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An Overview of Changes in the World Oil Market

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To the President of the Senate and the
Speaker of the House of Representatives

This report evaluates how U.S. vulnerability to another oil supply disruption has changed since the 1970s. U.S. oil production has declined since 1985, and oil imports have increased, reversing the trend established in the early 1980s and raising renewed concern about the energy security of the United States. We prepared this report to assist the Congress in its deliberations regarding U.S. oil vulnerability by providing an overview of changes in the world oil market and identifying areas for potential actions.

Copies of this report are also being sent to the Secretaries of Energy and State.

This work was performed under the direction of Flora H. Milans, Associate Director. Other major contributors are listed in appendix I.

Charles A. Bowsher

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Executive Summary

Purpose

U.S. oil production has declined in the past 2 years and oil imports hav increased, reversing a 7-year trend and raising concern about the vulnerability of the United States to another oil crisis. Central to this concern is that world oil reserves are heavily concentrated in the Middle East. Given these facts, the objectives of this report are (1) to provide the Congress with an overview of how U.S. vulnerability to an oil crisis has changed since the mid-1970s and (2) to identify areas of potential significance to policymakers concerned with energy security.

Background

Rapid oil price increases in the 1970s created general economic havoc worldwide and are believed to have contributed significantly to the global recessions of 1974 and 1980. Many industry analysts, in fact, have pointed to excessive dependence on imported oil in the 1970s as a principal cause of U.S. economic problems in the wake of the oil shocks

The development of additional oil supplies, the use of other energy sources, and improved energy efficiency in the 1980s reduced U.S. dependence on imports. However, recent developments have reversed this trend toward reduced dependency. Reports released by the Department of Energy, the American Petroleum Institute, and the National Petroleum Council have highlighted increased U.S. dependence on foreign oil, particularly from the Organization of Petroleum Exporting Countries (OPEC), since 1986—when prices dropped from about $27 per barrel to below $10 per barrel. While prices have rebounded somewhat import levels have continued to creep upward.

The prospect of a continued decline in domestic production, a growing dependence on oil imports, and recent events in the Persian Gulf have once again sparked congressional debate on energy security. At present however, there is no consensus as to whether these developments will lead to greater U.S. vulnerability to an oil disruption.

Results in Brief

In general, the United States and other major oil-importing countries ar less vulnerable to an oil crisis today than they were a decade ago. Dependency on oil, particularly imported oil, declined from the mid-1970s to the mid-1980s. Changes in the world oil market—such as abundant oil supplies, increased competition for oil revenues, and less hazardous transportation routes—have reduced, at present, the prospect o a serious oil supply disruption. In most plausible scenarios, barring a major military confrontation that would involve the loss of oil from several major oil-producing countries, disrupted oil supplies could probabl

be replaced elsewhere. Additionally, the United States and other major oil-importing countries have built significant emergency oil stocks and have strived both unilaterally and multilaterally to strengthen other response measures designed to mitigate the effects of serious disruptions.

Developments are being observed, however, that may eventually increase vulnerability to an oil crisis. Most notable among these trends is the expectation that in the 1990s oil production may once again become concentrated in the volatile Middle East. While such trends are highly uncertain, the consequences of oil disruptions are such that continued vigilance is warranted. GAO believes that long-term U.S. energy security can be improved by focusing on four areas (see Policy Directions).

GAO's Analysis

The degree to which the United States is vulnerable to an oil crisis today when compared with a decade ago can be measured by focusing primarily on (1) the dependency of the United States and other major oil-importing countries on oil, particularly imported oil, (2) the likelihood of an oil supply disruption, and (3) the ability of oil-importing countries to respond to a potential oil disruption. Policymakers familiar with trends in these areas can then identify specific areas involving U.S. energy security that may require additional attention.

Oil Dependency

Major oil-consuming countries, including the United States, are less dependent on oil today, largely because of a trend over the past decade characterized by both lower oil consumption and lower oil imports. Lower consumption was due in part to higher oil prices. Nevertheless, oil consumption in the transportation sectors of most industrialized oil-importing countries has continued to rise, reflecting limited success in switching to other fuels in this sector. Two-thirds of oil consumed in the United States, for example, is used in this sector, which has almost no fuel switching ability. Future demand for and dependence on oil in industrialized countries will thus be driven to a great extent by their respective transportation sectors.

The Likelihood of a Disruption

Changes in the world oil market over the past decade have diminished the prospects of a significant oil shortfall, in which the volume of oil lost could not be adequately replaced by other market sources. Principal reasons for this reduced likelihood include the following: (1) Oil is presently abundant in terms of available supply, and potential excess production

capacity could quickly increase supplies further, (2) declining revenues and market shares for OPEC countries have compelled some of these countries to pursue more stable production and pricing strategies as well as seek greater integration with marketing and refining operations in major oil-consuming countries, and (3) changes in oil transportation routes and additional pipeline capacity have diminished to a degree the strategic importance of the Persian Gulf as an oil route.

Despite these relatively positive developments, certain trends may create problems over both the short and long terms. Primarily, these include the potential growth in OPEC's market share due to the expected decline in non-OPEC production as well as potentially negative political and economic implications of shifting revenues within OPEC countries. Additionally, unforeseen contingencies—consequences of either political or natural causes—are fully capable of upsetting the current situation with little advance notice. Past experience has shown that even small, short-lived disruptions can create significant economic difficulties for oil-consuming countries, including the United States.

The Ability to Respond to an Oil Crisis

The United States and other major oil-consuming countries are better positioned to respond to an oil crisis today than they were in the early 1970s. Principal aspects of the improved ability to respond include significant growth in government-owned and/or government-controlled strategic oil stocks (which now total about 900 million barrels), the continued development of the International Energy Agency as a multilateral forum for coping with energy disruptions, and modest fuel-switching improvements in most major oil-consuming countries.

While these and other efforts to improve response measures have resulted in greater preparedness for oil-consuming countries in general, some areas may require additional clarification or improvement. With regard to the International Energy Agency, for example, dispute continues over the relative merits of using reserve oil stocks to alleviate an oil shortfall as opposed to implementing measures to reduce oil demand. Questions also remain as to whether (1) the sharing of oil offers benefits above those of the market at the outset of an oil crisis and/or (2) price disputes will arise if oil is actually allocated among member countries. In addition, emergency authorities and response procedures in the United States and elsewhere may require additional strengthening and modification if responses to severe disruptions are to be timely and effective.

Policy Directions

While the United States is less vulnerable to another oil crisis today than in the 1970s, the economic havoc that oil disruptions can cause warrants continued vigilance. Trends can change, but at the present time the trends point toward increased vulnerability in the 1990s. The nation's energy policies need to "insure" against unacceptable risks but at reasonable cost. In light of its analysis and the potentially serious consequences of a sustained oil shortage, GAO believes the United States can further reduce its dependency on oil and vulnerability to another oil crisis by focusing on four areas: (1) developing alternative fuels and emphasizing more efficient fuel use in the transportation sector, (2) continuing to build strategic oil stocks and resolving related disputes within the International Energy Agency, (3) adopting standby measures—provided they can be shown to be effective—to avoid overreliance on the Strategic Petroleum Reserve as this country's principal response to a disruption, and (4) maintaining a stable economic and regulatory atmosphere that encourages investments in oil and alternative energy programs. Specific options in these areas are discussed in the report.

Recommendations

This report raises policy considerations that need attention by government and private sector decisionmakers dealing with ways to reduce both U.S. dependence on oil and its vulnerability to potential oil disruptions. The report contains no specific recommendations.

Agency Comments

Since GAO did not evaluate a particular government program, the report was not sent for formal agency comments. However, a draft was provided to knowledgeable officials at the Departments of Energy and State and their suggestions were incorporated where appropriate.

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Abbreviations

AGA	American Gas Association
ARAMCO	Arabian American Oil Company
b/d	barrels per day
BP	British Petroleum Company
Btu	British thermal unit
CPE	centrally planned economy
CRA	Charles River Associates
CRS	Congressional Research Service
DOE	U.S. Department of Energy
DRI	Data Resources Incorporated
EEMS	Energy Emergency Management System
EIA	Energy Information Administration
EPCA	Energy Policy and Conservation Act of 1975
GSA	General Services Administration
IEA	International Energy Agency
IEP	International Energy Program
IMF	International Monetary Fund
IPSA	Iraq's pipeline in Saudi Arabia
MMB	million barrels
MMBD	million barrels per day
NYMEX	New York Mercantile Exchange
OECD	Organization for Economic Cooperation and Development
OPEC	Organization of Petroleum Exporting Countries
quad	quadrillion British thermal units
SPR	Strategic Petroleum Reserve
Tcf	trillion cubic feet
U.K.	United Kingdom

Introduction

Although supplies of oil are readily available today, increased imports from the Middle East in 1986 and 1987 have heightened awareness of U.S. vulnerability to another oil crisis. When world oil prices dropped dramatically in 1986, from about $27 per barrel to below $10 per barrel U.S. production declined and oil imports increased. For the first time since 1978, the generally downward trend in U.S. oil imports was signifi cantly reversed. Other major oil-consuming countries also experienced increased oil imports in 1986. Recent events in the Persian Gulf have further highlighted the importance of secure oil supplies.

Reports released by the Department of Energy, the National Petroleum Council, and the American Petroleum Institute in early 1987,[1] forecasting increased U.S. dependence on foreign oil imports, have sparked congressional debate on U.S. energy security. However, no clear consensus has appeared in the renewed energy debate as to whether increasing imports present a problem for the United States.

Additionally, rapid and unforeseen changes in oil prices can have widespread economic consequences. The rapid oil price increases in the 1970s caused economic havoc throughout the world and are widely believed to have been major contributors to worldwide recessions. Nevertheless, in time, high prices permitted the development of high cost oil resources around the world, helped to develop alternative energy sources, and provided impetus for significantly improved energy efficiency. Conversely, the rapid oil price decreases in 1986, while beneficial to consumers worldwide (at least in the short term), were harmful to important sectors of the world and domestic economies, such as oil-producing countries, the southern and western regions of the United States, and the banking and energy support industries. Although too early to determine, lower oil prices may also reverse the recent trend toward increased production outside of the Middle East and improved energy efficiency. In light of continuing congressional interest and heightened public awareness, we looked at the recent changes in the world oil market and the ability of the United States to respond to potential oil disruptions.

[1] U.S. Department of Energy, Energy Security: A Report to the President of the United States (Mar. 1987); National Petroleum Council, Factors Affecting U.S. Oil & Gas Outlook (Mar. 1987); American Petroleum Institute, Domestic Petroleum Production and National Security (Dec. 1986).

Objectives, Scope, and Methodology

Our review began as an outgrowth of our periodic assessment of energy concerns and issues. The principal objective of our review was to determine how the vulnerability of the United States to an oil crisis has changed since the mid-1970s. In comparing U.S. vulnerability today to that of 10 years ago, we focus on three major attributes of vulnerability:[2]

- How has the dependence of the United States and other major oil-consuming countries on oil, particularly imported oil, changed?[3] (Ch. 2)
- How has the likelihood of an oil crisis changed? (Ch. 3)
- How has the nation's ability to respond to an oil crisis changed? (Ch. 4)

We also discuss the implications these changes have on the United States and issues facing policymakers. (Ch. 5)

Our work focused on comparing U.S. vulnerability between 1976 and 1986 but also provided an assessment of expected changes in the future. Because of the integrated nature of the world oil market—that is, U.S. vulnerability is inseparable from that of other industrialized countries and U.S. trading partners—in making our assessment, we took into consideration other major importing countries that are members of the Organization for Economic Cooperation and Development (OECD)[4] and the International Energy Agency (IEA).[5] We used OECD and IEA also to accurately reflect broader international data and trends.

Our analysis of the likelihood of a disruption in chapter 3 focuses on the prospect of a significant oil shortfall, in which existing market sources cannot adequately compensate for the volume of oil lost. We recognize, however, that even small supply disruptions can cause oil prices to increase considerably as well as create temporary economic problems in oil-importing countries. Our analysis of the nation's ability to respond in chapter 4 addresses all types of disruptions since various U.S. responses

[2]"Vulnerability" refers to the potential impacts a physical shortage and/or a large increase in oil prices could have on the U.S. economy. We define vulnerability by three attributes: oil dependency, the risk that a disruption will occur, and the nation's ability to respond.

[3]By "U.S. dependence" we mean the ratio of oil consumption to total energy consumption as well as the ratio of oil imports to total oil demand.

[4]The 24 member countries of the OECD are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, the United States, and West Germany.

[5]Member countries for IEA are the same as for OECD with the exception of France, Finland, and Iceland.

will be determined by a disruption's severity as opposed to its particula cause.

During our review, we collected and analyzed national and internationa data and opinions from a number of government and private agencies and organizations.[6] The Department of Energy (DOE) and its Energy Information Administration (EIA) were particularly important because they collect and maintain much of the data available about U.S. and international energy use. Further, EIA is the official U.S. government agency responsible for collecting and documenting energy statistics. We gathered information from DOE/EIA Offices of Energy Emergencies; Policy, Planning, and Analysis; Energy Market and End Use; and Oil and Gas. The National Petroleum Council also provided a broad range of information about the U.S. oil industry.

In order to cross-check these data sources, we collected data and opinions from other energy and oil experts at trade associations, including the American Petroleum Institute and the American Gas Association, energy consulting and accounting firms, and major universities. We also gathered opinions from U.S. oil industry representatives, traders, and brokers involved in the oil market and oil futures trading on the New York Mercantile Exchange (NYMEX) and from the Commodities Futures Trading Commission, which is responsible for regulating the Exchange. Further, we spoke with consultants in the United States and abroad about specific issues—such as the Organization of Petroleum Exporting Countries' (OPEC) "downstream" activities,[7] fuel-switching capabilities i the United States and other OECD countries, and structural changes in the oil market—where available data were limited. Overall, we selected energy and oil experts with a variety of backgrounds and perspectives to ensure that opinions, data, and views of those knowledgeable of and affected by matters in this report were considered.

Finally, as an adjunct to our analysis of how the likelihood of a disruption has changed, the Congressional Research Service (CRS) prepared a follow-up report on previous work it had undertaken regarding a relate

[6]For consistency in the report, we present general energy consumption figures in quadrillion British thermal units (quad) and specific oil statistics in million barrels per day (MMBD). According to the EIA Annual Energy Review, 1986, one quadrillion British thermal units (Btu) equals approximately 0.47 million barrels of oil per day for a year. However, it is important to note that this conversion factor varies considerably depending on the fuel type and its heat content.

[7]The term "downstream" is used in the oil industry to differentiate refining and marketing activities from other activities, such as oil exploration and production, which in turn are considered "upstream" activities.

issue on oil transportation. The CRS analysis of oil pipelines in Saudi Arabia and Iraq and the potential contribution of these pipelines toward reducing the role of the Persian Gulf is summarized in chapter 3.

We provided a draft of the report to knowledgeable officials at the Departments of Energy and State and incorporated their comments as appropriate. However, we did not obtain official agency comments because we had not evaluated specific government programs or activities.

Our review was conducted between August 1987 and March 1988.

How Has the Dependence of the United States and Other Major Oil-Consuming Countries on Oil, Particularly Imported Oil, Changed Since the 1970s?

Total energy consumption by the United States and other OECD countries changed little between 1976 and 1986. However, the United States and other oil-consuming nations depend less on oil today than they did a dec ade ago because both oil consumption and oil imports have decreased. Both trends are due in part to higher oil prices relative to prices for other energy sources over the period. Despite this reduced dependency, oil consumption in the transportation sectors of major industrial countries is increasing. Moreover, substantially lower oil prices since 1986 have contributed to reversing the trends toward lower consumption and imports.[1] Various energy forecasts expect oil consumption and import levels to continue to grow slowly over the next few years.

U.S., Other OECD Total Energy Consumption Changed Little Over 10-Year Period

In 1986 total U.S. energy consumption was about 74 quadrillion British thermal units (Btu), nearly the same level as in 1976. However, annual energy consumption fluctuated considerably. For example, total energy consumption increased from a low of about 71 quads in 1975 to a high of about 79 quads in 1979, then decreased to about 71 quads by 1983. Consumption grew considerably in 1984 and then remained essentially stable through 1986 despite continuing economic growth. In 1987 total U.S. consumption increased slightly to about 76 quads.

Industrial consumption caused some of the fluctuation in total U.S. energy consumption and was primarily responsible for keeping total energy consumption from increasing during the period. As shown in table 2.1, in 1986 the industrial sector accounted for about 36 percent of all energy consumed. The industrial sector was the only end-use sector to decrease in total energy consumption between 1976 and 1986.

Table 2.1: U.S. Energy Consumption by End-Use Sector (In Quads and Percent)

	1976		1986	
	Quads	**Percent**	**Quads**	**Percent**
Residential & commercial	25	33	27	36
Industrial	30	41	26	36
Transportation	19	26	21	28
Total	**74**	**100**	**74**	**100**

Source: DOE/EIA Monthly Energy Review, June 1987.

[1] Oil prices in 1986 decreased from $27 per barrel to below $10 per barrel but increased in 1987 to about $17 to $18 per barrel. The decrease in oil prices in 1986 helped to increase U.S. oil consumption by about 550,000 barrels per day and increase imports by 1.1 MMBD compared to those of a year earlier. Prices for the first part of 1988 dropped below the average level for 1987.

As also shown in table 2.1, total industrial energy consumption fell from about 30 quads in 1976 to 26 quads in 1986, a 13-percent decrease. This trend reflects increased energy efficiency as well as broader changes in the nation's economy. As a result, the industrial sector's share of total energy consumption fell from about 41 percent to 36 percent.

