over future prices and the initial costs of plant construction. Even if these obstacles were overcome, the long lead times needed to construct a commercial-scale methanol plant would hold 1990 production to less than 1 million barrels per day.

Shale oil would cost $30 per barrel or more before refining. It poses significant environmental problems, including the disposal of spent shale and the leaching of toxic substances into ground water. The centralized location of shale resources in the West poses logistical problems and threatens to concentrate its environmental consequences in one region.

Grain-based alcohol is a doubtful economic alternative, and its potential for large-scale production is clearly limited.

All of these synthetic liquids have in their favor that they would provide the type of light liquid motor fuel that will be in shortest supply in the future, as the quality of natural petroleum decreases. 1/

Solar heating and cooling carry a resource cost of approximately $40 per barrel in their typical application--no higher than some synthetic fuel production costs. Unlike the synthetic liquids, however, solar applications

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1/ This is true worldwide. Superior, lighter oil has been overproduced in proportion to its occurrence. Many producers are now trying to produce heavy and light oil in proportion to reserves. This amounts to a trend to decreasing crude oil "quality," as measured by the ability to refine oil into light products such as gasoline.

minimize environmental damage and employ a more advanced technology. Yet solar energy could not replace large amounts of oil quickly because it would first become economic in the South and Southwest, where coal, nuclear-based electricity, and natural gas are used for heating. The use of oil for heating and generating electricity is centered in the Northeast, where it would have to become much more expensive before solar energy would be an economic alternative.

Reducing Oil Demand

Since the 1973-1974 OPEC price increases, the United States has made moderate progress in conserving oil; the extent of this progress differs significantly among various sectors of the economy. Industrial energy use has shown a marked decrease over the period, commercial conservation has been less pronounced, and households have shown little response. Yet household uses of oil--including autos, home heating, and some oil-fired electricity--comprise more than half of the demand for oil.

Incentives to encourage households to conserve energy are limited under current law. Few households anticipate owning their homes long enough to justify conservation investments. In addition, household improvements that conserve heating oil and gas produce somewhat intangible returns through lower fuel bills rather than immediate cash rewards. In order to achieve large aggregate energy savings, many millions of households would not only have to recognize the long-term cost advantage of conservation improvements, but would also have to be willing and able to make the front-end cash outlays to pay for them.

The price system has so far not offered much incentive to conserve gasoline. Most of the conservation that has been experienced in gasoline consumption has been achieved through the standards set by the Energy Production and Conservation Act (EPCA), which mandated more fuel-efficient autos, rather than through market incentives. By 1990, EPCA standards will have resulted in as much gasoline savings as would a direct $1.00 per gallon gasoline tax in 1980 that rose at the rate of inflation. 2/ Gasoline prices have only now risen to the level at which the costs of fuel-saving innovations are outweighed by the dollar value of fuel savings.

2/ See statement of Alice M. Rivlin in Automobile Fuel Economy, Senate Committee on Commerce, Science, and Transportation, 95:1 (1977); and Congressional Budget Office, Preliminary Projections of Fuel Savings and Revenues Associated with Increased Taxes on Motor Fuels (1979).

Conservation investments in the commercial and industrial sectors also suffer, as do households, from the somewhat intangible form in which their return occurs. In order to promote additional conservation, new incentives will be necessary. The subsidy inherent in higher incentives would make the cost of conservation higher than the price of the imported oil it saves. However, if the Congress sees fit to subsidize the production of alternative fuels by setting artificially high prices for them, a similar price for conservation may be in order.

Enforced Reductions

Policies that would reduce oil demand through substitution of alternative fuels or conservation require lengthy lead times for investments. Synthetic fuel production, solar and other renewable energy forms, and retrofits of existing energy-using equipment all have the potential to reduce oil imports by a significant amount, but these savings would probably not be realized fully until the 1990s. If the risks associated with the existing level of oil imports are perceived as being so severe as to warrant immediate reduction, then it might be appropriate to restrict imports either through a quota or through imposition of special taxes, despite the possible economic costs. 3/

Reduction Through a Quota. A quota could be implemented in three ways. The first would be to allow every U.S. importer a prorated share of imports. This, however, would revive many of the inefficiencies found in the former allocation system for domestic oil. Like all other quota schemes, it might also divert supplies to other oil-importing nations, possibly even lowering spot prices and improving availability outside the United States.

