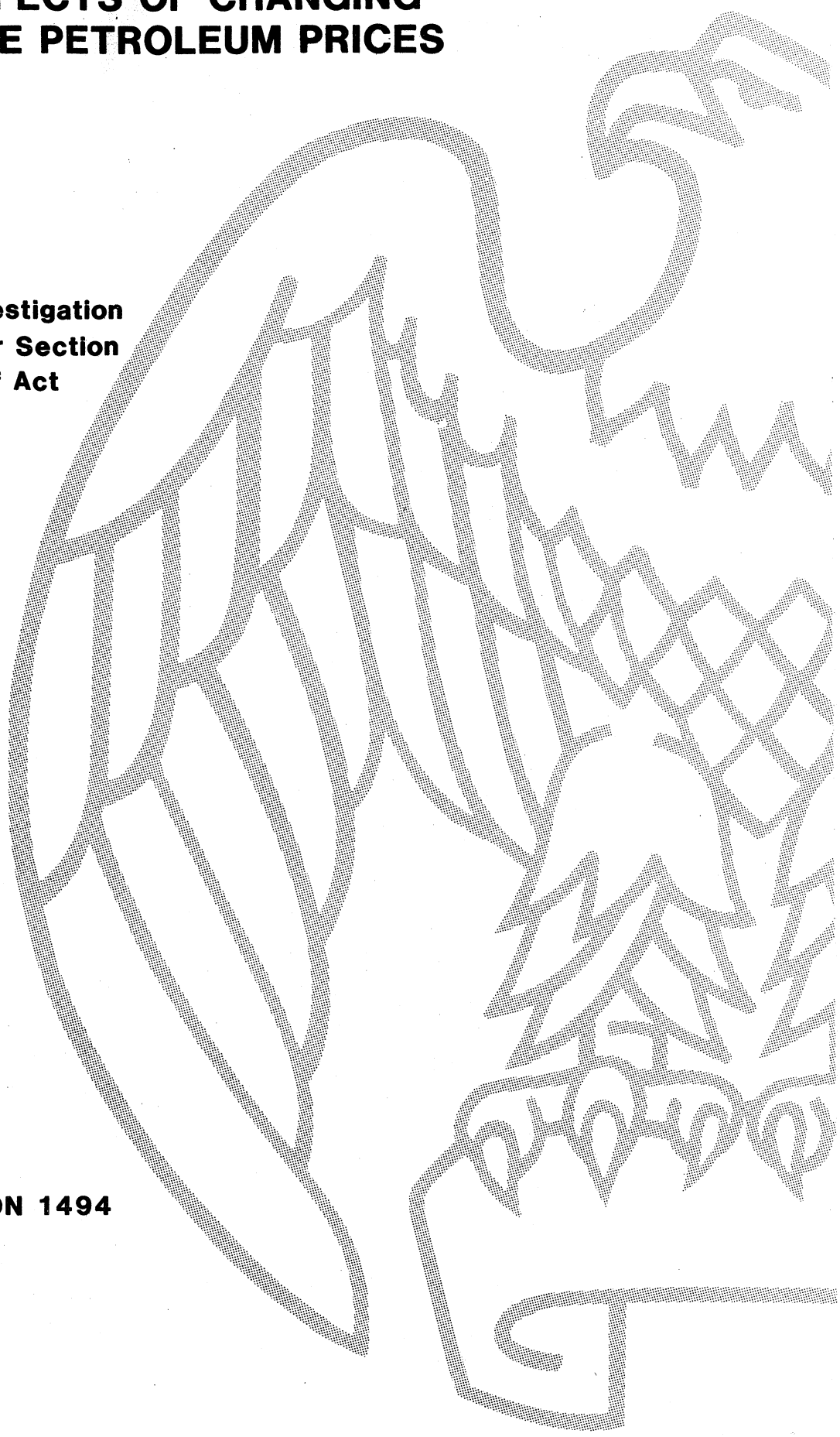
POSSIBLE EFFECTS OF CHANGING WORLD CRUDE PETROLEUM PRICES



Final Report on Investigation No. 332-161 Under Section 332(b) of the Tariff Act of 1930

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PREFACE

On April 22, 1983, the United States International Trade Commission, in accordance with the provisions of section 332(b) of the Tariff Act of 1930 (19 U.S.C. 1332(b)), instituted investigation No. 332-161 on its own motion for the purpose of assessing the future supply and prices of crude petroleum, and the possible effects of changing crude petroleum prices on such areas as U.S. trade, the petroleum industry, the petrochemical industry, and other energy-intensive industries. Notice of the investigation was published in the April 27, 1983, issue of the Federal Register (48 F.R. 19087). Information for this report was obtained from Commission fieldwork, industry submissions and publications, the Commission files, other Government agencies, and other sources.

This report assembles and presents in a readily usable form information and data from many diverse sources on certain possible effects of changing world crude petroleum prices on the United States. Because of the ubiquitous nature of petroleum, the report explicitly covers the effects that have a broad general application.

Prior to the Arab petroleum embargo in 1973-74, which resulted in dramatic price increases, world crude petroleum prices were relatively stable, particularly in relation to their subsequent movements. In 1973, the OPEC average crude petroleum official sales price was $3.39 per barrel. This price increased to $11.29 per barrel in 1974, remained relatively stable and averaged $12.03 per barrel in 1978, and, thereafter, increased to $18.67 per barrel in 1979, to $30.87 per barrel in 1980, and to $34.50 per barrel in 1981, before it decreased to $33.56 per barrel in 1982. The official selling price for OPEC marker crude petroleum was lowered to $29 per barrel from $34 per barrel early in 1983.

The effects of these price changes are still being felt in most of the world's nations, including the United States. Conservation, alternate energy source usage, the decoupling of the rate of GNP growth and the rate of energy use growth, and changes in international indebtedness and trade flows, are but a few of these effects.

In 1900, the United States and the U.S.S.R. produced more than 90 percent of the world's crude petroleum. The United States was a major exporter of crude petroleum and petroleum products. However, it was not until the late 1920's that U.S. companies secured interest in the first significant overseas potential crude petroleum resources. Developments in the world petroleum industry were curtailed with the beginning of World War II in 1938, during which the United States was the major source of Allied petroleum supplies.

From 1949 to 1971, energy consumption more than tripled, and this growth was accompanied by a shift in energy sources from coal to petroleum and natural gas. Many of the world's nations developed energy-intensive industries; other nations, particularly in the Middle East, became major world supply sources for crude petroleum. Over one-half of all waterborne international trade was accounted for by movements of crude petroleum and petroleum products.

As the world's crude petroleum resources were developed and huge fields discovered in certain nations, a world crude petroleum production capacity surplus developed. This development was the prime factor causing the emergence of supranational organizations, including the Organization of Petroleum Exporting Countries (OPEC) 1/ in 1960 and the Organization of Arab Petroleum Exporting Countries (OAPEC) 2/ in 1968. OPEC and OAPEC have been highly visible during the crude petroleum price changes that have occurred since 1972.

Some nations, including most of those in OPEC and OAPEC, have relatively large crude petroleum and natural gas reserves. In addition, most of these nations also have low production costs. It is primarily the combination of these two factors that have supported the competitiveness of these nations in the world's energy market. It is also the base upon which some of these nations are developing national petrochemical industries, and may develop other energy-intensive industries. 3/

The economic value of certain nations' energy reserves, particularly crude petroleum reserves, has allowed these nations to market their raw materials and refined products at a higher price than would be warranted by the cost of production. The largest share of the selling price is often an economic rent. The effects of future drastic, and possibly discretionary, price changes could alter the various scenario bases presented in this report. In reviewing this report, the volatility of world crude petroleum prices should be remembered.

This report presents the findings of the Commission investigation. It includes analyses of world crude petroleum supply and demand, factors that influence crude petroleum prices, U.S. trade, the U.S. petroleum industry, other energy-intensive industries, and certain other economic sectors. The report discusses possible implications of future world crude petroleum price changes on U.S. trade by utilizing several econometric models; the quantification of possible future impact on U.S. industry production and employment using the U.S. Department of Labor's input-output model of the U.S. economy.

The focus of this investigation is largely to analyze the possible impact of crude petroleum price changes. None of the scenarios presented are forecasts, but rather are the end results of the interaction of certain sets of assumptions. This study utilizes a number of recognized econometric models to insure adequate interaction of the many assumptions. The differences between the projected scenarios resulting from spinning the various models illustrates the effect of different assumptions. All of the model analyses presented are in constant dollars.

1/ The members of OPEC are: Algeria, Ecuador, Gabon, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, the United Emirates, and Venezuela.

2/ The members of OAPEC are: Algeria, Bahrain, Egypt, Iraq, Kuwait, Libya, Qatar, Saudi Arabia, Syria, and the United Arab Emirates.

3/ U.S. International Trade Commission, The Probable Impact on the U.S. Petrochemical Industry of the Expanding Petrochemical Industries in the Conventional-Energy-Rich Nations, U.S.I.T.C. Publication 1370, April 1983.

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EXECUTIVE SUMMARY

At any given time and at any given price point, the price of crude petroleum is reflected in almost all sectors of the U.S. economy. This occurs because the U.S. economy, like all industrialized economies, is heavily dependent upon energy, and the price of crude petroleum influences the prices of all energy materials. Accordingly, crude petroleum price changes cause a rippling effect throughout the economy. The degree of influence appears to be directly related to both the magnitude of the price change and the period of time during which the price change occurs. The greater the magnitude of the price change and the shorter the time period during which it occurs, the greater the impact on the economy. Regardless of whether the price change is a decrease or increase, the economy will react positively and negatively. Thus there is no completely benign crude petroleum price change.

The following highlights are the major findings of the Commissions' investigation:

- o The world price of crude petroleum depends upon the interaction of many economic variables, some of which are functions of the market, and others may be at least partly arbitrary.

The world price for crude petroleum essentially reflects the OPEC price, which is, in part, a discretionary price that includes a significant economic rent. This price reflects the market forces as well as the return revenues sufficient to satisfy the need of the crude-petroleum-producing nations. It is also a price at, or below which, commercial quantities of alternate energy materials have historically been unavailable for economic reasons.

The actual cost to produce each barrel of crude petroleum differs for each barrel between fields, wells, and even over time. However, on the average, the production cost of Persian Gulf crude petroleum ranged from two to eight times less than U.S. crude petroleum production cost in 1982.

The production costs of additional crude petroleum from known or newly developed sources range from approximately $5 per barrel to more than $20 per barrel. The lower cost crude petroleum would most likely be found in the Middle East, Mexico, and certain nations of South America. The higher cost crude petroleum would be obtained from the Arctic regions, deep offshore wells, by means of enhanced oil recovery techniques, and from unconventional sources, including very heavy petroleum-tar deposits and tar sands.

- o U.S. crude petroleum and petroleum products trade is restricted in an effort to reduce dependence on foreign supplies.

U.S. imports of crude petroleum and petroleum products accounted for a low of 31 percent to a high of 44 percent of domestic consumption during the period 1978-82. In order to reduce this dependence on foreign sources of supply, imports of crude petroleum and petroleum products are subject to license

requirements; however, the fees formerly attached to the license were suspended on April 7, 1979.

U.S. exports of crude petroleum are prohibited, except as approved by the Federal Government; however, a limited amount is exchanged on a barrel-for-barrel basis with Canada. There is legislation currently pending in Congress which would allow for the exportation of Alaskan North Slope crude petroleum to Japan. As there is currently no petroleum pipeline system operating from the west coast unloading facilities to the east coast, Alaskan production is shipped by tanker to handling facilities along the U.S. gulf coast by way of the Panama Canal. Restrictions on all U.S. exports of petroleum products were lifted in January 1981.

- o Future crude petroleum price forecasts vary greatly depending upon the design of the model and the interrelationships related to basic economic concepts.

Most models and econometric analyses which utilize parameters related to smooth projections of economic growth and do not recognize possible instant occurrences such as supply disruptions result in smooth crude petroleum price projections. A recent U.S. Government agency projection is summarized in the following tabulation (in 1982 dollars per barrel): 1/

	Value
1982 (actual)---------	$33.50
1990----------	31.00-33.00
1995----------	45.00-48.00
2000----------	56.00-59.00
2010----------	81.00-86.00

The values shown in the previous tabulation could be assumed to be actual prices if the inflation rate throughout the period shown was effectively zero.

- o Crude petroleum prices can change rapidly if some discretionary action is taken or event occurs which disrupts the normal supply. Such actions or events can include embargoes such as occurred during the Arab-Israeli War in 1973-74 or cutbacks in production as occurred during the Iranian Revolution in 1979-80.

The price changes feared by most of the world's nations are those of a large magnitude occurring within a short period of time. The following tabulation shows two hypothetical supply disruptions at two given dates and the resultant crude petroleum prices: 2/

1/ U.S. Department of Energy, Energy Projections to the Year 2010, October 1983.

2/ Data obtained from the U.S. Congressional Research Service.

Item	Apr. 1, 1980	Jan. 1, 1982
Resultant size of disruption in million barrels	7.1 to 7.7	5.0 to 5.3
Resultant crude petroleum prices per barrel	$90 to $300	$65 to $130

o U.S. Federal Government revenues are affected by both increases and decreases in crude petroleum.

It is estimated that each dollar per barrel rise in crude petroleum prices results in a net decrease of about $1 billion in tax revenues, due largely to increased industry operating costs, and corresponding declines in taxable corporate profits. While the U.S. economy benefits from, and overall tax revenues are enhanced by reduced crude petroleum prices, such price reductions reduce Government excise tax revenues. 1/ Taxes on crude petroleum, and petroleum products and operations at the Federal level raises significant revenues. The following tabulation lists the five Federal excise taxes directly imposed on petroleum and gives estimates of 1983 revenues which have remained relatively constant compared with previous years (in billions of dollars):

	Value
Windfall Profits Tax	$21.3
Gasoline Manufacturers Tax	4.0
Diesel, Special Motor Fuels Tax	0.6
Heavy Motor Vehicles Tax	0.3
Lubricating Oils Tax	0.1
Total	26.3

Revenues from five other closely related Federal excise taxes are estimated for 1983 to be more than $4 billion.

A significant decrease in crude petroleum prices may require tax changes in order to maintain or increase revenues, or protect conservation gains. Possible tax changes to accomplish these ends studied by various U.S. departments include: a Btu tax, which would be a tax on the heat content of a fuel; an ad valorem tax, which would be an excise tax on the value of the fuel; an import fee on crude petroleum and/or petroleum products; a tax on petroleum consumption; a tax on gasoline; and a Federal severance tax.

1/ Thomas W. Lippman, "Feldstein Says Decline in Price of Crude Oil Could Alter Energy Tax," Washington Post, Feb. 28, 1983, p. A2.

o State and local governments depend in part on taxes which impact the petroleum industry and in turn are affected

State and local governments impose a variety of taxes on firms operating in the crude petroleum and petroleum products sectors, as well as on consumption of such products. While most of these taxes are applicable to all industries and products, some, like the gasoline tax and severance tax, relate wholly or primarily to the petroleum industry and are important sources of revenue.

Severance taxes are taxes imposed on the removal of natural products, such as petroleum and natural gas, from land or water, and are based on the value or quantity of products removed or sold. As many as 25 States have considered, or are considering, some type of increase in the severance taxes on crude petroleum and natural gas. The following tabulation shows the percentage of certain State's tax revenues accounted for by severance tax revenues in 1981 (in percent):

	Revenue
Alaska	50
Louisiana	29
Wyoming	29
Texas	27
New Mexico	27
Oklahoma	27
North Dakota	23
Montana	21

State gasoline and diesel fuel taxes range between 5 and 12 cents per gallon and, with but two exceptions, are specific rates rather than percentages.

o Revenue requirements have prompted some States to initiate new taxes such as the unitary tax.

A unitary tax is a tax on the worldwide profit of multinational companies. A unitary tax is now being used by eleven States to raise revenues from industries, including the petroleum industry, which is a major profit-generating industry. In June 1983, the legality of this tax was upheld by the U.S. Supreme Court. A special Commission will investigate unitary taxes and make suggestions that respect states' rights and promote international trade.

o The expanding and potential market in petroleum futures is the direct result of recent price and supply instability. Although it could take several years for the international petroleum companies to assume a major role, trading in petroleum futures could become increasingly important.

Commodity-future contracts are standard agreements in that each contain quality, quantity, price, place, and date of delivery data. Both the buyer and the seller in the futures markets seek market positions that will better enable each to plan future operations. For the buyer, this ability to plan is increased by being assured of a future supply at a certain price; for the seller, this ability to plan is increased by being assured of a future market at a certain price.

At least five commodity exchanges have traded, are trading, or are expected to trade energy contracts including crude petroleum and petroleum products such as distillate and residual fuel oils, leaded and unleaded gasolines, gas oil, and liquefied propane. It is expected that natural gas will also be so traded by the beginning of 1985.

As of October 19, 1983, a total of 12,475 contracts each representing 1,000 barrels of crude petroleum remained open. 1/ There have been an average of 1,500 trades per day since 1981; the volume of trading is determined by the volatility of the crude petroleum market.

- o Crude petroleum price increases or decreases affect the production of crude petroleum.

The crude petroleum and natural gas sector may be positively stimulated by a price increase--drilling will increase, and production and reserves may increase. However, if the price increase is large, overstimulation of the drilling industry can result in a shortage of drill rigs, and lead both to a disruption in exploration and development efforts and to higher costs. Additionally, as the price of crude petroleum increases, the market for crude petroleum decreases and other energy sources become increasingly economically viable, thereby further decreasing the market for crude petroleum.

The crude petroleum and natural gas sector experiences a decrease in drilling, exploration, and development when prices decrease, but still must produce additional crude petroleum to satisfy an increasing demand stimulated by the lower prices. Alternatively, imports would increase, bringing with it all of the positive, as well as the negative, implications associated with increasing reliance on offshore supplies.

- o Some industries use petroleum both as a feedstock and as an energy source, and thus are particularly sensitive to crude petroleum price changes.

The petroleum refining and petrochemical sectors both use crude petroleum for energy and as a feedstock, and therefore tend to prosper with lower crude petroleum prices. However, to the extent that other nations' industries have still lower costs, U.S. export markets and even the U.S. market itself may become attractive to these nations. Low and high prices for energy and

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1/ Data obtained from the New York Mercantile Exchange.

feedstocks are often only meaningful in so far as they relate to prices in other nations, particularly when international trade and markets are concerned.

- o Other energy-intensive industries are usually affected by crude petroleum price changes in direct proportion to their energy intensiveness; the more important energy is to the industry, the greater will be the effect of price changes on the industry.

Other energy-intensive sectors experience many of the plusses and minusses that affect the previously discussed sectors as they relate to crude petroleum price changes. Some of the more sensitive industries (excluding petrochemicals and petroleum refining) are given in the following tabulation, in terms of the cost of petroleum and natural gas, as a share of the cost of all production materials (in percent):

Industry	Share of cost
Hydraulic cement	55
Noncellulosic organic fibers	54
Inorganic chemicals	25-40
Primary aluminum	26
Paperboard mills	24
Glass containers	24
Paper mills	18

- o Many of the economic difficulties in the world today are at least partially attributable to increases in crude petroleum prices during the last 10 years. These difficulties have impacted many of the world's financial institutions.

Industries and institutions associated with the financial services sector are sensitive to changes in crude petroleum prices. Affected are private banks, national banks, and other organizations, such as the International Monetary Fund. Because of the large volumes of capital involved with crude petroleum, difficulties in the financial services sector, even in one nation, can challenge the world financial system and the U.S. banking system.

Any crude petroleum price change can be viewed as moving money from one nation to another. In the case of a price increase the money flows from consuming to producing nation, whereas for a price decrease the opposite occurs. Too large a flow of money in any direction can disturb the stability of the world's banks.

Although crude petroleum price increases result in windfalls for producing nations, difficulties are also experienced because of a decrease in expected revenue. Also, petroleum-importing nations could benefit under this scenario as well as experience deficit difficulties.

o Net trade for the entire U.S. economy is projected to decrease with increasing crude petroleum prices. However, not all economic sectors are equally or adversely impacted.

The greatest expected net trade change with an increase in the price of crude petroleum occurs in the crude petroleum and natural gas sector. The petroleum refining and related products sectors also experience a net trade decline as the price of crude petroleum increases. The chemicals and allied products sector appears relatively unaffected by gradual price changes but are more likely impacted by a price shock. Some other sectors, such as those involving various mining ores, wood products, and certain textiles, may actually experience net trade increases as crude petroleum prices increase. The following tabulation shows the projected relationship between crude petroleum prices and net trade for 1990 and 1995. As crude petroleum prices are projected to change by two different paths or scenarios, the difference in the net trade balance resulting from these scenarios also changes as shown in the following tabulation: 1/

Petroleum price difference	Net trade difference:		
	Crude petroleum and natural gas	Petroleum refining and related products	Chemicals and allied products
	billions of 1983 dollars		
Low to high price scenario:			
1990=$15	40	12	0.0
1995=$18	57	17	3
Low to price-shock scenario:			
1990=$64	91	26	6
1995=$38	132	135	28

o Higher crude petroleum prices adversely affect real GNP but decrease the net trade balance.

Higher crude petroleum prices could result in decreases in the real gross national product (GNP) while causing a more favorable net trade balance. The following tabulation indicates the relationships between GNP and net trade for the low- and high-price scenarios (in billions of nominal dollars): 2/

	GNP	Net trade balance
1990:		
Crude petroleum price:		
$26.00 per barrel	1,957	-48
$41.00 per barrel	1,936	-25
1995:		
Crude petroleum price:		
$37.00 per barrel	2,219	-30
$55.00 per barrel	2,172	-7

1/ Projections obtained from econometric models of Data Resources, Inc.
2/ Projections obtained from the econometric model of Hubbard-Fry.

- o The average annual world growth rates of both GNP and crude petroleum production decrease under the high-crude petroleum price scenario relative to the low-crude petroleum price scenario. However, the non-OPEC developing nations, which include many of the world's crude-petroleum-producing nations, such as Mexico, experience an increase in the average annual growth rates both for GNP and crude petroleum production under the high-crude petroleum price scenario relative to the low-crude petroleum price scenario.

Higher world crude petroleum prices result in lower growth rates for the GNP in most of the world's nations and for lower growth rates in the production of crude petroleum in the Organization for Economic Cooperation and Development (OECD) and OPEC nations. The non-OPEC developing countries (NODC) which produce petroleum, however, would enjoy increased rates of growth both in GNP and crude petroleum production under the high-price scenario relative to the low-price scenario.

The following tabulation contains the average annual growth rate data projected for 1990, under high- and low-crude-petroleum-price scenarios (in percent): 1/

Source	GNP		Crude petroleum product	
	Low	High	Low	High
OECD	3.14	2.98	-1.12	0.21
OPEC	7.12	7.07	5.51	2.42
NODC	5.12	5.51	3.44	4.76
World total	3.73	3.68	3.47	2.23

1/ Data obtained from the 3RT econometric model.

U.S. PETROLEUM INDUSTRY

The U.S. petroleum industry is affected by any change in the price of crude petroleum, whether it be an increase or a decrease. Although higher prices are generally perceived as unfavorable and lower prices advantageous, the opposite can also be true. Higher prices are a natural response to any market disruption in supply and usually provide incentives for conservation as well as exploration for new sources of crude petroleum.

Decreases in crude petroleum prices result in certain negative impacts on the petroleum industry and the economy. For example, a 19-percent decline in crude petroleum prices resulted in a nearly a 60-percent decline in the number of U.S. drilling rigs operating from 1981 to 1982. 1/ Drilling is sensitive to crude petroleum price changes because it is expensive to search for and develop new reserves in increasingly remote and climatically harsh locations when the wellhead price for crude petroleum is low. 2/

A sharp decline in crude petroleum prices results in a twofold effect on U.S. banks. Mexico, Nigeria, Indonesia, and Venezuela are major debtors and rely heavily upon revenues from crude petroleum to pay off loans as well as to underwrite their imports. 3/

The U.S. synfuels industry has also been adversely affected by the drop in crude petroleum prices. As a result of the realization that crude petroleum prices were not rising at the rate previously predicted, the viability and long-term benefits associated with the development of alternate energy sources dissipated.

Structure and Operation

After the embargo in late 1973, the petroleum industry was forced to make certain structural changes such as the closure of older, less energy-efficient refineries and the production of the higher valued, lighter refined products. The demand for the industry's output decreased as other manufacturing industries took steps to improve energy efficiency and conservation.

United States

Traditional U.S. access to inexpensive and abundant petroleum ended in 1973 with the Arab embargo as crude-petroleum-producing nations began to increase control of their resources and the market. In 1979, the U.S. industry was again affected by the Iranian Revolution and the resultant market disruption which resulted in a 160-percent increase in the world price of crude petroleum from December 1978 to December 1980. These disruptions in supply demonstrated the economic vulnerability of the U.S. petroleum industry to crude petroleum price increases.

1/ "Stronger Products Market Buoys Outlook for Refiners, Producers," Oil & Gas Journal, Apr. 25, 1983, p. 41.

2/ Ibid.

3/ "Sharp Drop in Oil Prices Would Be Mixed Blessings," Washington Post, Feb. 23, 1983, p. F-1.

The United States has relied almost totally on the major international petroleum companies and the private sector to supply its petroleum needs. In 1970, the seven major petroleum companies owned 61 percent of the non-Communist supplies of crude petroleum outside the United States and Canada. By 1979, their ownership had decreased to 25 percent, as the shares owned by the producing countries increased from 6 percent in 1970 to 55 percent in 1979. 1/ Government to government, or government to independent refiners sales replaced private industry transactions which had been dominated by the large petroleum companies.

At the time of the Arab embargo in late 1973, the OPEC nations had begun to increase their control of crude petroleum production and regulate the destinations of the crude petroleum; however, the major petroleum companies still controlled 80 percent of OPEC's crude petroleum. The OPEC producers essentially failed in their embargo effort because companies merely redirected petroleum to keep within OPEC's restrictions. 2/ As a result, the producing nations restructured contracts with the major companies which limited the companies' freedom to distribute crude petroleum. 3/

During 1974-78, the nationalization effort was essentially completed and in 1979, during the Iranian crisis, the OPEC nations assumed control of the establishment of commercial contracts with independent refiners and marketers which had previously been supplied by the major multinational companies. These companies were essentially supplied with only enough crude petroleum which could be processed in their own refineries, and they had overall access to less than one-half of OPEC's production. By 1980, the major companies' control over OPEC's production had decreased to 46 percent and to 44 percent in 1982, as shown in the following tabulation (in percent): 4/

Year	Control of OPEC petroleum by major companies
1970-72	89
1973	85
1974	83
1975	78
1976	70
1977	65
1978	55
1979	48
1980	46
1981	45
1982	44
1983	42 (estimated)

1/ International Petroleum Encyclopedia, 1982, vol. 15, p. 424.
2/ Ibid., p. 5.
3/ Ibid., p. 8.
4/ Ibid., p. 10.

Although the role of private companies in the production and marketing of OPEC's crude petroleum has changed significantly since the early 1970's, companies continue to maintain key positions in the operations of the conventional-energy-rich nations (CERN's) industries because of their technical and marketing expertise as well as their financial resources.

Overseas

In recent years, there has been a sharp increase in the number of national petroleum companies controlling the reserves of crude petroleum and natural gas. The major petroleum-producing nations, with the exception of the United States, Canada, and the countries bordering the North Sea, and the nonmarket economies (NME's), are developing nations relying upon revenues generated by petroleum exports to spur economic growth. Some of the major petroleum-producing nations with national petroleum companies are shown in the following tabulation:

Nation	National petroleum company and date established
OPEC:	
Algeria	Sonatrach (1969)
Ecuador	CEPE (1972)
Gabon	Petrogab (1975)
Indonesia	Pertamina (1972)
Iran	National Iranian Oil Co. (1973)
Iraq	Iraq National Oil Co. (1975)
Kuwait	Kuwait Oil Co. (1977)
Libya	National Oil Corp. (1970)
Nigeria	Nigerian National Petroleum Corp. (1971)
Qatar	Qatar General Petroleum Corp. (1974)
Saudi Arabia	Petromin (1962)
Venezuela	Petroven (1967)
United Arab Emirates	Abu Dhabi National Oil Co. (1971)
Non-Opec:	
Mexico	PEMEX (1938)
Canada	Petro-Canada (1975)
Norway	Statoil (1972)
United Kingdom	British National Oil Corp. (1976)

The desire of petroleum-producing nations to gain larger shares of the upstream and downstream operations of their petroleum industries was essentially spearheaded by members of OPEC. OPEC's nationalization of the petroleum industry was complete and included exploration, production, and marketing functions; however, the large multinational companies are still relied upon for certain expertise in these areas. With the nationalization of the petroleum industry, OPEC's revenues generated by petroleum exports increased by more than 1,000 percent from 1973 to 1982.

Reserves 1/

Crude petroleum and natural gas are nonrenewable energy resources; therefore, it is important to know the recoverable quantities of these resources in the United States. The United States has estimated proved reserves of 27.3 billion barrels of crude petroleum, as of January 1, 1984, or 4.1 percent of total world reserves. 2/ In comparison, the nations of the Middle East 3/ hold 55 percent of the world's estimated proved reserves of crude petroleum. 4/

The United States also has estimated undiscovered recoverable reserves of 82.6 billion barrels, of which 66 percent is onshore. Major areas containing these resources are Alaska (including offshore areas) with 23 percent and the

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1/ According to the U.S. Department of Energy, the distinctions between "reserves" and "resources" are as follows:

> The "total resource" of crude petroleum, that is, the amount that existed before any production, consists of the total volume formed and trapped in place within the Earth. A portion of this total resource is not recoverable by current or foreseeable technology, for two principal reasons. First, much of this portion is dispersed at very low concentrations throughout the Earth's crust and cannot be extracted without mining rock or applying some other approach that could consume more energy than it recovered. Second, an additional portion of the total resource volume cannot be recovered because available production technology cannot extract all of the in-place crude petroleum and natural gas. This technical inability to recover 100 percent of the in-place hydrocarbons in a producible deposit may result from the economics involved, intractable physical forces, or a combination of both. The concept of "recoverable resources" normally excludes these unrecoverable fractions.
>
> The "total recoverable resource" includes both discovered and undiscovered recoverable resources. "Discovered recoverable resources" consist of two major parts: cumulative production and reserves. "Cumulative production is the sum of the current year's production and the production that occurred in all prior years. "Reserves" are volumes estimated to exist in known deposits, and which are believed to be recoverable in the future through the application of present or anticipated technology. "Proved reserves," are those reserves of crude petroleum which geological and engineering data demonstrate with reasonable certainty to be recoverable in the future under existing economic and operating conditions.

2/ "Worldwide Report," Oil & Gas Journal, Dec. 26, 1983, pp. 80-81.

3/ These nations include: Abu Dhabi, Iran, Iraq, Kuwait, Qatar, and Saudi Arabia.

4/ "Worldwide Report," Oil & Gas Journal, Dec. 26 1983, pp. 80-81.

Gulf of Mexico (including onshore gulf coast) with 16 percent. 1/ The following tabulation shows the estimated range of undiscovered recoverable crude petroleum resources (in billions of barrels): 2/

Region	Estimated range of crude petroleum	
	Low	High
Onshore:		
Alaska	2.5	14.6
Pacific coast	2.1	7.9
Colorado Plateau and basin and range	6.9	25.9
Rocky Mountains and northern Great Plains	6.0	14.0
West Texas and Eastern New Mexico	2.7	9.4
Gulf coast	3.6	12.6
Mid-continent	2.3	7.7
Michigan basin	0.3	2.7
Eastern interior	0.3	1.9
Appalachians	0.1	1.5
Atlantic Coast	0.1	0.8
Total onshore	41.7	71.0
Offshore:		
Alaska	4.6	24.2
Pacific coast	1.7	7.9
Gulf of Mexico	3.1	11.1
Atlantic coast	1.1	12.9
Total offshore	16.9	43.5
Total, United States	64.3	105.1

U.S. drilling activity accounts for approximately 85 percent of the world's total drilling activity, 3/ and it increased steadily from 1971 to 1981 by about 15 percent per year 4/ as a result of the increases in petroleum prices. However, decreased prices and the general economic conditions in 1982 resulted in a decrease of nearly 25 percent in drilling activity in early 1983. 5/ The following tabulation shows the relationship of the average domestic wellhead price for crude petroleum and drilling activity: 6/

1/ U.S. Geological Survey, Geological Estimates of Undiscovered Recoverable Conventional Resources of Oil and Gas in the United States, A Summary, Circular 860, 1981.

2/ Ibid.

3/ Standard & Poors, "Oil-Gas Drilling and Services, Basic Analysis," Industry Surveys, vol. 150, No. 40, sec. 1, p. 0-113.