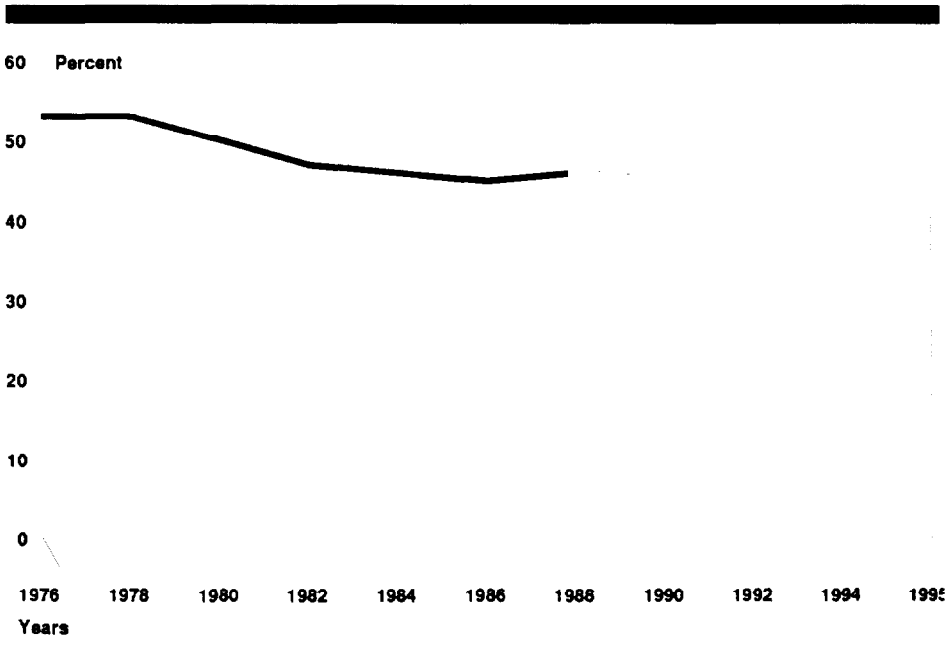
Between 1976 and 1985,[2] total energy consumption by other OECD countries increased by about 8 percent to 78 quads. Although the industrial sectors reduced consumption by about 6 percent between 1976 and 1985, a 20-percent increase in consumption in the OECD transportation sector more than offset this decrease. Further, energy use in the residential and commercial sector also increased during the 10-year period.

Oil Remains the Primary Energy Source Worldwide

Oil as a component of total energy consumption accounted for about 38 percent of all energy consumed worldwide in 1986, followed by coal, natural gas, hydroelectric, and nuclear power. Figure 2.1 shows the importance of oil in terms of total energy consumption in the noncommunist world.

[2]1985 OECD data are the latest available.

Figure 2.1: Oil's Share of Total Noncommunist World Energy Consumption, 1976-1995

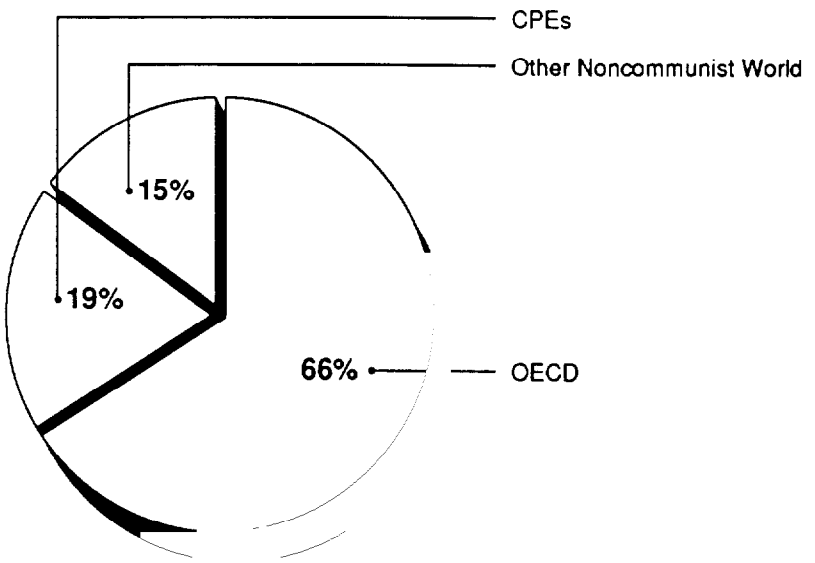


Sources: BP Statistical Review of World Energy, and EIA Estimates for 1988 to 1995

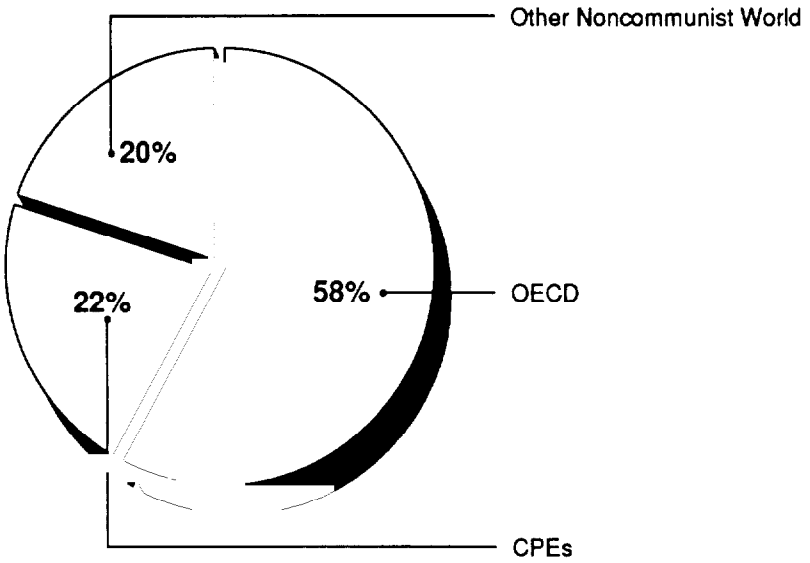
Oil represented 40 percent of U.S. and Canadian energy use in 1986 and 46 percent of Western European energy consumption. Over one-half of Japan's and the remainder of the noncommunist world's energy needs are supplied by oil. In contrast, coal provided nearly half of the energy used in centrally planned economies (CPE), which include the Soviet Union, the Peoples' Republic of China, and other communist countries, while oil's share was about one-quarter.

These data underscore the significance of oil in the United States and other major industrialized nations. It heats homes, fuels cars, enables the production of goods and services, and is an essential element for a responsive national defense system. It is these end-uses that make the supply of oil so critical to the United States and other economies. One need only look at the dramatic effects of the oil price shocks of the 1970s on the U.S. economy to further appreciate oil's importance. The price shocks were, in a large part, responsible for loss of economic output, inflation, unemployment, and balance of payment problems that persisted even after the supply disruptions ended.

Figure 2.2: World Oil Consumption, 1976-1986 (MMBD)



1976 World Oil Consumption = 58.7 mmbd



1986 World Oil Consumption = 60.7 mmbd

Sources: DOE/EIA Annual Energy Review, 1986, and International Petroleum Statistics Report, 1987

Total world oil consumption increased steadily during the mid-to-late 1970s, peaking at over 65 MMBD in 1979. World oil consumption then decreased during the early 1980s to about 61 MMBD in 1986 or roughly the same level as in 1976. As shown in figure 2.2, during the period between 1976 and 1986, the share of total oil consumption by the Unite States and other OECD countries fell while the share of developing countries and CPEs increased.

Oil Use in U.S. and Other OECD Transportation Sectors Increased Despite Decreases in Overall Consumption

While total oil consumption in the United States and other OECD countries decreased as energy consumption shifted away from oil, consumption for transportation in these countries rose. Further, the United States and other OECD countries relied almost entirely on oil for their transportation needs.

U.S. Energy Consumption Shifted From Oil and Natural Gas to Coal and Nuclear Power

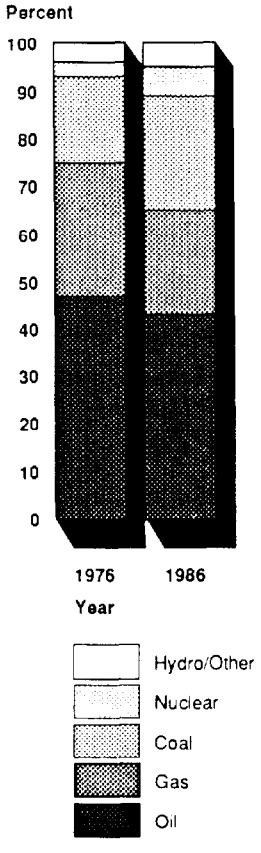
Figure 2.3 shows that both oil and natural gas consumption in the United States decreased since 1976 while coal and nuclear power consumption both increased. As a result of these changes, the share of oil i total U.S. energy consumption decreased during the period, from 47 per cent (17.5 MMBD) in 1976 to 43 percent (16.3 MMBD) in 1986. Further, the combined share of oil and natural gas fell from 75 percent in 1976 to 65 percent in 1986. The share of oil in U.S. consumption for 1987 is about the same as for 1986.

The trend toward a smaller share of oil consumption was interrupted by the rapid decline of oil prices in 1986. In 1986 U.S. oil consumption rose by 555,000 barrels per day, compared with 1985, to about 16.3 MMBD. A a consequence of the 1986 increase, U.S. oil consumption reached the highest level in 5 years. However, this increase was more than offset by a decrease in natural gas consumption, leaving total energy consumptio almost unchanged. In 1987 U.S. oil consumption increased to about 16.5 MMBD.

Oil Consumption Is Increasing in U.S. Transportation Sector

In contrast with total U.S. energy consumption, which declined only in the industrial sector, U.S. oil consumption since 1976 decreased in the

Figure 2.3: U.S. Energy Consumption by Source in 1976 vs. 1986 (In Percent)



Source: DOE/EIA Annual Energy Review, 1986

industrial[3] and residential/commercial sectors. These decreases reflect, in part, a shift to electricity for end-use in these sectors and a dramatic decline in the use of oil to produce electricity. However, oil consumption in the transportation sector has increased. For example, consumption of oil in the transportation sector increased from about 9.4 MMBD in 1976 to 10.2 MMBD in 1986, an 8.5 percent increase over the period. According to EIA, transportation use rose because the increase in the total number of automobile miles traveled more than offset the increase in the average

[3]Although the industrial sector had decreased its oil consumption since 1976, in 1986 it still relied on oil for about the same share of its total energy needs. This occurred because total energy consumption and oil consumption both decreased proportionately so that the ratio remained the same. Limited opportunities remain to further reduce oil use and dependence in the industrial sector because oil is used for special purposes, such as petrochemical feedstocks, motor fuels, asphalt, and road oil.

fuel efficiency of vehicles.[4] In 1987 consumption in the transportation sector increased to about 10.5 MMBD.

The increase in the use of oil in the transportation sector was large enough to offset about 40 percent of the decrease in oil consumption by the industrial and residential/commercial sectors. As shown in figure 2.4, by the end of 1986 the transportation sector was using nearly two-thirds of all oil consumed in the United States. With today's lower oil prices, the EIA expects the rate of vehicle efficiency improvement to slow slightly compared with improvements since the mid-1970s.[5] Nonetheless, EIA still expects a considerable improvement in fuel efficiency for personal vehicles—about 24 percent between 1987 and 1995. This improvement, however, is significantly higher than projections by Data Resources, Inc. (DRI). If oil prices remain stable and fuel efficiency slows compared with the 1970s, oil consumption in the transportation sector can be expected to continue to increase somewhat.

With the continued increase in oil use by the U.S. transportation sector, the Congress, federal and state governments, and private companies have begun developing alternative transportation fuels (i.e., ethanol, methanol, and natural gas) and the vehicles to use them. Among the more recent developments are

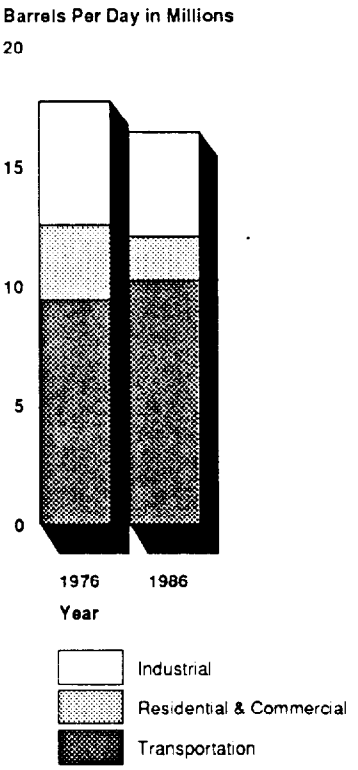
- legislation to promote the development and implementation of alternative fuels and vehicles,
- proposals by the General Services Administration (GSA) and the California Energy Commission to purchase flexible-fueled vehicles for the federal and state fleets,
- the development by automobile companies of vehicles that can operate on ethanol, methanol, gasoline, or a combination of these fuels, and
- use of methanol fuel pumps in California by major oil companies.

Although these actions will provide some additional emphasis to develop alternatives to oil for transportation uses, past efforts have met with limited success. While the technology needed for most of the alternative vehicles is reasonably well advanced, demonstration programs have not significantly improved the market for such vehicles. Further,

[4]According to the EIA, miles traveled is sensitive to the level of economic activity, while fuel economy is more sensitive to oil prices.

[5]EIA estimates that between 1976 and 1986 the average fleet fuel efficiency of personal vehicles increased by about 3.1 percent per year. EIA expects fuel economy of personal vehicles to increase about 3.0 percent per year between 1987 and 1995.

Figure 2.4: U.S. Oil Consumption by End-Use Sector (In MMBD)



Source: DOE/EIA Monthly Energy Review, June 1987

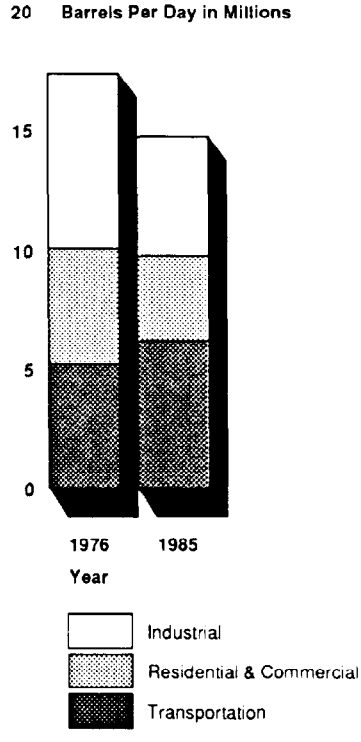
considerable lead time and competitive prices for these fuels will be required to develop the necessary infrastructures for their expanded use.

Other OECD Countries Also Shifted From Oil, but Transportation Use Is Rising

Over the period 1976 to 1986, oil consumption in other OECD countries fell by almost 12 percent and was accompanied by substantial increases in nuclear power generation and the use of coal and natural gas. For example, France decreased its oil consumption during the period by about 21 percent, the greatest of any OECD country. France's ability to move from oil was largely due to increased nuclear power. Other countries with significantly reduced oil consumption included Italy, with a 15-percent decrease, and the United Kingdom and Canada, with a 14-percent decrease each. West Germany and Japan cut their use of oil by about 8 percent each, 1 percent more than the United States.

Figure 2.5 shows that, as in the United States, other OECD countries' oil consumption fell in all sectors except transportation. Oil use in OECD transportation sectors increased by about 20 percent from 1976 to 1985 and comprised about 46 percent of all oil used in other OECD countries in 1985. Although more recent data are limited, oil consumption in the transportation sector is expected to have increased in 1986 because of falling oil prices and to have continued to increase in 1987, but at a slower rate.

Figure 2.5: Other OECD Oil Consumption by Sector (MMBD)



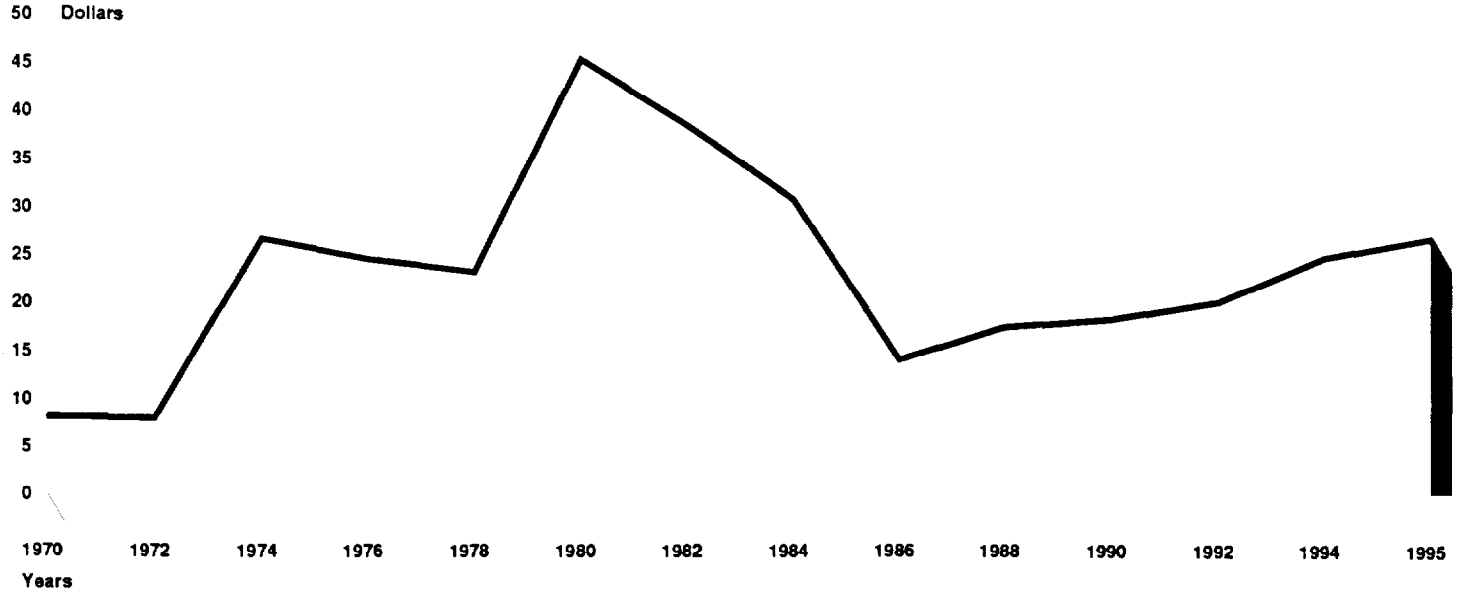
Note: Data do not include some processing losses, oil used in petroleum refineries, or other nonspecified oil consumption.