A second scheme would be to "auction" import licenses; the number of licenses so auctioned would be limited by the size of the quota. The cost of the import licenses would be passed through to refiners and, ultimately, to consumers. The resulting price increases would be reflected in all domestic oil as well, assuming decontrol. The level of price increases would be equal to an "embargo" on imported oil of similar magnitude.

3/ This discussion of import fees and quotas is based on Congressional Budget Office, Direct Federal Action on Oil Imports (1978).

A third way of implementing a quota would be based on the "Adelman Plan," originally put forward by Dr. Morris Adelman. The U.S. government would announce how much oil it was going to import and would solicit sealed bids from oil-producing countries to fill the quota. Presumably, this would require the producing countries to compete with each other, thus forcing import prices down.

This last plan, like others that have been put forward to "break up" OPEC, seems attractive in theory, but there is little certainty that it would work. Although OPEC has not yet instituted any formal production-sharing arrangements (even in the glut market of 1977, members used price discounting to equate supply and demand rather than the traditional cartel system), OPEC might decide to prorate, or otherwise divide, production for the U.S. market if faced with a quota. In that event, OPEC would probably reduce production until it was once again equal to demand, as restricted by quotas, so that prices would still rise. This would not only result in higher oil prices but could lead to a greater degree of OPEC control over the world market than it already has. Even if the imposition of quotas forced OPEC to lower its prices on world markets, they could still mean higher delivered prices to the U.S. consumer unless price controls were imposed because of the scarcity quotas would create in the United States.

Reduction Through Taxes. Demand could also be reduced by taxing imported oil, all oil, or specific products such as gasoline. A tax would induce some reduction in oil demand, but not without cost. Any tax would have both inflationary and recessionary effects, similar to those that are felt when OPEC raises prices by the same amount. This could be mitigated, however, by rebating the resulting revenues through lower personal income taxes, Social Security taxes, or the like.

More limited taxes than those on all oil pose additional difficulties. A tax on foreign oil only would create a windfall for domestic producers (since domestic refiners would be willing to pay domestic producers the market price plus the value of the tax), and might penalize refiners relying heavily on foreign crude. A tax on gasoline only would induce consumers to convert to diesel fuels, which compete with home heating uses for the supply of middle distillates and also create additional environmental degradation.

Demand reduction policy, in sum, may be limited in its effectiveness and expensive to the national economy. For example, this analysis assumes a world oil price of $51.56 per barrel in 1985, with projected imports of 10.1 million barrels per day. Reducing imports to 8.5 million barrels per day in that year would require raising prices to approximately $74.00 per barrel. An import fee of approximately $22.00 per barrel would be necessary,

imposing a cost on the economy of approximately $144 billion in 1985 dollars before recirculation. A gasoline tax of $0.50 per gallon in 1979 dollars, rising at the rate of inflation, would reduce demand by 450,000 barrels per day in 1985. Achieving the target of 8.5 million barrels per day in that year would require a gasoline tax of approximately $2.50 per gallon in 1985 dollars.

OFFSETTING LOSSES CREATED BY DISRUPTION OF OIL IMPORTS

It might not be possible, short of draconian measures, to reduce imports to levels at which their risks become tolerable. Disruptions of supply, for example, can occur at any level of imports. One alternative kind of energy policy would seek to reduce the losses posed by oil imports rather than reducing the imports themselves. A description of these alternative options follows.

The Strategic Petroluem Reserve

One of the most important options is the Strategic Petroleum Reserve (SPR). In order to test the usefulness of the SPR, supply interruptions were assumed with the reserve at various levels. Using the simulation described in Chapter V, if there were a one-year shortfall of 3.5 million barrels per day in 1984, a reserve of 250 million barrels could avert a loss in GNP of between $54 and $93 billion. Similarly, a 500 million barrel reserve could avert between $110 and $187 billion loss. The average benefit per barrel of oil in terms of averted GNP loss, net over costs, would be between $216 and $374. These figures do not include either the value of the reserve as a deterrent to politically motivated disruptions, or the revenues derived from selling the oil. The effectiveness of the SPR in averting economic losses would depend on the degree to which the United States could capture all of the benefits provided by the oil, and whether price controls and allocation policies were adopted.