4/ "Drilling Embarks on New Growth Trend," Oil & Gas Journal, Sept. 12, 1983, p. 88.

5/ Ibid.

6/ Ibid., p. 89.

Year	Domestic average wellhead price 1/	Wells drilled	Footage drilled
	Per barrel		Millions of feet
1971	$3.39	27,300	128.3
1972	3.39	28,755	138.3
1973	3.89	27,602	138.9
1974	6.87	32,893	153.2
1975	7.67	39,097	178.5
1976	8.19	41,455	185.3
1977	8.57	46,479	215.0
1978	9.00	48,513	231.4
1979	12.64	51,263	243.2
1980	21.59	62,628	294.3
1981	31.77	80,537	366.2
1982	28.54	88,258	402.2
1983 2/	$28.00 to 30.00	75,000	336.8

1/ Derived from official Statistics of the U.S. Department of Energy.
2/ Estimated.

As the cost of crude petroleum increased, so have the costs associated with production and exploration. Drilling activity, in recent years, has included exploration for unconventional sources of crude petroleum. The following tabulation shows the increases in the costs for a producing well versus a dryhole: 1/

Year	Average cost per well		Average cost per foot	
	Petroleum	Dryholes	Petroleum	Dryholes
	1,000 dollars			
1971	86.7	80.9	19.29	15.21
1972	78.4	86.8	18.41	16.02
1973	93.5	94.9	20.77	17.28
1974	103.8	105.8	22.54	19.22
1975	110.2	141.7	27.82	26.76
1976	138.6	177.2	34.17	33.86
1977	151.1	190.3	37.35	36.94
1978	170.0	230.2	41.16	43.49
1979	208.0	281.7	49.72	52.55
1980	243.1	339.6	58.29	64.60
1981	272.1	376.5	66.36	73.70
1982	336.3	464.0	80.40	90.03
1983 1/	340.0	475.0	90.00	100.00

1/ Estimated.

1/ U.S. Department of Energy, 1982 Annual Energy Review, April 1983, p. 41.

Because of increased competition between oilfield equipment suppliers and only a slight increase in petroleum consumption during the summer of 1983, there was a 28-percent reduction in drilling costs in late 1983. As a result, drilling activity showed less of a decrease in 1983 than previously anticipated. 1/ Although rig capacity utilization rates averaged less than 50 percent in 1983, compared with 90 percent during the peak drilling years in the 1970's, capacity utilization could reach 80 percent by 1984 if prices for crude petroleum begin to increase. 2/

Refining Capacity

As of January 1, 1983, there were approximately 225 refineries operating in the United States, compared with 308 in 1978. 3/ The major petroleum-product-producing States are Texas, California, and Louisiana. These States accounted for approximately 45 percent of the total number of U.S. refineries and 57 percent of the total refining capacity, as of January 1, 1983. 4/

The value of petroleum product shipments (in current dollars) increased from $91.7 billion in 1977 to $209.6 billion in 1981, but decreased slightly to $203.7 billion in 1982. 5/ During 1978-82, the four largest petroleum companies accounted for approximately 30 percent of the value of industry shipments. 6/

Between 1978 and 1982, about 83 U.S. refineries shutdown operations 7/ as a result of a combination of factors including decreased demand for petroleum products, market shifts, increased transportation costs, consoli- dation of refinery operations, and the decontrol of crude petroleum prices. In 1982, approximately 52 refineries closed and those U.S. refineries remaining open operated at about 70 percent of capacity, 8/ compared with 68 percent in 1981 and 85 percent in 1979. 9/

Another change in the refining environment is a decrease in Government regulations. An important factor in the growth of the number of refineries during the late 1970's was the existence, between 1974 and 1981, of the Crude Oil Entitlements Program. This program assured and subsidized the acquisition of crude petroleum by small refiners. With crude petroleum price decontrol

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1/ "Oil Industry Begins Recovery From Worst Slide in History," Washington Post, Oct. 3, 1983, pp. A-1 and A-6.

2/ Ibid.

3/U.S. Department of Commerce. Bureau of Industrial Economics, U.S. Industrial Outlook, 1983, January 1983, p. 8-2.

4/ "Annual Refining Report," Oil & Gas Journal, Mar. 21, 1983, p. 130.

5/ U.S. Department of Commerce, Bureau of Industrial Economic, U.S. Industrial Outlook, 1983, January 1983, p. 8-3.

6/ Ibid, p. 8-2.

7/ "Major U.S. Oil Firms Stress Efficiency, Productivity," Oil & Gas Journal, May 2, 1983, p. 75.

8/ U.S. Department of Energy, Energy Information Administration, Petroleum Supply Monthly, January 1983, p. 6.

9/ Ibid., March 1982, p. 6.

and the end of this entitlements program in 1981, large numbers of small refiners shutdown.

Environmental regulations restricting the use of lead to raise gasoline octane levels are also having an impact. They were recently expanded to cover small as well as large refinery sizes. The production of low-lead, high-octane gasoline requires investment in costly hardware. Many small refiners, faced with compliance to the new limits, have been unable to find a profitable solution, and have shutdown operations.

Another factor contributing to the decrease in U.S. production of refined products and the subsequent decline in capacity utilization is an increase in offshore refinery operations. Currently, the world crude petroleum market is witnessing a situation of oversupply as well as excess refinery capacity. Some of the excess product enters the U.S. market, which is already faced with decreased domestic demand for these refined products.

The sources and quality of crude petroleum supplied to U.S. refineries have changed in recent years. With the startup of the Trans-Alaskan Pipeline System in 1977, production of crude petroleum from the North Slope of Alaska could be transported to the lower-48 States. Crude petroleum produced from the North Slope has a specific gravity of about 27° API and a sulfur content of about 1 percent (by weight). The gravity is lower and sulfur content higher than the U.S. averages for refinery feedstocks. Thus, as North Slope production increased its share of U.S. crude petroleum supply, there was movement toward a lower average API gravity and also movement toward a higher average sulfur content. During 1982, North Slope production was about 20 percent of the U.S. total, compared with less than 6 percent in 1977. 1/

Competitiveness

A large share of the world's crude petroleum reserves that can be recovered by using conventional methods are located in the Middle East. The threat of disruptions in the supply of petroleum from this region has encouraged the United States to develop more energy-efficient production techniques and to explore the possible advantages associated with petroleum production from unconventional sources. To meet an increased demand for the lighter, higher valued products, the refining industry has developed more sophisticated processing techniques to increase the yields of desired products per barrel of crude petroleum.

The United States has historically maintained a relatively advantageous position in the world crude petroleum market vis-a-vis other conventional-energy-rich nations. The United States has been the leader in the development of new technology such as catalysts and equipment. Also, a well-developed infrastructure including pipelines, tankers, ports, and other support facilities has allowed the U.S. industry to more easily transport crude petroleum to refineries and petroleum products to the markets.

1/ Ibid.

Crude Petroleum

The United States has experienced several favorable trends in the domestic petroleum market in recent years with relatively stable production and a decline in both consumption and imports. The end of price controls in January 1981 and increased world crude petroleum prices combined to spur domestic drilling activity to record levels. Although the number of rigs in operation decreased in 1982, the number of reported well completions and total footage drilled increased. Because of the lag in the reporting of well completions, the sharp decline in rig activity during the last half of 1982 is expected to be reflected in 1983 well completion and footage statistics.

Since 1980, the major sources of crude oil supply (onshore production regions in the lower 48 States, offshore fields, and Alaska) have remained relatively constant. However, during the course of the 1970's the sources have shifted significantly. Lower 48 States offshore production has declined from its peak of 1.7 million barrels per day in 1971 to 1.03 million barrels per day in 1981 and is expected to remain at approximately that level through this decade. 1/

Lower 48-States onshore production has, however, declined from 7.8 million barrels per day in 1970 to 5.9 million barrels in 1981, a trend which is expected to continue with the exception of a slight upturn through 1983. 2/ This decline has been offset by the production of crude petroleum from Alaska. Alaskan production increased from 200,000 barrels per day in 1970 to 1.6 million barrels per day in 1981 and is projected to increase to a peak of 1.8 million barrels by 1989. 3/

Between 1978 and 1981, U.S. consumption of petroleum decreased by 15 percent; however, consumption is expected to increase with the economic recovery. 4/ With stable or declining world crude petroleum prices, the incentive for continued conservation is reduced.

There are potential sources of domestic production to offset the need for increased imports. Newly explored areas in the offshore regions may contribute significant additions to reserves. There have been, for example, some important discoveries off the coast of California. New Alaskan leases may hold substantial potential, but given the climate and logistics problems, it could be many years before this potential is translated into production. However, increased reserves and production from the frontier areas will probably be offset by the continued decline in lower-48 States onshore reserves and production.

The increased use of enhanced oil recovery (EOR) techniques may help slow the decline in onshore oil production. With conventional production techniques, only about 30 percent of the crude petroleum estimated to be in a field is producible. Current EOR techniques can increase the recovery of crude petroleum in place to as much as 40 percent.

1/ U.S. Department of Energy, 1982 Annual Energy Outlook, April 1983, p. 66.
2/ Ibid.
3/ Ibid.
4/ Ibid.

Most EOR processes work by altering the flow characteristics of the crude petroleum. The most common technique at present heats the crude petroleum through steam injection, lowering its viscosity and enabling it to flow from the reservoir to the well. Many of the EOR techniques are experimental, but 4 percent of U.S. petroleum was being produced by steam injection in 1982. 1/

Refined Products

Decontrol of crude petroleum prices resulted in changes in the refining industry. Substantial reductions in the consumption of petroleum for a variety of end uses occurred as well. At the same time, the protected status of a large percentage of small refineries under various provisions of the prior regulations effectively ended. These included not only access to crude petroleum but also cost advantages given to small refiners. In 1981 and 1982, there was a substantial reduction in refinery capacity as the industry realigned itself with the newer market conditions. Refineries convert the mix of hydrocarbon compounds found in crude petroleum into a slate of marketable petroleum products such as gasoline, distillate fuels, and residual fuels.

Refinery operations begin with a simple distillation process that separates the compounds found in the crude petroleum, using differences in the boiling ranges of the compounds. Simple atmospheric distillation yields are about 10 to 20 percent gasoline and 30 to 40 percent residual fuel. End-use consumption of products, on the other hand, is 30 to 45 percent gasoline, and 10 to 20 percent residual fuel. As a result, refineries require additional processes to transform the hydrocarbon molecules in order to change the yields coming from the distillation column into yields that are demanded by petroleum consumers.

Worldwide petroleum reserves contain a much higher proportion of "heavy" crudes than does the crude petroleum currently being produced and refined in the United States. Heavy oil presently sells at a discount to that of light oil because it cannot yield as high a percentage of the more valuable lighter products without further processing. The need to process heavier crudes and the economic advantage of upgrading heavy products into lighter products have led refiners to invest in new "cracking capacity" including thermal processes, such as cokers or new, heavy feed catalytic cracking units and associated feed pretreatment and hydrogen manufacturing facilities, which break down the long molecules of heavy, low-quality crude oil and add hydrogen to form ligher products. There are approximately 25 such projects planned to open between 1982 and 1984, representing a capital outlay of more than $5 billion. 2/

There are two other basic types of downstream processes that are used in refineries. These processes are "octane boosting" and desulfurization units. Octane is an indication of the antiknock quality of gasoline. As an alternative to refining higher octane gasoline refiners may add lead (tetra-ethyl) compounds to boost octane ratings of lower quality gasoline. Lead is a potential source of pollution and its content in gasoline is limited by

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1/ Ibid., p. 69.
2/ Ibid., p. 70.

Enviromental Protection Agency (EPA) regulations. Recent EPA rulings have further limited the amount of lead that refiners and blenders may use.

Another process used by refiners is desulfurization, which is a decontamination process that improves end-product quality. Sulfur dioxide is a gas that is emitted when fossel fuels containing sulfur are burned. These emmissions are unhealthy, and many local governments have restricted the amount of sulfur that may be present in fuel. Desulfurization units process high-sulfur feed into low-sulfur fuel. Two factors affecting the increased need for these types of units are the increasing availability of heavier poor quality crudes relative to better quality crudes and a shift in demand to low-sulfur fuels from high-sulfur fuels.

At the same time that investment in downstream processes occurred, smaller, simpler refineries have been closing. In 1978, total products consumption exceeded total refining distillation capacity by 2 million barrels per day. By the end of 1982, operable crude distillation capacity exceeded consumption by about 1.5 million barrels per day even though some 75 refineries with a total of 1.5 million barrels per day of distillation capacity closed between 1980 and 1982. 1/

The new equipment used to convert heavier crudes and excess residual fuel oil to lighter products is expensive and requires large amounts of capital. Between 1982 and 1990, downstream cracking capacity is projected to increase at an annual rate of about 2 percent. 2/

National Security

Rapid growth of the world economy has been dependent on relatively inexpensive energy. In 1974 and 1979, when OPEC rapidly increased its prices for crude petroleum, the consuming nations experienced a slowing down of economic growth and double-digit inflation. 3/ Industries which are energy intensive such as chemicals, aluminum, paper, automobiles, and so forth, decreased output because of high energy costs and the recession. As a result, consumption was decreased in an effort to reduce costs.

The United States continues to be dependent upon imported crude petroleum and, therefore, vulnerable to supply disruptions. As a result, considerable study has been devoted to ways in which this dependence could be lessened. Traditionally, the United States has employed mechanisms such as tariffs, quotas, and fees to limit dependence upon imports for national security reasons. Conservation programs were also initiated.

With U.S. energy policy moving back toward a market-oriented policy deemphasizing Government intervention, three basic strategies for assuring available supplies of crude petroleum in the event of a disruption include: (1) a continuation of the development of the Strategic Petroleum Reserve (SPR);

1/ Ibid., p. 71.

2/ Ibid.

3/ "The Economic Impact of Cheaper Oil," Business Week, Mar. 7, 1983, pp. 95-96.

(2) bilateral agreements with other petroleum nations; and (3) cooperation among consuming nations in the coordination of emergency sharing programs. 1/

U.S. Sources of Crude Petroleum

Crude petroleum is produced domestically in a wide geographic area covering the length and width of the lower 48 States and Alaska. However, the major crude-petroleum-producing States, in declining order of importance, are Texas, Oklahoma, Alaska, Louisiana, and California. In the aggregate, these five States annually have accounted for about 75 percent of the domestic production in recent years.

U.S. production of crude petroleum has remained virtually unchanged during 1978-82; however, the value of the petroleum produced increased by more than 200 percent. The following tabulation, derived from official statistics of the U.S. Department of Energy, shows the quantity, value, and unit value of U.S. crude petroleum production from 1978 to 1983:

Year	Quantity	Value	Unit value 1/
	1,000 barrels	1,000 dollars	Per barrel
1978	3,178,055	28,602,495	$ 9.00
1979	3,121,480	39,455,508	12.64
1980	3,137,905	67,747,369	21.59
1981	3,128,780	99,401,340	31.77
1982	3,164,915	90,263,376	28.50
1983	3,162,360	82,853,832	26.20

1/ The unit value of production is based on the actual domestic average wellhead price.

U.S. dependence on imports of crude petroleum and petroleum products as a means of satisfying domestic demand increased from 13 percent in 1950 to a record high of 47.8 percent in 1977 (table 1). As a result of increased prices, tight supplies, and the initiation of conservation methods, this ratio began to decrease and was 33 percent in 1982 and 32 percent in 1983 (table 1).

1/ U.S. Government Accounting Office, The Changing Structure of the International Oil Market, ID-82-11, Aug. 11, 1982, pp. 47-48.

Table 1.--Crude petroleum and petroleum products: U.S. demand and dependence on imports, by specified years, 1950-83

Year	Domestic demand	U.S. imports	Ratio of imports to domestic demand
	1,000 barrels per day		Percent
1950	6,507	850	13.1
1955	8,459	1,248	14.8
1960	9,661	1,911	19.8
1965	11,304	2,468	21.8
1970	14,697	3,419	23.3
1971	15,212	3,926	25.8
1972	16,367	4,741	29.0
1973	17,308	6,256	36.1
1974	16,653	6,112	36.7
1975	16,322	6,056	37.1
1976	17,461	7,313	41.9
1977	18,431	8,807	47.8
1978	18,847	8,363	44.3
1979	18,513	8,456	45.7
1980	17,056	6,909	40.5
1981	16,058	5,996	37.3
1982	15,253	5,041	33.0
1983 1/	14,890	4,797	32.0

1/ Estimated.

Source: Data for 1950-72, compiled from U.S. International Trade Commission, Factors Affecting World Petroleum Prices to 1985, USITC Publication 832, September 1977, pp. 1D-2. Data for 1973-83, compiled from U.S. Department of Energy, Petroleum Supply Monthly, October 1983, pp. 17-18.

OPEC's share of total U.S. petroleum imports increased from 48 percent in 1973 to 70 percent in 1977. During the same period, the share of imports by non-OPEC sources of crude petroleum fell from 52 percent to 30 percent. By 1983, OPEC accounted for 33 percent of total U.S. petroleum imports; non-OPEC sources accounted for 67 percent (table 2).

Refining Capacity

The major integrated petroleum companies are now facing growing competition on the supply side from petroleum-producing countries seeking to upgrade their raw crude production into high-valued intermediate and end products. This new source of refined product supply is expected to be very much in evidence. Already, arrangements have been made between Saudi Arabia and multinational companies to construct joint refinery and petrochemical complexes in Saudi Arabia.

Table 2.--Crude petroleum and petroleum products: U.S. imports from OPEC and non-OPEC sources, 1973-83

Year	Total imports	Imports from OPEC sources	Imports from non-OPEC sources
	1,000 barrels per day		
1973	6,256	2,993	3,263
1974	6,112	3,280	2,832
1975	6,056	3,601	2,454
1976	7,313	5,066	2,247
1977	8,807	6,193	2,614
1978	8,363	5,751	2,613
1979	8,456	5,637	2,819
1980	6,909	4,300	2,609
1981	5,996	3,323	2,672
1982	5,041	2,113	2,928
1983	4,615	1,534	3,081

Source: U.S. Department of Energy, Monthly Energy Review, October 1983, pp. 38-39.

A newer trend is for the petroleum-producing countries to utilize existing spare refining capacity around the world. There have been reports that Kuwait seeks to buy refining assets in the United States. As previously mentioned, OPEC producers have been freely upgrading their crudes to finished products in Western Europe as a means to circumvent the cartel's restriction on raw crude production and prices. Also, crude-petroleum-producing countries are using the Caribbean "offshore refineries" as a way to upgrade their crude into intermediate and end-products.

Strategic Petroleum Reserve

The Strategic Petroleum Reserve was established under the authority of the Energy Policy Conservation Act of 1975 in response to a growing U.S. vulnerability to market disruptions which threatened U.S. supplies of crude petroleum. The SPR was set up to increase supplies of crude petroleum available during a supply disruption by accumulating and holding stocks of crude petroleum. The storage cites for the SPR are salt domes located in Texas and Louisiana.

However, it was stated that "drawing out of the Strategic Petroleum Reserve to change the price of oil . . . was not its intended purpose. It was intended to be for emergencies." 1/ Within this context, it is expected that the Strategic Petroleum Reserves would not be used to stabilize crude petroleum prices in the event of disruptions similar to the 1978 Iranian Revolution. Although no true emergency existed at that time, a nervous market

1/ "U.S. Hesitant to Tap Strategic Oil Reserve," Washington Post, Oct. 5, 1983, p. A15.

bid up the price of crude petroleum from a range of $13 to $15 per barrel in 1978 to more than $30 per barrel in 1980. 1/ Market analysts feel that any interruption occasioned by the actions resulting from the current Iran-Iraq War could precipitate similar price behavior.

Supplies

In 1981, the SPR stocks reached 230 million barrels and increased to 293 million barrels in 1982, 2/ with a goal of 750 million barrels by 1990. A large strategic stockpile is difficult to create in a short period of time because of the time involved in finding storage capacity and fill rates. Market events also affect the SPR fill rate. In 1979, purchases for the SPR were suspended because of the crude petroleum shortage on the world market. Economic pressures also may affect the fill rates because additional demand for crude petroleum for the SPR in a tight market could result in price increases which would affect the U.S. economy as well as the economies of other nations. There has also been concern expressed that a rapid increase in the fill rate of the SPR could result in production decreases by the world's major producers.

Public Law 97-229, The Energy Emergency Preparedness Act of 1982, required a fill rate of 300,000 barrels per day unless the President found that such a rate was not in the national interest. The minimum required fill rate, subject to the availability of appropriated funds, is 220,000 barrels per day. The President has exercised this option and has proposed to reduce it to 145,000 barrels per day in fiscal year 1984 and 100,000 barrels per day in 1985. 3/

SPR imports accounted for about 5 percent of the total U.S. imports of crude petroleum in 1982, or an average of 167,000 barrels per day compared with 6 percent, or 256,000 barrels per day in 1981. 4/ In August 1981, the United States entered a 5-year purchase agreement with Mexico to buy 110 million barrels of petroleum. This product is intended for the SPR. Purchases average about 60,000 barrels per day.

Price

A major concern surrounding the SPR has been who should pay for it. Congress debated various methods for financing the SPR which would allow for the reduction of appropriated funds. It has been suggested that a Government bond with value linked to the world price of crude petroleum be issued to finance the SPR. Other methods have included borrowing funds previously earmarked for the development of synthetic fuels to purchase petroleum and requiring the industry to contribute petroleum reserves to the SPR. These proposals have been criticized by the Administration.

1/ Ibid.

2/ U.S. Department of Energy, Petroleum Supply Monthly, January 1983, p. 3.

3/ "SPR a Program That Can Be Cut, But Not Killed for Needed Savings," Oil & Gas Journal, May 23, 1983, p.23.

4/ U.S. Department of Energy, Petroleum Supply Monthly, January 1983, p.3.

In fiscal year 1983, an off-budget SPR account of $3.9 billion was created within the Treasury Department to finance purchases of crude petroleum. In fiscal year 1984, the proposal to reduce the SPR fill rate to 145,000 barrels per day is expected to reduce expenditures by $1.57 billion from the level of that in 1983. 1/

Bilateral Agreements

The United States has entered bilateral agreements with petroleum-producing nations, such as Saudi Arabia, in order to assure access to crude petroleum supplies. An example of U.S. bilateralism occurred during the 1979 Iranian supply disruption; the United States urged Saudi Arabia not to decrease production or raise prices. 2/ A similar request was made following the disruption resulting from the Iran-Iraq conflict. 3/

In August 1981, the United States entered into a 5-year agreement with Mexico to purchase 110 million barrels of petroleum to fill the SPR. 4/ This was the first major government-to-government supply agreement the United States has entered. The agreement provided the United States with a relatively assured source of supply for the SPR at a stable price through August 1986.

International Energy Agency

The International Energy Agency (IEA) is an autonomous body established in November 1974 to implement an international energy program. The IEA was set up within the framework of the OECD to carry out a comprehensive program of energy cooperation among twenty-one of the OECD's 24-member countries. 5/

The basic aims of the IEA are--

1) to promote the cooperation among the participating nations to reduce excessive dependence on petroleum as an energy source by means of energy conservation as well as alternate energy source research and development;

1/ "SPR a Program That Can Be Cut, But Not Killed for Needed Savings," Oil & Gas Journal, May 23, 1983, p. 23.

2/ U.S. Government Accounting Office, The Changing Structure of the International Oil Market, Aug. 11, 1982. p. 50.

3/ Ibid.

4/ Ibid., p. 51.

5/ IEA members are: Australia, Austria, Belgium, Canada, Denmark, Germany, Greece, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, and the United States. The OECD member countries of Finland, France, and Iceland are not members of the IEA.

2) to provide an information system on the international petroleum market;

3) to develop a stable international energy trade by means of cooperation between the crude-petroleum-producing and crude-petroleum-consuming nations which would promote the use of world energy resources in the interest of all nations; and

4) to prepare a plan for participating nations to share available supplies of crude petroleum in case of another major supply disruption.

The development and refinement of the Emergency Sharing System continues to be the major goal of the IEA. 1/ The Emergency Sharing System is triggered by the Secretariat of the IEA once a finding has been made that a member country or group of member countries are experiencing or expected to experience a 7-percent or more shortage in crude petroleum supply below a base level of consumption. 2/ Within 8 days of such a finding, the system is activated unless rejected by the Governing Board. If the Emergency Sharing System is placed into effect, the IEA members have 15 days in which to implement the system. 3/

Once the system is triggered the Secretariat of the IEA calculates, from IEA's data systems, individual countries allocation rights to receive petroleum and obligations to share petroleum. The Emergency Sharing System assumes that each country maintains an emergency reserve (such as the SPR in the United States) equivalent to at least 90 days of net imports to be used during a supply disruption; an effective program of demand restraint; and a national emergency petroleum sharing organization to implement obligations under the Emergency Sharing System. 4/

The process of reallocating crude petroleum supplies in an emergency is a complex task and IEA members have become increasingly concerned about the determination of the price of the crude petroleum shared during such a situation. In December 1981, the IEA established a test Design Group composed of several IEA-member government officials, the IEA Secretariat, and representatives of the petroleum industry in order to develop procedures for the Emergency Sharing System test. Past tests had emphasized the mechanics of the system and had not included the effects of price on emergency allocations.

The U.S. State Department has contended that the emergency allocation system can function successfully only if petroleum traded under the system is priced at market levels. 5/ Participation in the system by petroleum

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1/ U.S. Government Accounting Office, The Changing Structure of the International Oil Market, Aug. 11, 1982, p. 54.
2/ Ibid.
3/ Ibid.
4/ Ibid.
5/ U.S. Government Accounting Office, Determination of Oil Price in the International Emergency Sharing System--An Unresolved Issue, ID-83-15, Nov. 12, 1982, p. 7.

companies is voluntary and therefore it is unlikely that the industry would sell petroleum below the market price. 1/ It has been contended that companies would be more willing to participate in the program if not required to sell products at less than commercial terms. 2/ Also, the IEA system is designed to provide petroleum to member nations with supplies of petroleum in an emergency situation and is not to be used as a substitute for available supplies on the world market.

Trade Controls

Imports

The United States became a net importer of crude petroleum following World War II. As the volume of total U.S. imports of crude petroleum increased, the share of total imports accounted for by the OPEC nations also increased, thus spurring concern over U.S. dependence on foreign petroleum. For the purposes of national security, the United States has employed various methods to control imports of crude petroleum and thus reduce dependence on foreign supplies.

From 1955 to 1959, control programs were essentially voluntary with few mechanisms to police compliance. During the longer period of 1959 to 1973, imports of both crude petroleum and petroleum products were regulated by a mandatory program based on officially fixed quotas. The Mandatory Oil Import Proclamation (MOIP) was established by Presidential Proclamation No. 3279 on March 10, 1959, and provided quotas for virtually all U.S. imports of crude petroleum and petroleum products. The action was taken under the national security provisions of the Trade Agreements Extension Act of 1958. 3/ The program was originally designed to set volumetric limits on imports and thus insulate the price of U.S.-produced crude petroleum from the much lower world prices. 4/ It established a fixed ceiling on imports so that domestic production was needed to supply domestic demand.

Although numerous modifications were made to the original restrictions of Proclamation No. 3279 between 1959 and 1977, one proclamation in particular issued during this period may have had an important bearing on the level of trade of crude petroleum during 1978-82. That was Proclamation No. 4210, which was issued and became effective April 18, 1973. This proclamation suspended tariffs on imports of petroleum, provided for a gradual transition from the then existing quota method, and shifted to a system whereby fees for licenses covering such imports were charged and whereby it was possible to adjust such fees from time to time in order to discourage the importation of crude petroleum and petroleum products into the United States. These fees were to be raised when the quantity of imports increased to such a level as, for example, to threaten to impair the national security. These fees could

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2/ Ibid.

3/ Ibid., p. 8.

4/ Authority for such action was later provided for under sec. 232 of the Trade Expansion Act of 1962.

5/ U.S. Tariff Commission, World Oil Developments and U.S. Oil Import Policies, October 1973, p. 42.

also be reduced in times of shortages. The fee schedule provided for in this proclamation, with certain exceptions, permitted a maximum fee of 21 cents per barrel for crude petroleum.

Because of the continued shortages in international petroleum and resultant escalating world crude petroleum prices, Proclamation No. 4655, issued April 6, 1979, and effective April 7, 1979, suspended the import fees; however, licenses were still required. A proposal pending in Congress would suspend the requirement for these import licenses. 1/

Exports

The exportation of crude petroleum may be restricted by the President under section 103 of the "Energy Policy and Conservation Act," Public Law 94-163, dated December 22, 1975. In matters of export control of crude petroleum, the President acts through the Secretary of Commerce who imposes such restrictions as necessary in order to be consistent with the national interest and the purposes of this act. The Secretary enforces this provision of the act through requirement of validated export licenses. The rules governing these exports are set forth in section 377.6, "Petroleum and Petroleum Products," U.S. Department of Commerce, Export Administration Regulations, December 7, 1981.

According to the U.S. Department of Commerce, exports of crude petroleum may also be controlled by three other acts: the "Export Administration Act of 1979," Public Law 96-72, dated September 29, 1979; the "Naval Petroleum Reserves Production Act of 1976," Public Law 94-258, dated April 5, 1976; and the "Trans-Alaska Pipeline Authorization Act," Public Law 93-153, dated November 16, 1973.

Canada has recently been the only market for U.S. exports of crude petroleum and most of these exports are composed of sweet, light crude petroleum. These exports are part of a commercial exchange agreement between U.S. and Canadian refiners, and approved by the Secretary of the Department of Energy. Alaskan North Slope crude petroleum is exported to Canada to be refined and consumed therein in exchange for the same quantity of crude petroleum or refined products being exported from that country to the United States, provided: 2/ (1) that the exchange will result in lower prices for consumers of petroleum products in the United States; (2) within 3 months of the exchange, the transaction results in lower acquisition costs to the refiner than the refiner would have to pay for domestically produced crude petroleum in the absence of such an exchange; and (3) at least 75 percent of such savings in cost must be reflected in wholesale and retail prices of products refined from such imported crude petroleum.

1/ Platt's Oilgram, vol. 61, No. 196, Oct. 11, 1983, p. 5.
2/ U.S. Department of Commerce, Export Administration Regulations, Dec. 7, 1981, p. EAB218.

Federal company

Traditionally, the United States has relied on the major international and domestic petroleum companies to supply its petroleum needs. However, the Arab embargo demonstrated the U.S. vulnerability to market disruptions.

Since 1973, legislative proposals have been made which would establish a national petroleum company in the United States. The major purposes in establishing a national company have included lessening U.S. dependence on imported petroleum and the further development of domestic petroleum resources. Supporters of a national company generally agree that there should be an expanded role for the public sector in the ownership and operation of public resources; opponents believe that direct public involvement should be limited and emphasis should be placed on strengthening private enterprise and competitive markets. 1/ Fear has also been expressed that the creation of a national petroleum company would represent the first step toward widespread nationalization of the entire petroleum industry as well as other industries designated as imperative to national security. 2/

In 1977, the U.S. Government intervened in the domestic petroleum market by establishing the U.S. Department of Energy with, among its duties, the responsibility for implementing price controls and conservation programs, establishing and managing the SPR, and managing emergency allocation programs. The intervention of the U.S. Government in the domestic petroleum market was the result of a situation of tight supplies and uncertainty concerning the future availability of crude petroleum. 3/ However, with the surplus of supplies since late 1980, there has been a reversal back to a more market-oriented energy policy. In early 1981, price controls were lifted, small refiner assistance programs were terminated, and emergency petroleum allocation programs expired. The structure of the U.S. market remains dominated by the major privately owned petroleum companies.

U.S. PETROLEUM INDUSTRY STATUS

U.S. Production and Consumption

Crude Petroleum

The level of U.S. production of crude petroleum remained virtually unchanged during 1978-82, declining from 3.2 billion barrels per year in 1978 to 3.1 billion barrels per year in 1979-81, and then increasing to 3.2 billion barrels per year in 1982. The level of domestic production of crude petroleum depends on changes in inventory levels, the level of imports, and the demand for petroleum products.

1/ American Petroleum Institute, The Debate Over Establishing a National Oil Company in the U.S., Discussion paper #016, Jan. 9, 1979.

2/ Ibid., p. 3.

3/ U.S. Government Accounting Office, The Changing Structure of the International Oil Market, Aug. 11, 1982, p. 54.