Source: Energy Balances of OECD Countries, 1987

U.S., Other OECD Oil Imports Dropped Between 1976 and 1986, but This Trend Recently Reversed

The mix of U.S. oil imports from 1976 to 1986 shifted from OPEC sources toward non-OPEC suppliers, such as the United Kingdom, Canada, and Mexico. The development of these high-cost non-OPEC reserves was enhanced by higher oil prices in the early 1980s. Figure 2.6 shows the actual and estimated fluctuations in oil prices in constant dollars from 1970 to 1995. Changes in oil prices had a substantial effect on the demand for oil in the United States and other major oil-consuming countries and thus influenced oil imports. When oil prices rose, OECD countries also began to consume less oil, particularly imported oil. For most of 1987 the price of oil was in the $17 to $18 per barrel range; however, prices dropped below these levels in early 1988.

Figure 2.6: World Oil Prices, 1970-1995, in Constant 1986 Dollars



Note: 1987 through 1995 prices are EIA base case estimates.

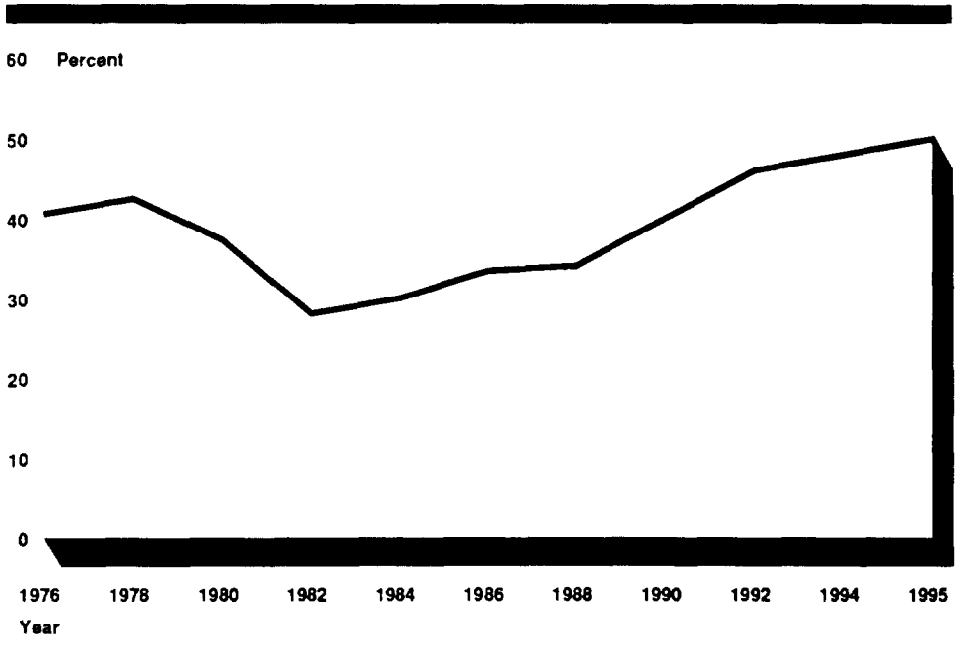
Sources: DOE/EIA Annual Energy Review, 1986, and Annual Energy Outlook, 1986

U.S. net oil imports[6] fell by about 1.6 MMBD, or about 23 percent, between 1976 and 1986. In 1976 the United States imported about 7 MMBD compared to 5.4 MMBD by 1986. During this period, imports increased

[6]Net oil imports were calculated by subtracting oil exports from gross oil imports.

sharply in 1977, reaching a high of about 8.6 MMBD, and dropped to a low of 4.3 MMBD in 1985. However, with the dramatic drop in oil prices in 1986, imports increased to 5.4 MMBD. According to DOE, part of this increase can be explained by expansion in U.S. inventories for oil and oil products. Imports for 1987 continued to increase at a much slower pace, compared with 1986, to about 5.7 MMBD. As shown in figure 2.7, the percentage of total U.S. oil consumption satisfied by imported oil fell during the period from about 40 percent in 1976 to 33 percent by 1986. In 1987 U.S. import dependence was about 35 percent.

Figure 2.7: U.S. Net Oil Imports as a Percentage of Total Oil Consumption 1976-1995 (In MMBD)

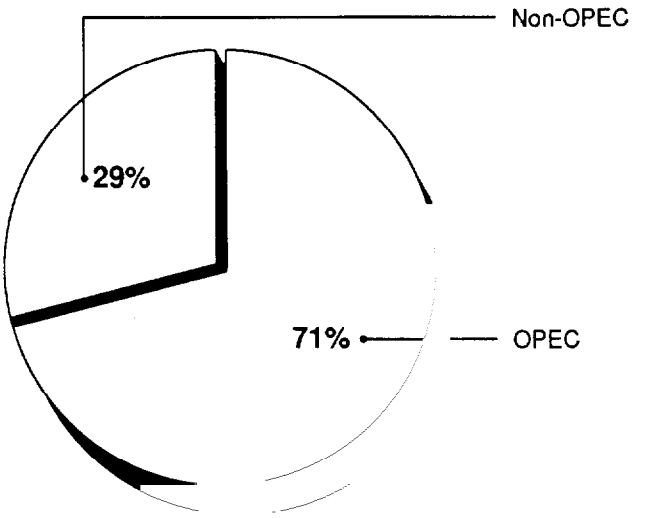


Note: Data from 1987 to 1995 are EIA base case estimates.

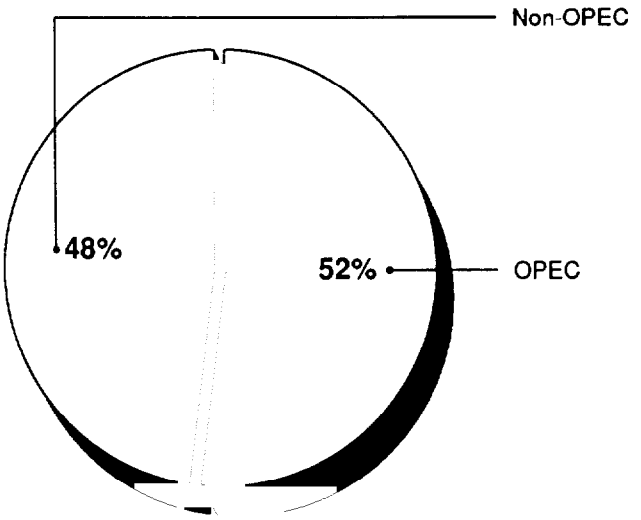
Sources: DOE/EIA Annual Energy Review, 1986; International Petroleum Statistics Report, July 1987; and EIA Estimates

The source of U.S. oil imports during the period shifted significantly from OPEC to non-OPEC suppliers. As shown in figure 2.8, for example, about 71 percent, or about 5.1 MMBD of total U.S. imports, came from OPEC in 1976. By comparison, in 1986, about 52 percent of total U.S. oil imports, or 2.8 MMBD, came from OPEC countries. (In 1987 the United States imported about the same amount of OPEC oil as it did in 1986). This diversification outside of OPEC to such countries as Canada, Mexico,

Figure 2.8: U.S. Net Oil Imports, OPEC vs. Non-OPEC (In Percent)



1976



1986

Sources: DOE/EIA Annual Energy Review, 1986; International Petroleum Statistics Report, July 1987; Annual Energy Outlook, 1986; and EIA Estimates

and the United Kingdom has helped to reduce U.S. reliance on OPEC supplies, particularly those imported from the volatile Middle East.

Other OECD countries also reduced their net oil imports by about 37 percent during the period. However, they did not decrease their imports from OPEC as significantly as did the United States—about 36 percent for the period compared with a U.S. decrease of about 44 percent. Other OECD countries depended on imported OPEC oil for about 52 percent of their total oil consumption in 1986 compared with 72 percent in 1976. In 1986, as oil prices fell, OECD countries began to import more oil from OPEC suppliers. This trend toward increasing oil imports from OPEC suppliers is expected to continue at a relatively slow rate.

U.S., Other OECD Oil Consumption Expected to Increase Slowly Through Late 1980s and Early 1990s

Forecasts for the United States and other OECD countries have projected relatively slow growth in oil consumption for the next several years—about 1 percent or less per year. EIA expects slow growth in the United States of about 1.2 million barrels per day, under its base case forecast, between 1987 (when oil consumption was around 16 million barrels per day) and 1995. DRI, on the other hand, expects a somewhat higher growth of about 1.5 million barrels per day, under its base case forecast, between 1987 and 1995. Forecasts differ considerably in the extent to which the transportation sector's consumption of oil will continue to increase. EIA, for example, expects limited annual growth in oil demand for transportation between now and 2000, arguing that vehicle efficiency improvements will offset, to a considerable extent, increases in the number of miles traveled. In contrast, DRI analysts expect consumption for transportation to grow by about 790,000 barrels per day between 1987 and 1995 because they do not expect fuel efficiency to improve as much as EIA projects. This growth in transportation accounts for about 53 percent of DRI's projected increases in oil consumption.

Excluding communist countries, oil's relative importance worldwide is expected to continue to decline from its current levels. Oil consumption in all OECD countries, including the United States, is expected to grow by about 1 percent per year, or a total of about 1.1 million barrels per day, by 1990 according to EIA. Natural gas and coal are expected to play a larger role overall in energy consumption in both the United States and other OECD countries between 1987 and 1995. DRI notes that since oil prices rebounded, natural gas will regain some of its lost market share. While the switch from oil to other energy sources will continue in OECD countries, DOE notes that growth in oil use by OECD countries is expected to be strongest in the transportation sector.

How Has the Likelihood of an Oil Supply Disruption Changed Since the 1970s?

Determining the likelihood of an oil disruption is a difficult task, given the inherent uncertainty of the world oil market. However, the potential for a serious supply disruption appears to have diminished at present. Principal reasons for this reduced likelihood include the following: (1) Oil is currently in abundant supply and substantial excess production capacity exists worldwide, (2) falling revenues and loss of market shares have provided an incentive for most OPEC members to maintain market stability, and (3) changes in the transportation of oil have lessened the impact of a disruption in the Persian Gulf. In most reasonable scenarios, barring a major military confrontation involving the loss of oil from several major oil producing countries, disrupted oil supplies could probably be replaced by other sources. However, observations about the stability of the market have all too often been proved erroneous by subsequent events. Developments are being observed today that could create problems over both the short and long terms. These developments include the prospect that non-OPEC oil sources may begin to decline as early as the mid-1990s, setting the stage for increased OPEC influence in the world oil market; the impact of fluctuating revenues on OPEC members' economies; and the role of OPEC refining and marketing activities under tight market conditions. Moreover, unforeseen contingencies—either political in nature or due to natural causes—can increase the likelihood of an oil supply disruption.

Readily Available Supplies of Oil Ease the Likelihood of a Significant Disruption

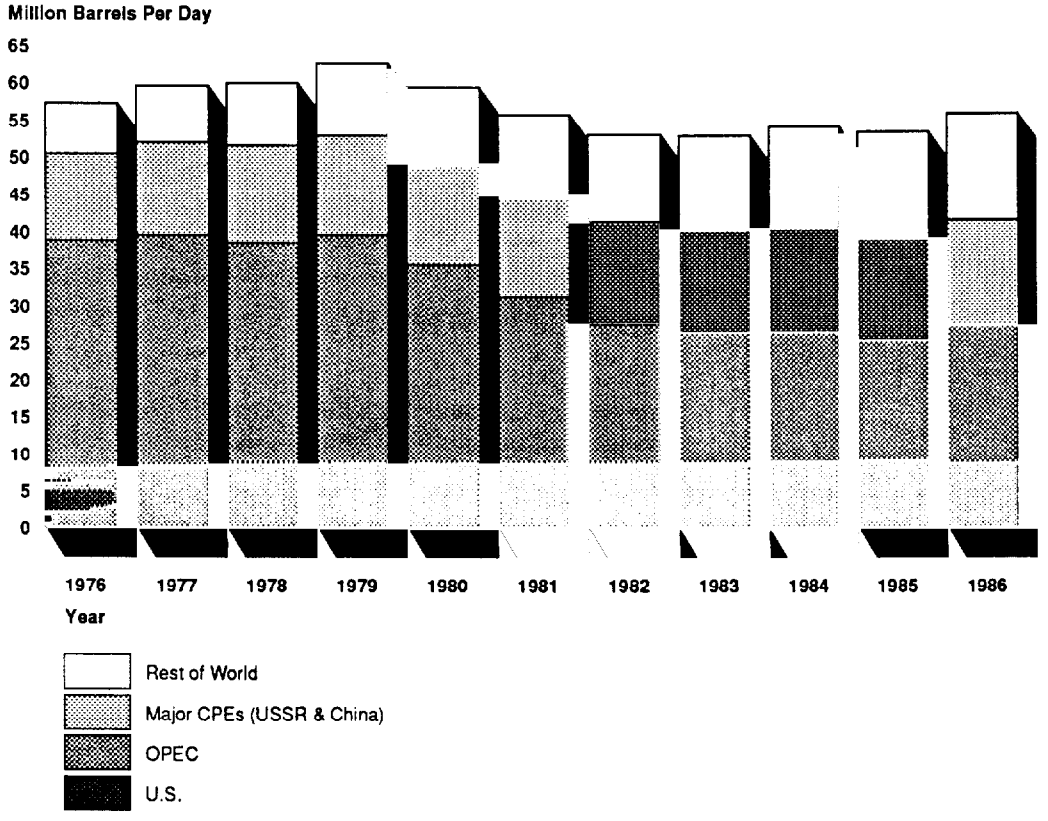
A number of non-OPEC countries increased production significantly since the 1970s. Non-OPEC production, in fact, now makes up a considerably larger share of total world oil production. Further, many producers can increase oil production if demand increases. With abundant sources and supplies of oil and the ability to further increase production, the likelihood of a significant shortfall in oil supplies has been reduced.

Production Trends Since the 1970s Have Resulted in an Abundance of Oil Thus Far in the 1980s

During the early 1970s OPEC countries increased their share of world oil production. By 1976, for example, total free world oil production was about 45.0 MMBD, of which OPEC countries supplied about 68 percent. Responding to higher oil prices during the late 1970s and early 1980s, non-OPEC production rose substantially. Total non-OPEC production increased almost 5 MMBD during the first half of the 1980s. Production from the United Kingdom's North Sea fields accounted for about one-fifth of the increase, and production from Mexico and several other countries added substantially.

As non-OPEC production became available, OPEC, particularly Saudi Arabia, which has the largest oil reserves, decreased oil supplies to maintain prices. OPEC's share of total free world production decreased steadily through the early 1980s to a low of about 41 percent by 1985. Because of lower oil prices in 1986, OPEC's share increased to 45 percent but fell back to 44 percent in 1987 as prices began to increase. Figure 3.1 shows how OPEC's share of total world oil production changed between 1976 and 1986.

Figure 3.1: World Oil Production, 1976-1986 (MMBD)



Source: DOE/EIA

Substantial Excess Production Capacity Worldwide Also Reduces Likelihood of a Disruption

In addition to abundant supplies of oil, a number of countries could increase production, in some cases substantially. Worldwide, excess production capacity is currently estimated by some government and industry sources at about 8 to 10 MMBD. According to one major oil company, OPEC countries have an incentive to over-report available production capacity because this influences the amount of oil that countries can sell under OPEC agreements and improves their ability to compete with other OPEC members. Consequently, upper-bound estimates of this range may be overstated somewhat. Excess production capacity is important because countries that can make a substantial amount of additional production available quickly can influence world oil prices by affecting supplies relative to demand.

Depending on where a potential disruption would occur, this excess production capacity may be able to compensate for oil lost during a supply shortage. Saudi Arabia, with current production of about 4 MMBD, could roughly double its production within a short period. Excess production capacity in other OPEC and non-OPEC countries could also add additional supplies of oil to the world market. Most OPEC, and to a lesser extent non-OPEC, producers may increase production during a supply disruption in order to recover revenues lost from low oil prices in 1986. OPEC members' production in excess of their quotas in 1987 illustrates this willingness.

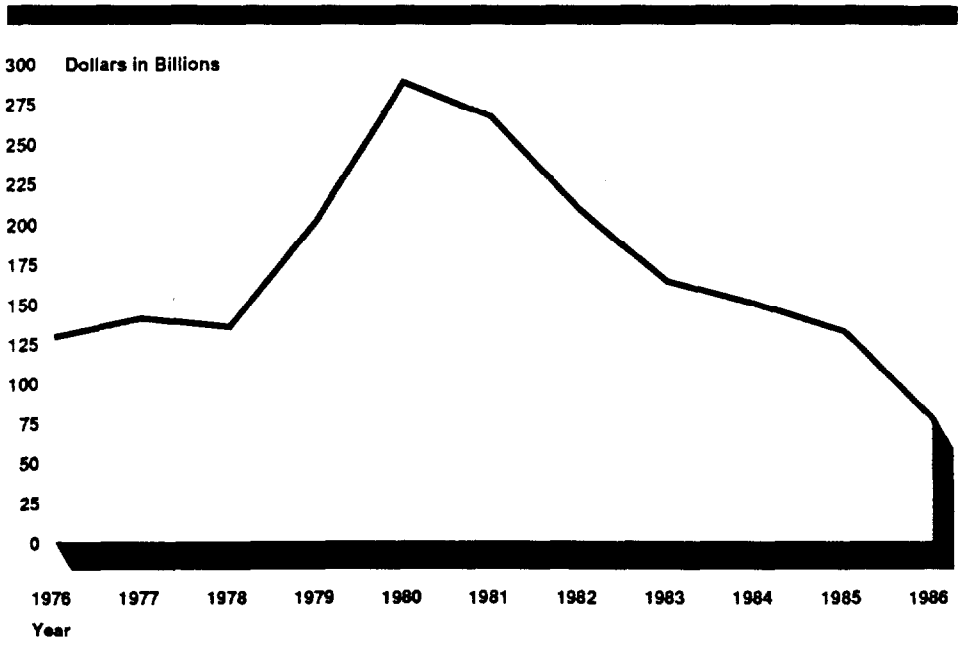
Most OPEC Members Have Incentive to Maintain Stability

The evolution of the world oil market in the 1980s has thus far worked to OPEC's disadvantage, largely because oil-consuming countries responded to the oil shocks of the 1970s by reducing consumption and seeking alternate sources of supply. Currently, oil-consuming countries are benefiting from two subsequent developments in OPEC: (1) OPEC's loss of oil revenues over recent years increased the prospect that some members would boost production, despite existing cartel quotas, to regain revenues in the event of a disruption elsewhere and (2) some OPEC members have invested heavily in downstream refining and marketing activities in major industrial countries. In addition, OPEC investments in other assets of industrial countries are likely to increase oil market stability by reducing the attractiveness of politically motivated disruptions, such as production cutbacks.