These results indicate that the Strategic Petroleum Reserve would be an effective policy option for decreasing the output losses likely to occur as the result of an oil production cutback. Nevertheless, final assessment of the effectiveness of this policy option must be balanced both against its cost and against the probability of a cutback. The actual value of the Strategic Petroleum Reserve to the federal government can be estimated only through a form of risk analysis, and the probability of a cutback cannot be determined.

The drawback of the SPR is that it requires a large up-front investment in procurement and storage costs--the latter approaching $4 per barrel. One solution might lie in financing the SPR through a public bond issue, allowing private investors to hold title to oil in the reserve as a transferable asset. Whatever the sources of financing, the SPR must be considered an effective option.

Rationing

Another policy that would address the effects of disruptions is rationing. Rationing plans are usually limited to motor fuels, since rationing of heating oil would be difficult to administer and could cause unnecessary hardship. Households consume roughly 5 million barrels per day of gasoline; businesses and government consume 2.5 million barrels per day of gasoline; and the economy as a whole consumes about 1.5 million barrels per day of diesel fuel, primarily in the commercial sector. Since rationing of commercial fuel is thought to have a greater detrimental effect on economic activity than rationing of household uses, it could be focused on the latter. In that case, rationing could allocate shortages of up to 1 million barrels per day. Beyond this level, it is doubtful that rationing would protect the economy from losses.

National Economic Policy

Losses might also be mitigated by macroeconomic measures. Expanding the money supply when foreign oil prices rise might reduce the recessionary effects of such increases, but this would have an adverse effect on the price level in the long run. Similarly, measures like the November 1, 1978, support package might be effective in maintaining the dollar's value in the short run. On the other hand, price controls and allocation programs would not mitigate the direct effects on GNP of oil price increases. In the example cited in Chapter V, an interruption of 3.5 million barrels per day in foreign oil supplies would result in an increase in the general price level of 20 percentage points in that year over the anticipated rate of inflation. Price controls and accompanying allocation programs, in this example, would reduce the inflation increment by only 3.5 percentage points; they could also contribute to the dampening effects of the interruption on the economy. Moreover, as discussed in Chapter IV, macroeconomic measures are of limited usefulness in quickly restoring the balance of payments, because they do not affect many important factors that contribute to the dollar's decline.

REDUCING THE RISKS ASSOCIATED WITH OIL IMPORTS

The third type of policy would seek to reduce the risks associated with any level of oil imports. For example, a barrel of oil received in exchange for U.S. goods and services would be preferable to one bought with dollars that might not return to the United States. Similarly, policies that would work to expand the supply of oil in countries outside of OPEC would serve the same purpose as those that reduce oil imports from OPEC itself.

A previous CBO paper described the "strategy for oil proliferation." 4/ That strategy consists of creating new sources of funds for oil and gas exploration and development in non-OPEC Third World countries that may have such resources. Some countries and international organizations have pursued the equivalent of this strategy by setting up "lending windows" or using their national oil companies to stimulate exploration in less developed countries. The United States could do likewise by extending credits for oil and gas exploration to non-OPEC Third World nations and accepting "participation" oil in repayment, or joining in international agreements to do so.

Both the costs and benefits of a proliferation strategy are uncertain. It is conceivable that the fund would become self-financing after several years, as initial loans were repaid. Given the possibility of higher real prices for crude oil, repayment would be easier to achieve over time. This program would suffer from the riskiness inherent in all oil and gas exploration, but there is a good chance that it would be cost-free from a budgetary standpoint.

To the extent that a proliferation policy succeeded, non-OPEC oil supplies would expand. This would ease price pressures in the long term and decrease the likelihood of disruptions in the international market. Moreover, a governmental lending entity could accept crude oil in repayment, avoiding the outflow of dollars associated with conventional imports. (It should be noted that if other industrialized countries adopted such a policy first, the United States might find its access to crude oil and petrodollar recycling worsened, and be forced to adopt such a strategy as a response.) Finally, exploration aid might be an effective tool in promoting better relations with strategically important countries such as the Sudan, Pakistan, and Egypt.

4/ Congressional Budget Office, A Strategy for Oil Proliferation: Expediting Petroleum Exploration in Non-OPEC Developing Countries (1979).