During 1978-82, apparent U.S. consumption of crude petroleum declined irregularly by about 18 percent, from 5.6 billion barrels in 1978 and 1979 to 4.6 billion barrels in 1982. One reason for the decline in the U.S. consumption of crude petroleum was the rise in the price of domestically produced crude petroleum from $9 per barrel in 1978 to about $32 per barrel in 1981. During the same period, the price of imported crude petroleum rose from about $13 per barrel in 1978 to $35 per barrel in 1981. These increases led to a policy of energy conservation and energy efficiency on the part of U.S. consumers, industry, and Government. As a result, the share accounted for by crude petroleum of the total energy consumed domestically declined from more than 48 percent in 1978 to about 43 percent in 1981 and 1982. 1/

Imports have accounted for a significant but decreasing share of the domestic consumption of crude petroleum during 1978-82. The ratio of imports to consumption declined from a high of 44 percent of the total volume of consumption in 1979 to a low of 31 percent in 1982; and from a high of 54 percent of the value of consumption in 1979 to a low of 34 percent in 1982.

Petroleum Products

U.S. production of distillate fuel oils decreased from 1.2 billion barrels in 1978 to 955 million barrels in 1982; however, the value of distillate fuel oils increased from $17 billion in 1978 to $37 billion in 1982 (table 3). U.S. production of residual fuel oils decreased from 608 million barrels in 1978 to 390 million barrels in 1982; whereas, the value increased from $5.9 billion in 1978 to $9.5 billion in 1982 (table 3).

U.S. production of motor fuels remained relatively stable during the same period, decreasing from 2.6 billion barrels in 1978 to 2.3 billion barrels in 1982 (table 3). The value of motor fuels, however, increased from $43 billion in 1978 to $90 billion in 1982, or by 109 percent. By way of comparison, the OPEC average crude petroleum official selling price increased by 160 percent during 1978-82, and U.S. refiner acquisition costs for crude petroleum increased by 156 percent.

As a result of decreased demand, refiners generally maintained lower inventories of petroleum products in 1982 than the amount maintained in 1978. The following tabulation shows inventories of the leading petroleum products from 1978 to 1982 (in millions of barrels): 2/

1/ Data for 1979-81 obtained from the U.S. Department of Energy, Petroleum Supply Annual, vol. 1 of 2, July 1982, p. 6. In addition to increased drilling, this source reports that the success ratio, number of successful wells drilled as a share of all wells drilled also increased during 1978-82. Statistics for the other years were obtained from U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, February 1983, p. 56.

1/ U.S. Department of Energy, Energy Information Administration, Petroleum Supply Monthly, January 1983, pp. 26, 27, and 32.

Year	Distillate fuel oils	Residual fuel oils	Motor fuel
1978	79	90	87
1979	84	96	87
1980	75	92	95
1981	70	78	92
1982	66	68	87

Table 3.--Petroleum products: U.S. production, by types, 1978-82

Year	Distillate fuel oils	Residual fuel oils	Motor fuel
	Quantity (1,000 barrels)		
1978	1,155,955	608,455	2,616,685
1979	1,150,845	615,755	2,500,980
1980	971,630	576,700	2,374,690
1981	953,745	482,165	2,337,825
1982	954,840	389,820	2,313,735
	Value (1,000 dollars)		
1978	17,316,206	5,877,675	43,096,802
1979	26,331,334	8,694,461	59,698,393
1980	31,918,046	10,761,222	87,174,870
1981	38,931,871	12,386,819	99,778,371
1982	36,875,921	9,464,830	90,281,940
	Unit value (per barrel)		
1978	$14.98	$9.66	$16.47
1979	22.88	14.12	23.87
1980	32.85	18.66	36.71
1981	40.82	25.69	42.68
1982	38.62	24.28	39.02

Price is a major factor in the total demand for petroleum products. As the price of these products increased, the consumers turned to lower cost alternate fuels such as natural gas, greater energy-efficient equipment and plants, more fuel-efficient automobiles, added insulation in homes and buildings, and in general, towards an overall policy of energy conservation.

The major end-use market for petroleum products during 1978-81 was the transportation sector, accounting for approximately 55 percent of the total volume of petroleum products supplied to end-use markets. The following

tabulation shows the petroleum products supplied to end-use sectors (in millions of barrels per day): 1/

Year	Residential and commercial	Industrial	Transportation	Electric utilities 1/	Total
1978	2.07	4.96	10.15	1.68	18.86
1979	1.91	5.14	9.99	1.47	18.51
1980	1.70	4.65	9.54	1.16	17.05
1981	1.64	4.04	9.36	.97	16.01

1/ Data represent deliveries to electric utilities.

U.S. consumption of petroleum products has varied since 1971 as a result of crude petroleum and petroleum products price changes, product availability, and conservation. In 1978, U.S. consumption of petroleum products was 18.8 million barrels per day and it declined to 18.5 million barrels per day in 1979. 2/ In late 1979, the average refinery acquisition cost for imported crude petroleum increased to $29 per barrel, compared with $15 per barrel in 1978. 3/ Partially as a result, retail prices for petroleum products increased in 1980, which led consumers to switch to alternative sources of energy and reduce consumption through conservation efforts. Since 1980, reduced industrial capacity utilization because of adverse economic conditions, combined with continued conservation and changes, and types of fuels consumed, contributed to declines in consumption. Consumption was 17 million barrels per day in 1980, 16.1 million barrels per day in 1981, 4/ and 15.2 million barrels per day in 1982. The following tabulation shows consumption of petroleum products and total energy, as well as the share of total energy consumption accounted for by petroleum products: 5/

Year	Petroleum products	Total energy	Petroluem products as a share of total energy
	------Quadrillion Btu's------		Percent
1978	37.97	78.18	48.6
1979	37.12	78.91	47.0
1980	34.20	75.91	45.1
1981	32.11	73.96	43.5

1/ U.S. Department of Commerce, Bureau of Industrial Economics, U.S. Industrial Outlook, 1983, January 1983, p. 8-3.
2/ U.S. Department of Energy, Energy Information Administration, Petroleum Supply Monthly, January 1983, p. 18.
3/ Ibid.
4/ Ibid.
5/ U.S. Department of Commerce, Bureau of Industrial Economics, U.S. Industrial Outlook, 1983, January 1983,, p. 8-1.

Although the quantities of petroleum products consumed decreased during 1978-82, the value increased from $140 billion in 1978 to $212 billion in 1982, as a result of inflation and tight supplies.

Total apparent U.S. consumption of distillate fuel oils decreased from 1.2 billion barrels in 1978 to 957 million barrels in 1982, or by 19 percent, because of increasing prices and conservation measures which particularly affected demand in the private home and commercial markets. At the same time, however, the use of distillate fuel oils in the transportation sector increased with the use of diesel fuel for trucks, buses, automobiles, and trains. Both the quantity and value of imports in 1982 accounted for about 3.0 percent of the apparent U.S. consumption of distillate fuel oils, compared with 1.7 percent in 1978.

Apparent consumption of residual fuel oils decreased steadily from 1 billion barrels in 1978 and 707 million barrels in 1981 to 581 million barrels in 1982, or by 42 percent. Of all the petroleum products discussed, residual fuel consumption reflected the sharpest decline in demand, as a result of a shift by electric utilities from residual fuel oils to less expensive alternate fuels such as coal, natural gas, and nuclear fuels. The decreases in capacity utilization of manufacturing plants stemming from economic conditions also contributed to the decline in residual fuel oil consumption. The quantity of residual fuel imports in 1982 accounted for nearly 46 percent of apparent U.S. consumption, compared with 40 percent in 1978, and the value of imports accounted for about 49 percent in 1982, compared with 45 percent in 1978.

Apparent U.S. consumption of motor fuel decreased irregularly from 2.7 billion barrels in 1978 to 2.4 billion barrels in 1982, or by 11 percent. Factors contributing to the fluctuations in consumption were gasoline price increases, improved automobile fuel efficiency, and changes in vehicle-use patterns. The quantity of imports accounted for about 2.3 percent of domestic consumption, compared with 1.7 percent in 1978, and the value of imports accounted for 2.2 percent in 1982, compared with 1.7 percent in 1978.

U.S. Trade

U.S. imports of all merchandise amounted to more than $242 billion in 1982. Approximately 24 percent of these imports, or $59 billion, are accounted for by imports of crude petroleum and petroleum products. Not only do imports of crude petroleum amd petroleum products account for such a significant share of all U.S. imports, but crude petroleum imports have accounted for between 31 and 44 percent of domestic consumption of crude petroleum, in terms of volume, during 1978-82.

Imports

Crude petroleum

U.S. imports of crude petroleum declined irregularly from 2.5 billion barrels in 1979 to 1.3 billion barrels in 1983, or by about 48 percent. U.S.

refiners prefer imports of light, sweet crude petroleum, 1/ as it contains a greater share of the valuable lighter fractions used to produce gasoline and diesel fuel; also, most U.S. refineries are designed to process that type of crude petroleum. However, at times of light crude petroleum shortages, imports of heavy, sour crude petroleum 2/ can be refined, but yield less of the lighter products and at a higher cost.

Table 4 shows that Mexico, Nigeria, Saudi Arabia, and the United Kingdom were the four leading sources of total U.S. imports of crude petroleum in 1981 and 1982. In the aggregate, these four countries accounted for 58 percent of both the quantity and the value of U.S. crude petroleum imports in 1982.

However, in 1983 there was a significant change in the composition of U.S. sources of imported crude petroleum. The following tabulation shows the quantity and value of imported crude petroleum, by major sources, during this period: 3/

Source	Quantity	Value
	1,000 barrels	Million dollars
Mexico	285,436	7,521
United Kingdom	129,997	3,931
Indonesia 1/	121,250	3,723
Nigeria 1/	119,378	3,627
Saudi Arabia 1/	116,215	3,417
Canada	101,000	2,665
Venezuela 1/	64,352	1,433
Algeria 1/	39,805	1,241
Iran 1/	36,484	1,058
Trinidad and Tobago	29,807	956
Other	239,493	6,920
Total	1,283,218	36,492

1/ OPEC member nation.

Of the 10 sources listed in the previous tabulation, 4 are not members of OPEC. Imports from these four non-OPEC sources alone account for more than 43 percent of all imports during this period. This reflects a significant change from the dependence of the United States on OPEC sources for the majority of its imports of crude petroleum during the 1970's. The following tabulation

1/ "Sweet" crude petroleum refers to crude petroleum with a sulfur content generally less than 0.5 percent.

2/ "Sour" crude petroleum refers to crude petroleum with a sulfur content generally greater than 0.5 percent.

3/ Compiled from official statistis of the U.S. Department of Commerce.

Table 4.--Crude petroleum: U.S. imports for consumption, by principal sources, 1979-83

Source	1979	1980	1981	1982	1983
			Quantity (1,000 barrels)		
Mexico	162,740	194,172	177,510	264,988	285,436
U King	68,017	56,779	134,267	158,379	129,997
Indnsia	137,304	120,916	124,751	87,722	121,250
Nigeria	401,298	311,660	238,459	197,357	119,378
S Arab	490,134	452,952	433,593	207,363	116,215
Canada	102,748	75,691	57,188	78,301	101,000
Venez	133,571	70,985	70,254	58,784	64,352
Algeria	218,292	163,754	96,514	29,643	39,805
Iran	119,928	8,475	0	17,093	36,484
Trinid	45,204	43,668	40,616	32,593	29,807
All Other	585,684	475,721	377,813	284,660	239,493
Total Imports	2,464,920	1,974,774	1,750,964	1,416,884	1,283,218
			Value (1,000 dollars)		
Mexico	3,038,461	5,923,589	5,392,686	7,563,362	7,520,719
U King	1,379,786	1,922,490	4,932,989	5,248,682	3,931,362
Indnsia	2,411,693	3,698,760	4,394,859	3,093,181	3,723,188
Nigeria	7,962,140	10,625,818	9,061,264	6,958,292	3,627,228
S Arab	7,848,102	12,230,681	14,008,695	6,974,455	3,416,521
Canada	1,872,178	2,196,424	1,928,184	2,225,008	2,664,691
Venez	2,134,482	1,694,865	1,997,979	1,412,707	1,433,332
Algeria	4,282,225	5,679,911	3,739,440	1,040,661	1,241,323
Iran	2,564,354	283,863	0	540,507	1,057,620
Trinid	884,331	1,495,585	1,547,899	1,144,667	955,502
All Other	11,680,483	16,147,017	13,953,918	9,522,297	5,920,467
Total Imports	46,058,234	61,899,003	61,457,915	45,723,820	36,491,953
			Unit value (per barrel)		
Mexico	18.67	30.51	33.20	28.54	26.35
U King	20.29	33.86	36.74	33.14	30.24
Indnsia	17.56	30.59	35.23	35.26	30.71
Nigeria	19.84	34.09	38.00	35.26	30.38
S Arab	16.01	27.00	32.31	33.63	29.40
Canada	18.22	29.02	33.72	28.42	26.38
Venez	15.98	23.88	28.44	24.03	22.27
Algeria	19.62	34.69	38.75	35.11	31.19
Iran	21.38	33.49	.00	31.62	28.99
Trinid	19.56	34.25	38.11	35.12	32.06
All Other	19.94	33.94	36.93	33.45	28.90
Average	18.69	31.34	35.10	32.27	28.44

Source: Compiled from official statistics of the U.S. Department of Commerce.

shows average U.S. imports of crude petroleum from 1970-82 grouped by OPEC and non-OPEC sources (in thousands of barrels per day): 1/

Year	OPEC	Non-OPEC	Total
1973	2,095	1,149	3,244
1974	2,540	937	3,477
1975	3,213	892	4,105
1976	4,049	1,238	5,287
1977	5,211	1,404	6,615
1978	5,245	1,111	6,356
1979	5,149	1,370	6,519
1980	3,890	1,373	5,263
1981	2,946	1,450	4,396
1982	1/ 1,875	1,586	3,461

1/ Compiled from official statistics of the U.S. Department of Commerce.

U.S. dependence upon OPEC sources of crude petroleum increased between 1970 and 1977, as OPEC member nations' share of the import market grew from 39 percent to more than 70 percent. Arab member nations' share of U.S. crude petroleum imports dropped to nearly 40 percent of all U.S. crude petroleum imports in 1980. The decrease in dependence on OPEC begun in 1980 continued in 1983, as can be seen from the following tabulation which shows U.S. crude petroleum imports for January-June 1983, by sources: 2/

Source	Volume (1,000 barrels)	Share of total imports (Percent)
Non-OPEC	365,532	66
OPEC	185,828	34
Arab OPEC	60,916	11
Total	551,360	100

Petroleum products.

The United States is a net importer of petroleum products primarily from Venezuela and refineries in the Caribbean nations. As a result of increased prices, the value of imports of petroleum products increased from $7 billion in 1978 to almost $15 billion in 1983, as can be seen in tables 5-8. As of January 1, 1984, the OPEC nations had the capacity to refine 4.6 million barrels of crude petroleum per day. 3/ U.S. imports of petroleum products

1/ U.S. Department of Energy, Energy Information Administration, Petroleum Supply Monthly, May 1983, pp. 12 and 13, and American Petroleum Institute, Basic Petroleum Data Book, May 1983, section IX, table 4.

2/ Compiled from official statistics of the U.S. Department of Commerce.

3/ "Worldwide Report," Oil & Gas Journal, Dec. 26, 1983, pp. 80 and 81.

could increase further as additional refinery capacity comes on-stream in the OPEC nations, as well as other conventional-energy-rich nations. The nations, with abundant supplies of crude petroleum and natural gas, have a competitive advantage in the production of energy-intensive products, such as petrochemicals, because of relatively assured supplies of raw materials at below-world prices. At a time when exports of crude petroleum from these nations appear to have peaked, they have developed, or are developing, downstream industries in order to diversify their exports as well as to further their economic development.

Residual fuel oils accounted for about 47 percent of the total value of U.S. imports of petroleum products in 1983. U.S. imports decreased in quantity from 338 million barrels in 1979 to 264 million barrels in 1983; however, the value increased from $5.7 billion in 1979 to $7.1 billion in 1983 because of rising prices. The major sources of U.S. imports of residual fuel oils in 1983 were the North Antilles (except the Bahamas) and Venezuela, together accounting for 46 percent.

U.S. imports of distillate fuel oils increased irregularly from 30 million barrels, valued at $804 million, in 1979 to 61 million barrels, valued at $2.0 billion, in 1983. Venezuela, Canada, and the Bahamas supplied about 63 percent of the total 1983 U.S. imports of distillate fuel oils.

U.S. imports of motor fuel increased irregularly from 25 million barrels in 1979 to 79 million barrels in 1983; however, during the same period the value of these imports increased from $807,000 to $2.6 billion. In 1983, the major sources for U.S. imports of motor fuel were the Netherlands, accounting for 20 percent, and Venezuela, accounting for 16 percent.

The share of the petroleum product import market held by OPEC member nations increased between 1973 and 1976; but has declined since that time, as shown in the following tabulation (per day): 1/

1/ U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, August 1983, pp. 32 and 33.

Table 5.-- Petroleum products: U.S. imports for consumption, by principal sources, 1979-83

Source	1979	1980	1981	1982	1983
			Value (1,000 dollars)		
Venez	2,639,804	3,202,196	3,078,736	2,995,228	2,890,272
N Antil	1,711,751	2,428,061	2,503,093	2,051,526	2,180,452
Algeria	374,378	633,030	1,059,741	1,351,209	1,655,822
Bahamas	1,508,071	1,262,283	1,146,145	941,492	1,547,388
Canada	533,898	588,264	966,541	799,031	1,187,966
Nethlds	245,082	71,519	507,191	544,600	774,398
Brazil	12,035	29,036	123,771	377,158	531,820
Mexico	9,723	85,705	292,863	235,754	475,919
China P	24,633	113,633	295,415	399,639	350,928
Indnsia	267,721	412,428	414,607	184,724	326,821
All Other	2,342,547	2,529,356	2,802,027	3,183,045	3,062,196
Total Imports	9,669,642	11,355,510	13,190,129	13,063,408	14,983,983

Source: Compiled from official statistics of the U.S. Department of Commerce.

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Table 6.--Residual fuel oils: U.S. imports for consumption, by pricipal sources, 1979-83

Source	1979	1980	1981	1982	1983
			Quantity (1,000 barrels)		
N Antil	63,333	63,794	62,409	57,588	62,974
Venez	135,803	106,485	85,570	78,859	57,310
Bahamas	39,238	29,788	17,252	15,681	25,903
Algeria	6,786	11,536	16,849	28,857	21,827
Canada	13,733	12,680	13,045	9,797	11,136
Brazil	503	1,019	3,884	7,408	9,456
Peru	1,283	385	1,505	4,270	9,525
Belgium	370	0	538	2,584	7,364
Mexico	19	3,328	12,828	10,939	8,290
Indnsia	11,973	7,755	11,483	3,966	5,496
All Other	65,464	45,240	32,361	45,791	44,289
Total Imports	338,505	282,010	257,724	265,739	263,568
			Value (1,000 dollars)		
N Antil	989,245	1,455,971	1,820,185	1,482,590	1,628,008
Venez	2,244,690	2,708,417	2,561,622	2,135,988	1,465,819
Bahamas	746,235	874,713	596,294	443,193	764,164
Algeria	146,607	356,080	563,715	919,461	639,192
Canada	209,265	275,148	361,061	265,308	303,483
Brazil	12,035	29,031	117,862	218,747	255,708
Peru	25,012	9,959	44,015	118,873	248,227
Belgium	6,164	0	19,784	87,853	224,793
Mexico	181	65,471	249,703	218,819	197,478
Indnsia	194,739	228,076	363,382	123,816	152,820
All Other	1,165,662	1,223,908	1,036,179	1,280,427	1,181,598
Total Imports	5,739,836	7,226,774	7,733,802	7,295,075	7,061,292
			Unit value (per barrel)		
N Antil	15.62	22.82	29.17	25.74	25.85
Venez	16.53	25.43	29.94	27.09	25.58
Bahamas	19.02	29.36	34.56	28.26	29.50
Algeria	21.60	30.87	33.46	31.86	29.28
Canada	15.24	21.70	27.68	27.08	27.25
Brazil	23.92	28.48	30.34	29.53	27.04
Peru	19.50	25.89	29.25	27.84	26.06
Belgium	16.67	.00	36.77	34.00	30.52
Mexico	9.56	19.68	19.47	20.00	23.82
Indnsia	16.26	29.41	31.65	31.22	27.81
All Other	17.81	27.05	32.02	27.96	26.68
Average	16.96	25.63	30.01	27.45	26.79

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 7.--Distillate fuel oils: U.S. imports for consumption, by principal sources, 1979-83

Source	1979	1980	1981	1982	1983
			Quantity (1,000 barrels)		
Venez	2,390	326	6,013	6,809	13,246
Canada	1,954	512	5,490	4,140	12,776
Bahamas	6,013	1,167	7,081	8,579	12,572
Nethlds	1,047	192	4,005	823	4,404
Mexico	1/	201	1,281	600	4,349
N Antil	10,624	7,234	3,142	3,572	2,659
Algeria	0	253	2,164	454	2,769
USSR	0	0	2,062	0	1,729
Trinid	2,689	1,147	835	26	1,185
Romania	0	0	219	0	1,088
All Other	5,350	4,290	6,072	5,686	4,463
Total Imports	30,066	15,322	38,363	30,689	61,240
			Value (1,000 dollars)		
Venez	41,230	10,041	230,403	240,524	426,918
Canada	61,542	10,976	214,258	157,025	420,225
Bahamas	203,974	40,528	272,993	303,559	401,011
Nethlds	26,545	8,437	152,700	32,340	146,207
Mexico	1	5,634	39,383	14,936	138,277
N Antil	281,953	257,206	114,209	116,071	85,919
Algeria	0	8,783	80,678	17,843	85,587
USSR	0	0	80,706	0	55,968
Trinid	71,019	39,296	31,026	748	38,797
Romania	0	0	8,908	0	36,246
All Other	117,372	141,092	229,987	196,782	129,538
Total Imports	803,636	521,992	1,455,250	1,079,829	1,964,692
			Unit value (per barrel)		
Venez	17.25	30.77	38.32	35.32	32.23
Canada	31.50	21.44	39.03	37.93	32.89
Bahamas	33.92	34.73	38.55	35.38	31.90
Nethlds	25.36	43.94	38.13	39.28	33.20
Mexico	6.53	28.01	30.76	24.90	31.80
N Antil	26.54	35.56	36.35	32.50	32.32
Algeria	.00	34.71	37.28	39.34	30.91
USSR	.00	.00	39.14	.00	32.38
Trinid	26.41	34.26	37.16	28.60	32.74
Romania	.00	.00	40.76	.00	33.30
All Other	21.94	32.89	37.88	34.61	29.02
Average	26.73	34.07	37.93	35.19	32.08

1/ Less than 500.

Table 8.--Motor fuel: U.S. imports for consumption, by principal sources, 1979-83

Source	1979	1980	1981	1982	1983
			Quantity (1,000 barrels)		
Nethlds	2,451	591	6,092	11,375	15,381
Venez	759	4	0	1,584	12,201
China P	619	2,559	6,767	9,559	10,371
Canada	5,039	3,439	3,780	3,833	7,904
Brazil	0	0	0	3,868	7,590
Romania	0	0	2,312	1,958	6,385
N Antil	1,651	1,014	2,690	3,676	5,045
Italy	3,552	1,153	3,113	1,643	3,071
Trinid	5,578	5,520	3,384	3,310	2,167
U King	377	1/	26	476	2,223
All Other	4,775	4,674	4,713	6,339	6,379
Total Imports	24,801	18,953	32,876	47,620	78,719
			Value (1,000 dollars)		
Nethlds	108,807	24,575	242,094	411,547	511,119
Venez	25,219	100	0	61,198	427,551
China P	21,615	81,809	258,744	336,884	308,895
Canada	138,132	129,582	153,485	153,673	277,089
Brazil	0	0	0	142,745	253,202
Romania	0	0	90,241	69,846	207,709
N Antil	71,305	39,807	109,325	138,844	175,764
Italy	162,967	53,075	121,305	59,402	101,245
Trinid	129,890	208,363	139,665	135,493	80,764
U King	12,517	1/	1,052	17,172	76,182
All Other	136,153	178,543	181,564	222,641	209,840
Total Imports	806,606	715,855	1,297,476	1,749,445	2,629,359
			Unit value (per barrel)		
Nethlds	44.39	41.60	39.74	36.18	33.23
Venez	33.23	25.02	.00	38.62	35.04
China P	34.91	31.97	38.24	35.24	29.78
Canada	27.41	37.68	40.60	40.09	35.06
Brazil	.00	.00	.00	36.90	33.36
Romania	.00	.00	39.02	35.68	32.53
N Antil	43.19	39.27	40.65	37.77	34.84
Italy	45.88	46.04	38.97	36.15	32.97
Trinid	23.28	37.75	41.28	40.94	37.26
U King	33.22	113.00	40.37	36.10	34.27
All Other	28.51	38.20	38.53	35.12	32.89
Average	32.52	37.77	39.47	36.74	33.40

Source: Compiled from official statistics of the U.S. Department of Commerce.

Year	OPEC imports	Share of total	Total imports
	1,000 barrels	Percent	1,000 barrels
1973	898	30	3,012
1974	740	28	2,635
1975	388	20	1,951
1976	1,017	50	2,026
1977	982	45	2,193
1978	506	25	2,008
1979	488	25	1,937
1980	410	25	1,646
1981	377	24	1,599
1982	1/ 238	15	1,625

1/ Compiled from official statistics of the U.S. Department of Commerce.

Among the reasons for this pattern of importation include steadily increasing demand during the mid-1970's, followed by increases in capacity coupled with either steady or declining demand since that time.

Imports of petroleum products are not a necessity in the United States; the majority of imports result from situations such as one in which the like imported product is of equivalent quality, though less expensive, than the domestic product. Many of the U.S. firms which import products do so because of affiliations, either direct or delitescent, which mandate purchases from the foreign affiliates. The decline in the share of U.S. petroleum product imports from OPEC member nations may be in part an effort to place energy imports from these nations in a position of being the last resource of U.S. demand. 1/

Exports

Crude petroleum

U.S. exports of crude petroleum are prohibited except as approved by the Federal Government. U.S. exports declined from about 29 million barrels, valued at $389 million, in 1978, to 13 million barrels, valued at $469 million, in 1982. Exports in 1983 declined further to 7 million barrels, valued at $224 million.

Alaskan North Slope crude petroleum.--Alaskan North Slope crude petroleum may now be exported to an adjacent foreign country, Canada. Legislation has recently been considered which would allow exports of Alaskan crude petroleum to Japan. At the present time, these exports are specifically restricted by the 1973 Trans-Alaska Pipeline Act and the 1977 Export Administration Act (as amended, 1979). Alaskan crude petroleum is produced on the Alaskan North Slope, transported via the Alaskan pipeline to export facilities, and is

1/ "OPEC Is Vulnerable," Fortune, July 14, 1980, pp. 66-69; and "This Time Oil Shouldn't Bust the Boom," The Economist, Aug. 20, 1983, pp. 57-60.

shipped to handling facilities along the U.S. gulf coast through the Panama Canal. A hearing was held before the Subcommittee on East Asian and Pacific Affairs of the Committee on Foreign Relations of the U.S. Senate on July 19 and 20, 1983, concerning the current prohibition of these exports. Despite testimony to the effect that ". . . promoting open energy markets through export of Alaskan oil would demonstrate to the international community U.S. determination to remove artificial impediments to free trade, in general, and to energy markets, in particular. Also, we would provide a potential new source of oil for one of our most important allies--Japan--and eventually, perhaps, for other countries on the Pacific rim with which we have extremely important relations." 1/

Testimony at these hearings also included statements by Administration officials that there would be significant savings for U.S. consumers, as well as additional Federal and State Government tax revenues. Negative aspects of the removal of the trade ban would include a possible idling of the domestic tanker fleet. Estimates of the expected change in trade patterns of up to 800,000 barrels per day could force owners of domestic tankers into default, as 40 percent of the domestic fleet is engaged in transport of Alaskan crude.

Other.--Canada has been the only market for U.S. exports of crude petroleum and most of these exports are composed of sweet, light crude petroleum. These exports are part of a commercial exchange agreement between U.S. and Canadian refiners, and approved by the Secretary of the Department of Energy.

Petroleum products

Exports of petroleum products during 1979-83 are shown in table 9. The value of U.S. exports increased by 451 percent from 1979-82. The reasons for this apparent dramatic increase include an increase in the unit value of petroleum product exports of between 200 and 300 percent, and the 1982 relaxation of export restrictions which are discussed in additional detail under the National Security section of this report. 2/ However, in 1983 exports declined by 27 percent to a value of $3.8 billion.

Tables 10-12 show the increase in volume of exports through 1982 of three major petroleum products, distillate fuel oil, motor fuels, and residual fuel oil, which together accounted for nearly 78 percent of petroleum product exports in 1982. Exports of distillate fuel oils increased from 1.1 million barrels in 1979 to 1.2 million barrels in 1981; between 1981 and 1982, distillate fuel oil exports increased to more than 28.2 million barrels. In 1983, exports declined slightly, to 26.4 million barrels.

1/ Testimony concerning export of Alaskan crude petroleum by Richard T. McCormock, Assistant Secretary for Economic and Business Affairs, U.S. Department of State, Department of State Bulletin, September 1983, pp. 57-59.

2/ The rules governing these exports are set forth in section 377.6, "Petroleum and Petroleum Products," of the Export Administration Regulations of the U.S. Department of Commerce (15 CFR section 377.6).

Table 9.--Petroleum products: U.S. exports of domestic merchandise, by principal markets, 1979-83

Market	1979	1980	1981	1982	1983
	Value (1,000 dollars)				
Japan	78,723	75,770	151,692	483,606	489,930
Canada	100,739	107,431	215,384	317,299	428,585
Singapr	3,516	63,529	143,159	215,560	420,931
Nethlds	44,157	64,386	272,025	602,893	308,827
Mexico	109,900	218,609	210,206	962,901	196,868
N Antil	2,076	4,940	16,876	75,657	147,947
Kor Rep	10,047	17,328	87,875	277,132	132,516
Italy	34,608	55,831	138,779	160,037	118,831
Taiwan	21,292	39,194	85,244	44,676	113,314
Panama	3,867	21,570	32,466	72,640	103,245
All other	460,586	644,245	876,873	1,579,493	1,307,695
Total exports	869,509	1,312,833	2,230,580	4,791,893	3,768,688

Source: Compiled from official statistics of the U.S. Department of Commerce.

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Table 10.--Distillate fuel oils: U.S. exports of domestic merchandise, by principal markets, 1979-83

Market	1979	1980	1981	1982	1983
			Quantity (1,000 barrels)		
Japan	203	20	403	5,458	4,955
Nethlds	0	0	192	3,743	4,146
Singapr	0	0	0	1,096	1,774
Canada	52	2	5	4	1,389
Spain	0	0	3	443	1,331
Ecuador	0	0	1/	617	1,254
N Antil	0	0	0	119	1,265
Kor Rep	0	0	127	1,447	1,032
Nigeria	0	0	0	261	949
France	0	1/	1	1,485	770
All other	802	364	485	13,572	7,552
Total exports	1,057	387	1,216	28,245	26,418
			Value (1,000 dollars)		
Japan	4,372	820	16,412	205,079	159,314
Nethlds	0	0	7,819	134,769	146,944
Singapr	0	0	0	41,144	60,400
Canada	911	74	181	141	46,822
Spain	0	0	91	15,285	42,095
Ecuador	0	0	2	25,002	41,984
N Antil	0	0	0	3,398	38,519
Kor Rep	0	0	5,351	54,735	32,042
Nigeria	0	0	0	10,427	31,421
France	0	1	25	62,357	30,131
All other	13,064	8,877	20,503	530,064	251,659
Total exports	18,347	9,773	50,384	1,082,400	881,330
			Unit value (per barrel)		
Japan	21.51	40.88	40.68	37.57	32.15
Nethlds	.00	.00	40.74	36.01	35.44
Singapr	.00	.00	.00	37.54	34.04
Canada	17.37	30.05	36.71	34.77	33.71
Spain	.00	.00	35.00	34.48	31.62
Ecuador	.00	.00	35.00	40.55	33.48
N Antil	.00	.00	.00	28.67	30.46
Kor Rep	.00	.00	42.09	37.81	31.04
Nigeria	.00	.00	.00	39.90	33.12
France	.00	32.35	34.98	42.00	39.14
All other	16.29	24.36	42.24	39.06	33.32
Average	17.35	25.25	41.43	38.32	33.36

1/ Less than 500.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 11.--Motor fuel: U.S. exports of domestic merchandise, by principal markets, 1979-83

Market	1979	1980	1981	1982	1983
			Quantity (1,000 barrels)		
Canada	22	13	190	128	1,846
Ecuador	0	0	0	173	1,098
Austral	0	78	0	1/	438
N Antil	1/	0	0	1/	275
Mexico	54	996	418	12,028	299
Colomb	2	1/	0	358	167
Peru	0	0	1/	1/	138
Panama	0	0	1/	30	71
Thailnd	0	0	0	30	31
Japan	1/	1	6	1	25
All other	99	237	412	1,189	48
Total exports	177	1,324	1,026	13,938	4,436
			Value (1,000 dollars)		
Canada	214	341	7,766	5,138	64,857
Ecuador	0	0	0	7,225	37,748
Austral	0	3,754	0	2	13,990
N Antil	1	0	0	1	11,607
Mexico	1,156	10,765	16,273	465,879	10,964
Colomb	55	2	0	13,840	5,625
Peru	0	0	5	2	4,927
Panama	0	0	1	1,098	2,444
Thailnd	0	0	0	1,626	2,053
Japan	4	22	232	21	840
All other	2,540	10,685	17,607	47,221	2,316
Total exports	3,971	25,569	41,883	542,052	157,370
			Unit value (per barrel)		
Canada	9.76	26.62	40.84	40.06	35.13
Ecuador	.00	.00	.00	41.71	34.39
Austral	.00	48.29	.00	29.81	31.91
N Antil	18.00	.00	.00	28.39	42.15
Mexico	21.59	10.81	38.97	38.73	36.72
Colomb	24.70	15.00	.00	38.64	33.60
Peru	.00	.00	27.83	27.82	35.77
Panama	.00	.00	29.52	36.36	34.55
Thailnd	.00	.00	.00	54.18	65.94
Japan	43.43	29.81	36.89	28.85	33.90
All other	25.66	45.04	42.71	39.72	48.17
Average	22.45	19.30	40.80	38.89	35.48

1/ Less than 500.