Falling Revenues May Reduce the Likelihood of a Disruption

As oil prices rose dramatically because of tight market conditions in the 1970s, OPEC oil revenues grew, reaching a peak of about $287 billion in 1980. However, reduced demand among oil-consuming countries and the influx of non-OPEC oil on the market in the 1980s contributed to an oil glut and a subsequent drop in world oil prices. Lower oil prices and reduced market share in turn precipitated a significant drop in oil revenues for OPEC countries—down to about $77 billion in 1986. Despite an increased volume of oil shipped by OPEC in 1986, OPEC revenues dropped by nearly 44 percent over the preceding year because the fall in oil prices more than offset the increase in sales during the same period. Figure 3.2 shows OPEC revenues from 1976 to 1986.

Figure 3.2: OPEC Oil Revenues, 1976-1986

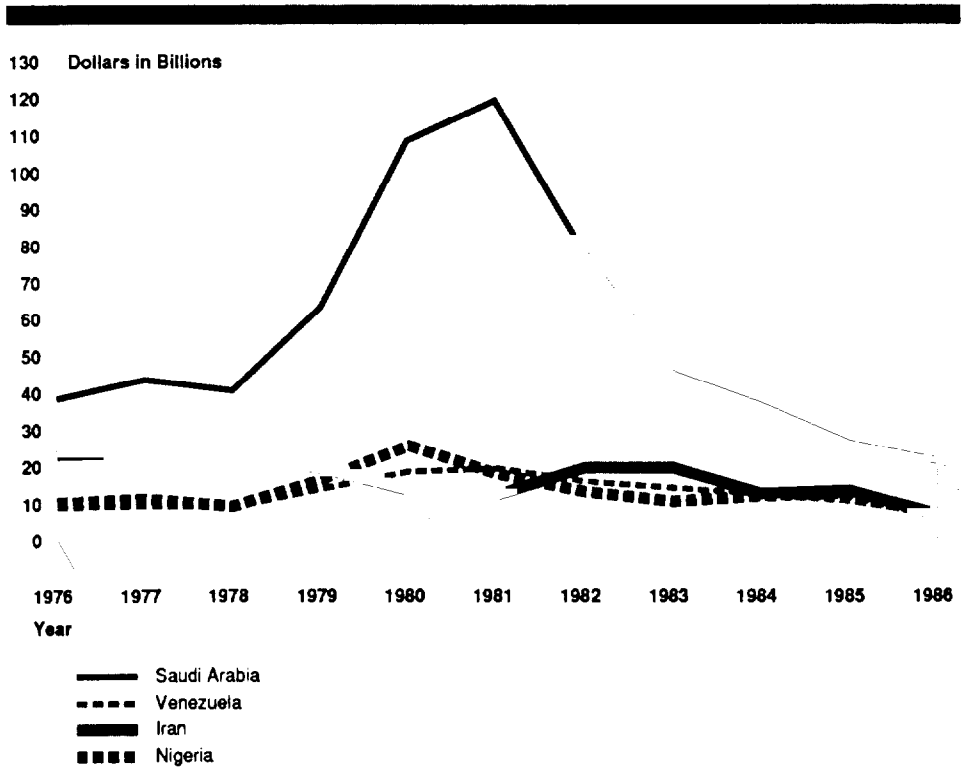


Source: Arthur Andersen

As shown in figure 3.3, in terms of dollars earned on oil exports, Saudi Arabia experienced the most significant fluctuation since 1976—this may be primarily because of its role as "swing" producer. During that year, Saudi Arabia received more than $38 billion in oil earnings. By 1981, Saudi revenues had increased to a peak during the period of nearly $119 billion. By 1986, however, Saudi revenues had dropped to

$21 billion. Figure 3.3 compares Saudi revenues during the period (1976 to 1986) with those of three other OPEC countries.

Figure 3.3: Oil Revenues for Selected OPEC Countries, 1976-1986



Source: Arthur Andersen

The impact of decreased oil export revenues on OPEC is reflected in the members' current account balances, which are basically the excess (or deficit) of export revenues over expenditures on imports.[1] When a deficit in this balance occurs, a country must draw on funds other than current receipts to meet its import costs. Over time, a country with a persistent current account deficit faces the choice of reducing its imports, increasing exports, or drawing on exchange reserves or external loans. When the deficit extends over a protracted period, it will eventually exhaust exchange reserves, increase foreign indebtedness, or

[1]The current account balance, which includes goods and services, factor income, and transfers, is different from the trade balance, which typically refers only to goods and services. The balance of payments differs from the current account balance in that the former also includes capital, unilateral transfers, and official reserves accounts.

both. Several OPEC countries are currently faced with this dilemma. Saudi Arabia, for example, is borrowing money in 1988 for the first time in over 20 years in order to pay for a persistent current account deficit, which stood at more than $10 billion in 1986. Venezuela's external debt as of 1986 amounted to nearly $34 billion, or 71 percent of its Gross National Product.

According to the International Monetary Fund (IMF), some OPEC countries have already cut back imports significantly and scaled back domestic development projects; further austerity measures will prove difficult to implement without inducing economic deprivation. These financial problems may pressure some OPEC countries to maintain or increase production (despite existing quotas) to capture additional oil revenues.

OPEC Downstream Activities May Add Stability to Oil Supplies

Over the past decade, several OPEC countries undertook measures to capture an increasing share of the petroleum product market.[2] These so-called "downstream" activities, involving the refining and marketing of petroleum products, were initially perceived as a move by OPEC to add control over petroleum product sales to its already significant position in crude sales. During the 1980s, however, it has become evident that these efforts by OPEC countries to integrate the various segments of their oil industries are driven by the individual countries' needs to secure market access in major industrial countries for their oil and thereby generate additional oil revenues.

OPEC members have used a variety of approaches to secure markets for their refined petroleum products in major oil-consuming nations. Kuwait, for example, has pursued 100-percent integration of its oil industry, from exploration and production (both domestic and overseas) to shipping, refining, and retail sales. At present, Kuwait owns nearly 4,800 gasoline stations in Western Europe, with a total market share of about 8 percent. Venezuela's downstream strategy is characterized by joint ventures with existing refiners and retailers in both Western Europe and the United States, where Venezuela acquired 50-percent equity in the CITGO Petroleum Corporation in 1986 and the Champlin Refining Company in 1987. Through its ventures with U.S. firms, Venezuela had the capability to sell gasoline products at more than 6,000 retail outlets in 1987. Libya's controlling interest in the Tamoil Italia Company has permitted it to capture 6 percent of Italy's total market

[2]Petroleum products, such as gasoline, jet fuel, and heating oil, are obtained from the processing of crude oil.

shares; Abu Dhabi recently agreed to a joint venture with Cia. Espanola de Petroleos SA (CEPSA), Spain's leading independent refiner.

Saudi Arabia's approach to downstream operations had traditionally been through the development of domestic refining capacity in cooperation with multinational companies, such as the Arabian American Oil Company (ARAMCO). Ongoing development of refineries at Al Jubail and Yanbu will eventually produce 800,000 barrels per day (b/d) of petroleum products. However, Saudi Arabia is presently reassessing its downstream strategy in light of the marketing successes of other cartel members. Industry sources have indicated that Saudi Arabia may form joint refining and marketing ventures with affiliates of ARAMCO majors in Western Europe and the United States during 1988. For example, in June 1988 Saudi Arabia was reportedly close to arranging a joint venture with Texaco, in which Saudi Arabia would obtain a 50-percent interest in Texaco's eastern U.S. refining and marketing system. Accordingly, Saudi Arabia would acquire 50-percent ownership of 3 refineries and 1,540 service stations.

According to some oil experts we contacted and studies we reviewed, the resulting linkage between producing countries and consuming countries through downstream ventures has tended to add stability to the world oil market.[3] As such, under present market conditions, OPEC countries with significant overseas petroleum investments are less likely to risk serious financial losses and reduced market share by destabilizing these markets through support of actions such as production cutbacks. This is particularly true of those OPEC countries strapped with serious economic problems.

Other OPEC investments in Western economies may also help stabilize the world oil market. Member countries have invested large amounts of their oil revenues in the West, either through direct purchase of real estate and other assets or through deposits in financial institutions. As a result, their investment earnings depend to a considerable extent on economic growth in the West. These earnings could be reduced if Western economies experience recessions. This close economic relationship is thus likely to lessen the attractiveness of a politically motivated oil disruption.

[3]See, for example, The Natural Resources Forum, The United Nations, The Impact of the New OPEC Downstream Operations on Oil Industry Structure (New York: The United Nations, 1987).

Changes in the Transportation of Oil Make Delivery Problems Less Likely

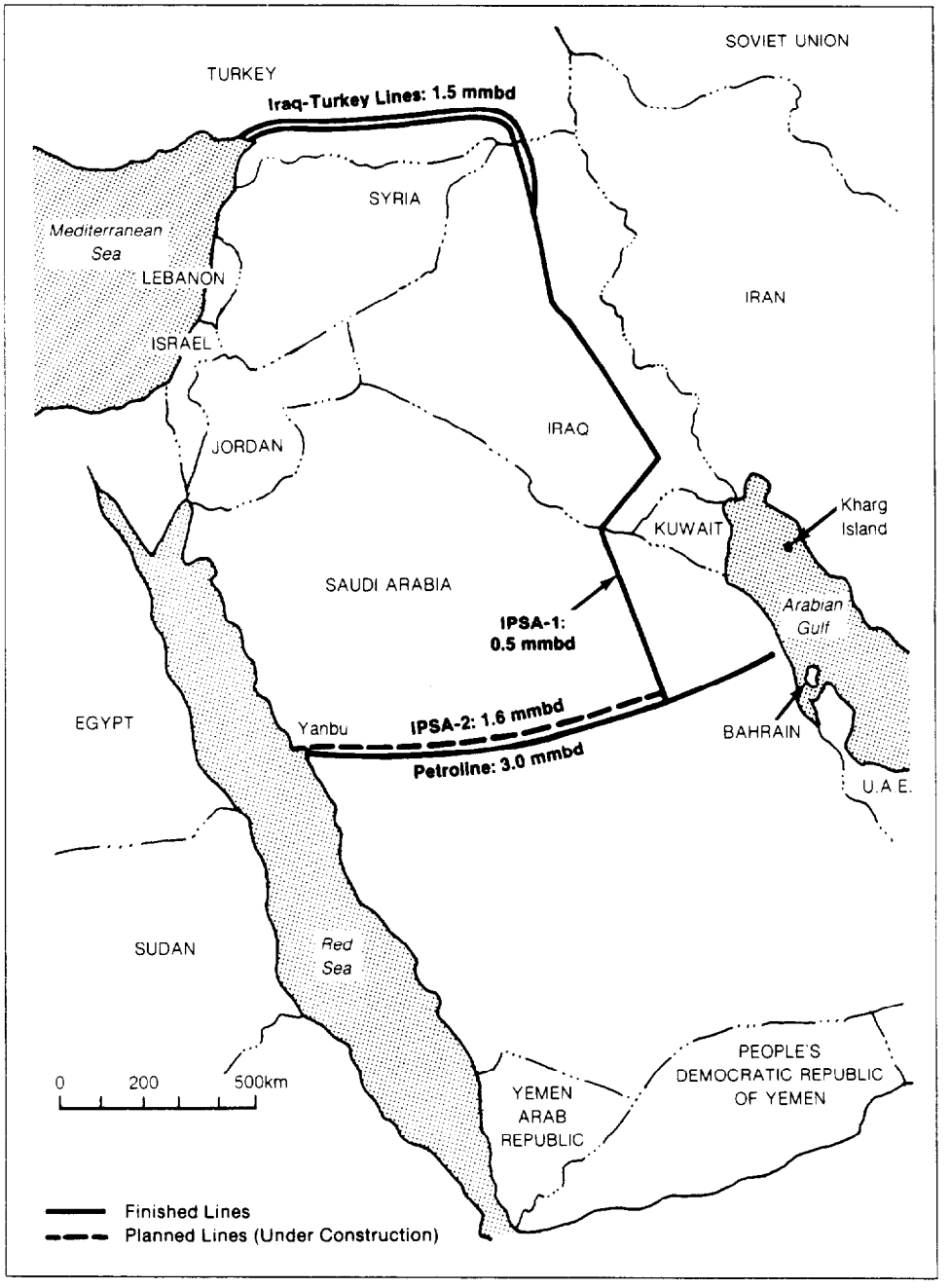
In the 1970s the United States and major oil-importing countries were acutely susceptible to disruptions in oil supplies caused by problems associated with the transportation of oil from its source to its end-use markets. In the 1980s, however, this susceptibility has decreased because of both the accelerated development of pipelines carrying oil from the highly unstable Persian Gulf region and less volatile tanker routes.

Increased Use of Pipelines

Efforts by some oil-producing countries to develop pipelines to transport oil less hazardously from the war-torn Persian Gulf region—an area with considerable risk potential for a supply disruption—has resulted in increased tanker sailings from the Eastern Mediterranean and the Red Sea since the late 1970s. By using pipelines to reduce shipments of oil through the Persian Gulf, the potential for transportation disruptions is probably reduced.

Major pipelines currently in operation or under construction are shown in figure 3.4. The combined capacity of these pipelines in currently about 4.5 MMBD. The Petroline, from Saudi Arabia's eastern oil fields to the Red Sea, was recently expanded to its current capacity of 3.0 MMBD. The Iraq-Turkey oil pipelines are fully operational but are using slightly less than their full capacity. As shown in table 3.1, of the combined 4.5 MMBD capacity, about 2.8 MMBD is used, leaving about 1.7 MMBD excess capacity that could be used during an emergency. This excess pipeline capacity exists primarily because some oil exporting ports are more competitive than others, depending on the location of purchasers.

Figure 3.4: Middle Eastern Pipeline Capacity



Source: Cambridge Energy Research Associates

Table 3.1: Available and Expected Middle East Pipeline Capacities and Current Use (MMBD)

	Capacity			
	Currently available[a]	Expected additions[b]	Current volumes	Currer exces capacit
Saudi Arabia				
Petroline	3.0	•	1.5[c]	1
Iraq				
Iraq-Turkey[d]	1.5	•	1.3	
IPSA[e]-1	N/A	•	.5[f]	
IPSA-2	•	1.6	•	
Total	**4.5**	**1.6**	**2.8**	**1.**

[a]These numbers do not include other pipelines, such as Tapline in Saudi Arabia, which are not available for exports or are closed.

[b]Expected to be available by late 1989 or 1990.

[c]Current volumes are about one-half current capacity when accounting for domestic needs.

[d]This pipeline includes two lines that will run parallel.

[e]IPSA stands for Iraq's pipeline in Saudi Arabia.

[f]This volume is included in the Petroline number.

Source: CRS/GAO.

With expected pipeline additions between now and about 1990, capacity in this region will increase to about 6.1 MMBD. Much of this additional capacity is expected to be used, however, leaving about the same level of excess pipeline capacity. Nonetheless, the ability to export as much a 6.1 MMBD by pipeline, compared with less than 1 MMBD around 1980, diversifies transportation routes and therefore reduces the transportation vulnerability of Middle East oil supplies to the United States and other OECD countries. In addition to these existing and planned pipelines speculation exists that several other countries are considering the construction of pipelines in this region. However, little data are currently available about these pipeline projects, and their construction is uncertain.

Tanker Routes Have Shifted

With declining oil consumption by the United States and other OECD countries, and the increases in non-OPEC countries' share of the world market during the early 1980s, transportation routes for oil changed. For example, growth in oil production from the North Sea and, to a lesser extent, Canada and Mexico shifted transportation traffic to these areas and away from the Persian Gulf. Shipping from these sources of supply, geographically closer to the United States and less volatile, has

somewhat reduced the likelihood of transportation problems. Nonetheless, this increased reliance on short haul crudes means that the impact of a disruption of nearby supplies could be felt more quickly.

Other Energy Sources Expected to Play an Increasing Role in Consumption

Although the United States and other OECD countries rely more heavily on oil than any other energy source to fuel their economies, alternative energy sources—such as natural gas, coal, nuclear energy, hydropower, and renewable resources—have captured an increasing share of energy markets over the past 10 years. The relative cost of these fuels has been an important factor in this shift. Continued growth in these energy sources, particularly natural gas and coal in the 1990s, could further reduce U.S. and other OECD countries' dependence on imported oil.

- Proved natural gas reserves in 1985, according to DOE, were 193 trillion cubic feet (Tcf) compared with 1985 consumption of about 17 Tcf. A considerable surplus of natural gas currently exists in the United States, which EIA forecasts will be largely absorbed in the next 1 to 4 years. U.S. companies also have contracts with Canadian pipelines and producers to import up to 1.9 Tcf of gas from Canada per year. In 1986 imports from Canada were about 0.7 trillion cubic feet of gas, leaving a considerable potential to increase imports. Recent negotiations involving the U.S.-Canada Free Trade Agreement may further facilitate gas imports. One indication of the expected growth in natural gas is EIA's projection that U.S. gas consumption will increase about 7 percent from about 16.8 Tcf in 1987 to about 18.0 Tcf by 1995.