One class of hydrocarbons that remains underdeveloped throughout the world is heavy oil--oil so viscous that it defies pumping at conventional temperatures and pressures. The world's heavy oil reserves are centered in Venezuela and Canada. The Alberta reserves are now being developed by Exxon, which expects production of about 150,000 barrels per day by the mid-1990s. The Venezuelan reserves, centered around the Orinoco River and Lake Maracaibo, are larger than the Canadian but not yet extensively developed. U.S. energy companies could assist in building such an industry in Venezuela, in exchange for price and marketing guarantees to Venezuela for allowing development. This arrangement could improve the stability and security of U.S. oil supplies.

Another policy would be aimed at existing producers with the ability to expand capacity. Some "banker nations," such as Saudi Arabia, Kuwait, or the United Arab Emirates, have potential production levels above those necessary to finance their national development plans. They have no incentive to expand production beyond that level in return for foreign assets that do not appreciate as fast as the value of their untapped oil. Proposals have been made to create an "indexed" asset that would be linked to the price level or adjusted for dollar devaluation. One variant of this proposal was put forward by former Venezuelan President Carlos Andres Perez, who suggested using surplus petrodollars, matched by funds from the industrialized countries, as the basis of a "Marshall Plan" for all underdeveloped countries. This proposal could not only help to expand the supply of oil from producing nations, but could also improve relations between oil consumers and oil producers. Oil producers would recognize the creation of an indexed asset or a Marshall Plan fund as evidence that oil consumers understand their problems. This might be particularly effective in maintaining the special relationship between the United States and Saudi Arabia.

A different group of policies would aim at improving the recycling of petrodollars and reducing the risk of continued dollar devaluation. One option would be to seek more oil under bilateral agreements, as most other industrialized countries do. This would involve the U.S. government in one of several new roles. The government could repay oil debts through lines of credit established against U.S. goods and services. Alternatively, it could "syndicate" export packages to oil producers in repayment for oil imports that, once again, the government would pass on to U.S. refiners and distributors. Petrodollars could also be recycled through stepped-up capital placement in the United States by OPEC members. This could be achieved by encouraging direct investment by those countries in U.S. firms and manufacturing assets.

In theory, an oil-for-goods exchange could benefit both parties. Japan has a number of such agreements, covering imports of almost 1 million barrels per day. Canada, England, France, Japan, and Sweden have either made such agreements with Mexico or are negotiating them. Failure by the United States to do likewise could be to its disadvantage if other oil-importing countries secure preferential access to large amounts of crude oil through this method.

Bilateral exchange of oil for commodities would help to stimulate domestic exports, resulting in growth and higher employment. Most other industrialized countries have government entities that promote exports through financing, assembling of export packages, reciprocal marketing guarantees, and other means. While the United States does have the Export-Import Bank, which lends money to other countries to help them import U.S. goods and services, it could do more in this regard. Other industrialized nations also promote exports through regional arrangements with African and Latin American countries. The less developed countries are rapidly becoming the largest market for U.S. exports because of their high rates of growth. Their demand could be strengthened through increased U.S. participation in international development institutions, increased U.S. support for the Agency for International Development, or through the Export-Import Bank.

The policy has possible drawbacks. First, the terms of exchange between oil and its reciprocal commodities must be fixed over time, or some mechanism must be created to accommodate changes in their relative prices. Second, in the event of a major disruption in oil supply, bilateral contracts might not be honored.

Many believe that a formal dialogue between the oil-producing and oil-consuming countries is inevitable. A formal French-Kuwaiti proposal exists for such a conference between OPEC countries and the members of the European Economic Community. Such a conference could go beyond the questions of oil price and availability to issues such as whether to abandon the dollar as the denominator of oil prices, questions of trade between the industrialized and less developed nations, and political solutions to the Palestinian question. Dialogue between oil producers and consumers could also take a regional form. Several proposals have been made for a North American "common market" that would accelerate trade between the United States and its neighboring energy producers, Canada and Mexico. This is a particularly attractive possibility with regard to Mexico, for which trade concessions have been a political priority.

Many regard this type of dialogue as an inevitable precondition to stability in the oil market. As Alberto Quros, president of Venezuela's state oil company, Maraven, has stated:

> Interdependence is the only way out, but only the developed nations can really take the steps leading to partnership with the developing world . . . . What is needed is a long-term understanding under which OPEC would now supply the volumes the world needs at prices that consumers can afford, in exchange for future considerations, financial assets, market prices, technology transfer and trade, in which the OPEC producers can have some confidence.

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