Source: Compiled from official statistics of the U.S. Department of Commerce.

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Table 12.--Residual fuel oils: U.S. exports of domestic merchandise, by principal markets, 1979-83

Market	1979	1980	1981	1982	1983
			Quantity (1,000 barrels)		
Singapr	1/	1,940	4,699	6,181	13,740
Japan	329	10	1,887	5,645	10,694
Taiwan	0	551	2,220	958	3,640
Nethlds	0	0	7,707	16,980	3,541
N Antil	0	100	0	2,812	4,056
Kor Rep	0	0	2,433	8,298	3,524
Canada	1,920	1,212	1,737	4,174	2,934
Panama	0	363	746	1,188	2,407
Italy	0	0	2,733	3,276	2,581
Hg Kong	0	0	509	209	1,771
All other	442	1,900	8,155	24,797	13,326
Total exports	2,691	6,076	32,826	74,518	62,216
			Value (1,000 dollars)		
Singapr	23	58,390	137,286	167,024	344,549
Japan	5,969	376	54,364	162,029	276,692
Taiwan	0	14,760	66,325	26,254	97,370
Nethlds	0	0	196,460	402,830	96,269
N Antil	0	1,732	0	69,436	96,113
Kor Rep	0	0	65,444	214,714	93,456
Canada	33,757	28,377	45,493	104,222	73,464
Panama	0	8,833	20,204	31,631	64,652
Italy	0	0	90,567	83,182	63,773
Hg Kong	0	0	14,401	5,257	44,994
All other	7,453	51,158	217,514	649,872	340,973
Total exports	47,202	163,627	908,059	1,916,451	1,592,305
			Unit value (per barrel)		
Singapr	147.63	30.09	29.22	27.02	25.08
Japan	18.12	37.47	28.81	28.71	25.87
Taiwan	.00	26.80	29.88	27.41	26.75
Nethlds	.00	.00	25.49	23.72	27.18
N Antil	.00	17.25	.00	24.69	23.69
Kor Rep	.00	.00	26.90	25.87	26.52
Canada	17.58	23.41	26.18	24.97	25.04
Panama	.00	24.34	27.09	26.62	26.86
Italy	.00	.00	33.14	25.39	24.71
Hg Kong	.00	.00	28.28	25.16	25.40
All other	16.86	26.93	26.67	26.21	25.59
Average	17.54	26.93	27.66	25.72	25.59

1/ Less than 500.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Exports of motor fuels followed a similar pattern, increasing in volume from 177,000 barrels in 1979 to 1.0 million barrels in 1981. After export restrictions were relaxed, export volume climbed to nearly 13.9 million barrels in 1982, although it declined to 4.4 million barrels in 1983. A smoother path of increase marked residual fuel oil exports between 1979 and 1982, as export volume increased from 2.7 million barrels to 74.5 million barrels. Exports in 1983 declined to 62.2 million barrels.

The major markets for petroleum products have been other developed nations without significant reserves of crude petroleum for use as a raw material base, especially Japan, Canada, the Netherlands, and Singapore. A notable exception to this rule is Mexico, whose economy depends upon the revenues generated from the export of crude petroleum to such an extent that imports of petroleum products are necessary to satisfy the Mexican domestic demand. These four nations together account for nearly 50 percent of U.S. exports of petroleum products.

Petrochemicals

U.S. exports of petrochemicals are estimated to have increased at an average annual rate of 20 percent between 1976 and 1981. 1/ A slight decrease in exports of U.S.-produced petrochemicals in 1982 compared with 1981 may have resulted from the international recession along with a worldwide surplus of available material. 2/

The ability of the U.S. petrochemical industry to be competitive in foreign markets depends to a significant degree on the price of crude petroleum. The U.S. Government, pursuant to the Emergency Petroleum Allocation Act of 1973, as amended, had imposed price controls on domestically produced crude petroleum which continued until January 28, 1981. 3/ Controls became discretionary with the President on June 30, 1979, and statutory authority for controls was to expire on September 30, 1981. 4/ However, these price controls were removed effective January 28, 1981, by Executive Order 12287.

The following tabulation shows the average U.S. refiner acquisition costs for crude petroleum, both domestic and imported, along with the composite cost: 5/

1/ U.S. Department of Commerce, U.S. Industrial Outlook, 1983, January 1983, pp. 9.4-9.9.

2/ Ibid.

3/ A two-tiered pricing system was applied to domestically produced crude petroleum from 1974 until Jan. 28, 1981, in response to rapid price increases in the world crude petroleum market. This was done to reduce the impact of the increased petroleum prices on the U.S. economy. The Federal Energy Administration developed the two-tiered system. This system linked maximum allowable price to production at a particular field in order to encourage maximum production of existing reserves, exploration and development of new reserves, and continuation of stripper well leases production (wells producing less than 10 barrels per day). The phased Federal decontrol of the price of crude petroleum began in April 1979.

4/ "Phased Decontrol of Crude Oil Prices Examined," Oil & Gas Journal, Apr. 5, 1982, p. 185.

5/ U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, August 1983, p. 82.

	Domestic	Imported	Composite
1978----------	$10.61	$14.57	$12.46
1979----------	14.27	21.67	17.72
1980----------	24.23	33.89	28.07
1981----------	34.33	37.05	35.24
1982----------	31.22	33.55	31.87

U.S. production of various major petrochemicals would be affected differently in the event of an increase or decrease in composite crude petroleum acquisition costs. Lower crude petroleum prices could create problems for U.S. exports of ethylene derivatives, as the price of the primary U.S. feedstock for ethylene, natural gas liquids (NGL's), has steadily been increasing. However, the price of the crude petroleum feedstocks used by Far East and European ethylene producers has been decreasing since 1981. If further decreases in the crude petroleum price occurs relative to U.S. NGL's, U.S. producers of ethylene derivatives would have a significant competitive disadvantage in the world market. 1/

Additionally, the further decline of world crude petroleum prices could prevent desired price increases planned by U.S. producers of aromatics, such as benzene, toluene, and xylene. The world price of these basic petrochemicals is closely tied to the price of crude petroleum and there would not be a sufficient increase in consumer demand to enable the refinery utilization rates to increase much above 75 percent. Therefore, while costs of production would remain high, there would be additional pressure on U.S. producers to lower their prices further, thus reducing their competitive position in the world market. 2/

Balance of Trade

The United States has been a net importer of goods throughout the 1978-82 period. As shown in table 13, the total trade balance deficit improved between 1978 and 1980, but increased again between 1980 and 1982 to a net trade deficit of more than $35 billion. However, the U.S. net trade balance, not including crude petroleum and petroleum products, would show the United States to be a net exporter of all other goods.

The variation in either of these statistics is dependent on crude petroleum trade, and the overall energy-dependence of the United States. As the world price of crude petroleum decreases, the competitive positions of U.S. manufactured goods would improve. In general, real growth in the United States would be expected to increase significantly along with the declining crude petroleum prices. Consequently, as operating rates would increase,

1/ "OPEC Rift: Petrochemical Fallout Seen," Chemical Marketing Reporter, Feb. 7, 1983, pp. 3 and 25.

2/ "Oil Price Cut Might Not Hurt Petrochemicals," Chemical & Engineering News, Jan. 31, 1983, pp. 5 and 6.

lower production costs would translate into a more competitive position both domestically and internationally. 1/

Table 13.--U.S. imports for consumption, exports of domestic merchandise, and net trade balance, 1978-82

(In millions of dollars)

Item	1978	1979	1980	1981	1982
	Imports				
All merchandise	172,952	205,923	239,943	259,012	242,340
Crude petroleum	32,298	46,058	61,899	61,458	45,724
Petroleum products	6,859	9,670	11,356	13,190	13,063
Chemical and allied products	6,711	7,762	8,831	9,637	9,734
	Exports				
All merchandise	141,154	178,578	216,592	228,961	207,158
Crude petroleum	389	394	751	577	469
Petroleum products	668	828	1,268	2,182	4,747
Chemical and allied products	13,660	19,012	22,736	23,371	21,583
	Trade balance				
All merchandise	(31,798)	(27,345)	(23,351)	(30,051)	(35,182)
Crude petroleum	(31,909)	(45,664)	(61,148)	(60,971)	(45,255)
Petroleum products	(6,191)	(8,842)	(10,088)	(11,008)	(8,316)
Chemical and allied products	6,949	11,250	13,905	13,734	11,849
All merchandise except petroleum and petroleum products	6,302	27,161	47,885	41,928	18,389

Source: Official statistics of the U.S. Department of Commerce.

The industries whose export trade is most affected by the changes in crude petroleum price are the industries in which energy costs contribute a significant share to the overall costs of production, such as the paper industry, which is one of the largest U.S. industrial consumers of energy. 2/ During 1972-81, the cost of energy to the domestic paper industry increased from 7 percent of sales to 14 percent of sales. During this period of

1/ "The Economic Impact of Cheaper Oil," Business Week, Mar. 7, 1983, pp. 95-99.

2/ Ibid.

increasing crude petroleum prices, the paper industry reduced its use of petroleum by 52 percent, shifting to other sources for power generation. 1/

Additionally, lower world crude petroleum prices directly influence the balance of trade by lowering the cost of each barrel of imported crude petroleum. The following tabulation shows the direct influence of a hypothetical $1 per barrel decrease in the price of crude petroleum on the overall U.S. balance of trade for the period 1978-82: 2/

Year	Actual trade balance	Hypothetical trade balance	Percentage change
	Million dollars		Percent
1978	(31,798)	(29,392)	7.6
1979	(27,345)	(24,880)	9.0
1980	(23,351)	(21,376)	8.5
1981	(30,051)	(28,300)	5.8
1982	(35,182)	(33,765)	4.0

The hypothetical change in the trade balance shown in the previous tabulation gives only an indication of the change which would have resulted from a decrease in crude petroleum prices. Assuming that all other factors would be held constant, a $10 per barrel decrease in the price of imported crude petroleum would infer a decline in the trade deficit of between 40 and 90 percent, based on the data for 1978-82. However, if crude petroleum prices were to escalate rapidly, as happened in 1973 and 1979, U.S. dependence upon imports would probably continue in the short term, as the short-term crude petroleum demand-supply function has been shown to be inelastic. 3/ In the long run, U.S. industrial conservation, consumer conservation, and willingness to switch to alternate sources could moderate possible negative impacts of the crude petroleum price increases. In recent history, rapid crude petroleum price increases negatively influenced the collective economies of the developed nations. The U.S. trade deficit would be expected to increase, as the added cost of imports, loss of export markets related to tightening of world capital, and probable worldwide economic slowdown act together on the U.S. economy.

1/ Ibid., p. 96.
2/ Based on official statistics of the U.S. Department of Commerce.
3/ American Petroleum Institute, The Social Costs of Incremental Oil Imports: A Survey and Critique of Present Estimates, February 1982.

OTHER U.S. INDUSTRIES

The previous discussion of trade indicates that many products could be affected by changes in crude petroleum prices. And, while the petroleum industry may be the most directly affected industry, other industries would also be subject to varying degrees of impact.

The impact would probably be the greatest for those industries that produce the most energy-intensive products. Thus the chemical industries--petrochemical, organic, and inorganic--cement industry, paper and paperboard industries, primary aluminum industry, glass containers industry, steel industry, and automobile parts industry are all affected by crude petroleum prices, although in differing degrees of sensitivity. Only about 4 percent of the cost of materials going to the manufacture of automobile parts is accounted for by energy cost, whereas, energy cost is 70 percent of the cost of materials used to make certain organic chemicals such as plastics and resins. 1/

The relationship between crude petroleum prices and energy-intensive industries appears obvious. Less obvious may be the relationships between crude petroleum prices and many other industries and institutions which could also be impacted, though in a secondary or indirect way. Sometimes the affected industries are not those industries directly affected by changes in crude petroleum prices, but secondarily affected industries such as the synthetic fuels industry or the coal industry. At other times, the affected industries or institutions are primarily impacted not because of energy factors, but by the sheer magnitude of the dollars involved; these industries or institutions would be just as affected by any other item that could produce the same magnitude of dollar change. Examples include the banking industry and institutions such as the International Monetray Fund (IMF), World Bank, and the Federal Reserve.

The automobile industry is affected by crude petroleum price changes not only by way of the energy it uses, but also by the prices it pays for materials such as automobile parts. It is also impacted by the quantity and types of automobiles demanded by customers which are in turn influenced by price and availability of gasoline, both of which are highly dependent on crude petroleum prices.

All of the preceding reiterates the theme that virtually all U.S. industries and institutions are to some degree influenced by changes in crude petroleum price. The United States produces, imports, exports, and consumes energy, including crude petroleum, in such quantities that almost all activities use or are in some way related to energy and petroleum.

While it is beyond the scope of this study to analyze all U.S. industries and institutions affected by crude petroleum price changes, some of the more important and/or historically discussed and potentially impacted sectors will be highlighted to draw attention both to these sectors themselves and to illustrate the pervasive influence of price changes.

1/ U.S. International Trade Commission, The Probable Impact on the U.S. Petrochemical Industry of the Expanding Petrochemical Industries in the Conventional-Energy-Rich Nations, U.S.I.T.C. Publication 1370, April 1983, p. 19.

Energy-Intensive Industries

It is readily apparent that those industries making products whose production costs are dominated by energy costs would be sensitive to crude petroleum price changes. Such changes result not only in price changes for petroleum products but for all energy products; over the long-term there can be virtually free substitution by almost any energy product for any other energy product. Short-term switching of energy products is often hampered by such factors as the requirement for new equipment to use the new energy form, for example, a new burner or furnace to utilize natural gas in place of fuel oil. The lack of readily available alternate energy products at a plant site or sites may also be a deterrent to short-term substitution. During the long-term, assuming the economic incentive is present, the alternate energy product would under most circumstances be made readily available by its current or new suppliers.

For the top 16 U.S. industrial energy consumers, as defined by 4-digit SIC codes, the cost of petroleum and natural gas, as a percent of the cost of all production materials, ranges from 84 percent for petroleum refining to 4 percent for motor vehicle parts. The industries placed between these two industries are also shown in the following tabulation: 1/

SIC code	Industry	Percent	SIC code	Industry	Percent
2911	Petroleum refining	84.09	2865	Cyclic crudes and intermediates	36.99
2821	Plastics and resins	70.69	3334	Primary aluminum	25.80
2873	Nitrogenous fertilizers	64.36	2819	Industrial inorganic chemicals	25.11
3241	Hydraulic cement	54.58	2631	Paperboard mills	24.39
2824	Organic fibers, non-cellulosic	54.32	3221	Glass containers	24.14
3079	Miscellaneous plastics products	52.05	2621	Paper mills	17.89
2869	Industrial organic chemicals	40.98	3312	Blast furnaces, steel mills	15.58
2812	Alkalies and chlorine	39.57	3714	Motor vehicle parts	4.06

As the OPEC official crude petroleum sales prices increased, particularly following the large increments of $7.90 per barrel between 1973 and 1974, and $12.11 per barrel between 1979 and 1980, a question was asked by some observers. The question was whether the energy-rich nations would increasingly capture larger future shares of the world's energy-intensive industries. Would the energy advantage these nations possess be of a sufficient order of magnitude to offset their other possible disadvantages, including higher construction costs, lack of technical and management personnel, relatively small domestic markets, and the need to import some raw materials for conversion? There are also other considerations and the

1/ Ibid.

question has not begun to be answered. However, some energy-rich nations are studying the development of paper, steel, and other energy-intensive industries.

About 8 of the top 16 energy-intensive U.S. industries are chemical related. It is primarily because of this energy-intensive nature of chemicals that many of the world's nations possessing abundant crude petroleum and natural gas resources are developing chemical industries; a 1983 study developed this issue in detail. 1/

In the case of certain petrochemicals, as much as 80 percent of the production cost is traceable to feedstock and energy costs when these imports are priced at world levels. If these imports are priced well below world levels the advantages conferred on the producer are obvious. It has been suggested that certain petrochemicals are best made in the energy-rich nations and that this fact should be accepted by the traditional producers. 2/

Petrochemicals

At present, the production of petrochemicals is centered in the industrialized nations of the world, including the United States, the European Community, and Japan. However, many of those nations with large reserves of crude petroleum, and particularly of natural gas (i.e., advantaged nations), that can easily produce, or are already producing, quantities in excess of their domestic demand at a low cost, are studying, starting to produce, or already producing petrochemicals. These nations include most OPEC nations, Canada, and Mexico. 3/

When crude petroleum is extracted from the ground, associated natural gas is often obtained. In the past, this natural gas has been, and in some cases is still being, flared, or burned in the atmosphere without regard to economic value. Flaring usually takes place because there has been, and often still is, no other economic use for the natural gas; the crude petroleum is primarily exported.

The flaring of natural gas has been extensively practiced by many nations, particularly those in the Persian Gulf. These nations have had no domestic use for the natural gas and without domestic distribution systems are not likely to develop domestic demand, but to transport natural gas overseas to markets in nations such as the United States and Japan entails large expenditures. A domestic collection network is required to capture the natural gas at the wellhead and move it to a central point; liquefaction plants are required to convert natural gas to liquefied natural gas (LNG); storage facilities must be built to contain the LNG; and special tanker

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1/ Ibid.

2/ "U.S. Should Accept Loss of Markets to New Producers," European Chemical News, Oct. 17, 1983, p. 21.

3/ For further information on petrochemicals see U.S. International Trade Commission, Study of the Petrochemical Industries in the Countries of the Northern Portion of the Western Hemisphere, December 1980 and The Probable Impact on the U.S. Petrochemical Industry of the Expanding Petrochemical Industries in the Conventional-Energy-Rich Nations, U.S.I.T.C Publication 1370, April 1983.

vessels must be built to transport the LNG to world markets. 1/ In addition, regassification plants are required in the consuming nations receiving the natural gas.

Alternatives to flaring natural gas are: (1) using it domestically as a household and commercial fuel, (2) exporting it as LNG, (3) using the natural gas and its components as feedstock to produce certain petrochemicals, and (4) utilizing the natural gas as a fuel to supply the energy needed to convert the feedstocks into petrochemicals.

Several of the advantaged nations reportedly charge their petrochemical industries, often including government-owned or government-controlled corporations, for the feedstocks and fuels used in the plants. The charges are often arbitrary, miminal, and insignificant compared with other production costs and prevailing world prices, according to industry sources. For example, it has been reported that Saudi Arabia is charging 50 cents per million British thermal units (1 million Btu's are approximately equivalent to 1,000 cubic feet) for natural gas. 2/ By the way of comparison, in the United States in 1982, the average wellhead value was $2.41 per 1,000 cubic feet, and the average delivered price to all electric plants was $3.49 per 1,000 cubic feet. 3/ Large intrastate pipelines charged as much as $4.30 to 4.50 per 1,000 cubic feet in 1983. 4/ Industry experts estimate that future U.S. natural gas prices could be higher, particularly if the Natural Gas Policy Act expires as scheduled in 1985. Changing natural gas prices and the possibility of continued fluctuations have caused some observers to speculate that trading in natural gas futures could begin by January 1985. 5/

In the United States and some other nations, the cost of production of certain petrochemicals may be largely attributed to feedstock and energy costs. For example, whereas energy and feedstock costs in the United States represent, on the average, about 70 percent of the production costs of ethylene, methanol, and ammonia, these costs represent about 20 percent of the production costs in certain advantaged nations. 6/ These differences in production costs can be used to gain market entry and increase market share via reduced prices and other means.

1/ Natural gas, as a gas, would be very expensive to ship because of the small quantity relative to a liquid that can be contained in any specified volume. Consequently, natural gas is liquefied, which results in the same specified volume being capable of containing a much larger quantity of natural gas now in liquid form and burned as LNG. To maintain natural gas as LNG requires either, or a combination of, high pressure and a low temperature. Hence the need for specially constructed ships.

2/ U.S. Department of State, Saudi Arabia's Emerging Petrochemical Industry--Implications for the West, Oct. 31, 1982.

3/ U.S. Department of Energy, Monthly Energy Review, April 1983, p. 91.

4/ "Deft Maneuvers in the Markets for Natural Gas," Chemical Week, Sept. 28, 1983, p. 14.

5/ "Natural Gas Futures Come A Step Closer," Chemical Week, Sept. 28, 1983, p. 54.

6/ U.S. International Trade Commission, The Probable Impact on the U.S. Petrochemical Industry of the Expanding Petrochemical Industries in the Conventional-Energy-Rich Nations, U.S.I.T.C. Publication 1370, April 1983, pp. 30-31.

Because the price of energy and feedstocks affects the ability of the U.S. petrochemical industry to compete for world markets, the industry is particularly concerned about anything that may raise its price relative to the prices available to petrochemical industries in other nations. In this regard, it is very much aware of, and greatly concerned about, any possible energy taxes, fees, or quotas. 1/

Other Energy-Intensive Industries

Other energy-intensive industries include hydraulic cement, primary aluminum, paperboard mills, glass containers, paper mills, and blast furnaces and steel mills. Since energy costs represent a significant share of the production costs in each of these industries, those nations with relatively low-priced energy supplies would appear to have an advantage. As in the case of petrochemicals, the difference in production costs between areas of low- and high-energy costs could be used to defray other expenses, such as transporation to world markets, to gain market access by price or other mechanisms, or add to return on investment.

Steel industry

Some advantaged nations are studying or implementing procedures designed to establish certain energy-intensive industries. Saudi Arabia, via the Saudi Arabia Basic Industries Corporation (SABIC), is building a steel industry. While it appears that at least initially the industry is designed to serve the domestic market, expansion to serve the Persian Gulf or other areas cannot be ruled out. Regardless, the market served by such newly established industries does reduce the export potential for these same industries located in developed nations, including the United States.

Aluminum industry

The U.S. aluminum industry has implemented major energy-saving programs including recycling and improvements in other operations. The energy requirements to make a pound of aluminum in the second half of 1982 were reduced by almost 22 percent compared to 1972. However, it is claimed that inspite of these improvements, uncertainties about supply and price of energy including natural gas, may cause the industry future problems. Even if these problems can be resolved, the industry still believes it will have a hard time competing with foreign producers having energy price advantages. 2/

1/ Petrochemical Energy Group, Submission in response to investigation No. 332-161, "Possible Effects of Changing World Crude Petroleum Prices," Oct. 25 1983, pp. 1-2.

2/ "U.S. Aluminum Industry More Efficient, But Faces Competitors With Cheaper Energy," Energy Users Report, June 13, 1983. p. 644.

Other industries

A series of congressional hearings were held "to examine the cause and effect of the decline in the nation's basic industries." The next 5 to 10 years were viewed as crucial for U.S. smokestack industries. Issues considered important were whether these industries possess the potential "to regain their competitive edge" or "are likely to continue to deteriorate and die," along with changes and actions associated with either scenario. 1/

Financial Services

Industries and institutions associated with financial services of almost any type are sensitive to changes in crude petroleum pricing; in general, this sensitivity increases as the size of the change in the price of crude petroleum increases. The sensitivity is also affected by the length of the period of time over which the price change occurs; the longer the period, the more time the financial services sector has to react.

The financial services sector is primarily affected by changes in crude petroleum prices because of the large number of dollars involved and the ubiquitous nature of crude petroleum. The price of crude petroleum is important to, and affects, virtually all industries and almost all nations. And in each of these effects, there is usually a financial factor, hence the impact on financial services industries and institutions.

The impact is felt in both the private and public sectors. The private sector often extends loans and other services to both crude petroleum-importing nations and crude petroleum-exporting nations, both of which may be subject to repayment difficulties depending upon the direction and extent of a crude petroleum price change. If repayment difficulties do arise, both the private and public sectors may become concerned; the private sector's initial fears are usually centered about the possibility of losses, whereas the public sector's concerns are often broader and sometimes shared by the private sector, involving the maintenance of confidence in the private institutions, as well as the solvency of the debtor nations. Such concerns were sharpened during the winter of 1982-83 and the spring of 1983 when bankers and policy-makers examined the health of the world banking system. 2/

At that time, recent assistance by the IMF to Mexico, Argentina, Brazil, and Chile for approximately $18 billion added to the urgency of such an examination. Concern was expressed by some observers that decreasing crude petroleum prices could prompt some crude petroleum-exporting nations that in the past had helped other nations meet their debts to also turn to international agencies, such as the IMF, for assistance. 3/ In a scenario of

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1/ U.S. Senate, Committee on Finance, Subcommittee on Economic Growth, Employment, and Revenue Sharing, Hearing on the Future of U.S. Basic Industries, July 22 and 25, 1983.

2/ "Banks Leery of Third World Loans," Washington Post, Apr. 21, 1983, p. D11.

3/ Group of Thirty, The International Monetary Fund and the Private Markets, March 1983, p. 23.

this type, private and public sectors, including banks, international agencies, and governments, would be affected. Some of the factors involved in such a scenario are quite complex.

It has been suggested by some observers that certan banks possibly were overgenerous lenders in the past. 1/ It has been reported, for example, that some of the most aggressive banks were approving loans based on crude petroleum reserves valued at up to $70 and $100 per barrel. 2/ A number of these observers were disturbed when many of these banks then turned to the IMF, the Bank for International Settlements, and the U.S. Government for aid. 3/ These tactics were viewed by some as a "bail out," and objections were raised by many, including some U.S. Congressmen. 4/ However, even though these objections may have had some merit, aid to financially pressed countries enables them to continue to pay for imports, a large share of which comes from the United States. These U.S. exports benefit U.S. workers and farmers, and U.S. industries. For example, it has been estimated that the slump in the Mexican economy after Mexico's near default in August 1982 resulted in the loss of about 200,000 U.S. jobs because of lost exports. Third World financial and economic problems likely reduced U.S. economic growth by approximately 1 percent in 1983. 5/

It has been suggested that recent worldwide debt problems, if anything, have shown that the crucial ingredient for solving such problems is cooperation. The more successfully debtor nations, creditor nations, banks, and international institutions interact, the greater the ability of the system to solve economic problems. 6/

Government Institutions

The U.S. Government and other quasi-government organizations often cannot avoid becoming involved in the aftermath of significant crude petroleum price changes. Changes in revenues for crude petroleum-exporting nations and trade balances for some crude petroleum-importing nations, particularly the non-OPEC developing nations, may be of such magnitudes as to cause concern about the continued economic viability of certain lending institutions and nations. The maintenance of stability is important not only for the continued health of the international monetary system, but also for political and national security reasons. Although private financial organizations are often the first or most directly affected members of the financial services sector, the importance of maintaining public confidence in the banking and world monetary systems necessitates Government involvement under certain circumstances. Often this

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1/ ". . . That Needs IMF Fuel," Washington Post, Apr. 20, 1983, p. A21.

2/ "Oil Industry Dip Hurts Growth in Banking," The Journal of Commerce, May 26, 1983, p. 1C.

3/ "Banks Charging $800 Million for Help to Mexico," Washington Post, Mar. 20, 1983, p. G1

4/ Ibid.

5/ "U.S. and Mexico End Talks on Economy, Central America," Washington Post, Apr. 20, 1983, p. A26.

6/ "International Lenders Debate Likelihood of New Wave of Trouble," Washington Post, May 15, 1983.

involvement touches many issues. International banking can become an arcane area and even the experts disagree as to whether a specific international debt problem is one of a temporary shortage of cash resources or one of insolvency. 1/ This makes popular support even more difficult to obtain.

However, for the world to return to faster economic growth rates many observers argue that Third World nations must be able to both service their debts and to continue to import, particularly the necessary items. It has been suggested that governments and their central banks provide the required funds to these nations immediately to carry them through the period during which they are engaged in negotiations with the IMF. If such a program were adopted, Governments could become even more sensitive to changes in petroleum prices. 2/

Private Organizations

Private financial services organizations may be affected by changing crude petroleum prices via any number of diverse routes. They may loan money to energy-rich nations for crude petroleum exploration, development, production, refining, or export, or, to energy-deficient nations for crude petroleum or petroleum products imports; in addition, they may become involved by loaning money for any host of activities which are earmarked for financing with crude petroleum revenues, such as the imports of crude petroleum-exporting nations. They may also finance the petroleum and imports of nations which later become incapable of repaying the loan because of an increase in the price these nations must pay for necessary imports of crude petroleum or petroleum products.

International Monetary Fund

The membership of the International Monetary Fund (IMF) consists of 146 countries, including all industrial market countries except Switzerland, some African, Asian, and European NME's, and most developing countries. 3/ A major function of the IMF is to provide member nations temporary financing for balance of payments deficits by utilizing resources provided by other member nations. It is primarily in implementing this function that the IMF may become sensitive to changes in crude petroleum prices.

The balance-of-payments deficiencies traceable to changes in crude petroleum prices may occur regardless of whether the change is an increase or a decrease. When there is a price increase it is usually the importing nations that are most vulnerable to balance-of-payments problems, whereas, when there is a price decrease it is often the exporting nations that may have problems. Thus the IMF may become involved as a result of any and all crude petroleum price changes.

1/ "Study Faults Plans for Consolidating Third World Debt," Washington Post, Apr. 20, 1983, p. F1.

2/ "Regan Warns of New Debt Woes," Washington Post, May 10, 1983, p. D1.

3/ Group of Thirty, The International Monetary Fund and the Private Markets, March 1983, p. 23.

A report to the Trilateral Commission included in its recommendations certain items specifically tailored to aid the IMF meet its challenges. These recommendations were to allow the IMF to borrow directly from the market and to relax the IMF's limit on member borrowing. 1/

Private banks

In the aftermath of the relatively significant increases in OPEC's average crude petroleum official sales prices occurring in 1973-74 ($3.39 per barrel to $11.29 per barrel) and in 1979-80 ($18.67 per barrel to $30.87 per barrel), most observers believed prices would continue to escalate. 2/ Prices in the $100 per barrel range were forecast by some observers. Assuming these circumstances, certain U.S. banks became involved in a wide variety of loans in a number of nations. It has been suggested that both banks and developing countries, including crude petroleum-producing nations, were guilty of "enormous self-deception." 3/ The nine largest U.S. banks, for example, loaned more than $25 billion to Mexico and Brazil; these nations together with Argentina had international debts of about $200 billion in early 1983, with much of the debt held by private banks in Europe and Japan, as well as in the United States. 4/

In actuality, a crude petroleum supply surplus occurred that was particularly obvious in late 1982 and early 1983. This event led to a decrease in the official sales price of OPEC crude petroleum from $34 per barrel to $29 per barrel. The elasticities of both the demand and supply of crude petroleum, particularly over the longer term, were incorrectly estimated by most forecasters. In addition, a global economic slowdown, at least partially attributable to the previous crude petroleum price increases, further decreased demand.

The net result was that by the first quarter of 1983, there was an increasing concern that certain nations might be unable to repay their debts, at least in the shorter term. Aside from the efforts to assure the liquidity of such nations, involving other institutions, some of which are discussed in this report, attention was focused on possible mechanisms that might prevent U.S. banks from again encountering such difficulties. U.S. regulators studied methods to supervise the international lending functions of U.S. banks; the methods studied included restricting any one bank's loan amount to any one country, changing accounting and other practices designed to draw a bank's attention to the risk of certain loans, and increasing the amount of information any bank would have to disclose on its foreign loans. 5/

1/ "Study Faults Plans for Consolidating Third World Debt," Washington Post, Apr. 20, 1983, p. F1.