  Similarly, new supplies of gas from the Soviet Union and Norway may displace oil in some applications. Gas, according to one international energy expert in Rotterdam, could play a more significant role in Western Europe's energy needs during the 1990s and beyond because supplies are readily available. However, new markets will need to be developed.

- Coal reserves in the United States of about 265 billion tons are the largest in the world, representing about 26 percent of the total world reserve. The United States has more coal than any other fossil fuel and has increased its consumption of coal steadily since 1976. Consumption of coal is expected to continue to increase, predominately for the generation of electricity by utilities. EIA estimates the consumption of coal in the United States will increase by about 23 percent by 1995.

DOE estimates that worldwide coal consumption will also grow substantially before the end of the century, ranging from an increase of about 30 percent in Europe to about 50 percent in Japan. One of the most significant factors determining increased coal consumption will be the ability of industrialized nations to develop clean-burning coal technologies to reduce air pollution.

- Nuclear energy has continued to produce an increasing amount of domestic power over the past 10 years and has been partially responsible for reducing oil consumption in electricity generation. However, decisions to construct and operate new power plants have become sensitive to public concerns about overall safety and the disposal of hazardous wastes. EIA expects that U.S. consumption will increase from 4.8 quads in 1987 to about 6.4 quads in 1995 because of plants on line or coming on line. Elsewhere in the free world, other countries are projecting significant increases, but these are uncertain.
- Diversification in other energy sources such as hydropower or renewables (geothermal, solar, wind, and wood) account for the remaining portion of U.S. energy consumption. While some of these energy sources may have significant potential in the longer term, their relative contribution between 1987 and 1995 will probably be minimal. A combination of factors, such as declining oil prices, removal of federal tax credits, and price competitiveness of other fuels, has curtailed development of some of these sources.

Several Factors May Set the Stage for Increased Likelihood of an Oil Supply Disruption in Future

Thus far in this chapter we have discussed why the likelihood of an oil supply disruption has diminished over the last 10 years. However, given the inherent uncertainty of the market, it is difficult to determine how long this trend will continue. Several issues may significantly influence the potential for a supply disruption in the future.

Remaining World Oil Reserves Concentrated in OPEC Countries

Of remaining recoverable oil, it is estimated that about 67 percent, or nearly 795 billion barrels, has been identified as either proved or inferred reserves and could be produced with current technology and existing prices.[4] The estimated remaining, recoverable oil is defined as "undiscovered."[5] Of the remaining worldwide conventional oil reserves, the Middle East dominates with a 53-percent share (421 billion barrels) of the total. (See fig. 3.5.) Current production levels there could be maintained for many years.

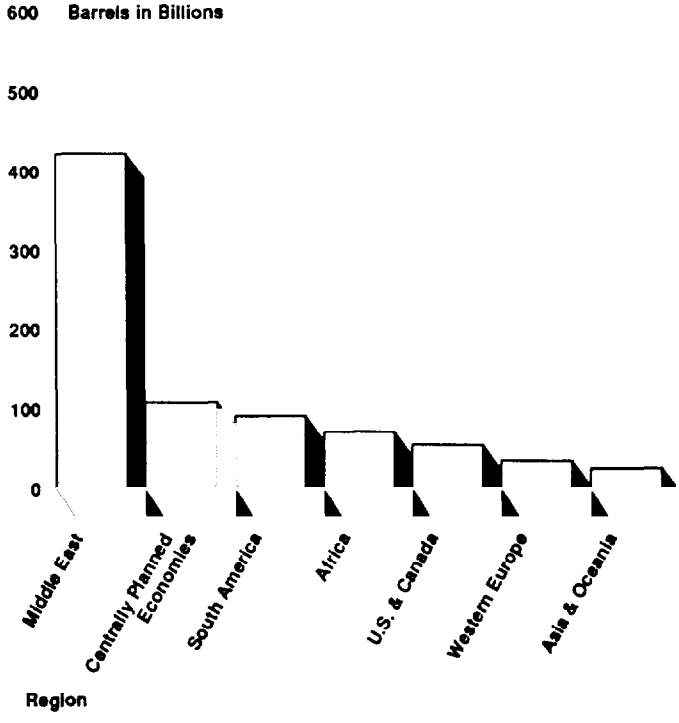
All OPEC countries together, including those in South America, Africa, and Asia, account for about 66 percent of the total recoverable, conventional oil reserves. Saudi Arabia's share of the total recoverable reserves is substantial and is estimated to be about 166 billion barrels of oil or 21 percent. With significant reserves and current production levels, most OPEC countries will be producing oil well into the next century.

By way of comparison, the United States and Canada together constitute only about 7 percent of the total remaining oil or some 53 billion barrels. The Soviet Union, China, and other centrally planned economies together account for about 107 billion barrels of oil, or nearly 13 percent of total conventional reserves. The remaining 110 billion barrels of oil, or about 14 percent, are distributed among South America, Africa, Western Europe, and Asia/Oceania.

[4]Proved reserves are those that can be determined using drilling and production data along with geological and geophysical information. Inferred reserves are those that represent the growth in proved reserves over time as oil fields are continuously developed and new drilling confirms additional reserves. Nonetheless, assessments of world reserves are inherently subjective because the accuracy of attempts to estimate the unknown is limited.

[5]Estimates of undiscovered conventional oil range between 262 and 927 billion barrels.

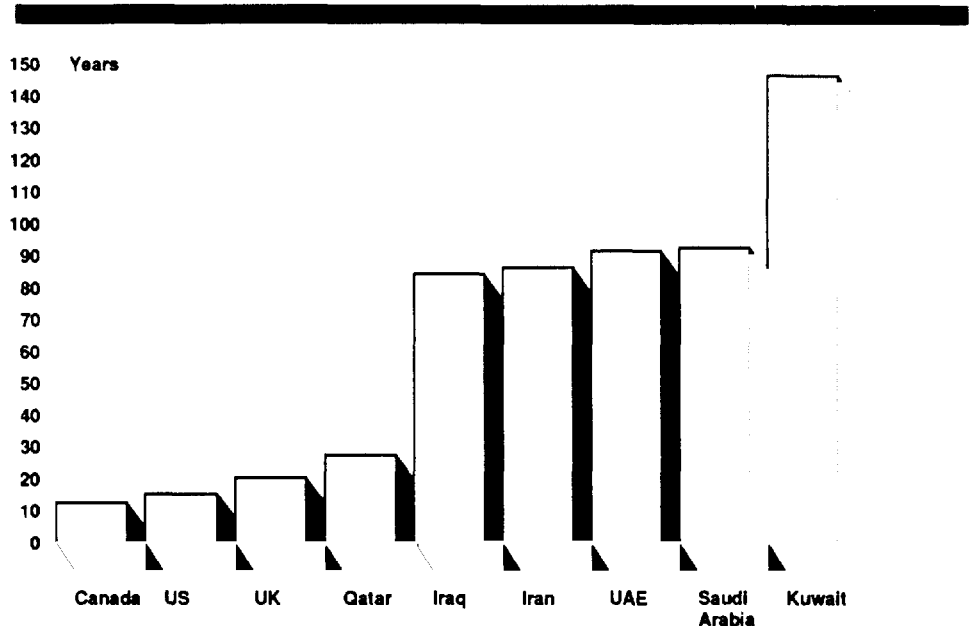
Figure 3.5: Distribution of Remaining Worldwide Conventional Oil Reserves
(Total of 795 Billion Barrels)



Source: Department of Interior, U.S. Geological Survey

Since the majority of remaining recoverable reserves are located in OPEC countries, where cumulative production has been relatively low, current production levels in these countries could be sustained for many years. For example, as shown in figure 3.6, Middle Eastern OPEC countries have reserve-to-production ratios from 27 to over 145 years. Saudi Arabia, Kuwait, Iran, and Iraq can all sustain 1986 production levels, from identified reserves, for at least 84 years. In contrast, the resources of many non-OPEC producers may become constrained much earlier (given curren production). For example, the United States and the United Kingdom (the leading North Sea exporter of oil) can sustain 1986 production levels from identified reserves for about 15 and 20 years, respectively. Canada is estimated to be able to sustain existing production for about 12 years.

Figure 3.6: Identified Reserves and Years of Production at 1986 Levels (Selected Countries)



Source: Department of the Interior, U.S. Geological Survey, and GAO Analysis

These data, however, do not fully reflect a country's conventional resource potential. Oil-producing regions can increase their proved reserves each year through additions, such as extensions to existing reserves, revised estimates of reserves based on new information, and new discoveries of oil deposits. Such additions to reserves, according to DOE, have allowed the United States to maintain or exceed its current reserve-to-production ratio for more than 35 years. Clearly, the non-OPEC oil-producing countries are not running out of oil in the foreseeable future, but concern exists that additions to domestic reserves will not continue at previous rates.

Decreasing U.S. Production and Eventual Declines in Other Non-OPEC Production May Allow OPEC to Increase Market Share in 1990s

The 1986 oil price drop decreased U.S. domestic production and raised significant concerns about the adequacy of future production and new additions. While other free world, non-OPEC production increased during the same period to offset some of this loss, how long this non-OPEC production can continue before declining is uncertain. The difference between non-OPEC supplies and world oil demand will be filled by OPEC. The somewhat higher prices in 1987 and thus far in 1988 are expected to keep non-OPEC production relatively stable overall or increasing slightly before its decline, but U.S. production will probably continue to

experience some losses setting the stage for an increased OPEC market share.

1986 Price Drop Initiated U.S. Production Decline

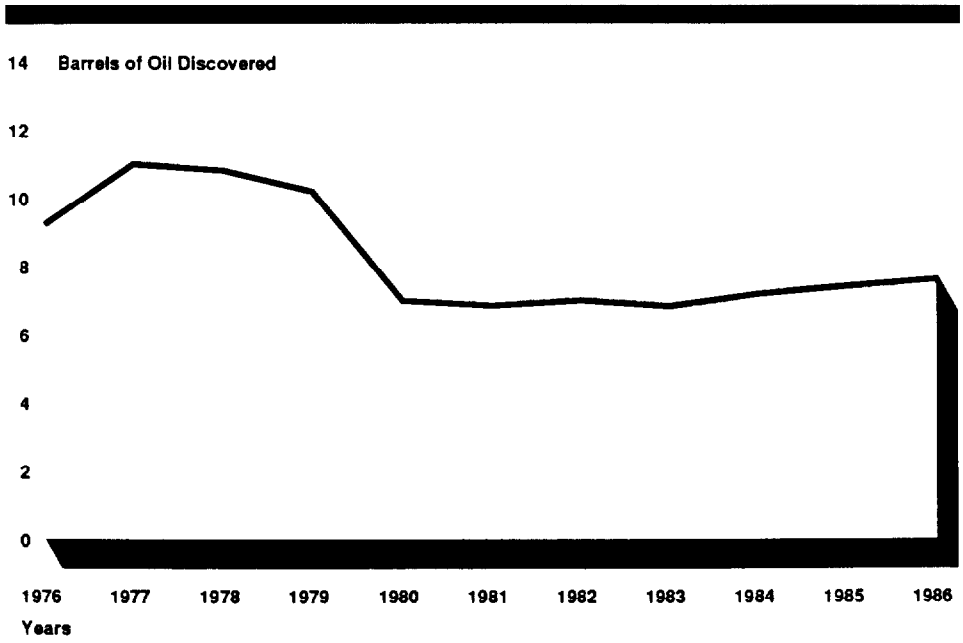
While the total U.S. crude oil production generally increased during the period 1979 to 1985, the substantial price drop in 1986 reversed this trend. For example, domestic crude oil production increased from about 8.5 MMBD in 1979 to about 8.9 MMBD by 1985. However, during 1986 production dropped by almost 800,000 barrels per day. Although "lower 48" production has been declining since 1970, the drop in oil prices substantially accelerated this decline. Crude oil production in the lower 48 states decreased from about 7.1 MMBD at the end of 1985 to about 6.5 MMBD by year end 1986. Alaskan production from Prudhoe Bay continued to increase, on average, and has offset some of this decline. Nonetheless, even with oil prices moderating in 1987 at about $17 to $18 per barrel, EIA projects total U.S. domestic production will continue to decline. Under EIA's base case forecast, total U.S. crude oil production (lower 48 states and Alaska) is expected to decline from an average of 8.3 MMBD in 1987 to about 7.6 MMBD in 1990 and 6.5 MMBD in 1995.

The cost to find and produce oil in the United States is considerably more than in other countries. DOE estimates that finding costs in the United States average about $8 to $10 per barrel, or over twice the Middle Eastern cost. Moreover, finding and producing U.S. oil from difficult areas, such as offshore fields or the Alaskan North Slope, can double these costs. When lifting and development costs are added, DOE estimates that the average cost of producing a barrel of oil in this country is about $14. This figure does not include taxes and royalty payments, which can further increase the per barrel cost. In addition, the National Petroleum Council indicated in its report, Factors Affecting U.S. Oil & Gas Outlook, that at 1986 prices domestic producers will not drill enough wells to replace their depleting oil reserves. Since the United States has been explored extensively and is a mature producing region, most of the large oil fields have probably been found. Thus, new discoveries are not likely to be sufficient in number or large enough to shift the distribution of world oil.

While more difficult environments, such as Alaskan and deep water offshore, may still hold some promise for a large field, overall finding rates (based on the amount of oil found per foot of well drilled) in the United States declined since the 1970s and have remained relatively constant thus far in the 1980s. As shown in figure 3.7, the average number of barrels found in 1976 per foot of drilling in this country was about 10.

By comparison, in 1970 the average number of barrels found was about 17. By the early 1980s, this number had dropped to about 7 barrels per foot.

Figure 3.7: Barrels of Oil Discovered Per Foot of Drilling, 1976-1986



Source: DOE

Without new large discoveries, declining finding rates may mean that more drilling or improved techniques will be necessary to sustain domestic production. Further, several major oil companies we spoke with noted the need for stable policies or incentives in order for them to make substantial long-term investments necessary for additional domestic production. Nonetheless, between 1970 and the early 1980s, U.S. drilling activity increased almost threefold while net additions to oil reserve remained relatively constant.

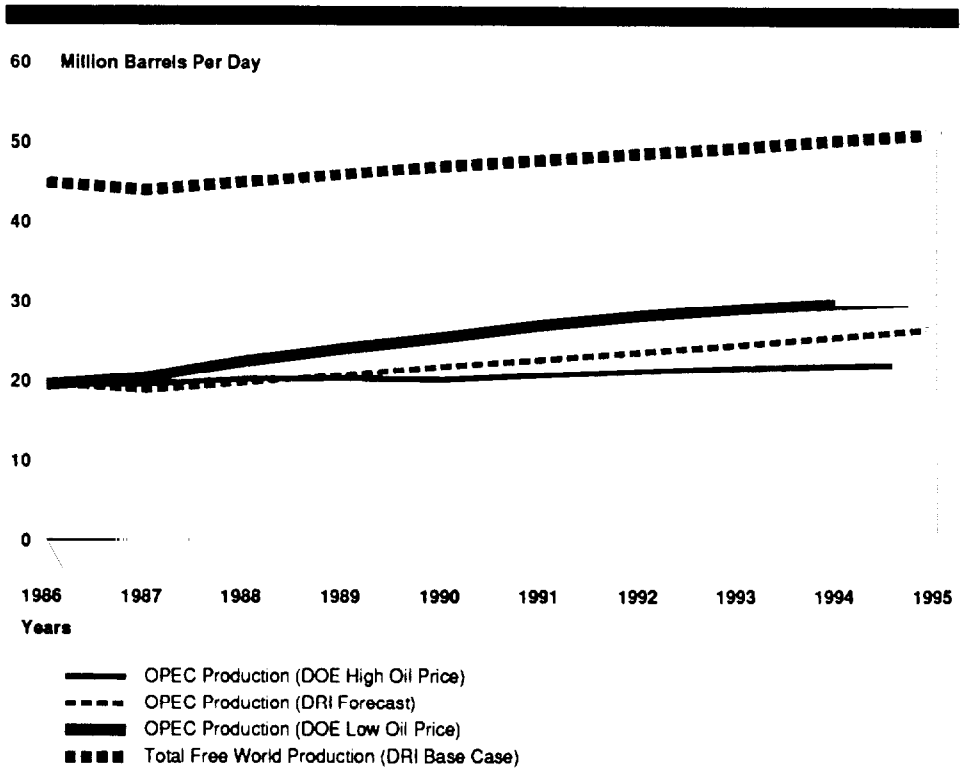
Timing in Decline of Other Non-OPEC Production Uncertain

Many expect non-OPEC production outside the United States to increase over the next several years (given current expectations about relatively stable or slightly increasing oil prices) and then start to decline sometime in the mid-1990s. While U.S. production decreased substantially in 1986, other non-OPEC production increased to offset some of this decline.

Canada and the United Kingdom both showed production levels at least as high, on average, in 1986 as in 1985. This may be partly due to changes in policy or tax laws that encouraged exploration activity. Further, as noted in a recent Arthur Andersen study, World Oil Trends (1987-88 Edition), non-OPEC developing countries increased their 1986 production by about 350,000 barrels per day and were anticipated to increase production by almost the same amount in 1987. The study also noted that over the next 3 to 5 years, developing countries, such as Egypt, Mexico, Brazil, Columbia, India, Malaysia, Brunei, Oman, Yemen, Syria, Argentina, Peru, and Angola, will add significant capacity.

One of the largest single factors in the expected decline appears to be the projected drop in North Sea oil production. Sufficient new reserves and improved technology and/or incremental production may add to total reserves worldwide. Nonetheless, at some point in the 1990s, non-OPEC oil production will probably level off and/or begin to decline, causing a shift toward OPEC supplies, where the vast majority of reserves are located. The greatest uncertainty is the timing of these changes—the point where non-OPEC production turns downward and OPEC excess production is substantially reduced—has proved to be a moving target as expectations about key variables continue to change. Figure 3.8 shows DOE's estimates of OPEC's potential market share between 1986 and 1995 compared with DRI's estimate.