2/ Central Intelligence Agency, Economic and Energy Indicators, Apr. 1, 1983, p. 11.

3/ "The Burden of Debt: A Threat to Stability?," Washington Post, Feb. 1, 1983, p. C8.

4/ "Volcker: Aid to Debtor Nations Isn't 'Bail-Out' for Big Banks," Washington Post, Feb. 3, 1983, p. C11.

5/ Ibid.

Within the U.S. banking community, the foreign debt experience has caused U.S. banks to become very wary of increasing foreign loans. 1/ One of the reasons for the study of methods to supervise international lending is the desire to make it safer for U.S. banks, and by doing so, to retain U.S. private banks in the international lending picture.

Automobile Industry

The automobile industry, as indicated previously, is subject to impact related to changes in the price of crude petroleum to the extent these changes affect the cost it must pay for energy and the parts it purchases. In addition, however, it is also subject to impact by the way changes in crude petroleum prices affect the price of gasoline and automobile purchasers' income, and as a result, the perception of the type of car (if any at all) they wish to purchase.

Petroleum-Related Industries

If the petroleum industry (including crude petroleum production and refining) is the industry most directly impacted by changes in the price of crude petroleum, those industries closely allied to the petroleum industry should be similarly affected. In the context of this report, these closely related industries would be those industries supplying the services, materials, equipment, and comparable items to the petroleum industry; the major related industries include drilling, exploration and development, oilfield services, and oilfield machinery and equipment. Additionally, there are other affected industries related not just to petroleum, but also to other industries; these include the railroad equipment, shipbuilding and repairing, measuring and controlling instruments, and railroad line hauling industries. Finally, there are the other energy supply industries that compete with the petroleum industry for energy markets and are thus impacted by those events affecting the petroleum industry; these major energy supply industries include coal, natural gas, synthetic fuels, and nuclear power.

The above named industries are listed only for illustrative purposes. Obviously because of the ubiquitous nature of petroleum, and the dollar sums involved, there are few industries unaffected by crude petroleum price changes. Further, the determination of whether an industry is related to the petroleum industry is to a degree arbitrary. A mission for this section of the report is to indicate to the reader that a certain crude petroleum price change is often perceived as advantageous or disadvantageous depending upon the point of view of the analysts and the industry. While it is generally agreed that a decrease in crude petroleum prices is advantageous for the United States on a macroeconomic scale it could be viewed differently in certain industries in the United States.

1/ "Banks Leery of Third World Loans," Washington Post, Apr. 21, 1983, p. D11.

Field Industries

The degree of activity in each of the field industries--drilling, exploration, field services, and machinery and equipment--is closely related to both the level of, and changes to, crude petroleum prices. In general, activity in each of these industries is higher when prices are higher and increases when prices rise; in general, the opposite is also true. However, the timelag between changes in activity level in each of these industries and changes in crude petroleum price varies. Often the timelag differs depending upon whether the price change is an increase or a decrease. At times of already high prices accompanied by further price increases, the availability of equipment, such as drilling rigs, may act as a constraint on additional activity in some of the field industries.

Drilling

The activity of drilling wells is affected by both crude petroleum price levels and changes. It is also affected by general economic conditions and the assessment of the future economic outlook; a healthy economy and a rosy outlook add incentive to the expectation level created by prices and potential price changes. The following tabulation shows how drilling increases as prices increase: 1/

Year	OPEC price 1/	U.S. price 2/	U.S. well completions 3/
1973	$3.39	$3.89	27,602
1974	11.29	6.74	32,893
1975	11.02	7.56	39,097
1976	11.77	8.14	41,455
1977	12.88	8.57	46,479
1978	12.93	8.96	48,513
1979	18.67	12.51	51,263
1980	30.87	20.89	62,462
1981	34.50	31.77	80,537
1982	33.63	28.52	88,258

1/ Average official sales price per barrel.
2/ Average wellhead price per barrel.
3/ Total, including crude petroleum, natural gas, dry wells, and service wells.

1/ Central Intelligence Agency, Economic and Energy Indicators, Apr. 15, 1983, p. 11; American Petroleum Institute, Basic Petroleum Data Book, September 1982, Sec. VI, Table 1; Independent Petroleum Association of America, U.S. Petroleum Statistics, 1983 Preliminary, p. 2.

In 1982, in spite of a weakening in prices, drilling activity continued at an apparently accelerated rate, up about 10 percent from that of 1981. This has been attributed by observers to continued relatively high price levels and a decrease in the cost of drilling because of lower prices for drilling fluids, pipes and tubes, and other materials. In many instances it has been reported that the decrease in the drilling cost more than offset the expected revenues losses from the decrease in crude petroleum prices with the result that it continued to be economically attractive for petroleum companies to continue to drill. 1/ In addition, it is believed by some that the reported record drilling level in 1982 may be distorted because of statistical reporting delays by the inclusion of wells actually completed in 1981. 2/

Regardless of the actual number of well completions in 1981 versus those completed in 1982, it is a fact that a large surge occurred in these years. Future drilling activity will be closely tied to future price changes; if these changes are in the form of decreases, the future drilling level will depend to a large degree on whether additional drilling savings via operating efficiencies and costs of materials reductions are realized. Further, since natural gas is also obtained by drilling, a strong natural gas market and price would add incentive.

Exploration and development

Exploration and development outlays in total, and broken down by large companies and independents, have generally increased with the increase in crude petroleum prices, as the following tabulation shows (in millions of dollars): 3/

Year	Large companies	Independents	Total
1973	5,275	2,865	8,140
1974	8,550	3,905	13,355
1975	6,830	3,420	10,250
1976	8,646	5,864	14,510
1977	10,305	6,194	16,500
1978	11,275	8,025	19,300
1979	15,000	11,750	26,750
1980	20,553	15,647	36,200
1981	1/	1/	50,000

1/ Not available.

1/ Independent Petroleum Association of America, Report of the Cost Study Committee, Annual Meeting, Dallas, Texas, Oct. 12-15, 1982, p. 1.

2/ "Spending Plans by U.S. Firms 9.5% Less Than Outlay in '82," Oil & Gas Journal, Feb. 28, 1983, p. 40.

3/ Independent Petroleum Association of America, U.S. Petroleum Statistics, 1983, Preliminary, p. 8.

In general, the independents have increasingly accounted for a larger share of total outlays. However, the large companies still lead in offshore and hostile region outlays, including offshore California and Louisiana, and Alaska. 1/

The sizes of exploration and development budgets are largely discretionary for most companies; a company does not have to expend a given amount for exploration and development in any specific year to in order continue to operate. Often these budgets are used to complement the effects that changes in crude petroleum prices could have on the company's financial statements. 2/ Accordingly, the budgets reflect not only what is currently going on, but even more importantly, what future expectations are. A large or expanded future exploration and development budget may not be particularly appropriate if the future is one of supply surplus and soft prices.

Oilfield machinery and equipment

As drilling activity and exploration and development budgets act and react to crude petroleum price levels and changes, the industry supplying the machinery and equipment used in drilling, exploration, and development is affected. 3/ Overall, as the following tabulation indicates, the cost indices of oilfield machinery and oil well casing have increased, but not to the same degree as that of the crude petroleum price throughout the period from 1973 to 1982: 4/

Year	Oilfield machinery	Oilwell casing	Crude petroleum
1967	100.0	100.0	100.0
1973	133.2	133.2	126.0
1974	157.8	170.7	211.8
1975	196.3	211.5	245.7
1976	217.6	223.0	253.6
1977	236.5	244.3	274.2
1978	261.2	271.6	300.1
1979	289.7	285.2	376.4
1980	335.3	327.4	551.6
1981	397.1	406.6	796.2
1982	437.8	451.9	733.7

1/ "Independents Drill 88.4% of U.S. Wells," World Oil, Feb. 15, 1983, p. 121.

2/ "Oilwell Uses EIA Price Model to Anticipate Flat U.S. Drilling Activity Through Mid-'80's," Oil & Gas Journal, Feb. 21, 1983, p. 73.

3/ Oilfield machinery and equipment include such items as drill bits, derricks, drill rigs, drilling tools, pumps, and motors.

4/ Independent Petroleum Association of America, U.S. Petroleum Statistics, 1983, Preliminary, p. 7.

Because of the expectation by most industry observers that there may be little, if any, real upward crude petroleum price movement perhaps through 1985, the oilfield machinery and equipment industry appears to be focusing on the long-term prospects. Under such a scenario, short-to-mid-term exploration and development budgets should stretch further because of possible decreases in the costs of oilfield machinery and equipment. 1/

Other Industries

Transportation

There is little doubt that the transportation industry is sensitive to crude petroleum prices and price changes. Fuels derived from crude petroleum constitute almost all of the energy used in transportation, and in 1982 accounted for 97 percent of the energy used in the U.S. transportation industry. The quantities of transportation fuels consumed are related to their prices.

While the relationship of fuels prices and quantities consumed in the transportation industry is more transparent, the importance of the revenues generated in the transportation industry by moving petroleum should not be overlooked. The world tanker industry went into the doldrums when crude petroleum prices increased. This occurred primarily because conservation caused decreased demand which resulted in lower quantities of petroleum shipped, rather than because of the higher prices for the fuels used to propel the tankers.

During early 1983, U.S. vessels carried between 3 and 4 percent of the bulk cargoes that moved through U.S. ports. Legislation has been proposed again that would gradually increase that percentage, over a period of 15 years, up to 20 percent. Although some experts argue against such legislation because it could raise the cost of shipping, other experts claim it could lead to the construction of 268 ships during the 15 years and mean up to 8,800 U.S. merchant jobs. 2/

Petroleum movement

The location of the world's major crude petroleum production sites does not, by and large, coincide with the location of the world's primary consumption centers. This arrangement results in large quantities of petroleum moving between production and consumption sites by tanker, barge, and pipeline. Between distant nations the primary transportation mode is tanker, whereas within nations or between contiguous nations it is often by barge or pipeline.

1/ "Spending Plans by U.S. Firms 9.5% Less Than Outlay in '82," Oil & Gas Journal, Feb. 28, 1983, p. 40.

2/ "Cargo Bill Still Afloat on Hill," Washington Post, May 7, 1983, p. D10.

During the late 1960's and early 1970's, the world's demand for crude petroleum was increasing rapidly, and it did not appear that it would ever stop. It was during this period that numerous tanker construction programs were started and it seemed each company was trying to outdo the other with ever larger tankers. Very large crude carriers (VLCC's) gave way to the ultra large crude carriers (ULCC's).

A peak year for the tanker industry was 1973. Crude petroleum was priced at about $2.75 per barrel in the Persian Gulf and the average VLCC shipping cost around the Cape of Good Hope to Europe was about $3.15; shipping cost was well above 50 percent of the total cost, insurance, and freight (CIF) price. Then the oil embargo occurred in late 1973 and early 1974 and crude petroleum prices started their rise. In late 1982 crude petroleum was priced around $34.00 per barrel and freight averaged $0.75 per barrel; in spite of the effects of inflation and higher fuels prices, shipping cost decreased to about 2 percent of the total price. 1/

Many factors were involved in bringing about this change. The growth rate of demand not only decreased, but for some nations actually became negative; other sources of energy were used, conservation efforts were effective, and a world economic slowdown started. Other factors that had negative impacts on the tanker industry included the shorter hauls from non-OPEC sources such as Alaska, Mexico, and the North Sea fields vis-a-vis those from the Persian Gulf to the major developed countries; the opening of the Yanbu pipeline in Saudi Arabia which further reduced tanker movements from the Persian Gulf; and a reduction in the use of idle VLCC's for the temporary storage of crude petroleum. 2/ The last factor's effect was to loose additional VLCC capacity onto a market already in an overcapacity status.

As of mid-1982, it was estimated that more than one-half of the commercially owned tanker capacity was surplus and essentially accounted for by the larger tankers. New ship orders have been concentrated in the smaller tanker category (60,000 dwt or below). And, the petroleum-exporting nations, some of which remain interested in building their tanker fleets, are deemphasizing the large crude petroleum tankers and concentrating on smaller petroleum products tankers. 3/

Activity in the construction of specialized carriers, such as liquefied natural gas (LNG) and liquefied petroleum gas (LPG) vessels decreased in 1982. Some nine LNG tankers and 18 LPG vessels are reportedly on order for future delivery.

The future of the tanker business will depend primarily upon what (crude petroleum vs. petroleum products vs. LNG vs. LPG) is shipped, quantities shipped, individual shipment sizes, and the routes involved. Some see the road back for the tanker industry as being long. 4/ However, if world petroleum demand growth approaches pre-Arab oil embargo rates, and if, as a

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1/ "The Tide May Be On The Turn," Petroleum Economist, October 1982, p. 402.
2/ Ibid.
3/ Ibid.
4/ Ibid., p. 401.

recent study indicated, significant price increases and market disruptions do occur, a more rapid tanker industry recovery is possible. 1/

Fuels prices

The prices of fuels directly affect the cost of almost all modes of transportation, whether it be movement of freight or passengers. And, as the price of crude petroleum has changed in the period since 1973, so too has the price of fuels; the following tabulation contains price data for the United States during 1973-83 (in cents per gallon): 2/

Year	Motor gasoline	Kerosene	Light fuel oil	Heavy fuel oil	Average of 4 products	Crude petroleum 1/
1973-----	14.72	14.08	12.61	8.45	12.49	9.88
1974-----	25.53	24.02	22.57	20.43	23.48	21.60
1975-----	30.27	27.41	26.09	22.03	27.03	24.71
1976-----	33.82	31.67	30.38	21.66	29.55	25.93
1977-----	36.99	35.81	34.41	25.87	33.21	28.48
1978-----	39.22	37.23	35.66	23.00	33.72	29.67
1979-----	56.84	56.60	54.47	33.63	49.50	42.19
1980-----	87.40	80.26	78.21	44.43	72.77	66.83
1981-----	101.63	101.03	97.20	61.17	88.75	83.90
1982-----	92.90	97.18	91.95	57.80	82.44	75.88
1983 2/--	84.48	85.12	80.09	57.04	75.62	62.26

1/ Refiner acquisition cost of crude petroleum.
2/ Estimates based on data through October.

The effect of the increases in fuels prices has been a slower rate of growth in energy consumption in the transportation industry. Throughout the period from 1965 to 1973, the growth rate averaged 5.2 percent annually; for the period 1973 to 1981 the growth rate averaged 0.5 percent annually. 3/ This decreased rate of growth was the result, in part, of both a decrease in annual miles traveled per vehicle and gallons of fuel consumed annually per vehicle, as shown in the following tabulation: 4/

	Distance (miles)	Amount (gallons)
1965----------	9,890	775
1973----------	10,080	851
1980----------	9,410	711

1/ International Energy Agency, World Energy Outlook, 1982, p. 13.
2/ Independent Petroleum Association of America, IPAA Wholesale Prices, November 1983, p. 1; and U.S. Department of Energy, Energy Information Agency, Monthly Energy Review, April 1983, p. 82.
3/ U.S. Department of Energy, 1981 Annual Report to Congress, May 1982, p. 9.
4/ Ibid., p. 191.

Mechanical improvements in engine and drive train components, coupled with body design changes, are expected to increase the average road miles per gallon of new cars and trucks from the present 18 miles per gallon to around 26 miles per gallon by the year 2000. The result will be an increase in the average for the entire U.S. vehicle population in road miles per gallon until at least the year 2010. Transportation sector fuels demand is forecast to decline until the mid-1990's. 1/

Other Energy-Source Industries

The major use of petroleum is as a source of energy, although it is also used as a petrochemical feedstock and to make lubricants, paving materials, wax, coke for electrodes, and other miscellaneous items not usually used as fuels. Since its prime use is as a source of energy, all other sources of energy are, or could potentially be, competitors of petroleum for most energy markets.

Studies of future energy requirements usually differ not only on total future demand, but also on the percent of the total future demand to be satisfied by petroleum, natural gas, coal, nuclear, and other energy sources, such as geothermal, hydropower, solar, and biomass. Changes in the relative prices of these fuels not only impact total energy demand, but also the distribution of how that total energy demand is supplied by the various energy sources.

Changes in the relative prices of the different energy sources often also affect the research and development (R. & D.) efforts associated with the different sources. For example, low petroleum prices usually decrease crude petroleum exploration and development activities and vice versa. In addition, changes in the prices of the conventional energy sources 2/ usually directly impact the efforts expended on the development of unconventional energy sources. 3/

The costs of production for the various energy sources differ. In general, sources with costs much above those of other energy sources cannot effectively compete on the basis of price in the marketplace; this assumes the higher cost sources receive no special consideration. The following tabulation

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1/ U.S. Department of Energy, Energy Projections to the Year 2010, October 1983, pp. 1-12.

2/ The term conventional energy source usually means petroleum, natural gas, coal and such other energy sources available at prices which make them directly competitive. Thus hydropower, nuclear, or wood could be conventional energy sources in certain nations,

3/ The term unconventional energy source usually means the newer energy sources such as oil shale, tar sands, heavy oils, coal gasification and liquefaction, geopressurized natural gas, wind, biomass other than wood, solar, certain types of geothermal resources, and other sources usually at the leading edge of technology and/or uneconomic when compared with conventional energy sources.

compares certain unconventional energy source prices, which include a 15-percent return on investment after taxes (in constant 1979 dollars): 1/

Energy source	Price 1/	
	Dollar per barrel of petroleum equivalent	Dollars per million Btu's
Tar sands	$17	$2.80
Oil sands	23	3.80
Oil shale	22	3.70
Coal gasification	$48-56	$8.00-9.30
Coal liquefaction	44	7.30
Biomass:		
Methanol	28-42	10.00-10.00
Ethanol	33-48	10.00-15.00
Fuel gas	60-90	10.00-15.00

1/ Equal to energy source production cost plus a 15 percent return on investment after taxes.

If the prices from the previous tabulation are compared with those of conventional energy sources, it is apparent that they are higher. The following tabulation contains actual 1979 prices for certain conventional energy sources: 2/

Energy source	Price
U.S. refiner acquisition cost of crude petroleum:	
Domestic production---per barrel--	$14.27
Imported---do----	21.67
Natural gas:	
Averaged wellhead value---per 1,000 cubic feet----	1.18
Delivered to electric plants---per million BTU--	1.75
Coal: Delived to electric plants---do----	1.22

1/ Approximately equal to one million Btu.

Whereas the above data are in terms of 1979 dollars, the relationships between prices are approximately the same in 1983. Even though natural gas, crude petroleum, and coal prices are higher, so too are the production costs for the alternative energy sources.

1/ "Push to Produce Synfuels Becomes Worldwide Effort," International Petroleum Encyclopedia, 1981, p. 11.

2/ U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, April 1983, pp. 82, 91, 92.

Unless a currently unforeseen revolutionary breakthrough occurs in synthetic fuels or for renewable energy resource technologies, and/or a significant conventional energy supply disruption happens, the prices of unconventional energy sources could remain sufficiently above the prices of conventional energy sources to preclude their widespread market use and possibly even diminish interest in these unconventional sources of energy. As the world petroleum market has softened resulting in lower prices, private development efforts of the unconventional energy sources have decreased and certain programs have actually been terminated. 1/ It has been stated that regardless of how low unconventional energy sources may be priced, OPEC crude petroleum will always be lower priced to remain competitive. 2/

As crude petroleum prices rise, commercial interest in other energy sources increases. However, the concern expressed by some industry observers is that on-again, off-again R. & D. efforts in unconventional energy sources are at best inefficient. And, since it appears that some alternate energy sources will be required sooner or later to replace exhausted fossil fuel sources, continuous efforts would appear to be desirable. A leading industrial figure has said that "The dilemma . . . is how to plan for the long run in the face of uncertainties." 3/

Various mechanisms have been, and are being, studied and used to help insulate efforts in unconventional energy sources from the fluctuations in petroleum prices. The most common mechanisms are U.S. Government R. & D. and other programs, price supports and guaranteed prices, and loan guarantees. 4/ It has also been suggested that international cooperation in R. & D. on alternate energy sources by the petroleum-importing nations could be beneficial. 5/ Such efforts would reduce costs and share the risks.

Other observers have suggested that the real cost of imported petroleum is two to three times $29 per barrel. This would indicate that some unconventional energy sources could be competitive even now. According to these observers, the real cost of imported petroleum should be determined by assigning costs to the sometimes intangible economic effects associated with petroleum imports such as balance of trade. 6/

Renewable energy sources, such as hydropower, geothermal, solar, and biomass conversion, have often been promoted as the energy sources of the future. One of the apparent attractions of these sources has been the expectation that these energy sources were "environmentally benign." It now

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1/ "U.S. Synfuels Industry: Alive and Shrinking," Chemical Business, Oct. 18, 1982, pp. 29-34.

2/ "Synthetic Fuels Program in U.S. has Fatter Yielded Little Output", Chemical & Engineering News, Oct. 10, 1983, p. 11.

3/ "Uncertainty, Cost/Price Squeeze Hit Fledgling Synfuels Industry," Oil & Gas Journal, May 24, 1982, p. 24.

4/ op. cit.

5/ Energy Users Report, May 5, 1983, p. 461.

6/ "Synthetic Fuels Program in U.S. has Faltered, Yielded Little Cutput," Chemical & Engineering News, Oct. 10, 1983, p. 12.

appears probable that the use of most any energy source holds the potential of adverse ecological consequences. 1/

CERTAIN OTHER EFFECTS OF CRUDE PETROLEUM PRICE CHANGES

The ubiquitous nature of petroleum often results in crude petroleum price changes impacting certain industries and institutions that may appear to be far removed. Previous sections gave some insight into the impact of price changes on particular trade practices, products, industries, and institutions for which the connection to crude petroleum is perhaps more obvious. However, there are other areas and issues, certain of which are discussed in this section, that may also be significantly affected by crude petroleum price changes. These include government revenues and taxes, environment, and the market in petroleum futures. Depending upon one's viewpoint, one or more of these items may be at least as important as any of those previously discussed. For example, the reaction by the Government to the loss of government revenue may lead to cuts in services or increases in taxes.

Government Revenues

All levels of government are recipients of revenues that are affected in some way by changes in petroleum prices. It has been said that each one dollar per barrel rise in crude petroleum prices increases the U.S. Federal deficit by about $1 billion. On the other hand, although the U.S. economy in general benefits from reduced crude petroleum prices, Federal and State Governments incur losses in revenue. 2/ This latter scenario results from the overall effects petroleum price changes have on such items as inflation rates, markets, investment, and interest rates, and the relationships between these items and sources of government revenue. While the relationships of some of these factors to revenues may be considered circuitous by some observers, there are other revenue mechanisms where the relationships to energy prices, or more particularly to petroleum prices, are more direct and maybe even obvious. Certain of these sources of government revenues are further treated in this section. Discussed are certain of the newer energy and petroleum taxes that have been and are being considered, not only in the United States, but also in other nations, as well.

Taxes on crude petroleum and petroleum products and operations at the Federal, State, and local levels raise significant revenues. They are also important in the assessment of the economic worth of energy sources, including petroleum. And, while Federal and other State and local government taxes are discussed separately in this report they are not mutually exclusive, but very

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1/ Ibid., p. 11.

2/ "Feldstein Says Decline in Price of Crude Oil Could Alter Energy Tax," Washington Post, Feb. 28, 1983, p. A2.

much interrelated. 1/ Often increases in taxes at one level will reduce tax revenues at another level.

In general, taxes are of two types: those that tax income and those that tax assets. The impact of a tax is basically determined by two factors. The first factor is the rate of taxation; the higher the rate the greater the impact. The second factor is the point at which the tax is applied; for an ad valorem tax, the higher the value of an item at the time the tax is applied, the greater the impact of the tax. 2/ For example, the same ad valorem tax if applied to petroleum products will have a greater impact than if applied to crude petroleum, essentially because of the difference in values.

The following illustration shows how the various taxes (which are underlined) and other costs impact the cash flow of a typical energy source producer: 3/

- Revenues:
  Minus operating costs,
  Minus depreciation,
  Minus royalties,
  Minus property taxes,
  equals,
- Before tax income:
  Minus depletion,
  Minus severance taxes,
  Minus tax loss carried forward,
  equals,
- Taxable income:
  Minus State income tax,
  Minus Federal income tax,
  Plus tax adjustments,
  equals,
- Net income:
  Plus depreciation,
  Plus depletion,
  Plus deferred deductions,
  Minus equity investment,
  equals,
- Cash flow

1/ American Mining Congress, Methods of Analysis and Impact of Mineral Tax Law, Bureau of Mines Technology Transfer Seminar held in association with the American Mining Congress, Washington, D.C., June 14, 1983, p. 22.
2/ Ibid.
3/ Ibid., fig. 18.

Federal Level

Federal level taxes affecting the energy sector, including crude petroleum and petroleum products, are the income tax and several other more specific taxes of which the most significant, at least in terms of dollars, is probably the Windfall Profits Tax.

In addition to the current federal taxes, certain additional federal level taxes have received wide media coverage. These taxes are primarily intended to encourge continued conservation, to increase domestic energy source production, and to raise federal revenues.

Certain current taxes

Federal fuel and related taxes are levied on a number of items; although the revenues usually go into the general fund, in some cases the revenues generated are earmarked for specific purposes. For example, from July 1, 1970 to September 30, 1980, a number of aviation excise taxes funded the Airport and Airway Trust Fund until October 1, 1980. 1/

Of the 15 current Federal excise taxes, 10 are on fuels or closely related areas. The following tabulation lists the five federal excise taxes directly imposed on petroleum and estimates of 1983 revenues (in millions of dollars): 2/

Item	Value
Windfall Profits Tax------	21,275
Gasoline Manufacturers Tax----------	3,958
Diesel, Special Motor Fuels Tax----------	613
Heavy Motor Vehicles Tax--	270
Lubricating Oils Tax------	105
Total----------	26,221

In addition, there are five Federal excise taxes in closely related areas. The following tabulation lists these taxes and estimates of 1983 revenues (in millions of dollars): 3/

1/ U.S. Congress, Committee on Finance, Subcommittee on Energy and Agricultural Taxation, Energy Tax Options, June 9, 1982, p. 7.
2/ Ibid., p. 256.
3/ Ibid.

	Value
Airline Passenger, Freight Tax	1,458
Truck, Bus, Chassis, Bodies Tax	1,184
Tires, Tubes, Rubber Tax	662
Black Lung Coal Tax	612
Truck, Bus Accessories Tax	270
Total	4,186

Certain of these taxes are analyzed further and the possible effects on each of changing crude petroleum prices is discussed in the following sections. The Windfall Profits Tax is highlighted because of its importance; of all of the revenues expected to be obtained in 1983 from the Federal taxes in the previous tabulations, the Windfall Profits Tax revenue is estimated to account for approximately 70 percent.

Fuel and related taxes currently in effect may be affected by changes in crude petroleum prices. Revenues from those taxes imposed as a percent of sales price, or ad valorem taxes, stand to increase as prices rise, unless the higher prices decrease consumption, in which case tax revenues may remain essentially the same or actually decline. Revenues from specific taxes, in cents per gallon or dollars per barrel, decrease as consumption decreases; unless the specific rate is changed, there is no possible offsetting effect such as in the case of ad valorem taxes.

The present law covers the following Federal fuel and related taxes: Highway Trust Fund Taxes, Fuel Efficiency Taxes, Import Fee Authority, Inland Waterways Fuel Tax, Aviation Excise Taxes, Superfund Taxes, and Black Lung Excise Tax on coal. 1/

Windfall Profits Tax.--The Windfall Profits Tax was implemented in the Spring of 1980 with passage of the Crude Oil Windfall Profits Tax Act. It was primarily designed to transfer to the Government from the private sector some of the expected profits resulting from the elimination of crude petroleum price controls.

Provisions.--The act established three categories of crude petroleum: 2/

1. Tier one - All crude petroleum except that properly classified in either of the other tiers.

2. Tier two - Crude petroleum produced from wells at a rate of less than 10 barrels per day and that produced from the Naval Petroleum Reserve.

1/ U.S. Congress, Committee on Finance, Subcommittee on Energy and Agricultural Taxation, Energy Tax Options, June 9, 1982, pp. 6-7.

2/ U.S. Congress, Congressional Budget Office, Analysis of Special Tax Provisions Affecting Independent Oil and Gas Producers, May 1983, p. 20.

3. Tier three - Crude petroleum produced from properties developed after 1978, heavy oil, and incremental tertiary crude petroleum.

The standard percent tax rates specified by law for these tiers are 1/--

Tier	Rate 1/
One	70
Two	50
Three	30 2/

1/ Percent of the windfall profits where windfall profit is defined as the difference between the market wellhead price and the 1979 controlled price indexed to reflect changes in the GNP deflator.

2/ The Economic Recovery Act of 1981 initiated a scheduled reduction in rate; the 1983 rate is 25 percent and it is scheduled to reach 15 percent in 1986.

Revenue estimates.--The estimate at the time of passage of the act of 10-year net revenues was $227 billion. By the spring of 1983, the estimate had been reduced to $75 billion, principally because of changes in crude petroleum prices. The following tabulation contains estimates of gross Windfall Profits Tax revenue and the Windfall Profits Tax net Federal Government budget effect (in millions of dollars): 2/

Source	1980	1981	1982	1983	1984	1985	1986	1987	1988
Gross	9,826	25,842	16,506	13,359	12,021	11,094	10,201	9,679	8,991
Net	4,719	13,545	8,778	7,204	6,473	5,896	5,374	5,052	4,687

The differences between the two lines of figures in the previous tabulation are primarily due to reduction in income taxes due to the deductability of the Windfall Profits Tax, as well as income tax credits for excess payments of Windfall Profits Tax.

It has been reported that Tier One crude petroleum production accounted for the largest share of both taxable production and tax liability in 1981 as shown in the following tabulation: 3/

1/ Ibid., p. 21.

2/ John H. Jennrich, "U.S. Windfall Profits' Tax Seen Falling $152 Billion Short of Target," Oil & Gas Journal, Mar. 7, 1983, p. 29.

3/ U.S. Congress, Congressional Budget Office, Analysis of Special Tax Provisions Affecting Independent Oil and Gas Producers, May 1983, p. 22.

Tier	Share of taxable production	Share of Windfall Profits Tax liability
One----------	70.3	82.0
Two----------	13.1	11.2
Three----------	16.6	6.8
Total------	100.0	100.0

The U.S. Supreme Court unanimously upheld the constitutionality of the Windfall Profits Tax on June 6, 1983. It had been challenged on the grounds that since it exempts certain Alaskan crude petroleum production from the tax, it violates the constitutional provision requiring that Federal taxes be uniformly applied to all states. 1/

Future.--It has been estimated that for each decrease in price of $1 per barrel, a petroleum company loses about 15 cents; while the local, state, and Federal Governments lose the balance. This effect would be expected by the experts to remain true down to the $18 to $20 per barrel price range. Lost Federal revenue could be regained by boosting the excise tax rates or the imposition of one or more of the additional taxes discussed in the U.S. Congress, newspapers, and trade press. 2/

It has also been claimed that although the tax raises revenues, albeit less than originally estimated, it has negative energy effects. Investment in exploration, development, and production should be lower with the tax than without the tax, resulting in lower current and future production of domestic crude petroleum. The same study also pointed out that since the tax, which started in March 1980, is scheduled to undergo a 33-month phaseout beginning no later than January 1, 1991, the rate of production in future years could be slowed as the termination date draws nearer. Producers are scheduled to pay another 3 percent less tax each successive month during the phaseout period. 3/

Highway Trust Fund.--The Highway Trust Fund obtains its revenue from taxes on sales of gasoline, diesel fuel, other motor fuels, lubricating oils, tires and tubes, tread rubber, trucks and trailers, truck parts and accessories, and use of heavy motor vehicles. 4/ Possible new taxes on gasoline and other motor fuels are discussed in a later section of this report. New taxes could be structured as an increase in present Highway Trust Fund taxes or in an entirely different manner, hence one of the reasons for separating discussions of current and possible new taxes.

1/ Fred Barbash, "Supreme Court Upholds Windfall Oil Profits Tax," Washington Post, June 7, 1983, p. A1.

2/ "Uncertainty, Cost/Price Squeeze Hit Fledgling Synfuels Industry," Oil & Gas Journal, May 24, 1982, p. 28 and 29.

3/ "EIA Study Decries Windfall Tax," Platt's Oilgram News, May 31, 1983, p. 6.

4/ Ibid., p. 6.

Fuel Efficiency Taxes.--There are Federal programs designed to promote automobile fuel efficiency. 1/ One program is concerned with the average miles per gallon achieved by the total automobile population, or fleet, produced by a manufacturer in a specific year. A second program is concerned with the average miles per gallon achieved by individual automobile models. Failure to meet either results in a tax penalty which normally would be passed on to the automobile purchasers by the manufacturers.

The fleet mileage requirements have thus far been met by U.S. automobile manufacturers; however, some have reportedly had to use credits earned earlier in the program to offset recent fleet deficiencies. The fleet requirement for 1983 is 26 miles per gallon. It is scheduled to increase to 27 miles per gallon in 1984, and to 27.5 miles per gallon by 1985.

The individual model miles per gallon requirements are flexible. For the 1984 model year, for example, all models achieving below 12.5 miles per gallon are subject to a $2,150 tax per automobile, whereas those models failing to achieve 19.5 miles per gallon are subject to a $450 tax. The tax is graduated upwards between the 19.5 and 12.5 miles per gallon levels. Tax receipts have been estimated at $1.7 million for FY 1982. 2/

MOIP fee.--Presidential Proclamation No. 4210, dated April 18, 1973, established a system of fees for licenses covering imports; this action was taken by the President under section 232 of the Trade Expansion Act of 1962, as amended. The fee system was a part of the MOIP established by Presidential Proclamation No. 3279, dated March 10, 1959. From its inception and until the switch to a license fee, the MOIP utilized a quota. A zero fee is currently in effect and scheduled to remain in effect indefinitely; however, importers are required to observe all of the requirements of Presidential Proclamation No. 3279, as amended. 3/

Inland Waterways Fuel Tax.--Diesel and other liquid fuels used on inland and intracoastal waterways by commercial cargo vessels are subject to this tax. The tax was 6 cents per gallon through September 30, 1983; on October 1, 1983 it increased to 8 cents per gallon and is scheduled to increase further on October 1, 1985, to 10 cents per gallon.

Aviation excise taxes.--Excise taxes currently exist at a 5-percent level on domestic air passenger tickets and at a 4-cent-per-gallon level on gasoline used in general aviation. In addition, excise taxes on aircraft tires and tubes are collected.

Superfund taxes.--The Superfund Tax is used to collect revenue for the Hazardous Substance Response Trust Fund. The burden of the tax is claimed by chemical industry observers to primarily fall on the petrochemical industry;

1/ Motor Vehicle Information and Cost Savings Act, amended by The Energy Policy and Conservation Act of 1975 (PL 94-163); Automobile Fuel Efficiency Act of 1980 (PL 96-425); Energy Tax Act of 1978 (PL 95-618).

2/"Gas Guzzler Tax Closes in on Domestic Car Producers," Ward's Automobile Reports, Oct. 24, 1983, p. 1; also comments of Automobile Manufacturers Association.

3/ 45 F.R. 85817.

alternatives to spread the tax base have been and are being considered. A method of expanding the tax base would be to base the tax on the disposition of hazardous waste that all industries must dispose of rather than primarily on petrochemical industry feedstocks. 1/ Under consideration is a simplified proposal that such waste would be divided into toxic and nontoxic hazardous waste; certain nontoxic waste could be classified as hazardous waste because of specific properties such as explosiveness and corrosiveness. 2/

Black Lung Excise Tax on coal.--The Black Lung Disability Trust Fund receives revenue from an excise tax on domestically mined coal, except liqnite. The tax rate formula precribes a tax as the lesser of (1) $1 per ton for underground mined coal and $0.50 per ton for surface-mined coal or (2) 4 percent of the sales price of the coal. 3/

Possible future taxes

While the national economy benefits from crude petroleum price decreases, a sustained decline "would require a top-to-bottom reassessment of . . . energy tax policies." Such would be the case because a decline in price to less than $25 per barrel "will have a very substantial effect on the entire taxation of energy in this country." The tax changes would either increase revenues, and/or protect conservation gains. 4/ Some observers have argued that energy taxes do a poor job of increasing revenues vis-a-vis other taxes, such as the income tax. 5/

Although some of the taxes previously mentioned, such as the Windfall Profits Tax, could be changed, industry observers' speculation has centered on different methods. Attention has been focusing on a Btu tax, 6/ an ad valorem energy tax, an import fee on crude petroleum and petroleum products, a tax on domestic crude petroleum consumption, additional taxes on gasoline and other motor fuels to go either to the Highway Trust Fund as current revenues do, or into the Treasury's general fund. 7/ It is interesting to note, the United States has not been alone in considering new and/or higher taxes on petroleum and/or energy. The European Community has often been reported to be considering several schemes designed to maintain conservation, including an

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1/ "Superfund Will Need More Money to Continue Cleanup Work," Chemical & Engineering News, Nov. 28, 1983, p. 15.

2/ "CMA Says Superfund Burden Should Be More Widely Shared," Chemical Marketing Reporter May 30, 1983, p. 3.

3/ U.S. Congress, Committee on Finance, Subcommittee on Energy and Agricultural Taxation, Energy Tax Options, June 9, 1982, p. 7.

4/ "Cargo Bill Still Afloat on Hill," Washington Post, May 7, 1983, p. D10.

5/ Petrochemical Energy Group, Submission in response to investigation No. 332-161, Possible Effects of Changing World Crude Petroleum Prices, Oct. 25, 1983, p. 4.

6/ Btu is the abreviation for British thermal unit, or the amount of heat required to raise the temperature of one pound of water by one degree Fahrenheit.

7/ U.S. Congress, Committee on Finance, Subcommittee on Energy and Agricultural Taxation, Energy Tax Options, June 9, 1982, pp. 8 and 9.

excise tax on crude petroleum and petroleum product consumption. 1/ It is also known that the EC is looking into an energy consumption tax to finance its 5-year energy program. 2/ The tax reportedly would be limited to petroleum product fuels, hard coal, lignite, gas, and electricity; the more exotic energy sources such as solar energy would not be covered. 3/

Reportedly, the United States has declined to discuss with the European Community the possibility of a tax on energy. The EC Commission had issued a statement indicating that it was worth considering setting a "security net" 4/ which would limit the impact of a potentially drastic price decrease. 5/ Such a price decrease could disrupt conservation plans, alternate energy source development, and international economic stability.

Any energy tax could affect such broad economic indicators as GNP, employment, and inflation. In addition, depending upon the type of tax and its magnitude and application, it could affect certain industries, consumers, energy producers, and States more than others. Any energy tax could, further, impact conservation, energy import dependence, use of any particular energy source, national security, and energy prices. Accordingly it has been stated that there is no best energy tax; the most appropriate energy tax sometimes is defined as that tax which most nearly addresses the pertinent issue(s) of the day. 6/

Some industry leaders are concerned that shortly after crude petroleum prices have been decontrolled, and work is progressing on the elimination of natural gas controls, new energy taxes are being considered. They interpret energy taxes as a first step in the Federal control of energy prices, possibly leading to new Federal energy allocation controls. The histories of the MOIP, or the crude petroleum entitlements program, are used to support this theory. Both programs started with rather clear-cut objectives, but overtime grew in scope and complexity to accommodate various interests. Inevitably, those who argue this point believe the Government, under an expended energy tax system, would again have to decide who gets how much energy, the types, and the prices. 7/

The following tabulation contains estimates of U.S. Federal revenue gains that could be expected from certain options (in billions of dollars): 8/

1/ "Officials Concerned That Lower Prices Could Cause Rethinking of Energy Policies," Energy Users Report, Mar. 10, 1983, p. 284.

2/ "EC Energy-Use Tax Plan Still Alive," Platt's Oilgram News, June 6, 1983, p. 2.

3/ "European Community Commission Urges Tax to be Imposed by EEC on Energy Consumption," Energy Users Report, July 7, 1983, p. 693.

4/ Taken to mean a minimum crude petroleum selling price.

5/ "Reagan Administration Rules Out Talks With EEC Over Tax as Prices Fall," Energy Users Report, Mar. 3, 1983, p. 315.

6/ U.S. Congress, Committee on Energy and Commerce, Subcommittee on Fossil and Synthetic Fuels, Implications of Proposed Taxes, June 15, 1982, p. 31.

7/ U.S. Congress, Committee on Finance, Subcomittee on Energy and Agricultural Taxation, Energy Tax Options, June 9, 1982, pp. 173 and 174.

8/ "Agency Advises Against 'Windfall' Tax on Natural Gas," Oil & Gas Journal, Feb. 28, 1983, p. 55.

Options	1984 to 1988 total
$2-per barrel petroleum import fee	20.4
5-percent tax on domestic energy	88.6
$2-per barrel fee on U.S. and imported petroleum	39.9
30-cents-per-1,000 cubic feet natural gas tax	14.1
5-cents-per-gallon gasoline tax	19.5

As expected, the broad base programs would raise larger revenues. In addition, a broad base program would probably have a relatively equal impact on all industries and sectors of the economy. A narrow base tax, such as one just on natural gas or gasoline, has the potential of impacting particular industries or sectors of the economy more than others.

Btu tax.--A Btu tax would be a tax on the heat content of a fuel. For example, 1 million Btu's are generally accepted 1/ to be contained in 975 cubic feet of natural gas; 0.17 barrels, or 7.2 gallons of crude petroleum; 0.04 tons, or 80 pounds of coal; or 293 kilowatt-hours of electricity, and the consumer of each would pay the same Btu tax. The Btu tax, however, does not take into consideration other properties of the energy source which may greatly influence the true value of the energy source; these properties include the cleanliness of the fuel when burned, and the ease of storing and transporting the fuel.

A Btu tax of about 10 cents per 1 million Btu could raise $5 billion to $6 billion per year. 2/ It is assumed, generally, that a Btu tax would be a domestic consumption tax applicable to domestic production and imports that are domestically consumed but not levied on exports. A Btu tax, further, could be designed to exempt certain energy sources such as the renewable energy sources, including solar and wind energies; it could also be structured so as to exempt other energy sources such as biomass and shale oil.

A Btu tax would encourage the conservation of all energy sources subject to the tax. However, it would affect the various sources differently because of price differences between the different sources. Overall, though, it would not be as effective in promoting the use of alternate energy sources vis-a-vis petroleum as a petroleum import fee. Thus, it would do less to increase the

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1/ The actual heat contents of fossil fuels even within one class, such as natural gas, crude petroleum, and coal, differ depending on the actual composition of the fossil fuel. The data cited are generally accepted approximations.

2/ "Another Round of Taxation Loans Ahead For U.S. HPI, and Oil Companies," Hydrocarbon Processing, March 1983, p. 23.

energy independence and security of the United States and reduce the threat of another petroleum disruption. 1/

A Btu tax would also fall unevenly on the States. Those areas that use the most energy would be the most severely affected.

A Btu tax could also negatively affect U.S. industries' competitiveness, particularly the energy-intensive industries, versus foreign industries not subject to such items. This could be reflected in reduced exports and increased imports.

Particularly affected would be the petrochemical industry which uses energy materials both as sources of energy and as feedstocks. The decrease in the official OPEC crude petroleum price in 1983 and the prospect of still lower energy prices have increased the optimism of many U.S. petrochemical companies that they can remain competitive with new overseas petrochemical facilities having the advantage of below world-level energy and feedstock prices.

Ad valorem energy tax.--An ad valorem tax on energy has many of the advantages and disadvantages of the Btu energy tax, which is also a broadbase energy tax. 2/ However, the ad valorem tax is an excise tax based on value, whereas the Btu tax is based on energy content. It could be argued that an ad valorem tax, since it is a tax on commercial value, would more accurately reflect and tax the true value of an energy source. In addition to Btu content, important in all fuels, the true value of an energy source takes into account such other properties as storage costs and transportation costs which are reflected in the value to which the ad valorem tax would be applied.

A decision to be made if an ad valorem tax is assessed is at what price level should it be levied--the ultimate consumer price, wholesale price, some other middleman price, wellhead price, or some other price. Further, since most fuels are marketed differently, how could comparable price levels be determined so that each energy source is taxed equitably?

Import fee on crude petroleum and petroleum products.--There had been an import fee on petroleum under the MOIP imposed by the President to promote national security. A new fee could be imposed in the same way or by legislation. A fee could be levied exclusively on crude petroleum imports, just petroleum products imports, or both; further the fee could be the same for both crude petroleum and petroleum products, or higher for one or the other. In addition, a fee could be a specific amount per barrel or it could be an ad valorem fee, a percentage applied to the value per barrel. Each fee variation could have different affects on the quantity of imports, domestic crude petroleum and petroleum products production, and domestic and international prices.

1/ U.S. Congress, Committee on Finance, Subcommittee on Energy and Agricultural Taxation, Energy Tax Options, June 9, 1982, p. 107.

2/ The main advantage of a broadbase energy tax versus a tax on one fuel (petroleum, for example) is that since it is applied to many items, the absolute rate can be lower and the same amount of revenue would be raised.

A petroleum import fee would raise petroleum prices leading both to conservation and switching from petroleum to other fuels. The price of domestically produced crude petroleum would increase as would the incentives to produce additional petroleum to the extent that the increases in prices are allowed to remain with the producers, rather than be taxed away. It has been estimated that on the average about one-half of any additional revenues accruing to domestic producers because of higher prices would be absorbed by the Windfall Profits Tax. On the other hand, the Windfall Profits Tax for newly discovered crude petroleum is scheduled to decline to 15 percent by 1986. 1/

It has been stated that a petroleum import fee is neither "wholly good nor wholly bad; there are advantages, disadvantages, and uncertainties that need to be weighed." However, such a fee would create greater incentive for petroleum production and conservation, and alternate energy source development. 2/

The reaction to a petroleum import fee by the petroleum-exporting nations could be a major consideration. It could be perceived by them as an attempt by the implementing nation to limit import demand at the expense of the petroleum-exporting nations. 3/ Indeed, a major petroleum-exporting nation's oil minister has publicly warned against the placing of fees on imported petroleum and threatened a response. 4/

The Congressional Budget Office estimated that a $10 per barrel import fee in 1983 could reduce GNP by 1.4 percent, industrial production by 3.3 percent, and increase unemployment by 0.5 percent. 5/ Both Houses of the U.S. Congress passed resolutions in 1983 indicating their opposition to an imposition of a fee on imported crude petroleum and petroleum products. 6/

Tax on petroleum consumption.--A tax on petroleum consumption would cover both domestically produced and imported petroleum. Its effects would be similar to those of an import fee. Unlike the import fee, however, there would be no additional incentive for increased domestic production.

Tax on gasoline.--In 1932, the first Federal tax on gasoline was imposed at the rate of 1 cent per gallon. The tax reached 4 cents per gallon by 1959 and remained at that level until it was raised 5 cents per gallon to a total of 9 cents per gallon on April 1, 1983. 7/ Gasohol, previously exempted from a Federal tax, is now subject to a 4-cents-per-gallon tax.

1/ U.S. Congress, Committee on Finance, Subcommittee on Energy and Agricultural Taxation, Energy Tax Options, June 9, 1982, p. 10.

2/ U.S. Congress, Committee on Government Operations, Subcommittee on Environment, Energy, and Natural Resources, Oil Import Fee: Its Energy Policy Implications and Consumer Impacts, Apr. 27, 1982, p. 61.

3/ Ibid., p. 63.

4/ "Yamani Warns On Import Fees," Platt's Oilgram News, May 26, 1983, p. 1.

5/ "New Federal Tax On Imported Oil Isn't a Good Idea," Washington Post, May 27, 1983, p. A10.

6/ 98th Cong., 1st sess., S. Res. 52 and H. Res. 24.

7/ Surface Transportation Assistance Act of 1982.

Several states have raised or are considering raising gasoline taxes. However, even with the increases, U.S. gasoline taxes are considerably less than those found in most European nations. In the United Kingdom, for example, 1982 taxes averaged about $1.14 per gallon; and in Italy they averaged approximately $1.84 per gallon. 1/ Currently in the United States, State and Federal taxes average 15 to 20 cents per gallon, depending upon the State.

Although a gasoline tax does raise revenue, it is a less efficient mechanism to encourage conservation than a broader base tax. Further, it does not directly, at least, add to the incentives to develop energy resources. The gasoline tax, however, does encourage less driving and the use of more fuel-efficient cars, and thus increases gasoline conservation. As with all of the energy taxes discussed, there may also be negative effects. Those include the impact of less travel on the motel and restaurant business and a reduction in taxes actually collected, because of curbed driving practices and/or more efficient cars, by States not raising gasoline taxes.

Other proposals.--Also discussed has been a $5 per barrel Federal severance tax that its proponents claim could raise about $20 billion in new revenues. It is possible such a tax would include a provision to "reduce the fiscal disparity between energy-producing and energy-consuming" States by earmarking part of the monies collected for transfer to the nonproducing States. 2/

A Windfall Profits Tax on natural gas has also been placed on a list of tax options. Such a tax could presumably be coupled with price decontrol legislation. Projected revenue is $20 billion per year. 3/

A plan using a $2 per barrel crude petroleum import fee, coupled with other changes, has also been proposed. This proposal would eliminate certain subsidies given to independent crude petroleum and natural gas producers; it would also change the tax provisions such as the more liberal amortization rules and the more favorable percentage depletion allowance which favor the independent producers relative to the integrated companies. Removal of these provisions could increase Federal revenues by an estimated $30 to $40 billion between 1984 and 1988. 4/

State and Local Levels

State and local governments require revenues, most of which are raised by taxes, particularly the income tax and the property tax. Both of these taxes are applicable to the crude petroleum and petroleum products sectors. In addition, other taxes, including a severance tax, are imposed by most States that have resource deposits such as crude petroleum and coal.

3/ "Federal Tax on Gasoline Increased By 5 Cents Per Gallon Starting April 1," Energy Users Report, Apr. 7, 1983, p. 376.

4/ "More Taxes: The Major Concern For Industry in 1983," World Oil, Feb. 15, 1983, p. 26.

5/ Ibid.

4/ "Tax Reform Urged," World Oil, June 1983, p. 13.

A Supreme Court decision that upheld most of an Alabama law that prevented petroleum companies from recouping from customers their increased severance taxes may affect new State tax legislation. Some observers believe this decision will make it easier for States to increase petroleum taxes without obviously affecting its citizens. A possible result would be reduced exploration, development, and production, along with increased reliance on imports. 1/

As in the case of Federal level taxes, those taxes most specifically affecting petroleum will be covered in more detail. In general, an increase in any tax rate will tend to decrease payments of other taxes; the size of the decrease depends upon how the other taxes are calculated. 2/

While a royality is not a tax, it is usually considered a deductible expense when calculating State and Federal income taxes. 3/ It is a payment to the owner of a mineral right, and its method of assessment is often similar to a severance tax and may be on the basis of production, income, or value. Therefore, changes in royalty rates usually affect tax revenues. Further, depending on the method of assessing the royalty, tax revenues may be affected by crude petroleum price changes.

Severance taxes

Severance taxes have been defined as "taxes imposed distinctively on removal of natural products--e.g., oil, gas, other minerals, timber, fish, etc.--from land or water and measured by value or quantity of products removed or sold." It has been said that "any tabulation of severance tax laws is complicated by the fact that some taxes that are not, according to the law, severance taxes nevertheless possess all of their characteristics." 4/

Current status.--Severance taxes have become important sources of many States' revenues and are used for such things as roads and school improvements. The following tabulation shows the percent of certain State's tax revenues accounted for by severance tax revenues for 1981: 5/

1/ "Supreme Court's Okay Doesn't Make Selective Taxation by States Good Law," Oil & Gas Journal, June 20, 1983, p. 1.

2/ American Mining Congress, Methods of Analysis and Impact of Mineral Tax Law, Bureau of Mines Technology Transfer Seminar held in association with the American Mining Congress, Washington, D.C., June 14, 1983, p. 38.

3/ Ibid., p. 26.

4/ "Summary of State Severance Taxes or Minerals as of Jan. 31, 1983," Minerals and Metals: A Bimonthly Survey, February/March 1983, p. 41.

5/ "Watch Out for Increasing State Severance Taxes," World Oil, June 1983, p. 207.

	Severance tax
Alaska	50
Louisiana	29
Wyoming	29
Texas	27
Oklahoma	27
New Mexico	27
North Dakota	23
Montana	21

Future trends.--It has been reported that as many as 25 States have considered, or are considering, some type of increase in the severance taxes on crude petroleum and natural gas. The additional revenues are needed to offset actual or expected deficit spending in some of the States. It is believed by some industry observers that higher severance taxes combined with existing and proposed Federal taxes could impact certain companies and possibly make uneconomic some crude petroleum and natural gas projects. 1/

Two general methods of increasing severance taxes are usually studied. One method is to change the severance tax in those States that charge a specific tax per unit produced to one that taxes on a percent of value produced. Other States already using a percent of value method are investigating increasing the percentages charged.

It has also been reported that some States not benefitting from severance taxes have expressed fears. These States believe that States with severance tax revenues could use these revenues to justify the lowering of other business taxes to attract industry. A severance revenue sharing bill between the States has been proposed and has received consideration. 2/ The previously discussed possible Federal severance tax also attracts support since the revenues would be shared with nonproducing States.

Revenue.--For those States collecting severance taxes based on value, rising crude petroleum prices may mean increasing revenues. However, to the extent that increasing crude petroleum prices cause decreasing consumption, the full revenue expectations may not be met.

Decreasing crude petroleum prices, unless offset by volume increases, may also cause revenue difficulties for those States with ad valorem severance taxes. This situation could be particularly difficult for those States highly dependent upon the severance tax for needed revenue.

Federal income tax regulations recognize the severance tax and certain allowances are made. However, concern exists at the Federal level about the interaction of severance taxes and some Federal tax laws, including the Windfall Profits Tax. The Federal Government has wished to discourage States from raising severance taxes at the expense of the Federal Treasury. 1/

1/ Ibid.

2/ Ibid., p. 210.

3/ U.S. Congress, Committee on Ways and Means, Crude Oil Windfall Profits Tax Act 1979, June 22, 1979, p. 35.

Gasoline taxes

State gasoline taxes have been in the 5-cent-to-12-cent-per-gallon range, and with but two exceptions, are specific rates rather than percentages. Revenues depend primarily on gallons used rather than price per gallon; conservation and decreased consumption negatively affect revenues.

Current status.--From 1978 to 1982, domestic demand for motor gasoline declined from 7.6 million barrels per day to 6.5 million barrels per day, or by almost 15 percent. 1/ Except where offset by higher specific rates, or ad valorem tax rates, States' revenues from gasoline sales also declined by similar percentages.

During this period it has been difficult for most State and local legislatures to raise gasoline taxes. World crude petroleum price increases, particularly between 1979 and 1980, U.S. crude petroleum price decontrol in 1981, and the economic slowdown, have made legislating further increases in the price of motor gasoline a political liability. 2/

Future trends.--Some forecasts of future U.S. highway consumption of motor fuels show a continued downward trend for motor gasoline, as the following tabulation indicates (in thousands of barrels per day): 3/

	Gasoline	Diesel	Total
1984---------	6,300	1,000	7,300
1985---------	6,175	1,047	7,222
1986---------	6,060	1,111	7,171
1987---------	5,965	1,165	7,130
1988---------	5,880	1,214	7,094
1989---------	5,810	1,288	7,098
1990---------	5,750	1,357	7,107

To the extent that motor fuels consumption decreases or falls below previous estimates, revenue realizations will not meet revenue projections. Projected revenues may also be affected by the use of fuels exempted from motor fuels taxes, such as had been the case with gasohol in some States.

Either an increase in the specific tax or conversion to an ad valorem tax could be used to maintain revenues. However, it is usually difficult to raise taxes and motor fuels taxes are no different. It also appears that, historically, it has been relatively easier to increase specific rates than to convert to an ad valorem tax. 4/

1/ U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, May 1983, p. 40.

2/ "The Revenue Train of Using Less Gasoline," Business Week, Mar. 10, 1980, p. 37.

3/ John M. Collins and George H. Unzelman, "Alternatives Available to Meet Diesel Octane Quality Challenge, " Oil & Gas Journal, May 30 1983.

4/ "The Revenue Drain of Using Less Gasoline," Business Week, Mar. 10, 1980, p. 37.

Other taxes

State and local governments often can use additional revenue. From time to time they have studied, or adopted, tax measures that particularly impact crude petroleum and/or petroleum products. Certain of the more recent will be presented.

Gross receipts tax.--New York State on March 28, 1983, enacted into law a 2-percent tax on the gross receipts of the 18 major petroleum companies operating in the State for a period of 3 years. 1/ The tax could be passed on to the consumers by the firms subject to it. The tax was expected to raise $200 million in new revenues for New York State in 1983-84. 2/

However, the gross receipts tax on the State's 18 largest petroleum companies was challenged in the Supreme Court of the State of New York, County of New York, on April 18, 1983; it was claimed to be "discriminatory and unconstitutional" on "several counts," and "violated the Equal Protection Clauses of the Fourteenth Ammendment of the U.S. Constitution and the Bill of Rights of the New York Constitution." 3/

It has been reported that an agreement has been reached between 16 large petroleum companies and the State of New York whereby the 2-percent gross receipts tax will be phased out. 4/

Unitary Tax.--As of mid-1983, some States taxed multinational companies, including petroleum companies, on worldwide income. 5/ It is estimated that the revenues from this tax total $600 million annually. Other States had been considering imposing such a tax but were uncertain as to its legality. 6/ However, the U.S. Supreme Court approved such a tax in June 1983. If all interested States levied the tax, annual State revenues reportedly could exceed $1.2 billion. 7/

The Supreme Court decision caused concern for both the Federal Government and multinational companies. The Federal Government indicated concern over the issue and indicated that the United States should have but "one voice" under the Constitution in international tax affairs, and that voice should belong to the Federal Government. The multinational companies claim the

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1/ "New York Slaps New 2% Receipts Tax on 18 Firms," Oil & Gas Journal, Apr. 11, 1983, p. 52.

2/ "Four Major Oil Companies File Suit Against New York's Gross Receipts Tax," Energy Users Report, Apr. 28, 1983, p. 448.

3/ Ibid.

4/ Bureau of National Affairs, Energy Users Report, July 7, 1983, p. 697.

5/ Company income subject to State tax assessment is determined by a complex formula that takes into account ratios of payroll, sales, and property in the taxing State with the same factors in other States and nations wherein the company has business. "Unitary Tax Panel Staff meets Privately With Interested Parties Before Hearing," Energy Users Report, Nov. 23, 1983, p. 327.

6/ Fred Barbash, "High Court Upholds State Tax on Firms' Overseas Earnings," Washington Post, June 28, 1983, p. A1.

7/ Ibid.

decision subjects them to double taxation. The U.S. Congress has shown interest, and has considered legislation to bar such taxes. 1/

A Commission studying the unitary tax will examine problems encountered by States attempting to tax multinational corporations and foreign policy implications of the tax. Reportedly, policy options are to be developed that respect states' rights and promote international trade. 2/

Market in Petroleum Futures

The trading of commodity-futures has been an established practice for items such as eggs, broiler-chickens, gold, and silver. One of the most recent items to be thus traded is petroleum. Following previous unsuccessful trading efforts in 1974 on the Forward Contract Exchange in Amsterdam and the New York Cotton Exchange, future contracts for No. 2 heating oil were relatively successfully introduced on the New York Mercantile Exchange in November 1978. 3/

Commodity-futures contracts are standard in that each contain quantity, grade or quality, and price, and the place and date of delivery. Changing prices and availabilities are two of the major reasons petroleum-futures markets are developing. Both the buyer and seller in the futures markets seek market positions that will better enable them to plan future operations. For the buyer this ability to plan is increased by being assured of a future supply at a certain price; for the seller this ability to plan is increased by being assured of a future market at a certain price. 4/ It has been stated that although it could take several years for the international petroleum companies to assume a major role, trading in petroleum futures will be important; European companies may have a 4-to-5-year headstart. The same report indicated that futures trading is not "speculative," but a "locking-in of margins," and will increase as management awareness increases. 5/

Petroleum Traders and Markets

In the 1970's, particularly after the Arab-petroleum embargo in 1973-74, the relationships of the international petroleum companies, petroleum-producing nations, and petroleum-consuming nations began changing. In general, the producing nations became more assertive, and the long supply-soft

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1/ Ibid., p. A-5.

2/ "Unitary Tax Panel Holds First Meeting, Names Staff-Level Task Force of Experts," Energy Users Report, Nov. 9, 1983, p. 238.

3/ Jane Jackimczyk, Energy Futures, New York, 1983, p. i; and "Oil Futures Trading: Successes in New York and London," Petroleum Economist, January 1982, p. 9.

4/ William G. Prast and Howard L. Lax, Oil-Futures Markets, Lexington Mass. 1983, pp. 5-9.

5/ "Gulf Oil Official Sees Growing Importance of Futures Market," Platts' Oilgram News, May 27, 1983, p. 2.

price scenarios since 1981 have curbed the growth in the power of the producing nations.

Before the 1970's, the international petroleum market was characterized by inexpensive, abundant petroleum supplies that were essentially controlled by the major international petroleum companies. It has been estimated that in the early 1970's, about 75 percent of all internationally traded crude petroleum under long-term contract was marketed by the major international petroleum companies; this figure decreased to 50 percent by 1978, and to 42 percent in 1981. 1/ At the same time, the ownership by OPEC governments of OPEC petroleum production increased from 2 percent in 1970, to 20 percent in 1973, and from 80 to 90 percent by 1980. 2/ However, by the time the crude petroleum crosses the borders of the major consuming nations, the major international petroleum companies are still often in control. 3/

In general, the last decade has witnessed an increase in the number of players, as well as changes in the roles of certain players involved in international petroleum trade. Certain aspects of these players and their roles are important to the petroleum-futures market. It has been suggested that the large number of players "increased competition and contributes to a higher degree of uncertainty and nervousness." 4/ A major reason for the existence of futures trading is to decrease this uncertainty and nervousness by helping to stabilize prices. 5/

Multinational petroleum companies

The large multinational petroleum companies were instrumental in developing the world petroleum market and international petroleum trade, particularly through the 1950-70 period. It was, to a degree, the success these companies had that helped create OPEC; and OPEC has been a prime instrument in the changes that have taken place in the world petroleum market since 1970. Starting in earnest around 1973, nationalizations and other actions have led to a decline in the stature of the international petroleum companies.

With this loss in stature, the international petroleum companies also lost a share of the supplies previously available to them. Not only do they now have to buy crude petroleum, in many instances, to supply their own needs, but they are now also in most cases no longer supplying their former customers. In addition, the prices at which they now buy are higher than those when they produced their own crude petroleum on a concession or equity basis. This has not only increased their internal costs, but also reduced their incentive to trade with third parties. Thus, there remains the need for additional players and/or expanded and new roles for former players.

1/ U.S. General Accounting Office, The Changing Structure of the International Oil Market, Aug. 11, 1982, p. i.
2/ Ibid., p. 1.
3/ Ibid., p. 2.
4/ Ibid., p. 18.
5/ Prast and Lax, op. cit., p. 77.

OPEC and its member State-owned companies

A part of the activities previously performed by the multinational petroleum companies has been assumed by OPEC and state-owned companies. Essentially, the entire ability to control production and prices previously held by the multinational petroleum companies has been transferred to OPEC and its member State-owned companies. With these changes has come the less rigid world petroleum markets of today compared with the days when the multinational petroleum companies were dominant. The new market structure has increased price instability and market volatility, spot-market operations, and future uncertainty. It has also supplied at least part of the incentive for OPEC and the State-owned companies to consider diversifing into refining, marketing, transportation, and petrochemicals. 1/

Other traders

Aside from the multinational petroleum companies, and OPEC and its member State-owned companies, many more entities are currently involved in the world petroleum market. They include independent petroleum producers, refiners, traders, brokers, and consuming nations, many with their own State-owned petroleum companies.

With the changes in the balance of power between the multinational petroleum companies and OPEC and its member State-owned companies, the opportunities and need for increased trader activity became apparent. Some independent petroleum companies and refiners were thrust into the world market to secure crude petroleum supplies. Certain of the companies have banded together to form buying consortiums. Some entities such as brokers and traders saw the possibilities of enhanced profits.

The petroleum-consuming nations, because of their dependence upon imported crude petroleum for economic health, have taken a number of steps in their attempts to assure future supplies. These steps involve the formation of supranational organizations, such as the International Energy Agency, inventory buildup and management, and increased involvement of Governments. This heightened involvement may also take an indirect form, such as improving the political and economic atmosphere with supplier nations, or a direct form, such as government-to-government negotiations, sometimes effected through national petroleum companies.