Figure 3.8: Free World Oil Supplies and OPEC's Projected Market Share, 1986 to 1995



Sources: DOE and DRI

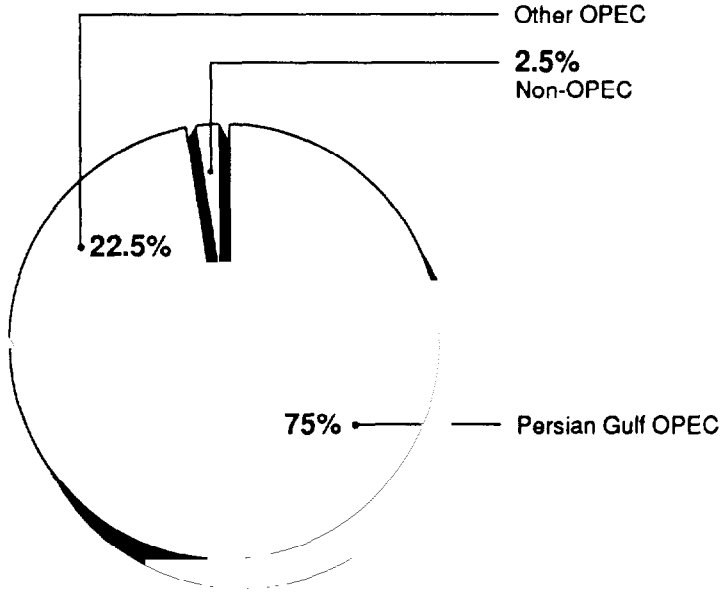
Excess Production Capacity Primarily in OPEC

During the early 1980s, OPEC lost market share to non-OPEC producers, who in turn generally held their own production close to the maximum levels they could sustain. As a result of this earlier trend, today nearly all excess production capacity is concentrated in OPEC countries. Because of this concentration, the United States and other OECD countries may have limited access to their production during a supply disruption. The fraction of excess capacity remaining outside of OPEC is located primarily in Norway, Mexico, Canada, and the United Kingdom. The United States has almost no ability to increase production within a short time frame.

Figure 3.9 shows that of total estimated excess production capacity, about 75 percent, or 6 to 7.5 MMBD, is located in Persian Gulf countries. Saudi Arabia's current excess production capacity of about 4 MMBD probably provides that country with the most potential influence of any OPEC country over world oil prices. Outside of Persian Gulf OPEC, Venezuela

(with about 8 percent of the total), Libya (with 6 percent), and Nigeria (with 5 percent) have most of the remaining excess capacity.

Figure 3.9: World Excess Production Capacity, 8-10 MMBD Total



Opinion varies as to how quickly worldwide excess capacity will shrink because of a number of highly uncertain variables such as oil prices, OPEC supply quotas, and oil demand. According to oil experts we interviewed, excess production capacity outside of the Persian Gulf could be fully utilized by the early- to mid-1990s.

Shifts in OPEC Revenues May Have Implications for U.S./OECD Energy Security

Plummeting OPEC revenues in the present period of excess world oil supplies have created a situation in which many member countries may no longer be able to pursue reforms intended to boost domestic economic growth and social welfare. This represents a marked departure from the 1970s when revenue-rich OPEC countries pursued numerous programs to improve the overall standard of living within their respective borders. If revenues continue to decline for the remainder of the 1980s, various

OPEC countries may find it difficult to meet the expectations of their people to improve living standards. This problem in turn sets the stage for political unrest.

Recent studies of the world oil market indicate that oil-consuming countries cannot be complacent about political and economic instability in revenue-poor OPEC countries. This instability could have serious implications for the United States and other OECD countries both in terms of trade balances and energy security. With regard to trade, major exporters of manufactured goods to OPEC countries could suffer further market losses if economic downturns continue in some OPEC countries. Major oil-importing countries would likewise be affected in terms of energy security if moderate OPEC governments are overthrown as a consequence of prolonged political and economic instability brought on by revenue loss. In such a scenario, the flow of oil supplies from these countries would be highly susceptible to temporary disruption.

Varying revenue needs have also tended to strain relations among some OPEC members, particularly in the Persian Gulf region. Saudi Arabia, for example, has maintained that pricing and production strategies resulting in stable market conditions are in its best interests. Iran has lobbied for higher oil prices to finance its military efforts. Iraq has consistently maximized its production despite requests by other OPEC countries for it to restrain output. The divergence in how these countries view their revenue needs represents a potentially destabilizing factor for the cartel as a whole.

In the longer term, OPEC will likely be able to recover from the revenue problems that have plagued its members thus far during the 1980s. This will be particularly true if, as widely expected, non-OPEC supplies begin to decline significantly at some point during the next decade. An improved revenue picture for the cartel in general may permit greater cooperation among members to coordinate their objectives in terms of production quotas and price targets. In addition, as OPEC recovers both revenues and market shares when non-OPEC supplies diminish, some cartel members may once again consider actions such as production cutbacks as a means for exacting political gains.

Stabilizing Influence of OPEC Downstream Activities Limited

As previously discussed, several OPEC countries have made major investments in downstream activities in oil-consuming countries. This is generally perceived within the oil industry as a positive development, tying the interests of producers more closely with those of consumers. However, these activities benefit OPEC countries primarily during periods of slack world oil demand, when cartel members must compete with non-OPEC countries for market access. As noted in the discussion of production trends, this situation may change altogether by the mid-1990s. At that time, under potentially tight market conditions, with more limited non-OPEC production, OPEC countries may no longer need joint or wholly-owned downstream outlets to sell their oil. With the risk of losing market shares to non-OPEC suppliers reduced, some cartel members may be less constrained to participate in actions such as deliberate production cutbacks.

Improved revenue flows during the next 10-20 years may also encourage some OPEC members to revert to increasing their domestic refining capacity (the original Saudi downstream strategy) to capture a greater share of the petroleum product market. In a 1986 GAO report, we stated that although this situation does not represent an immediate problem to western refining interests, it may require continued monitoring.[6] A 1985 report by the Massachusetts Institute of Technology, for example, emphasized that if OPEC's refineries do eventually displace refinery capacity in major oil-importing countries, those countries will be susceptible to disruptions in which petroleum products such as gasoline would be limited in supply and expensive in cost.[7]

Unforeseen Contingencies Can Alter the World Oil Supply Picture

No analysis of the world oil market can accurately anticipate an oil disruption triggered by unforeseen contingencies, such as political actions and natural causes. Wars, such as the Iran-Iraq conflict, sabotage, and other actions are fully capable of disrupting oil supplies to varying degrees. A 1987 CRS report emphasized, for example, that as oil pipelines grow in capacity and strategic value, their vulnerability to sabotage may grow as well.[8] In March 1988 an electrical workers' strike in Panama temporarily shut down a pipeline that transports 650,000 barrels

[6]Petroleum Products: Effects of Imports on U.S. Oil Refineries and U.S. Energy Security (GAO/RCED-86-85, Apr. 15, 1986).

[7]International Energy Studies Program, Export Refineries and Energy Security in Importing Nations (Boston: M.I.T., Dec. 1985).

[8]U.S. Congress, Disruption of Oil Supply From the Persian Gulf: Near-Term U.S. Vulnerability (Washington, D.C.: The Congressional Research Service, Nov. 1, 1987), CRS-87-863 ENR.

per day of Alaskan crude oil intended for southern and eastern U.S. markets. Moreover, various oil facilities, including pipelines and loading terminals, may in some regions be susceptible to disruption by natural causes, most notably earthquakes.

Finally, discussions in 1988 between OPEC and non-OPEC producing countries regarding production raise the question of what effect a broader OPEC/non-OPEC agreement on production levels could have on the world oil market. Non-OPEC producers officially invited to these discussions with OPEC included Malaysia, Brunei, Egypt, Mexico, China, Oman, Colombia, and Angola; observers included the Soviet Union and Norway. While these discussions are likely to continue in light of persistent oil price instability, their ultimate outcome remains uncertain.

How Has the Ability of the United States and Other Major Oil-Importing Countries to Respond to an Oil Crisis Changed?

By the late 1970s major oil-consuming countries had initiated measures—both unilaterally and multilaterally—to improve their ability to respond to an oil crisis. Since then we have seen a substantial growth in government-controlled oil stocks, the continuing development of an international forum—the International Energy Agency (IEA)—to provide a multilateral response to energy crises, and modest improvements in fuel-switching capability. While several major oil-consuming nations have stated that they plan to rely primarily on demand restraint measures during an actual oil crisis, the United States emphasizes a policy of relying on market forces and drawing down SPR early in a crisis to mitigate economic problems associated with supply disruptions.

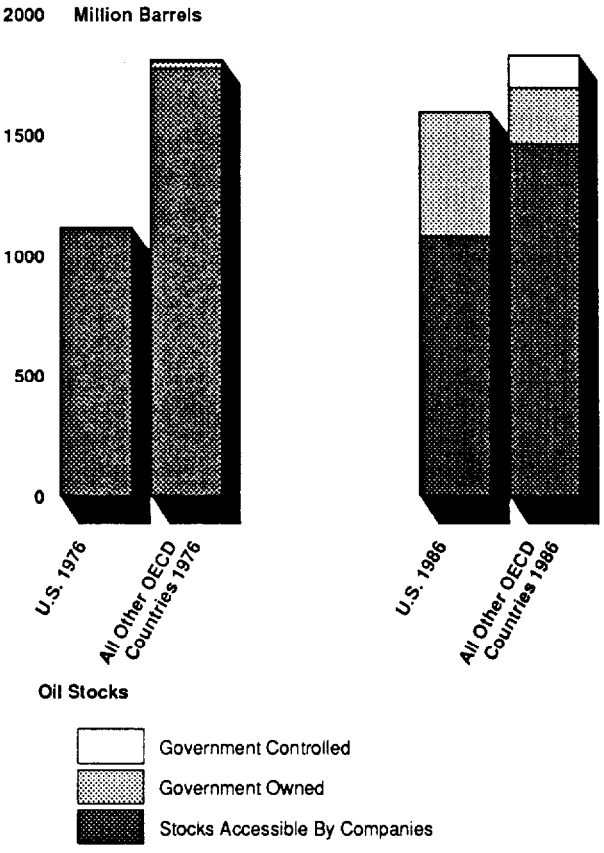
Notwithstanding these efforts to improve response measures, concerns remain. For example, oil industry experts continue to debate IEA policy issues ranging from appropriate emergency oil stock levels to the effectiveness of the agency's system for allocating oil. Questions also persist with regard to the scope of government authority in the United States and elsewhere, as well as the adequacy of existing energy emergency response procedures. A recent change in the manner in which oil is traded—the oil futures market—may also have an impact on the ability of countries, including the United States, to respond to an oil supply disruption.

Governments Have Developed Substantial Reserve Oil Stocks Since the 1970s

Tightening market conditions in the early 1970s, as well as the 1973 Arab oil embargo, accelerated efforts in some major OECD oil-consuming countries to stockpile oil in order to minimize the effects of future shortfalls. Initially, these countries relied primarily on oil stocks held by private companies in excess of their normal operational requirements. In order to reduce U.S. vulnerability to the effects of a severe oil supply disruption, as well as to carry out U.S. international energy commitments, the United States created the SPR. Several other OECD nations also began to build government-owned stocks during the 1970s.

As shown in figure 4.1, oil stocks in OECD countries totaled slightly more than 2.9 billion barrels in 1976. Most of the 2.9 billion barrels consisted of privately held stocks—totaling about 1.1 billion barrels in the United States and 1.8 billion barrels in other OECD countries. It is estimated that government-owned or -controlled stocks at that time accounted for about 32 million barrels of the total.

Figure 4.1: Total Primary Oil Stocks in OECD Countries, 1976 vs. 1986



Source: DOE/EIA and IEA

By 1986 total stock levels had increased to about 3.4 billion barrels. While the net increase of 500 million barrels is almost exclusively government-owned oil in the United States, other OECD countries have also stored more oil under government ownership or control. U.S. company stocks decreased from a little more than 1.1 billion barrels in 1976 to about 1.0 billion barrels in 1986, while government-owned stocks of more than 500 million barrels were added to the SPR. Other OECD countries experienced a somewhat greater decline in company stocks, from about 1.8 billion barrels in 1976 to about 1.5 billion barrels in 1986. However, as shown in figure 4.1, oil stocks owned by governments or controlled by special organizations in these countries increased from only 32 million barrels in 1976 to about 360 million barrels in 1986.

According to oil industry officials, the principal reason for this reduction in oil stocks was that the industry is more efficient today than in the 1970s and thus needs lower operating inventories. For example, according to one industry representative, one refinery today can process oil into a number of products that may previously have required several different refineries. In addition, many oil terminals have been consolidated, allowing for greater utilization of the remaining terminals and for less oil to be stored. In terms of European companies, some that are required to meet IEA emergency commitments of their respective countries have been able to reduce stocks as oil consumption decreased slightly in the 1980s.[1]

Several major oil-importing countries, including the United States, Japan, and West Germany, presently have plans to raise their respective oil stock levels. The United States, for example, plans to raise the SPR level to 750 MMB by 1995 or earlier; Japan is considering a stock level target in excess of 300 MMB by 1995. Plans for government-owned oil stocks are under consideration in France and Belgium. However, the potential size and availability of these stocks are unknown.

Excess Production Capacity Could Act as Buffer Before Oil Stocks Are Necessary

With current excess production capacity at about 8 to 10 MMBD (see ch. 3), potential supply disruptions could be offset in some cases without drawing down strategic oil stocks, such as the SPR. The location of a disruption would be the largest single factor influencing the extent to which this excess production capacity could be used. For example, if an oil disruption cut off supplies from the Persian Gulf, only about one-quarter of total world excess capacity could be made available. However, if a disruption involved only one or two smaller producing countries, the majority of the excess capacity could be brought on line.

Other Developments Also Strengthen the Ability to Respond

Although the stockpiling of oil by governments of major industrial countries stands out as perhaps the most significant development in terms of responding to a crisis, other developments have occurred over the past decade that can also reduce the impact of an oil disruption. These include the continuing development of the IEA, modest fuel switching capability, and emergency government authorities.

[1] IEA emergency oil stock levels are based on a country's net oil imports for the previous year.

The International Energy Agency

Established by the International Energy Program agreement (IEP) in 1974, IEA has since evolved into a 21-nation forum for developing a coordinated response to a potential oil crisis. Through the agency's Emergency Sharing System, IEA members agree to (1) maintain emergency reserves equal to 90 days of net oil imports, (2) establish measures to reduce demand by at least 7 to 10 percent or substitute emergency stocks held in excess of the 90-day requirement, and (3) subject their oil supplies to an international allocation formula to calculate each country's rights to receive oil or obligation to provide oil in a serious disruption.[2] This system is designed to deal with short-term oil supply disruptions by limiting excessive price increases and thereby minimizing the economic damage to member countries. Of importance is the expectation that the system will compensate for reduced supplies by using emergency oil stocks and restraining demand. The system is also designed to allocate available supplies so that members share the burden of an oil shortfall. In recent testimony,[3] we noted that this oil-sharing feature may make a useful contribution by reducing the rise in oil prices because it could potentially reduce stockbuilding, hoarding, and panic buying. This could in turn limit disruption-induced price increases. Hence, even if oil is exchanged under the sharing system at market prices, the prevailing market prices could be lower than they otherwise would be.

Over the past decade, IEA has continued to develop measures for improving the emergency preparedness of its members. For example, agency members have performed five tests of the Emergency Sharing System since 1976 to help ensure that the system functions effectively in an actual crisis situation. In 1984 IEA member countries further agreed to coordinate the drawdown of strategic stocks and/or employ demand restraints, which, in the U.S. view, would apply early in a supply disruption whether or not the disruption is sufficient to activate the IEA oil-sharing system. The agency performed its first simulated test of this system in January-February 1988. According to IEA analysis, there appears to be a new willingness by a number of members to draw down stocks in disruptions not large enough to trigger the Emergency Sharing System.

[2]We use the terms "oil-sharing plan" and "oil-sharing system" in this chapter to refer to the segment of IEA's Emergency Sharing System that provides for the allocation of oil among members.

[3]Renewal of Authorities for U.S. Participation in the International Energy Program (GAO/T-NSIAD-88-32, May 17, 1988).

Further, IEA's Industry Advisory Board provides an opportunity for representatives from private oil firms to participate in IEA meetings. This board has advised the agency on numerous issues, ranging from implementing emergency allocation decisions to developing antitrust and breach of contract defenses, to ensure agency-industry cooperation in energy emergencies. The agency also took over and improved OECD's energy data system to the extent that it is a primary information source on developments in the world oil market. These developments and others reflect IEA's effort to develop a multilateral response to oil disruptions of varying magnitudes. As we noted in our 1985 review of the IEA,[4] the mere existence of an international agency dedicated to coping with energy crises can help deter politically motivated disruptions directed at one or more member countries.

Fuel Switching Opportunities

The results of several analyses and expert opinion together indicate that modest fuel switching opportunities would be available in the event of a disruption. Since the oil price shocks of the 1970s, industrialized oil-consuming countries have increased the number of dual-fired facilities equipped to burn natural gas or coal. These fuels are generally burned instead of oil whenever they are cheaper. Oil-to-gas switching seems most promising as an immediate response mechanism to a crisis. However, the degree to which oil consumption can be reduced by fuel switching in a crisis will depend to a great extent on the predisruption price and usage of these other fuels.

In the United States, within about a 1-month time frame, most of the fuel-switching ability is located in industrial sector boilers and process heaters and in electric utilities burning oil and gas. In an August 1987 analysis, "The Strategic Role of Natural Gas in Replacing Imported Oil," the American Gas Association estimated that the immediate fuel-switching[5] potential in the United States was 352,000 barrels per day and 710,000 barrels per day within 1 year. Alternatively, a recent DOE study Oil Use and Oil Dependency in the U.S. Economy, (DOE/PE-0078, Dec. 1987), also concluded that the United States has limited fuel-switching capability and estimated that within 1 to 2 years less than 1 MMBD is

[4]Status of U.S. Participation in the International Energy Agency's Emergency Sharing System (GAO/NSIAD-85-99, Jan. 13, 1985).