Futures Activity

Futures trading in petroleum has started. How it actually develops with time is, of course, unknown. It could wither and die, continue at a low activity level, or become one of the major factors in future world petroleum trade. One trade publication has summarized the situation by stating that although the petroleum futures market is "here to stay . . . continued resistance from the oil industry and end-users means that this [growth] is

1/ Prast and Lax, op. cit., p. 58.

likely to be a slow process." 1/ Some of this resistance has been attributed to an industry that could be concerned about organizations that have historically not been involved in the petroleum industry or trade trying "to muscle in on the action." 2/ In addition, some governments of petroleum-consuming nations may have misgivings about the possible appearance of futures trading as speculation, and certain governments of petroleum-producing nations may have concerns about further erosion of their ability to determine prices. 3/

It has been stated that futures trading in crude petroleum may be blamed by some for price volatility; actually, it is claimed futures markets only reflect price. However, certain issues could be subjects for future study. These include the relationship between the futures market and price and crude petroleum reserve behavior, as well as potential trading and hedging strategies. 4/

Items for futures trading

Futures trading in petroleum can be either in crude petroleum and/or petroleum products. For the successful development of a futures market the following basic requirements are necessary: 5/

- o A market with a large number of buyers and sellers,
- o A standardized product,
- o A fluctuating price,
- o An advantage for both buyers and seller to arrange for the purchase or sale of the item before the time it would actually be consumed, produced, or distributed.

Petroleum products appear to possess characteristics satisfying these requirements. Distillate (No. 2 heating oil) and residual (No. 6 heating oil) fuel oils have been relatively successful items in futures trading. By the third year, heating oil trading volume totaled 932,123 contracts, making it one of the fastest growing markets in the whole U.S. commodities industry. 6/ Other petroleum products are trading or are expected to be trading by 1985.

1/ "Oil Futures Trading: Can New Markets Help Price Stability?," Petroleum Economist, January 1982, pp. 11-12.

2/ "Oil Futures Trading: Successes in New York and London," Petroleum Economist, January 1982, pp. 11-12.

3/ Frank E. Niering, Jr., "Oil Futures Trading: Can New Markets Help Price Stability?," Petroleum Economist, June 1983, p. 227.

4/ "Don't Shoot Crude Price Messenger, 'NYMEX' Treat Says," Platts' Oilgram News, June 10, 1983, p. 1.

5/ Jane Jackimczyk, Energy Futures, New York, 1983, pp. 1 and 2.

6/ Ibid., pp. 1-3.

Initial trading in crude petroleum futures has not been as successful. A 1974 petroleum contract on the New York Cotton Exchange, for example, was unsuccessful primarily because of quality standardization difficulties. Whereas specifications (such as the American Society for Testing Materials Standards) for petroleum products are rather widely used and accepted, such is not the case for crude petroleum. The composition of various crude petroleums, which are natural substances extracted from the earth, vary more widely than the compositions of various petroleum products which are made in different refineries.

The open interest of the crude petroleum futures market, as of October 1983, was estimated to be 12,475 contracts, each representing 1,000 barrels of crude petroleum. The average number of trades per day thus far in 1983 has been approximately 1,500 per day; however, during the month of October, trading increased to nearly 2,000 contracts per day. At the current average world price of $29 per barrel, the value of the outstanding contracts would be $362 million. A representative of the New York Mercantile Exchange has expressed the expectation that the size of the crude petroleum futures market would increase as the world crude petroleum market becomes more volatile.

A crude petroleum futures market does, however, appear to have advantages for both crude petroleum producers and refiners, the primary sellers and buyers of crude petroleum. Significant crude petroleum price fluctuations have reduced the financial flexibility of both to survive future fluctuations; a futures market could reduce the magnitude of future price changes. In addition, a futures market could help assure small and independent refiners of future crude petroleum supplies at known prices. 1/

Status of futures trading

At least five commodity exchanges have traded, are trading, or are expected to trade energy contracts, including crude petroleum and petroleum products such as distillate and residual fuel oils, leaded and unleaded gasolines, gas oil, and liquefied propane. The organizations involved are the New York Mercantile Exchange, New York Cotton Exchange, International Petroleum Exchange (London Commodity Exchange), Chicago Board of Trade, and the Chicago Mercantile Exchange. 2/ Natural gas could be traded as early as January 1, 1985. 3/

Environment

Changes in petroleum prices may have environmental impact implications. Pollutants are associated with the production and use of petroleum as with almost all other energy forms. Hence, an increase in the price of petroleum may cause the decreased use of petroleum but could increase the use of an energy source material considered less environmentally desirable by some

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1/ Ibid., p. 6-1.

2/ Ibid., pp. 1-4.

3/ "Natural Gas Futures Come A Step Closer," Chemical Week, Sept. 26, 1983, p. 54.

observers. On the other hand, a decrease in the price of petroleum could cause an increase in the use of petroleum products. In this context, increased automobile usage because of lower gasoline prices would also be considered by some observers to have a negative environmental impact. These examples are indicative of others; they indicate that a crude petroleum price change generally perceived as good, or bad, may have quite the opposite environmental impact.

The largest fraction, well over one-half, of each barrel of crude petroleum refined in the United States is used as gasoline, jet fuel, and diesel fuel by the transportation sector. Since there is essentially no substitute for these liquid fuels, the transportation sector is directly affected by crude petroleum prices and has no alternate fuels available, at least for the short term. Airlines, bus lines, ships, the travel industry, and others, are in turn affected and in return have effects on the environment. Although any number of cases could be developed, the impact of crude petroleum prices on motor-vehicle size, efficiency, and miles used, and hence ultimately on environment is further analyzed in the following sections.

In addition to motor fuels, other petroleum fuels are also made from crude petroleum. Since in many of their applications these petroleum fuels are more easily (relative to motor fuels) substituted for by other types of fuels, such as coal, changes in crude petroleum prices often prove more difficult to assess impacts on environmental quality. Higher petroleum prices could conceivably cause a switch to other less environmentally desirable sources of energy, thus causing an increase in environmental pollution rather than a decrease in energy usage which would have a positive environmental impact.

Acid Rain

Although acid rain is but one type of pollution, its examination provides some insight into the complex relationship of energy source, pollution, and economic activity. A discussion is included in this report with that end in mind, and does not indicate that acid rain is the only, or foremost, environmental concern.

Definition and occurrence

Certain compounds resulting from the combustion of hydrocarbon fuels enter the atmosphere and cause rainfall to become more acidic, hence, acid rain. The two principal compounds formed are sulfur dioxide and nitrogen oxide. Interestingly, each compound comes primarily from a different source. Sulfur dioxide, now that most petroleum fuels have maximum sulfur content specifications, comes mainly from the burning of coal, particularly those coals with a high sulfur content. Nitrogen oxide comes principally from motor vehicles. It has been stated that there is a direct link between acid rain and emissions. 1/

1/ Cass Peterson, "Acid Rain Tied Directly to Emissions," Washington Post, June 30, 1983, p. A1.

Acid rain may adversely impact forests, soils, crops, nitrogen-fixing plants, drinking water, and buildings. It is a cause of concern not only within some nations, but between certain nations.

Control

Generally viewed, methods to control acid rain fall in either of two categories; the first set of methods attempts to control the emissions that make rain acid, while the second set of methods attempts to control the impact of the acid rain once it falls.

To control emissions, two approaches are used. The first is to remove, or at least reduce, the sulfur content of the fuel. Distillate and residual fuel oils, for example, usually are treated to remove most, if not all, sulfur; alternatively, the crude petroleum used to make these oils can also be treated. The second is to remove part, or all, of the potentially offending emissions from the smoke by the use of stack scrubbers on plants or catalytic converters or mufflers on vehicles.

The impact of acid rain can be at least partially countered by the use of specially treated building materials and coatings. The effect on soil and water can be partially negated through the use of lime or other compounds effective at neutralizing the acid rain.

Implications

Acid rain may impact society both economically and esthetically. It is reported by some observers that electricity bills in certain sections of the United States could rise appreciably, perhaps by 50 percent, if specific programs of acid rain control are adopted; other observers disagree with the upper limit of the possible rise in prices. The principal costs would involve installing stack scrubbers on some coal-burning plants and switching to other energy sources by other coal-burning plants. 1/

Switching of fuels can cause an increase in the price of the new fuel and a decrease in price for the old fuel. This can cause competitive problems for the switchers particularly in those markets where competitors do not operate under similar environmental restrictions; in addition, it may cause concern for the producers of the displaced fuel. For example, a switch from certain high-sulfur-content coals could pose a threat to those companies and States involved in the production of these coals. 2/

The control of emissions from automobiles has increased automobile prices which may influence demand. Further, the effectiveness of catalytic converters or mufflers used to control the emissions is adversely affected by lead additive octane enhancers. The switch to other octane enhancers for use

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1/ "EEI Predicts Rate Hikes Up to 50 Percent if Congress Adopts Pending Acid Rain Bill," Energy Users Report, June 30, 1983, p. 664.

2/ Cass Peterson, op.cit.

in unleaded gasoline, such as toluene and xylene, reduces the quantity of gasoline that can be obtained from a given quantity of crude petroleum. This not only increases crude petroleum consumption, which could lead to a tighter market and higher prices, but also raises the price of gasoline. And again, this could negatively affect automobile sales and/or automobile use which would then affect Government revenues at all levels because of reduced tax receipts.

Motor Vehicles

While motor vehicles can be categorized in various ways, a definition often used includes motorcycles, passenger automobiles, motor trucks, and buses. Of these categories it is generally assumed that the greatest discretion in use is associated with passenger automobiles. Public transportation is often a substitute for passenger automobile travel; alternatively, purely pleasure use of passenger automobiles is not a necessity and may be dispensed with altogether in many instances. However, it should be recognized that a decrease in motor vehicle use, and particularly in purely pleasure automobile travel, can adversely impact State and Federal revenues from fuel taxes, restaurant and fast-food business, and hotel and motel occupancy rates. Nevertheless, because motor-vehicle use does consume large quantities of petroleum, it is sensitive to crude petroleum prices. Some of the effects of this sensitivity are discussed in the following sections.

Automobile size and mileage

Smaller, lighter automobiles do use less motor fuel to travel the same distance compared with larger, heavier automobiles. This fact has been known for some time and is one of the bases behind the widespread use of smaller, lighter automobiles in most of the world's nations for at least the last two decades because of higher motor fuel prices relative to the United States.

It could also be assumed that use of the automobile would also be closely correlated to the price of motor fuel. However, some observers have concluded that motoring habits are relatively inflexible and are not significantly responsive to motor fuel price changes. Consumer demand for motor fuel does depend on motor fuel price, but it also depends on consumer income and motoring habits, as well as automobile efficiency.

The following tabulation contains data relating to passenger automobile usage with motor gasoline and crude petroleum prices: 1/

1/ American Petroleum Institute, Basic Petroleum Data Book, May 1983, Sec. XII, Tables 7 and 7a; Independent Petroleum Association of America, IPAA Wholesale Prices, May 1983, p. 1.

Year	Average miles per passenger automobile	Average miles per gallon	Average motor gasoline wholesale price	Average crude petroleum wholesale price
			----------Per barrel----------	
1973	9,767	13.29	$6.18	$3.89
1974	9,225	13.65	10.72	6.74
1975	9,406	13.74	12.71	7.56
1976	9,535	13.93	14.20	8.14
1977	9,613	14.15	15.54	8.75
1978	9,812	14.26	16.47	9.00
1979	9,245	14.49	23.87	12.64
1980	8,865	15.32	36.71	21.19
1981	8,758	15.71	42.68	31.77

This tabulation indicates that at least partially as a result of the $4.54 per barrel increase in the average motor gasoline wholesale price between 1973 and 1974, the average miles per passenger automobile decreased a little over 5 percent. Thereafter, in 1975-78, average miles per passenger automobile steadily increased to where it was above the 1973 level in 1978, although the average motor gasoline wholesale price increased 167 percent between 1973 and 1978. Presumably, old driving habits were accommodated in spite of the continued price increases. From 1978 to 1981, continued price increases coupled with the economic slowdown in the later years resulted in fewer average miles per passenger automobile each successive year. If old driving habits reassert their influence, industry observers believe the average miles per passenger automobile should show an upward trend as the economy picks up.

Diesel engines

To the extent that less fuel is burned per mile of vehicle use, and less miles are driven, higher crude petroleum prices would tend to decrease vehicle emissions pollution. On the other hand, to the extent that higher crude petroleum prices cause a switch from gasoline to diesel-powered passenger automobiles because of their generally greater fuel efficiency, higher crude petroleum prices would tend to increase vehicle emissions pollution. Particulates emissions from diesel engines are much higher at present than from comparable gasoline engines fitted with catalytic converters or mufflers, although diesel engines do emit less carbon monoxide. 1/

1/ Council on Environmental Quality, Eleventh Annual Environmental Quality Report, Dec. 10, 1980, pp. 212-213.

Other Factors

The industrial, residential, commercial, and electricity sectors, in addition to the transportation sector, are the other principal markets for energy materials to be used as fuels. Some energy materials are not used as fuels, but rather in such nonenergy applications as feedstocks, lubricants, and paving materials. These uses generally do not carry as great an environmental impact potential as fuel uses. However, this does not mean that they are necessarily, or always, benign towards the environment. For example, the disposition of used motor oil or empty plastic soda containers can have negative environmental impacts.

Changes in crude petroleum prices may affect both the level of fuel consumption and the choice of the fuel consumed. Further, the level of consumption is determined not only by the price of the fuel, but also by the actual structure of the sector.

Energy source used

Fuels are usually not exclusively priced on a Btu content basis; further, the price per Btu of fuels varies between the fuels. These facts are partially the result of interfuel competition and the differences, other than Btu content per specified unit, between fuels. The differences between fuels include such factors as physical state, transportation costs, and storage costs, and are capable of making certain fuels more attractive than others. Most often, the more attractive fuels can command price premiums. And, with the increase in environmental concern, "clean burning " fuels are usually considered environmentally attractive and possess a competitive advantage. The following tabulation contains the average retail prices for certain widely used fuels both in terms of value and Btu content using standard conversion factors: 1/

No. 6 fuel oil-------	$29.08 per barrel	$4.62 per million Btu
No. 2 fuel oil-------	49.81 per barrel	8.55 per million Btu
Natural gas----------	3.49 per 1,000 cubic feet	$3.20-3.40 per million Btu
Coal-----------------	40.37 per short ton	1.60-1.75 per million Btu

In general, the tabulation would indicate that coal has the greatest advantage when comparing fuel prices on a Btu basis. However, the burning of coal results in relatively higher stack emissions and the ashes present a waste disposal problem. Both cost money to solve. Stack gas scrubbers can remove undesirable emissions and ashes can be disposed of, but the capital required to accomplish both raises the price per of coal million Btu above the figure in the tabulation and thus closer to the price per million Btu for the competitive energy sources. On the other hand, No. 2 fuel oil would appear to have advantages relative to No. 6 fuel oil which enable it to command a price

1/ U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, May 1983, pp. 82, 83, and 91.

premium on a Btu basis; these advantages include ease of movement and storage. No. 6 fuel oil has a high viscosity and must usually be preheated in storage to permit pumping and again preheated at the burner to assure atomization and complete combustion in the furnace. The price of natural gas may be distorted to a degree by Federal price controls; it is assumed that in a free market the price would be higher, although by how much is open to discussion. Some industry observers believe that if natural gas prices increase sufficiently under decontrol, the industry would be prompted to convert furnaces from natural gas to petroleum, or other fuels.

Overall, therefore, it appears that the combustion of certain energy sources is environmentally more desirable than the combustion of others. However, many factors influence the price of energy sources and all energy sources have some degree of environmental impact. If only relatively environmentally clean energy sources are used, the environment would probably benefit, but the prices for these sources would increase and the results of a cost-benefit analysis would be difficult to assess.

Quantity used

Obviously, the quantity of an energy source used is directly correlated with its environmental impact. No matter what energy source is used, the environment benefits to the degree that less is used. In this regard, recent U.S. energy awareness, to the extent that it resulted in structural changes in energy use which in most cases equates with lower energy consumption, will benefit the environment.

Structural changes in energy use are those changes that will persist even when economic activity increases. It is known, for example, that in OECD countries during the period from 1960 to 1973, every 1-percent increase in gross domestic product (GDP) was associated with a 1-percent increase in energy use. From 1973 to 1981, as the GDP grew at an average annual rate of 2.3 percent, energy consumption grew at only 0.2 percent per year. It appears that the ratio of annual growth rates in GDP to energy use has increased to more than 11 for the latter period versus 1 for the period 1960 to 1973. Less energy consumption is apparently required to support a 1-percent increase in GDP. This lower intensity of energy use is attributed to such factors as new, more efficient industrial processes and motor vehicles, increased building and home insulation, as well as acceptance of lower winter and higher summer temperatures in buildings and homes. 1/

What share of this apparent change in linkage between economic activity and energy use is due to structural change that would not be reversed, at least to some degree, by lower energy prices is unknown and often discussed by the experts. Presumably insulation, for example, would not be taken out of buildings and homes if energy prices decreased. But to what degree would the consumers still be willing to tolerate lower winter and higher summer temperatures in buildings and homes?

1/ International Energy Agency, World Energy Outlook, 1982, p. 69.

It has been argued by some observers that most U.S. energy analysts are in "unfamiliar and unexpected terrain" when attempting to deal with structural energy changes. The average household consumes 20 percent less energy than it did a decade ago; of this figure it is estimated that 60 percent may be structural and perhaps permanent. 1/

To the extent that higher crude petroleum prices lead to reduced energy consumption due to structural changes, the environment benefits. To the extent that higher prices cause switching to relatively less environmentally benign fuels, the environment suffers.

WORLD CRUDE PETROLEUM SUPPLY AND DEMAND

After a period of relative scarcity and rising prices, the world crude petroleum market appears to be entering a situation of surplus coupled with decreasing prices. The current surplus of crude petroleum is, in part, attributable to the two major price shocks of the 1970's, which resulted in an effort by the crude petroleum importing countries to initiate conservation programs and/or switch to alternative fuels.

The price increases in 1973-74 resulted from embargos imposed by the Arab crude petroleum producing nations. In 1979-80, price increases followed the political instability in Iran and the subsequent reduction of Iranian crude petroleum exports. As a result of these price shocks, the world price of crude petroleum increased from approximately $4 per barrel in early 1973 to more than $35 per barrel by late 1980. After the outbreak of hostilities between Iran and Iraq, a third price shock was avoided because of slow economic activity within the industrialized world and untapped OPEC production capacity. The world market in 1982 was dominated by a slack market in which production capacity exceeded consumption by nearly 10 million barrels. Subsequently, prices began to fall.

Supply

There are many factors which will determine the availability of crude petroleum supplies in the future. Current proved reserves, exploration, production, and production capacity are all measures of supply, and are affected by the world price of crude petroleum. The remaining world proved reserves 2/ of conventional crude petroleum are about 670 billion barrels, or 29 years of production at current rates of consumption, and recoverable resources of conventional crude petroleum 3/ (including proved reserves) are about two or three times as large. 4/

1/ Proved reserves are defined as remaining conventional reserves proved by producing wells and recoverable with present technology and prices.

2/ "Oil/Gas Specialists View Demand," Platts' Oilgram News, June 15, 1983, p. 4.

3/ These reserves are recoverable using unconventional recovery methods at high development costs.

4/ International Energy Agency, World Energy Outlook, 1982, p. 203.

World proved reserves, which were estimated to be 670 billion barrels in 1983, and recoverable reserves are heavily concentrated, with 55 percent in the Middle East (table 14). The United States only accounts for about 4.4 percent. The U.S.S.R. accounts for about 9 percent, Mexico, 7 percent, and Western Europe, only 3.4 percent (table 15).

Total world crude petroleum production in 1982 was 53 million barrels per day (table 15). Of this total, the United States accounted for 8.7 million barrels per day; Saudi Arabia 5.9 million barrels per day; and the U.S.S.R. 12.4 million barrels per day (table 15). As shown in the following tabulation, the OPEC nations accounted for 39 percent of the total world production of crude petroleum in 1982; the OECD 1/ nations accounted for only 24 percent: 2/

Region	1970	1973	1980	1982
	Percent			
OECD	26.8	22.9	22.9	24.3
OPEC	49.9	54.2	43.8	39.3
Non-OPEC developing nations	6.5	5.2	9.4	10.8
NME's	16.8	17.7	23.9	25.6
Total	100	100	100	100

1/ The members of OECD are: Australia, Austria, Belgium, Canada, Denmark, Finland, France, the Federal Republic of Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, and the United States.

2/ International Energy Agency, World Energy Outlook, 1982, p. 203. op.cit.

Table 14.--Crude petroleum: Estimated proved reserves, as of Jan. 1, 1983

Area	Crude petroleum	
	Reserves	Share of total
	1,000 bbl.	Percent
Asia-Pacific	18,969,400	2.8
Indonesia	9,100,000	1.4
Australia	1,586,000	.2
Western Europe	23,019,480	3.4
Netherlands	308,700	1/
Norway	7,660,000	1.1
United Kingdom	13,150,000	2.0
Middle East	370,100,800	55.2
Abu Dhabi	30,400,000	4.5
Iran	51,000,000	7.6
Iraq	43,000,000	6.4
Kuwait	63,900,000	9.5
Qatar	3,330,000	.5
Saudi Arabia	166,000,000	24.8
Africa	56,907,020	8.5
Algeria	9,220,000	1.4
Libya	21,270,000	3.2
Nigeria	16,550,000	2.5
Western Hemisphere	115,705,900	17.3
Argentina	2,428,700	.4
Brazil	1,800,000	.3
Canada	6,730,000	1.0
Mexico	48,000,000	7.2
United States	27,300,000	4.1
Venezuela	24,850,000	3.7
Communist areas 2/	84,600,000	12.6
Peoples' Republic of China	19,100,000	2.9
U.S.S.R	63,000,000	9.4
World total	669,302,600	-

1/ Less than 0.05 percent.

2/ Includes Albania, Bulgaria, Cuba, Czechoslovakia, East Germany, Hungary, Mongolia, North Korea, Poland, Romania, Vietnam, and Yugoslavia.

Source: "Worldwide Report," Oil & Gas Journal, Dec. 26, 1983, pp. 80-81.

Table 15.--Crude petroleum: Rate of production, productive capacity, and capacity utilization, by country, 1982

Country	Rate of production 1/	Productive capacity 2/	Capacity utilization
	1,000 barrels per day		Percent
OPEC member nations:			
Algeria	700	900	78
Ecuador	215	225	96
Gabon	150	150	100
Indonesia	1,240	1,650	75
Iran	2,200	3/ 5,500	40
Iraq	800	3/ 3,500	23
Kuwait	4/ 769	4/ 2,500	31
Libya	1,300	2,100	62
Nigeria	1,103	2,200	50
Qatar	341	600	57
Saudi Arabia	4/ 5,919	10,000	59
United Arab Emirates:			
Abu Dhabi	800	2,035	39
Dubai	374	370	95
Sharjah	7	10	70
Venezuela	2,000	2,400	83
Other nations:			
Argentina	483	5/	5/
Bahrain	45	5/	5/
Brazil	252	5/	5/
Canada	1,233	5/	5/
Mexico	2,734	5/	5/
Netherlands	28	5/	5/
Norway	488	5/	5/
People's Republic of China	2,050	5/	5/
United Kingdom	2,050	5/	5/
U.S.S.R	12,410	5/	5/
United States	8,655		
World total	53,002	5/	5/

1/ Rate of production as of January 1982, for OPEC member nations and, as of July 1981, for all other nations.

2/ Productive capacity is the maximum production rate that can be sustained for several months; it considers the experience of operating the total system and is generally 90 to 95 percent of installed capacity. This concept does not necessarily reflect the maximum production rate sustainable without damage to the fields. This information is available only for OPEC nations.

3/ Prior to Iran-Iraq war.

4/ Includes 50 percent of production in the Neutral Zone shared by Kuwait and Saudi Arabia.

5/ Not available.

Source: Central Intelligence Agency, Directorate of Intelligence, International Energy Statistical Review, Nov. 30, 1982; "Worldwide Report," Oil & Gas Journal, Dec. 27, 1982; and "Oil Price Cuts, Overproduction Jolt Solidarity Among OPEC Members," Oil & Gas Journal, Nov. 22, 1982, pp. 39-42

Note.--The rates of production among individual OPEC member nations tend to vary in order to maintain a certain level of total OPEC crude petroleum production.

As the OECD's and OPEC's shares of the world's production of crude petroleum declined between 1970 and 1982, there has been an increase in importance of the nonmarket economies (NME's) and the non-OPEC developing nations, such as Mexico, as world suppliers of petroleum.

Future production potential in the OPEC nations is expected to remain relatively stable from 1985 to 2000, although capacity shifts within the group could occur. OECD production potential is expected to decline during the period, and non-OPEC developing nations and the NME's could become major world suppliers of crude petroleum, as shown in the following tabulation: 1/

Region	1980	1985	1990	2000
	Million barrels per day			
OECD	14.9	13.3	11.3	9.7
OPEC	35.6	31.4	29.1	27.9
Non-OPEC developing nations	5.6	7.7	8.3	9.5
NME's	14.8	12.6	10.6	10.5
Total	70.7	65.0	59.3	57.6

OECD

While the OECD nations consumed about 64 percent of the total world supply of energy in the early 1980's, they produced only about 25 percent. Most of the OECD output of crude petroleum originates in North America, primarily the United States. 2/ Europe has only recently become a significant source of supply, since the development of the North Sea resources, however, problems associated with recovering the crude petroleum under the harsh conditions in the North Sea at high production costs have slowed production potential. OECD production potential of crude petroleum in the future is likely to decrease slightly; however, as shown in the following tabulation, the United States should continue to be the leading producer among the nations and Canada's importance should increase slightly: 3/ 4/

1/ International Energy Agency, World Energy Outlook, 1982, p. 214.
2/ Ibid., p. 233.
3/ For information on current U.S. production of crude petroleum and petroleum products, see the section of the study entitled, "U.S. Petroleum Industry Status."
4/ International Energy Agency, World Energy Outlook, 1982, p. 233.

Nation	1985	1990	2000
	Million barrels per day		
United States	9.0-9.8	7.1-9.0	6.0-7.3
Canada	1.2-1.3	1.2-1.5	1.3-1.5
United Kingdom	2.0-2.3	1.7-1.9	1.0-1.6
Norway	.4-.6	.5-.7	.6-1.0
Other Western Europe	.3-.5	.3-.5	.3-.5
Australia/New Zealand	.3-.4	.5-.6	.5-.6
Total	13.2-14.9	11.3-14.2	9.7-12.5

A large portion of Canada's crude petroleum reserves are located in the Western Provinces and are estimated to be 6.7 billion barrels, as of January 1, 1983. Proved reserves of light crude petroleum, more desirable for the production of light petroleum products such as motor gasoline, are estimated to be approximately 5 billion barrels, or approximately 75 percent of the total. 1/

There are also extensive deposits of about 1 billion barrels of crude petroleum in Alberta and Saskatchewan, however, these reserves are difficult and expensive to recover because of climate, terrain, and location in relation to markets. 2/ Also, crude bitumen in oil sands is estimated at more than 1 trillion barrels, but the technological and logistical problems associated with its recovery are formidable, and thus the capital costs would be high. 3/ The following tabulation shows estimated crude petroleum reserves, by region: 4/

Region	Crude petroleum proved reserves
	Million barrels
Western Canada	19,200
Mackenzie-Beaufort	9,400
Arctic Islands	4,300
East coast	7,400

Canadian crude petroleum producton in 1982 totaled approximately 486 million barrels, or 1.2 million barrels per day. As shown in the following tabulation, Alberta accounted for about 87 percent of Canada's petroleum production: 5/

1/ "Worldwide Report," Oil & Gas Journal, Dec. 26, 1983, p. 81.
2/ Ibid.
3/ "Chemical Cooperation in Resources of the North American Continent," Chemical & Engineering News, Sept. 22, 1980, p. 35.
4/ Geological Survey of Canada.
5/ "Worldwide Report," Oil & Gas Journal, Dec. 27, 1982, pp. 105-107.

Province	Average production
	1,000 barrels per day
Alberta	1,068
British Columbia	35
Manitoba	9
Saskatchewan	116
Ontario	2
Northwest Territories	3
Total	1,223

In 1981, production of light crude petroleum totaled 450 million barrels and that of heavy crude petroleum was about 75 million barrels. 1/ Canadian production capacity for crude petroleum from oil sands was about 60 million barrels in 1981. 2/ More than 87 percent of Canada's total production of petroleum comes from Alberta, 13 percent from Saskatchewan, and 4 percent comes from the Northern Territories, Manitoba, Ontario, and New Brunswick.

OPEC

OPEC has often been depicted as one of the most effective cartels in history, able to manipulate crude petroleum prices at will. However, there are tensions within OPEC resulting from the different objectives of the 13 member nations. Political infighting among the OPEC members concerning financial needs has resulted in difficulties in reaching unanimous decisions on production levels and price. 3/ OPEC's production decreased from 31 million barrels per day in 1979 to 19 million barrels per day in late 1982, and to less than 14 million barrels per day in early 1983. 4/

The reasons for the sharper decline in OPEC's petroleum production than in world production are: (1) the increased physical availability of the non-OPEC petroleum supplies throughout this period, and (2) OPEC and non-OPEC producers pursuit of different policies. OPEC's policy was price-oriented, while that of most other producers was volume-oriented. Thus OPEC currently maintains a substantially higher price structure than its non-OPEC competitors, but has lost substantial volume to the latter, most of whom are producing at or near capacity. 5/

Saudi Arabia, the leading OPEC crude petroleum producer, had estimated proved reserves of crude petroleum of 166 billion barrels, or about 25

1/ "Chemical Cooperation in Resources of the North American Continent," Chemical & Engineering News, Sept. 22, 1980, p. 35.
2/ "Newsletter," Oil & Gas Journal, May 25, 1981.
3/ "Its Almost High Noon for a Feuding OPEC," Business Week, Dec. 27, 1982, p. 22.
4/ "The Problems OPEC Can't Solve," Business Week, Mar. 21, 1983, p. 22.
5/ United States Senate, Committee on Energy and Natural Resources, World Outlook-1983, Feb. 21, 1983, p. 347.

percent of the world's total, as of January 1, 1983. 1/ As of this date, Saudi Arabia also has proved reserves of 3 billion barrels in the neutral zone which is shared equally by Saudi Arabia and Kuwait.

In 1983, Saudi Arabia's 555 producing wells had a combined output of approximately 4.9 million barrels per day, representing a 49-percent decrease from the 1981 production of approximately 9.6 million barrels per day. 2/

Saudi Arabia acts as the "swing" producer for the OPEC cartel. In April 1982, it imposed a 7 million barrels per day production ceiling on crude petroleum in response to OPEC's desire to maintain a price of approximately $34 per barrel in the world market. 3/ In early 1983, Saudi Arabia imposed a production ceiling of 5 million barrels per day at a price of $29 per barrel in order to maintain OPEC's share of the world crude petroleum market. 4/

Saudi Arabia has an effective crude petroleum production capacity of 10 million barrels per day 5/ and its four crude petroleum refineries have a combined capacity to process 860,000 barrels per day. 6/ Construction of new refineries, valued at $10 billion, should increase the amount of crude petroleum processed. 7/ This could result in sufficient production of petroleum products to satisfy domestic demand, as well as an increase in Saudi Arabia's potential to export refined products.

Future OPEC production is expected to be influenced by various technical, economic, and political factors. The following tabulation shows OPEC's potential future production capacity (in millions of barrels per day): 8/

1/ "Worldwide Report," Oil & Gas Journal, Dec. 26, 1983, p. 81.
2/ Ibid.
3/ "Economy Vulnerable to Shifts in Oil Market," Financial Times, Apr. 26, 1982, p. II.
4/ "OPEC Cuts Oil to $29, Sets Production Quotas," Washington Post, Mar. 15, 1983, p. A-1; and U.S. Central Intelligence Agency, The World Factbook-1982, p. 20.
5/ "Worldwide Report," Oil & Gas Journal, Dec. 26, 1983, p. 80.
6/ For further information on OPEC's pricing policies, see the section of this report entitled "Price factors."
7/ "Worldwide Report," Oil & Gas Journal, Dec. 27, 1982, p. 78.
8/ International Energy Agency, World Energy Outlook, 1982, p. 246.