[5]Immediate fuel switching means within 1 month.

switchable from oil to other fuels.[6] Overall, most energy experts confirmed the belief that the immediate fuel-switching capability in the United States is modest—probably 500,000 barrels per day or less. Further, estimates of immediate fuel switching capabilities in Western Europe are somewhat lower than in the United States—about 400,000 barrels per day, with most concentrated in the industrial sector. By including potential fuel switching in the electric utilities, this estimate could be increased slightly.

Government Authorities

A successful response by the United States and other major oil-consuming countries to an energy crisis may depend largely on the ability of these governments to implement a variety of programs designed to limit the effects of such crises. Most oil-importing countries have developed measures to restrain demand—such as speed limits, driving restrictions, and rationing/allocation of oil—during a crisis. The United States, in contrast, favors a policy that relies on market forces to determine the price and allocation of oil in a crisis. Since 1984 the United States has modified its policy by adding to its market-oriented approach a policy of drawing down SPR early in a crisis to stabilize markets and limit price spikes.

In the United States, a response to an oil supply disruption would in most circumstances involve the activation of key emergency authorities by the President. A wide range of authorities are available to the President, depending on the nature of the disruption. For example, the Energy Policy and Conservation Act authorizes actions such as U.S. participation in IEA's oil-sharing plan, utilization of SPR in response to severe disruptions and/or IEA obligations, and controls on the import/export of petroleum products. The Defense Production Act of 1950 authorizes actions, such as the allocation of petroleum, to promote national interests and the activation of a federal manpower reserve of energy executives.

DOE's Office of Energy Emergencies would coordinate the U.S. federal response and recommend specific response options to the Secretary of Energy and the President through a process known as the Energy Emergency Management System. According to DOE, an effective public information program is another critical element in clarifying the nature of an energy emergency and the likely U.S. response. For example, in order to

[6]Data contained in the study also show that industrial sector fuel switching is limited because oil is concentrated in uses that cannot be readily replaced by natural gas.

maintain communication with relevant state energy officials, DOE (1) employs DIALCOM, an electronic message system, to provide timely and accurate energy data during a crisis and (2) conducts regional seminars on energy emergency preparedness.

Governments in other IEA countries, according to DOE, were also working toward improving their emergency authorities and would coordinate their activities with the United States. In addition, according to an official at the Department of State, some IEA countries have enacted legislation that permits their governments to require private companies to use their oil stocks rather than stockpile them when the IEA oil-sharing plan is triggered in a crisis.

Several Factors Still Cause Concern About the Ability of the United States and Other Countries to Respond

The adequacy of previously discussed government measures in responding to an actual crisis is uncertain. Some aspects of these response measures—including the availability of OECD oil stocks and the effectiveness of IEA policies, government authority, and the Department of Energy's emergency procedures—may require additional strengthening and/or clarification.

Not All OECD Oil Stocks Will Be Available During a Disruption

Total stocks are not necessarily indicative of OECD countries' ability to respond to an oil disruption because stocks include oil that may not be readily available, such as minimum operating inventories.[7] These inventories are needed to keep industry's oil supply/distribution systems functioning smoothly and may not be available for emergency use.[8]

As shown in figure 4.2, when minimum operating inventories and other company stocks (not required by governments) are excluded, total available stocks for an oil emergency are significantly lower than discussed earlier. Available 1986 stocks in the United States under government discretion consisted of 512 MMB of oil in the SPR.[9] The United States does not mandate that private companies hold oil stocks for an oil emergency

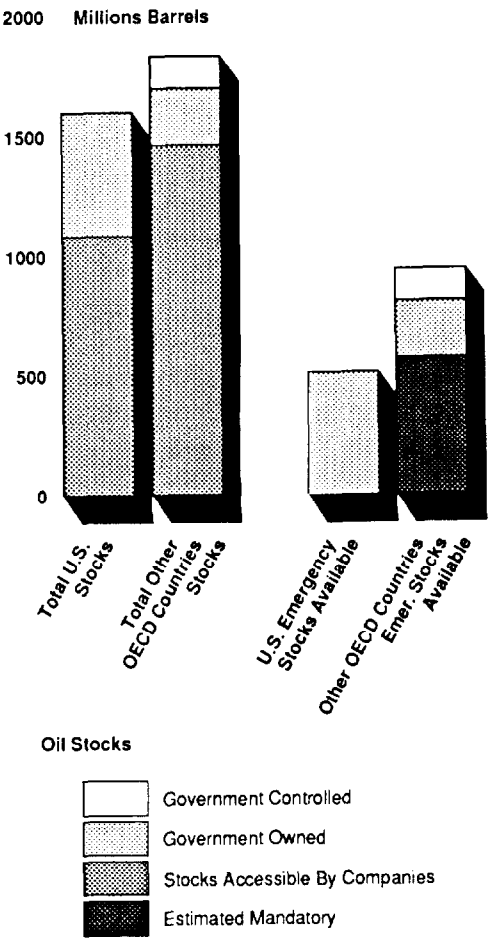
[7]GAO will soon release a report examining IEA oil stocks in greater detail.

[8]Some oil industry officials and analysts we spoke with believe that minimum operating inventories can operate the supply/distribution system for 10 to 12 days before replacements are needed.

[9]The SPR currently contains about 548 million barrels of oil.

Available government-owned stocks in other OECD countries totaled about 233 million barrels.

Figure 4.2: Total OECD Oil Stocks Compared With Emergency Oil Stocks
(Year End 1986)



Source: DOE/EIA and IEA

In addition to government-owned stocks, several European countries have established special organizations that presently hold 130 MMB of stockpiled oil. These stocks, under tight government control, should be readily accessible in the event of a crisis. Many OECD countries also rely to a considerable extent on companies to hold emergency stocks in orde to meet international commitments to the IEA and thus an additional 57(MMB of oil is estimated by IEA to be available through mandatory privat(company holdings.[10] However, the amount of total mandatory company holdings that could actually be made available in an oil supply emergency is unclear.

Because government-owned oil stocks are costly, many European countries may continue to rely predominantly on private companies to maintain emergency oil stocks for use during a supply disruption and for meeting international commitments. Although the United States has cor tinued to urge other countries to increase stock levels, it is difficult to convince all countries to do so. Some countries oppose increasing stock levels on the grounds that demand restraint measures are adequate to meet these requirements and are less costly.

Potential Problems Involving IEA Response Measures

Although for over 10 years the IEA, with its 21 oil-consuming member countries, has been evolving into a forum for developing a coordinated response to a potential oil crisis, problems persist. The relative merits of strategic oil stocks versus demand restraint measures and the effectiveness of the oil-sharing plan remain topics of considerable discussion among industry experts. These problems underscore that arranging for the collective energy security of IEA member countries is a complex task.

The Oil Stocks Versus Demand Restraint Debate

IEA's 21 member countries are not wholly in agreement over whether to use strategic stocks or demand restraints as the main or principal response to an oil shortfall. The U.S. position emphasizes early coordinated use of oil stocks by IEA countries as the best way to mitigate the economic damage associated with an oil supply disruption, helping to calm markets, forestall panic buying, and dampen price spikes. Further, U.S. policy favors letting the market determine how consumption should

[10]Eighteen of the 21 IEA countries are required by the IEA charter to retain emergency oil stocks tha meet or exceed 90 days of net oil imports, based on the previous year. The remaining three countries are net exporters and as such, do not have to maintain these levels. To meet this commitment, countries can include government-owned/controlled stocks and some company stocks (including minimum operating inventories).

be reduced rather than having governments make such decisions. Allocation and price controls, according to this policy, inhibit efficient energy use because such programs cannot anticipate or correctly adjust for shifts in demand caused by supply uncertainty or the impact of higher oil prices.

In contrast, a majority of IEA members plan to rely on a variety of demand restraint measures, including allocation, as a main or principal response to an oil crisis. A June 1986 IEA Secretariat report showed that most member countries intended to rely on compulsory orders, allocation/rationing, and persuasion as measures to limit the effects of a shortfall. Moreover, the official International Energy Program Agreement defines demand restraints as acceptable emergency response mechanisms.

One significant problem raised by this debate is the potential for conflict between the United States and other IEA member countries should the SPR be used while other countries pursue demand restraint. In this situation, described as "free-riding" by some industry analysts, the United States pays the cost of adding to world oil supplies while other member countries receive much of the benefit. In a 1986 study contracted for by DOE, analysts suggested that reliance by most IEA members on demand restraint measures only increased the burden of mitigating a disruption on those countries, such as the United States, with large strategic reserves. While most IEA members believe that demand restraint measures are viable options to respond to an oil crisis, questions remain with regard to whether (1) demand restraints can be implemented quickly and can meaningfully reduce demand, (2) reduced consumption in a crisis can be attributed to nonprice restraints as opposed to rising oil prices, and (3) demand restraints are as cost effective as using strategic oil stocks.

In recent months, more IEA members appear willing to use a combination of demand restraints and early drawdown. As the debate continues, the controversy will most likely focus on the ability of IEA measures to reduce consumption levels early in a crisis to offset lost oil supplies. Additional attention will be given to the economic costs of government-imposed demand restraint responses relative to reliance on the drawdown of strategic stocks. Since a coordinated response to an oil supply disruption would be most effective for all IEA countries, energy considerations, such as resolving this dispute, should be an important part of U.S. diplomacy.

Effectiveness of Oil- Sharing Plan Unclear

A major objective of the IEA oil-sharing plan is to limit price spikes during a world oil crisis through the coordinated use of oil supplies held by member countries. In the event of a crisis that triggers the oil-sharing plan,[11] the IEA would calculate country allocation rights (to receive oil) and obligations (to give up oil). The price of this redirected oil would then be based on "comparable commercial transactions." Prices for shared oil would therefore most likely reflect prices prevailing on the spot oil market—most oil today is traded either on a cargo-by-cargo basis (i.e., the spot market) or on the basis of long-term contracts with spot-related pricing provisions.[12]

Throughout the 1980s, pricing and allocation issues related to the oil-sharing plan have continued to generate discussion among oil experts. With regard to pricing problems, some doubts remain as to how much benefit the oil-sharing plan offers relative to that of the existing spot market at the outset of an oil crisis. For example, if IEA oil is transferred at market prices, the question arises as to how the oil-sharing system will alter the allocation of supplies from that achieved by the spot market, and therefore, how much the system will benefit members of the IEA. Another potential problem involves price disputes that could arise oil is actually to be allocated among IEA members. Although it is entirely possible that most oil will be allocated by the system without price disputes, the IEA Dispute Settlement Centre exists to address such problems. However, its effectiveness is uncertain because it has never been tested in a crisis.

Some Aspects of Government Authority Are Unclear

U.S. presidential authorities and federal response measures may require additional strengthening to avoid developments that could jeopardize an effective U.S. response to an oil crisis. As we reported in 1983, the executive branch must rely on a "legislative mosaic of discretionary statutory authorities, many of which are not specifically targeted to cope

[11]The IEA sharing plan can be triggered when a member or group has or is expected to experience a shortfall of 7 percent or more in oil supplies.

[12]Not a market where oil is physically delivered or picked up, the spot market refers to all oil priced on the day it is transacted. Since the price is not prearranged, as in most term contracts, traders at various locations worldwide can charge whatever price the current supply and demand conditions warrant.

with oil crises."[13] Consequently, implementation problems and administrative difficulties could develop because, among other reasons, (1) statutory authorities triggered by national security concerns are not necessarily available in all situations involving imported oil shortages and (2) litigation could arise regarding congressional, state/local government, and private sector roles in a crisis.

In addition to these problems, some important authorities have already expired or are scheduled to expire over the next few years. Most federal statutes authorizing mandatory demand restraints on petroleum use terminated with the expiration of the Emergency Energy Conservation Act of 1979 (July 1, 1983) and a section of the Energy Policy Conservation Act of 1975 (EPCA) (June 30, 1985). Other authorities scheduled to expire unless extended include sections of EPCA relating to U.S. participation in the International Energy Program (June 30, 1990) and maintenance of the SPR (June 30, 1989); the Defense Production Act, which activates important domestic emergency responses (Sept. 30, 1989); and the Export Administration Act of 1979, which prohibits the export of most Alaskan crude oil and also allows the President to prohibit the export of refined petroleum (Sept. 30, 1989).

Some IEA members have also faced problems involving their authority to respond effectively to oil disruptions. Specifically, some IEA governments anticipate difficulty in persuading private companies to draw down their emergency stocks—companies may choose to build up their supplies in a crisis to hold out for future price increases. However, more recent information from the IEA indicates that most countries have the authority to order the draw down of oil stocks. Notwithstanding these authorities, the potential for litigation similar to that involving U.S. companies may affect the use of these stocks.

DOE's Energy Emergency Procedures May Require Additional Clarification

Although DOE may have strengthened its responsiveness to energy disruptions by developing the Energy Emergency Management System (EEMS) and other programs, additional clarification and/or improvements may be necessary. For example, a 1987 draft of the DOE Energy Emergency Operations Manual provides no additional clarification of

[13] Analysis of Department of Justice Memorandum Concerning President's Statutory Authorities in Oil Crises (GAO/OGC-83-6, Mar. 4, 1983).

preplanned response options that DOE had outlined in a 1982 report.[14] In a 1983 review,[15] we had found those options to be characterized by insufficient detail and vague procedures for implementation. In addition, a DOE official told us in January 1988 that EEMS was still under development and documentation describing the system was still in draft form—shortcomings that we had also observed about the system's predecessor, the Emergency Response Management System, in 1983. Finally, we believe that DOE may not be presently considering economic policies—including income tax adjustments, federal block grants, the Low Income Home Energy Assistance Program, the Earned Income Tax Credit, and various monetary policies—that could offset, to varying degrees, some of the effects of an oil supply disruption, particularly for certain disadvantaged groups.[16] In view of these issues, questions remain as to whether (1) DOE's system for responding to energy emergencies is essentially in place or in need of modification and (2) whether the United States is sufficiently prepared to cope with potentially serious economic dislocations brought about by severe disruptions.

Effects of the Oil Futures Market on Oil Prices During a Disruption Are Uncertain

Since the oil futures market was in its infancy during the last oil crisis, it is unknown how this market will affect oil prices during a crisis. However, the futures market should make information about oil prices more available; and thus, at least in theory, these prices should more accurately reflect current and expected future supply and demand conditions.

Oil Futures Trading Has Increased Dramatically

Trading in energy futures began in 1978, with heating oil futures contracts offered on the New York Mercantile Exchange (NYMEX). Trading in leaded gasoline futures followed in 1981, but these contracts have now been phased out. In 1983 crude oil futures trading was added. Because of the success of these energy contracts, the NYMEX also introduced trading in unleaded gasoline in 1984 and propane futures in 1987. In terms of volume, energy futures contracts and energy options in 1987

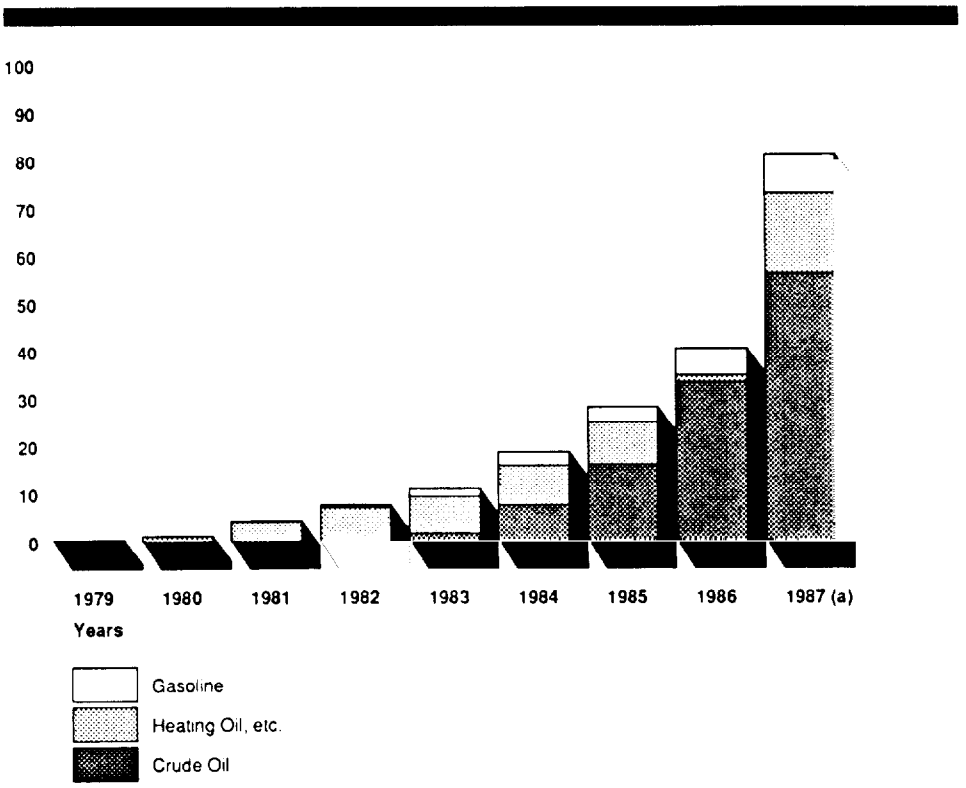
[14]Comprehensive Energy Emergency Response Procedures was prepared by DOE and released by the Office of the President on December 31, 1982, in compliance with the Energy Emergency Preparedness Act of 1982.

[15]Analysis of the Comprehensive Energy Emergency Response Procedures Report (GAO/RCED-83-106, Feb. 17, 1983).

[16]Benefits and Limitations of Economic Policy Responses to an Oil Supply Disruption (GAO/RCED-85-151, Aug. 8, 1985).

accounted for 94 percent of all contracts traded on the NYMEX, increasing the average daily volume, as shown in figure 4.3, from its inception in 1978 to almost 81 million barrels per day in 1987. Trading in crude oil futures accounted for nearly 56 million barrels per day of this total. While these volumes seem high when compared with worldwide production of about 55 million barrels per day, less than 1 percent of the contracts actually resulted in the delivery of oil or products—which is typical of commodity futures markets in general.

Figure 4.3: Growth in Energy Futures Trading, 1979-1987



(a) Average Daily Volumes as of 12/14/87, including propane volumes of .2 mmbd

Source: New York Mercantile Exchange

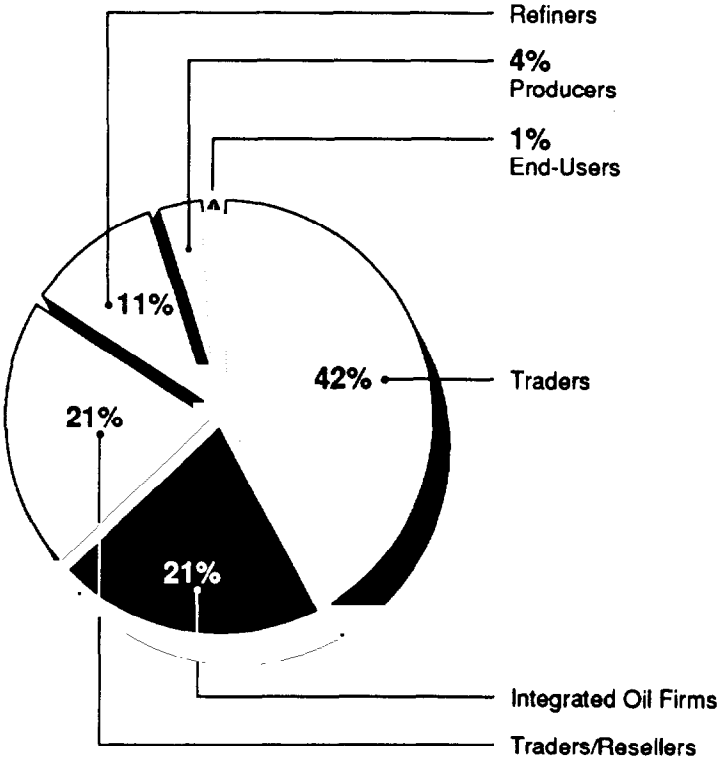
Traders Comprise a Large Share of Futures Market

As shown in figure 4.4, traders were responsible for about 42 percent of the transactions on the NYMEX energy futures market in 1987, representing the largest group of participants in the market. These firms primarily engage in oil futures or options trading in order to make short-term

profit on price fluctuation. Traders, in general, assume significantly more price risk than other market participants because of these short-term transactions.

Most other participants in the futures market, such as integrated oil companies or refiners, can use the market to reduce their risks of holding inventory or purchasing oil on the spot market with its fluctuating prices. Integrated oil companies comprise about 21 percent of the market as do "traders/resellers" (i.e., firms that trade oil as well as market and distribute oil like wholesalers). The remainder of the 1987 energy futures market included refiners, producers, and end users.

Figure 4.4: Participants in the Energy Futures Market for the First Half of 1987
(Percent)



Source: New York Mercantile Exchange

The Market Should Improve Information but No Consensus Exists About Its Possible Impacts

An important contribution of the futures market is to make information about oil prices more readily available to participants around the world. Because the market involves a large number of participants and a significant volume of trade, it provides a barometer of the prevailing and expected future conditions of supply and demand to participants that purchase oil supplies. Thus, many spot market participants consult the futures market price before setting their price.

Opinions varied on the effects of the futures market in the event of an oil supply disruption. In theory, futures markets should improve information flows and thus enable spot and future prices together to more accurately reflect information about current, and expected future, supply and demand conditions. Although there are different views about potential positive as well as negative effects of the oil futures market, the influence of such a market during a disruption is largely unknown. For example, the futures market may help the spot price more accurately reflect expectations about future supply and demand conditions. However, in the case of a disruption, it is unclear whether the existence of a futures market would make spot prices higher or lower than they would be without the futures market. Nonetheless, because the oil futures market allows large quantities of oil to be traded in short periods of time, improved understanding of the implications of this market during a supply disruption is important.

Issues in Formulating a Long-Term U.S. Energy Policy to Reduce Oil Vulnerability

As previously indicated, although oil supply disruptions can cause economic havoc, U.S. vulnerability to such an occurrence is lower now than it has been in some time. The United States and other industrial countries are less dependent now on oil, particularly imported oil, than they were in the 1970s. These trends are due in part to higher oil prices that reduced oil consumption and stimulated additional sources of production. These additional sources of production also allowed the United States to import less oil from OPEC countries.

Additionally, barring a significant military confrontation in major oil-producing regions, the potential for another oil supply disruption, which would result in a shortfall of oil that could not be compensated for by the market, appears to have diminished. This reduced likelihood of a disruption is primarily due to readily available oil supplies and a significant amount of excess production capacity, which could increase supplies further.[1]

Further, if a disruption in oil supplies were to occur, the United States and other OECD countries are now better able to respond, principally because of the development of strategic oil stocks. These stocks—which if drawn down could add at least 3 million barrels per day of oil to worldwide supplies—could substantially increase available supplies if an oil disruption were to occur. Other developments—such as the continuing development of the IEA, modest fuel-switching capability, and emergency government authorities—have also improved the ability of the United States and other countries to respond.

The current reduced U.S. vulnerability to oil disruptions is illustrated by the three simplified oil disruption scenarios in table 5.1.

[1] Other reasons for this reduced likelihood are cited in ch. 3.

Table 5.1: Illustrations of Middle East Oil Supply Disruptions and Potential Offsetting Supplies

Oil Amounts in MMBD

Examples of supply disruptions	Amount of oil disrupted[a]
Persian Gulf closed	7.0
Saudi Arabia production lost	4.2
Iran/Iraq production lost	4.5
Potential replacements of supply	**Amount**
World Excess Production Capacity	8 to 10.0
In Persian Gulf	6 to 7.5
Outside Gulf	2 to 2.5
Fuel switching in the United States and Europe	.9
Moving oil through excess pipeline capacity in Saudi Arabia and/or Iraq	1.7
Strategic oil stocks at least	3.0

Note: These examples are not intended to indicate which scenarios are most likely but rather the impact of disruptions of different magnitudes in key locations. They do not include the potential increase in stock buildup that could occur as a result of a disruption, which would exacerbate the supply loss. Similarly, they do not include lower oil consumption that would be encouraged by higher prices or by demand restraint measures, which would tend to reduce the shortfall.

[a]These numbers are approximations.

In the short term, a potential disruption in the Persian Gulf region is perhaps the most significant because of the magnitude of the disruption—about 7 MMBD of production shipped by tanker—and because the majority of excess production capacity is located in this region. As table 5.1 indicates, if the entire Persian Gulf were closed to shipping, the amount of worldwide excess production capacity that could be made available is about 2 to 2.5 MMBD. By switching fuels and using available excess pipeline capacity, industrial countries could add perhaps another 2.6 MMBD, for a total reduction in the lost supply of about 4.6 to 5.1 MMBD. This leaves a shortfall of about 1.9 to 2.4 MMBD that would need to be covered by strategic oil stocks. Since SPR stocks alone have the current capability to be drawn down and distributed at about 3 MMBD over a 3-month period and then at a declining rate, the entire disruption could conceivably be offset for some time. Furthermore, European countries and Japan also have strategic stocks that, if they choose to use them, could reduce the effects of such a large supply disruption.

In the second and third scenarios, however, even if all production from Saudi Arabia, or all production from Iran and Iraq, were lost, excess production capacity can make the difference between having to invoke emergency response measures in the United States and other industrial countries or being able to rely on the market. An important ingredient in these potential situations, of course, is whether these oil-producing

countries are willing to use their excess capacity if a disruption occurs elsewhere. This might occur because, with lower oil prices over the past few years leading to lower revenues, OPEC countries might be motivated to raise revenues by increasing production whenever possible.

Current Trends Indicate Potential for Increased Vulnerability in the 1990s

While the United States appears to be less vulnerable to an oil supply disruption today than in the 1970s, expected developments could have an unfavorable impact in the decade to come. Two trends, increasing oil consumption and declining non-OPEC production, present the most immediate concerns.

Oil consumption in the United States and other OECD countries is expected to increase, particularly in the transportation sector. As noted earlier two-thirds of all oil consumed in the United States is for transportation, and this sector has virtually no fuel switching capability. Other OECD countries also use a considerable portion of their oil for transportation purposes. If oil consumption continues to increase with few alternative sources, dependency by the United States and other industrialized countries will also increase.

Secondly, non-OPEC oil production will probably remain level or begin to decline in the 1990s. U.S. production, the largest single free world source of non-OPEC oil production, is already declining and is expected to continue to decline. Production in other countries is expected to remain essentially level or perhaps begin to decline in the 1990s. This eventual decline in total non-OPEC oil production will help set the stage for OPEC countries to increase market share, particularly if oil consumption is also rising. This is of particular concern because known oil reserves are heavily concentrated in these countries.

Possible Return to Western Hemisphere Sources in the Next Century

Although one must recognize the extremely tenuous nature of looking beyond the 1990s, the energy situation may look somewhat better in the next century—that is, more diversified energy sources may become available outside the Middle East. While potentially unfavorable trends could present problems in the 1990s, vast supplies of undeveloped energy resources exist in the United States and other Western Hemisphere nations—such as Canada, Mexico, and Venezuela—that could be tapped under the proper circumstances (i.e., higher prices and improved technology).

These energy sources include the following:

- United States: Heavy oil in the West; natural gas in formations that are not yet economical; oil shale; coal, either to be used directly or indirectly as a feedstock for more convenient fuels, (e.g., coal liquids, synthetic gas, or methanol); uranium; and others;
- Canada: Tar sands, abundant natural gas resources, and uranium;
- Mexico: Substantial oil and gas resources; and
- Venezuela: Huge deposits of heavy oil.

In addition, energy sources could include renewable fuels, such as solar energy and biomass, whose potential as viable fuel sources increase each year.

Generally, the two most important circumstances for the development of such resources are the right combination of technology, including technology for protecting the environment, and price. Currently, it is more expensive to produce these alternative sources of energy than to produce conventional oil. The present abundance of conventional oil further reduces their market potential. While the longer-term outlook may be somewhat more optimistic, substantial lead times are needed in order to bring new energy sources such as these to the marketplace.

The Policy Dilemma

If the governments of consuming countries were convinced that an energy supply problem was emerging, it is likely that they would take decisive action to prevent it. Given the complexity of the issues, however, a clear understanding of the nature of the threat is extremely difficult to achieve.

First, action by industrial countries to change current energy trends means trading off important, competing interests, such as encouraging the growth of national economies; protecting the environment; reducing federal budget deficits; and maintaining stable and friendly relations with other countries while furthering somewhat different national energy goals. Second, in the past, forecasts have often proved inaccurate and in some cases alarmist. In the 1970s, for example, many oil experts were nearly certain that oil prices would continue to increase to $50 or more per barrel by the mid-1980s. But these expectations were dramatically revised when prices tumbled to under $10 per barrel in 1986. Third, certain developments could change current projections. These include

- major oil discoveries elsewhere, such as in the North Sea, Alaska, China, offshore United States, Latin America, and Africa;

- lower worldwide oil consumption, which could be brought about either by higher prices, lower economic growth, or the development of alterna tive fuels or technologies at a quicker pace than is presently envisioned and
- higher or more sustained production from currently known sources, which could be brought about by either higher prices, improved techno ogy, or unanticipated additions to reserves.

The crux of the matter is that such possibilities are speculative. So mar factors go into determining economic growth or the development of improved technology alone that predicting their impact is almost impossible.

In essence, the dilemma facing the United States and other industrial governments is that although current trends point to an emerging energy problem, with possibly severe consequences, significant uncertainty exists in the forecasts, and the "costs" of corrective action—in trade-offs and dollars—are considerable. Many options are available tc the United States to reduce its vulnerability, such as providing tax advantages to industry, reducing or eliminating unnecessary regulations, and providing subsidies for the development of certain fuel sources. The problem lies in agreeing on the nature and degree of the threats to energy supplies and on the commitment necessary to tackle the issue. Despite these costs and uncertainties, however, it may not be prudent to wait for more information because many options available t industrial governments would require years before their effects could b felt.

Where to Focus Attention

In light of this report's analysis, we believe actions in four areas will provide significant leverage for reducing both U.S. dependence on oil and its vulnerability to potential oil supply disruptions.

1. Emphasize energy efficiency, particularly in the transportation secto

The U.S. transportation sector, which now accounts for nearly two-thirds of all oil used in the United States, is the only sector of the economy that has continued to increase its consumption of oil over the last 10 years. Furthermore, transportation is the only sector that is almost totally dependent on oil—about 97 percent. Because of these factors, it makes sense to encourage the development of alternative fuels and the more efficient use of energy in the transportation sector.

We believe the federal government has four key policy instruments with which to reduce the use of oil for transportation: (1) fuel efficiency standards, (2) gasoline taxes, (3) government-supported research and development for alternative transportation fuels and vehicles, and (4) government regulations concerning the use of vehicles or fuels. Whatever choices the government makes, it has significant leverage in the transportation sector to reduce U.S. dependence on oil.

While action in the transportation sector could go a long way toward reducing U.S. oil dependence, improvements in energy efficiency in other sectors should also be encouraged. Although the United States and other major industrial countries have significantly improved their energy efficiency (by about 20 percent on the average) since the 1970s, recent decreases in oil prices threaten to slow down or reverse this trend. By continuing to encourage the application of energy-efficient technologies where possible and cost-effective, this nation can further reduce its dependency on oil.

2. Continue to build stocks and resolve early response disputes

A major reason for reduced U.S. vulnerability is that the United States and other industrial countries have developed emergency oil stocks for use in times of shortage. Certainly one of the most direct ways to continue to reduce our vulnerability to an oil disruption is to continue developing surge capacity that can quickly replace disrupted oil supplies. The United States should therefore continue to develop its Strategic Petroleum Reserve as quickly as fiscally responsible. Furthermore, it should continue to encourage other countries to do the same.

Stockpiling oil is not enough, however. We need to clarify agreements with other industrial nations about when to use these stocks. Some disagreement exists among members of the IEA regarding the appropriateness of various response measures for use in a serious oil disruption. In addition to relying on the market, the U.S. policy is that strategic stocks should be used as a first line of defense. However, many other IEA nations have expressed an intention to institute demand restraints, such as restrictions on driving or on building temperatures, during a disruption before using their strategic oil stocks. If, as an early response to an oil supply emergency, the United States used its strategic reserves and other countries did not, other countries would be getting, in the view of many, a "free ride" at U.S. expense. Concern about this possibility might be strong enough for the United States to delay the early use of the SPR, causing additional uncertainty that could exacerbate already increasing

prices. Industrial countries should come to terms with their different viewpoints. The more agreement there is on "early response" before a disruption takes place, the better.

A related point is the potential implications of the oil futures market or the U.S. ability to respond to a crisis. In the case of a disruption, it is unclear whether the existence of the oil futures market would make spot prices higher or lower than they would be without this market. Moreover, because the oil futures market provides for the rapid trading of large volumes of oil, its potential behavior during a disruption needs to be studied more closely.

3. Develop other response measures in addition to SPR

Although current U.S. policy almost exclusively focuses on drawing down the SPR in an oil emergency, companion programs could supplement, or back up, the effectiveness of the SPR and help reduce vulnerability. Companion programs could include, for example, demand restraints—such as emergency driving restrictions—to reduce consumption, and changes in fiscal policy—such as low-income energy assistance programs—to mitigate the effects of a disruption. Even if the United States hopes never to use these measures, those that can be shown to be effective should be tested and readied for implementation. The consequences of a significant or sustained oil shortage in the future are too great to concentrate all of our energy response efforts on one mechanism. Furthermore, if the SPR does not operate as planned, measures to reduce consumption may help fill the void until problems are resolved.

As the oil shocks of the 1970s illustrated, energy security is not simply the business of the federal government. Over the past decade many state energy officials have expressed concern over limitations in federal energy contingency planning and their potential impact on state energy emergency plans. This underscores the importance of federal-state coordination in front-end planning for energy emergencies. By providing states with accurate information on which to base decisions before, during, and after an emergency, the federal government can improve the nation's ability to mitigate the harmful effects of a supply disruption. By maintaining open lines of communication with the federal government, the states in turn can play a significant role in formulating a truly national consensus on U.S. energy policy, including emergency response measures.

4. Maintain a stable economic and regulatory atmosphere

Rapid price movements (upwards in the 1970s and downwards in 1986) contributed to severe economic dislocation in the United States and elsewhere. It is generally believed in fact that these movements are disruptive to the interests of consumers and producers alike. In contrast, more gradual and predictable price movement would permit both producers and consumers to plan more efficiently.

Discussion and studies in recent years have sought ways to protect against disruptive price movements without imposing heavy-handed government intrusion that would stifle the spirit of the marketplace. Some advocate legislation of a price floor on imported oil to serve as a "safety net" for energy investment. Such a policy would protect U.S. investors in oil and alternative energy projects from sudden, and perhaps politically motivated, price reductions. Others favor using the SPR to avert rapid price increases even when a disruption is not imminent. In this sense the SPR would act as a preventive measure as opposed to a cure, with the government attempting to prevent extreme oil price movements in much the same way a central bank would act if the federal money supply were uneven.

It is beyond the scope of this report to discuss either the merits or shortcomings of these proposals. However, we believe that such discussion among federal officials and private sector representatives may ultimately improve the environment for investments in U.S. energy projects. Given the long lead times required to develop resources for many energy projects, fundamentally stable government policies and regulations should be encouraged. This stability is of critical concern to U.S. energy investors engaged in either domestic or multinational enterprises.

Finally, as this report has discussed, a relatively small number of countries may control a significant portion of U.S. energy supplies well into the next century. An important role of government is to work through diplomatic and other means to maintain an environment that is conducive to investments in energy projects worldwide and to the free flow of international energy supplies.

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