Nation	1985	1990	2000
Algeria	0.9	0.6-0.7	0.3-0.4
Ecuador	.1	.1- .2	.1-0.2
Gabon	.1	.1- .2	0-0.1
Indonesia	1.3	.9-1.4	.8-1.2
Iran	4.0	3.6-4.0	3.0-4.0
Iraq	3.5	4.0-4.5	4.0-4.5
Kuwait	2.5	2.4-2.6	2.4-2.6
Libya	2.0	1.5-1.8	1.5-1.8
Neutral Zone	.6	0.4-0.5	.4- .5
Nigeria	2.2	1.6-2.2	1.3-1.6
Qatar	.5	0.2-0.4	.1- .2
Saudi Arabia	9.5-10.5	9.5-11.0	9.5-11.0
United Arab Emirates	2.0- 2.4	2.0-2.4	2.0-2.4
Venezuela	2.4	2.2-2.4	2.4-3.0
Total OPEC	31.6-33.0	29.1-34.3	27.8-33.5

Non-OPEC Developing Nations

Many of the non-OPEC developing nations are heavily dependent upon revenues generated from the exportation of crude petroleum to assist in the development of other segments of their economies. The production potential for the year 2000 for these nations has been forecasted to increase with Mexico continuing to be the major producer. The following tabulation shows the production estimates for some of these nations in 1985, 1990, and 2000 (in millions of barrels per day): 1/

Nation	1985	1990	2000
Latin America:			
Argentina	0.5-0.6	0.5-0.6	0.4-0.6
Brazil	.3	.3-.4	.3-.4
Mexico	3.5-4.0	4.0-5.0	4.5-5.5
Other	.7- .8	.7-1.2	.7-1.5
Africa:			
Egypt	.6-.8	.4-0.8	.4-.6
Other	.5-.7	.6-0.9	7-1.5
Middle East and Asia:			
Oman	0.3	0.3	.3
India	.4-.5	.4-.5	.4-.5
Malaysia	.3-.4	.3-.4	.3-.4
Other	.6-.8	.8-1.0	.8-1.5
Total	7.7-9.2	8.3-11.1	8.8-1.5

1/ Ibid., p. 252.

Of these nations, Mexico has the largest share of crude petroleum production potential. Mexico, with estimated crude petroleum reserves of 48 billion barrels, as of January 1, 1984, ranks fifth in the world behind Saudi Arabia, Kuwait, the U.S.S.R., and Iran. 1/ Mexico had estimated production of 2.7 million barrels per day in 1983 and is the fourth largest producer in the world behind the U.S.S.R., Saudi Arabia, and the United States. 2/

The following tabulation shows Mexico's crude petroleum production by zones: 3/

Zone	Average production (1,000 barrels per day)
North Zone	48
Central Zone:	
Poza Rica	91
N. Falade Oro	6
Veracruz	11
Southern Zone	831
Gulf of Campeche	1,669
Total	2,656

Nonmarket Economies

The NME's have been important in the world petroleum market as both exporters and importers; however, in recent years, net exports from this region have declined slightly and future projections show a decline in petroleum production. The following tabulation shows the future production potential for the U.S.S.R. and China (in millions of barrels per day): 4/

Nation	1985	1990	2000
U.S.S.R	10.5-11.5	9.0-11.0	1/
China	4.0- 6.0	2.3- 3.0	1/
Total	14.5-17.5	11.3-14.0	1/

1/ Not available.

Of the NME's, the U.S.S.R. has the largest reserves of crude petroleum. Estimates of crude petroleum reserves vary widely; the U.S.S.R's official estimates have been classified as State secrets since 1941, in addition to which the estimation method used by the U.S.S.R. differs from that used in the West. Western estimates made between 1975 and 1980 of the U.S.S.F's proved

1/ "Worldwide Report," Oil & Gas Journal, Dec. 26, 1983, p. 80-81.
2/ Ibid., p. 106.
3/ Ibid., pp. 100-101.
4/ Ibid., pp. 258 and 260.

reserves vary from 4.1 billion metric tons to 15.1 billion metric tons. 1/ Estimates indicate that proved crude petroleum reserves for the U.S.S.R. are on a par with those of Saudi Arabia. Both pessimistic and optimistic estimates are viewed skeptically by most Western Europeans, and U.S. industry observers often used figures ranging from 8.6 billion metric tons to 10.3 billion metric tons. 2/

Crude petroleum production has increased during 1960-80 from 148 million tons to 603 million metric tons. Although production increased each year from 1975 to 1980, it did not in any of the years reach the planned production level, as the following tabulation indicates: 3/

Year	Production	
	Actual	Planned
	--Million metric tons--	
1975	491.0	496
1976	519.7	520
1977	546.0	550
1978	571.4	575
1979	586.0	593
1980	603.0	620-640

China is known to have significant reserves of crude petroleum; however, relatively little definitive information is available as to the size of these reserves. This lack of information can be at least partially attributed to Government secrecy, although the historic general lack of exploration activity makes it difficult for anyone to make realistic assessments of Chinese resource potentials. 4/

Although Chinese use of crude petroleum dates from around 3000 B.C., it was only after 1949 that substantial crude petroleum deposits were discovered with the aid of the U.S.S.R., particularly during the period 1949-58. 5/ The large transfer of Soviet technology to China, particularly during the period of the First Five-Year Plan (1953 to 1957), was one of the most important factors in the development of the Chinese petroleum industry. 6/ The Second

1/ U.S. Congress, Joint Economic Committee, Subcommittee on International Trade, Finance, and Security Economics, Energy in Soviet Policy, June 11, 1981, p. 27.
2/ Ibid.
3/ Ibid.
4/ Jeffery Sega, "Need for More Oil Exploration," Petroleum Economist, November 1981, p. 495.
5/ Ibid.
6/ Ibid., p. 477.

Five-Year Plan (1958 to 1962) and "The Great Leap Forward" (1958), during which time Soviet technicians returned home, saw the development of a policy of Chinese self-reliance. 1/ However, the loss of Soviet refinery expertise adversely affected the development of the Chinese refinery industry. 2/ Although the Third Five-Year Plan (1966 to 1970) was suspended by the Cultural Revolution (1966 to 1969), the petroleum industry appears to have suffered little. The period of the Fourth Five-Year plan, or from 1971 to 1975, saw renewed emphasis on self-sufficiency and high technology; numerous technology exchanges were started with the West. 3/ The petroleum industry benefited through the discovery of new fields further east, nearer the population center, and the development of offshore capabilities. 4/ The 1976-85 economic plan called for continued crude petroleum production; however, production has remained relatively stable since 1978, as it appears production from existing fields has ceased to increase, as the following tabulation indicates (in millions of metric tons): 5/

Item	1976	1977	1978	1979	1980	1981
Crude petroleum production	87.0	93.64	104.05	106.15	105.95	1/ 100.20

1/ Estimated.

Demand

There is a close relationship between crude petroleum demand and price. The price increases which occurred between 1973 and 1980 resulted in conservation, fuel switching, and certain structural changes such as research and development of new processes and technologies which would promote energy efficiency. Demand for crude petroleum is also affected by the general economic conditions of consuming nations. World energy demand had, on the average, increased at or near the same rate as the GDP. In 1973 and 1980, there were significant reductions in the amounts of energy required to produce an additional unit of GDP. 6/

OECD

The crude petroleum price increases in 1979 did not immediately affect the economies of the OECD nations. OECD economic growth continued to average about 3.3 percent in 1979, whereas total primary energy demand rose about 2 percent, and crude petroleum consumption increased by about 1 percent. 7/

1/ Ibid., p. 478.
2/ Ibid.
3/ Ibid.
4/ Ibid.
5/ Ibid., p. 483.
6/ International Energy Agency, World Energy Outlook, 1982, pp. 69 and 79.
7/ U.S. Senate, World Petroleum Outlook-1983, Feb. 21, 1983, p. 308.

However, in 1980 and 1981, the OECD's GDP grew by only 1 percent per year while energy demand decreased by 3 percent in 1980 and 2 percent in 1981. Crude petroleum consumption decreased by 8 percent in 1980 and 7 percent in 1981. 1/ The OECD's GDP decreased by 0.5 percent in 1982. Lower economic activity combined with the lingering effects of the 1979 crude petroleum price increases caused energy demand to fall by another 2 percent and crude petroleum consumption to decrease by 5 percent. 2/

It has been suggested that the 1979 crude petroleum price increases resulted in the decoupling of energy demand from economic growth and that the future price differences between petroleum and other sources will be enough to further reduce petroleum consumption. 3/ On the other hand, it has been said that declines in demand are caused by the prolonged recession and that with a recovery, there will be increased capacity utilization by the energy-intensive sectors of the economy which will result in increased consumption. 4/

OECD consumption of crude petroleum declined from 41.4 million barrels per day in 1978 to 34.5 million barrels per day in 1982. 5/ Demand for crude petroleum is expected to decrease slightly in the near term but could increase in the long term while imports are expected to continue to satisfy most of the OECD demand. The following tabulation shows future demand projections for the OECD nations and the share to be satisfied by imports: 6/

Year	Total demand	Demand for imports
	Million barrels per day	
1980	38.7	24.2
1985	35.0-36.0	21.0
1990	34.0-37.0	20.0-24.0
1995	33.0-43.0	18.0-30.0

OPEC

Energy consumption in the OPEC nations is influenced by the rate of future economic growth. During the 1960-73, the OPEC nations experienced growth of 9.2 percent per year compared with 5 percent per year in the OECD and 5.9 percent per year in the non-OPEC developing nations. By 1973-80, economic growth rates had declined to approximately 6.5 percent per year for OPEC and are expected to continue to decline to about 6.3 percent per year by 1985, 5.8 percent by 1990, and 5.5 percent by the year 2000. 7/ The reasons for the possible declines include political uncertainties and foreign exchange shortages resulting from large development projects.

1/ Ibid.
2/ Ibid.
3/ International Energy Agency, World Energy Outlook, 1982, p. 79.
4/ Ibid.
5/ U.S. Senate, World Petroleum Outlook-1983, Feb. 21, 1983, p. 309.
6/ International Energy Agency, World Energy Outlook, 1982, p. 26.
7/ Ibid., p. 160.

It has been estimated that OPEC's demand for crude petroleum will increase as will the per capita consumption of energy in these nations. The following tabulation shows the future projections for crude petroleum consumption and per capita consumption of crude petroleum: 1/

Year	Total demand	Per capita consumption
	Million metric tons	Metric tons
1980	217.3	0.66
1985	308.0-336.0	0.81-0.88
1990	411.0-478.0	0.94-1.10
1995	705.0-855.0	1.28-1.50

Non-OPEC Developing Countries

In order to achieve industrialization goals, the non-OPEC developing countries are expected to show higher economic growth rates than the OECD nations. During 1960-73, the non-OPEC developing nations experienced growth rates of about 6 percent per year, however, between 1973 and 1980, growth declined to about 4.7 percent per year. 2/ Although actual growth rates are expected to remain between 3.5 percent and 4.8 percent in the future, these rates exceed those expected to be experienced by the OECD nations. 3/

While the non-OPEC developing nations represent almost half of the world's population, they account for only about 25 percent of world economic output and 15 percent of the world's commercial energy consumption. 4/ Crude petroleum provides nearly 65 percent of the commercial energy supplies in these nations. 5/

The following tabulation shows possible future demand for crude petroleum and per capita consumption of crude petroleum for the non-OPEC developing nations: 6/

1/ Ibid., p. 162.
2/ Ibid., p. 161.
3/ Ibid.
4/ Ibid., p. 153.
5/ Ibid., p. 154.
6/ Ibid., p. 162.

Year	Total demand	Per capita consumption
	Million metric tons	Metric tons
1980	733.5	0.24
1985	830.0-890.0	0.24- .27
1990	1001.0-1145.0	.24- .27
1995	1615.0-1984.0	.37- .46

Nonmarket Economics

The U.S.S.R. produces about 30 percent of the total NME energy requirement and accounts for more than 50 percent of total energy consumption. Consumption of crude petroleum in the U.S.S.R. increased by about 4.5 percent per year during the period 1973 to 1980, however, increased costs associated with crude petroleum production have led to a switch from crude petroleum to natural gas in an effort to reduce demand. It has been estimated that crude petroleum consumption should only increase from 0.8 percent to 1.5 percent per year by the 1990's. 1/ Any change in the production and consumption of crude petroleum in the U.S.S.R. affects the other NME's as well since 85 percent of their aggregate consumption in 1980 was provided for by exports of crude petroleum from the U.S.S.R. 2/

Consumption of crude petroleum in the U.S.S.R. is expected to increase only slightly and actually decrease as the share of total energy consumed in the future, as shown in the following tabulation: 3/

Year	Production	Consumption	Share of total energy consumed
	Million metric tons		Percent
1980	603	450	37
1985	560-620	480	35
1990	540-620	500-525	32
2000	520-615	510-580	27

1/ International Energy Agency, World Energy Outlook, 1982, p. 187.
2/ Ibid.
3/ Ibid., p. 182.

PRICE FACTORS

The determination of crude petroleum prices is a complex procedure seen by some analysts as a function of an ideal market system. 1/ However, other analysts see it as at least partly arbitrary and determined by a select group of planners. 2/

Such basic market factors as supply, demand, and available productive capacity work together to play major roles in the price determination of crude petroleum. In addition, the price and availability of substitute materials, discovery rates of new resource deposits, technological advances in areas such as enhanced oil recovery techniques (EOR), and the political stability of crude petroleum producing and crude petroleum exporting-nations are all contributing factors to the price determination. 3/

The rate of change of the price of crude petroleum in response to changes in one or more of these factors may be somewhat slower than expected in most true market systems. Since alternative products are not easily substituted, a relatively inelastic short-term relationship exists with the price of crude petroleum and such factors as supply and demand. This relatively inelastic short-term relationship is not carried over into the long term, as changes in the marketplace which have continued and stabilized have usually been effective in altering the price of crude petroleum. 4/ An example of the greater elasticity of the long-term relationship between crude petroleum prices and supply and demand was seen as the worldwide decrease in consumption since 1979 and resulting decrease in demand for crude petroleum created downward pressure on prices in the spot market, and eventually caused a decrease in the OPEC benchmark price of crude petroleum from $34 per barrel to $29 per barrel on March 14, 1983. 5/ During this period, the price of crude petroleum did respond to market pressures, and changes in market structure influenced directional changes in the pricing pattern of crude petroleum. The following tabulation shows how certain changes in market factors would be expected to affect price:

1/ "Analysis of Oil Price Shocks in the MPS Model," Energy Prices, Inflation, and Domestic Activity, M.I.T. Center for Energy Policy Research, 1979, pp. 102-103.

2/ Deagle, Edwin A. Deagle Jr., The Future of the International Oil Market, March 1983, p. 17, and Edward N. Krapels, Pricing Petroleum Products, 1982, pp. 21-35 and 137-139.

3/ U.S. International Trade Commission, Factors Affecting World Petroleum Prices to 1985, USITC Publication 832, September 1977, pp. 12 and 13; and Energy Modeling Forum, World Oil Summary Report, February 1982, pp. 26-48.

4/ Ibid.

5/ "OPEC Cuts Oil to $29, Sets Production Quotas," Washington Post, March 15, 1983, pp. A-1 and A-14.

Market factor	Direction of pressure on price
Demand:	
Increase	Upward
Decrease	Downward
Supply:	
Increase	Downward
Decrease	Upward
Proved reserves:	
Increase	Downward
Decrease	Upward
Production rate:	
Increase	Downward
Decrease	Upward

In addition to the actual costs of the production of crude petroleum, there is a factor added into the price known as "economic rent." Economic rent is added to all of the costs of crude petroleum production; it is added in excess of the opportunity cost of the crude petroleum. 1/ The addition of economic rent into the price of crude petroleum allows the material produced with very little overhead to sell for very close to the same price as the material which is difficult and much more costly to recover. In some cases, economic rent may consist of more than 90 percent of the crude petroleum price. 2/ The ability to add economic rent into a price is a reflection of the short-term inelasticity of the supply/demand versus price relationship and the wide range of crude petroleum production costs. 3/

Production Costs

The average cost to a U.S. producer of producing one barrel of crude petroleum declined in relative terms by approximately 12 percent between 1981 and 1982. 4/ This figure is derived from the premise that about 80 percent of the cost per barrel of domestically produced crude petroleum for a new well is accounted for by drilling and capital costs. 5/ Additionally, the size of the field tapped by each well affects the unit cost of the crude petroleum. In 1982, the average cost of a completed well in the United States declined to approximately $378,000 from $445,000 in 1981. 6/

It is possible, however, to compare estimates of the various cost components, and in this manner recognize the differences between the costs to the producer of recovering crude petroleum in different parts of the world.

1/ Paul A. Samuelson, Economics, McGraw-Hill Book Co., 1973, pp. 577-564.
2/ Milton H. Spencer, Contemporary Economics, Worth Publishers, Inc., N.Y., 1971, pp. 447-448.
3/ Ibid.
4/ "U.S. Per/Barrel Cost of New Oil Down," Oil & Gas Journal, Aug. 16, 1982, p. 88.
5/ Ibid.
6/ Ibid.

The following six tabulations show production cost components as estimated by major U.S. and multinational petroleum companies (per barrel): 1/

Year	Lifting cost	
	Domestic	Foreign
Company A:		
1980	$3.32	$3.82
1981	4.70	4.63
1982	4.77	4.21

Year	United States	Australia and Far East	Canada	Europe	Middle East and Africa	Other Western Hemisphere
	Production costs 1/					
Company B:						
1980	4.00	15.45	3.09	3.70	3.27	1.89
1981	8.41	17.87	5.31	6.57	9.12	2.22
1982	8.40	16.90	7.29	6.13	4.30	3.10
	Exploration expense					
Company B:						
1980	0.96	1.18	3.50	1.63	1.42	11.00
1981	1.69	1.20	3.31	2.20	6.12	17.00
1982	2.24	1.50	1.39	2.34	38.60	11.89

1/ Production costs include taxes other than income taxes, specifically the windfall profits tax. Natural gas is included in these data by conversion to crude oil equivalent.

1/ Data taken from 10-K's for fiscal year ending Dec. 31, 1982 filed with the Securities and Exchange Commission as of Mar. 31, 1983 for the following companies: Atlantic Richfield Co., Exxon Corp., Getty Oil Co., Mobil Corp., Occidental Petroleum Corp., and United States Steel Corp., parent of Marathon Oil Co.

Year	Production costs 1/ for--			
	United States	Canada 2/	Middle East	North Sea 3/
Company C:				
1980	5.75	3.60	1.03	2.48
1981	10.40	5.33	1.31	9.19
1982	9.00	8.41	1.44	8.32

1/ Cost in terms of dollars per equivalent barrel of liquids (including crude petroleum, condensates, natural gas liquids, and natural gas); does not include exploration or development costs.

2/ Includes Petroleum and Gas Revenue Tax for 1981 and 1982, and Incremental Tax for the period Jan. 1, 1982 through May 31, 1982.

3/ Includes Supplementary Petroleum Duty tax which became effective Jan. 1, 1981.

Year	United States	Canada	Europe	World
	Lifting costs			
Company D:				
1980	4.05	2.12	5.03	4.39
1981	7.60	4.13	8.90	7.25
1982	7.49	5.13	7.75	7.26
	Exploration expense			
Company D:				
1980	0.87	1.61	1.20	1.22
1981	1.38	2.34	1.09	1.94
1982	2.11	1.39	1.95	2.24

Year	Average production cost 1/		
	Eastern Hemisphere	United States	Other Western Hemisphere
Company E:			
1980	2.22	4.50	3.72
1981	2.61	7.62	3.43
1982	2.94	7.07	5.62

1/ Includes both crude petroleum and natural gas; gas volumes have been converted to equivalent barrels on the basis of energy content.

Year	Average production cost 1/		
	United States 2/	Europe	Middle East and Africa
Company F:			
1980	4.91	3.26	1.22
1981	11.42	2.25	2.10
1982	10.20	1.91	1.23

1/ Natural gas was incorporated by conversion to equivalent barrels using the conversion 6 MCF = 1 barrel.

2/ Includes the Windfall Profits Tax.

Although comparisons cannot be made between the costs listed by the different companies, within each of the companies' individual statistics, the costs expended in different geographic areas of the world give an impression of the variation in production costs. Specifically, the data for companies C, E, and F clearly indicate a significant difference in production cost, in each of the 3 years shown, between the United States and the Middle East. In 1982, the ratio of production costs in the United States to those in the Middle East ranged from 2.4 to 8.3. 1/

Production costs are also not necessarily uniform within countries, or even within certain oilfields. In many cases, after the first phase, or primary phase, of petroleum recovery is completed, significant amounts of the crude petroleum remain unrecovered; different techniques such as deep drilling and EOR may be employed to recover additional crude petroleum in subsequent phases of the recovery process. These techniques incur a greater cost than is expended in the initial phase of recovery, and contribute to a higher production cost per unit of recovered crude petroleum.

Three crude petroleum production cost categories have been defined by the planning department of a major multinational corporation as follows: 2/

1. Low-cost.--The majority of current world crude petroleum production falls into this category, including production in most of the Middle East, Mexico, and parts of South America.

2. Medium-cost.--This category includes crude petroleum from the North Sea and parts of Africa and the Middle East, especially where deep drilling is necessary to reach the deposits (such as those in Iran).

1/ Derived from data obtained from the 10-K's of major petroleum companies listed previously.

2/ "The Shell Group's Latest Look at: Cost of Developing New World Crude Supplies," Shell Oil Co., 1982.

3. High-cost.--This category includes crude petroleum obtained from difficult geographic areas such as the Arctic region, deepwater offshore wells, through tertiary EOR techniques (of conventional sources), and recovery of non-conventional sources such as very heavy petroleum and tar sands.

Although there are no precise figures for quantifying the actual dollar cost per barrel for each of these categories, the costs are estimated to be as follows: 1/

Category	Cost (per barrel)
Low-cost	$5-$10
Medium-cost	10-20
High-cost	greater than 20

The greater volume of low-cost crude petroleum remaining unrecovered is primarily located in the Persian Gulf and almost entirely within OPEC member nations. Aside from OPEC nations, Mexico is the only country containing large untapped reserves of low-cost crude petroleum.

Differentials

The price of crude petroleum to the refiner is a reflection of both the physical qualities of the material and common trade-related costs such as transportation. These differentials may contribute up to 5 percent of the landed cost of the crude petroleum to the U.S. purchaser, thus making a significant addition to the price that the purchaser must pay.

Transportation

Table 16 shows the landed costs of U.S. imports of crude petroleum from various foreign sources.

1/ Ibid.

Table 16.--Crude petroleum: Landed cost of U.S. imports from selected countries, 1978-82

(Per barrel)

Country	1978	1979	1980	1981	1982
Algeria	$14.91	$21.90	$37.90	$40.49	$35.24
Canada	14.50	20.43	30.47	32.16	26.85
Indonesia	14.64	20.69	33.92	37.57	36.80
Iran	13.88	25.02	30.37	1/	32.32
Libya	14.72	23.68	37.72	40.92	36.05
Mexico	13.54	20.86	31.80	33.78	28.73
Nigeria	14.86	22.96	37.05	39.70	36.21
Saudi Arabia	13.92	19.15	30.02	34.19	34.83
United Arab Emirates	14.39	21.90	32.89	37.87	36.46
United Kingdom	NA	22.16	35.88	37.24	34.32
Venezuela	12.83	18.18	25.86	29.87	24.43
Average	14.38	21.65	33.95	36.52	32.22

1/ Not available.

Source: U.S. Department of Energy, 1982 Annual Energy Review, April 1983.

The average costs of U.S. imports and the average world prices of crude petroleum during the same time period are shown in the following tabulation: 1/

Year	Average cost	Average world price
	Per barrel	
1978	$13.14	1/
1979	18.69	1/
1980	31.34	$33.89
1981	35.10	37.05
1982	32.27	33.59

1/ Not available.

The difference between the cost of the U.S. purchasers of crude petroleum and the average world price may be attributed to the fact that the majority of U.S. crude petroleum imports originate in countries in which the total costs involved are minimized, particularly transportation costs. This results in landed prices of crude petroleum which are generally less than the average world price. For example, in 1982, 343.3 million barrels of crude petroleum were imported from Mexico and Canada, accounting for more than 24 percent of all U.S. crude petroleum imports. The average cost for the crude petroleum

1/ Official statistics of the U.S. Department of Energy.

from these nations was approximately $28.51 per barrel, more than $5 per barrel less expensive than the average world price.

In order to compare the transportation costs from various sources, we can approximate these costs by subtracting the free on board (fob) cost of the petroleum from the landed cost as reported by the U.S. Department of Energy. Table 17 shows the estimated transportation costs from major crude petroleum-producing areas to the United States.

The transportation costs for U.S. imports from certain major exporting areas correlates well with the distance traveled. The transportation costs for the Western Hemisphere nations are the least expensive when considering sales to U.S. purchasers. Medium-cost-transportation areas include nations bordering on the Atlantic Ocean or having easy access to the Atlantic Ocean, such as Algeria and Nigeria. The areas which incur the highest transportation costs in order to reach the United States are the Persian Gulf and the Far East. The producers in these areas generally ship their crude petroleum around the southern tip of Africa in order to reach receiving terminals on the U.S. east coast.

However, the price differentials owing to transportation cost advantages may only be a contributing factor toward the choice of a source of supply in a market situation where there is an excess of available crude petroleum. If there is a greater demand than there is crude petroleum availability, all possible sources of supply will be tapped. In a market glut, the purchaser can take advantage of the transportation differentials and minimize his costs by emphasizing purchases from nearby producers. Between January and March of 1983, the United States was importing approximately 4.27 million barrels per

Table 17.--Crude petroleum: Estimated transportation costs from major exporting areas, 1978-82

Country	1978	1979	1980	1981	1982
	Per barrel				
Algeria	$0.81	$1.35	$1.33	$1.40	$1.05
Indonesia	1.00	1.34	1.55	1.64	1.48
Mexico	0.51	0.57	0.69	0.65	0.57
Nigeria	0.82	1.16	1.23	1.17	1.04
Saudi Arabia	1.22	1.52	1.49	1.71	1.50
United Kingdom	1/	0.96	1.30	1.16	0.82
Venezuela	0.38	0.81	1.08	1.01	0.51

1/ Not available.

Source: Derived from official statistics of the U.S. Department of Energy.

day of crude petroleum and petroleum products. 1/ Approximately 79 percent of these imports, almost 3.38 million barrels per day, originated in Western Hemisphere nations 2/ or the United Kingdom. Arab OPEC sources accounted for only 375,000 barrels per day, a decline of nearly 88 percent from the peak annual rate achieved in 1979 of 3.06 million barrels per day. 3/

Quality

The quantity of crude petroleum is assessed according to two major characteristics, density and mineral content. One method of assessing the quality of the particular crude involves determining the density in API gravity, 4/ which is indicative of the complexity of the hydrocarbons which comprise the crude petroleum. Table 18 shows the pricing differentials of different crudes on various dates throughout the period from 1979 to 1983.

Table 18.--Crude petroleum: Official Government selling prices 1/

Source	Crude type	API gravity	1/1/59	1/1/80	11/1/81	3/1/83
			Per barrel			
Saudi Arabia	Arab Heavy	27	$12.51	$25.00	$31.50	$26.50
	Arab Medium	31	12.89	25.45	33.00	27.40
	Arab Light	34	13.34	26.00	34.00	29.00
	Arab Berri	39	14.06	27.52	35.60	29.50
Venezuela	Tiajuana	26	13.36	25.20	32.88	27.88
	Tiajuana	31	14.22	26.90	35.00	29.84
	Oficina	34	14.69	28.75	37.06	31.09

1/ Prices applicable to sales to third parties and that sold back to companies still retaining an equity interest in Middle East petroleum-producing ventures.

Source: Basic Petroleum Data Book, vol. III, No. 2, May 1983.

Generally, the lighter, or less dense the crude petroleum, the greater the yield of the lighter products, such as motor gasoline and distillate fuel

1/ U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, August 1983, pp. 32-33.

2/ Venezuela, the Bahamas, Canada, Mexico, Trindad and Tobago, Puerto Rico, and the U.S. Virgin Islands.

3/ U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, August 1983, pp. 32-33.

4/ API gravity is a scale of measurement adopted by the American Petroleum Institute which runs from 0.0 (equivalent to specific gravity 1.076) to 100.0 (equivalent to specific gravity 0.6112).

oil. The lighter products command the highest prices of the petroleum products, as can be seen in the following tabulation (per barrel): 1/

Product	Wholesale product price		
	1978	1980	1982
Motor gasoline 1/	$17.01	$38.22	$39.31
Distillate fuel oil 2/	15.88	33.94	38.72
Residual fuel oil 3/	11.51	23.14	26.54

1/ A complex mixture of relatively volatile hydrocarbons, with or without additives, blended to form a fuel suitable for use in spark-ignition engines.

2/ Refined product used primarily for space heating, diesel engine fuel, and electric power generation.

3/ The heaviest parts of the crude petroleum and generally not considered primary U.S. refinery products.

The prices for these refined petroleum products, during each of the years shown in the previous tabulation, show that the lighter products consistently are valued higher than the heavier products. Although the composition of the refinery output can be altered by varying the temperature and pressure of the refinery process, the added cost to breakdown heavier, more complex hydrocarbons from heavier crude petroleum into the desired products makes the heavier petroleum less desirable for most refinery processes. Accordingly, the lighter crude petroleums usually sell for a higher price than the heavy crudes.

As the differentials between the refined products' prices remained consistent over time, the differentials between both the Saudi and the Venezuelan crudes remained consistent. These differentials were also noted to be consistent during a period in which prices for petroleum and petroleum products increased by more than 130 percent and then decreased by approximately 15 percent.

The mineral content of crude petroleum ranges from trace to 8 percent in terms of sulfur, up to 1.6 percent in terms of nitrogen, and from 1 part per billion to 100 parts per million of certain metals, particularly nickel, copper, and vanadium. 2/ Although nitrogen does not diminish the quality of crude petroleum in the same manner as does sulfur, it is considered undesirable because it interferes, or poisons, certain catalysts used in the processing procedure. 3/ Sulfur content, together with API gravity, has the greatest influence on the price of crude petroleum. Crude petroleum with

1/ American Petroleum Institute, Basic Petroleum Data Book, vol. III, No. 2, May 1983.

2/ Kirk-Othmer Encyclopedia of Chemical Technology, vol. 17, 1982, pp. 125-130.

3/ James H. Gary, and Glenn E. Handwerk, Petroleum Refining: Technology and Economics, Marcel Dekker, Inc., 1975, p. 18.

concentrations of sulfur greater than 0.5 percent are known as "sour" crudes and require more extentive processing than do "sweet" crudes, with sulfur content generally less than 0.5 percent. 1/ When necessary, sulfur and nitrogen are removed from the crude petroleum by hydrotreating reactions; desulfurization requires less severe conditions than does nitrogen removal. 2/

Minerals such as nickel, copper, and vanadium, which also interfere with the activity of catalysts even at minute concentrations, may also be removed by hydrotreating. They may also be removed partially, or reduced, by solvent extraction. 3/ One multinational petroleum company has developed a new procedure to remove contaminants from less expensive crude petroleum. The procedure, which is known as asphalt residual treating (ART), involves the addition of a product which aids in the removal of minerals. 4/ A second process, known as reduced crude conversion (RCC), when used in conjunction with ART, allows the petroleum company to refine a less expensive crude petroleum 5/ and to produce a higher yield of light products such as gasoline, at a considerable savings compared with other processing techniques.

In most cases, however, it is more desirable to avoid as many of the potential complications as possible, since older refining facilities are not equipped to handle the less expensive crudes. The price differentials between the sweet and sour crudes follow the same pattern as the differentials between the light and heavy crude petroleums. The differentials generally available to the refiner ranged from $5 to $7, because the more expensive domestic crude petroleums were priced at approximately $28 to $30 per barrel, as of June 1983 while a heavy sour crude petroleum from Mexico was available at a price of $23. 6/

Alternate Energy Sources

The prices of other energy sources, such as natural gas, coal, and synthetic fuels, are all somewhat dependent upon the price of crude petroleum. 7/ The following tabulation shows the responsiveness of natural gas and coal prices to a 1 percent change in the price of crude petroleum for seven OECD nations: 8/

1/ Gary and Handwerk, op. cit., pp. 115-117.
2/ Ibid.
3/ Ibid., pp. 19, 116.
4/ "More Motor Fuels from Dirtier Crudes," Chemical Week, July 27, 1983, pp. 21-22.
5/ Ibid.
6/ Ibid.
7/ International Energy Agency, World Energy Outlook, 1982, pp. 86-88.
8/ Ibid., pp. 83-86

Nations	Natural gas	Coal
	Percent	
United States	0.97	0.76
Japan	0.67	0.65
West Germany	0.88	0.95
France	0.76	0.71
United Kingdom	0.75	0.74
Italy	1.21	0.86
Canada	0.90	0.64
Average	0.95	0.75

As crude petroleum prices increased in the past, alternate energy sources became more economically viable. And in the same manner, as the price of crude petroleum in the world market has recently declined, alternate energy sources came to be viewed as not as vital and their development far less financially attractive. The U.S. Government, however, continued to provide incentives for development of noncrude-petroleum-energy sources through the auspices of the Synthetic Fuels Corp. (SFC). The SFC was established through the Energy Security Act of 1980 in order to insure the continued development of synthetic fuels technology through loans, loan guarantees, price guarantees, and joint ventures. 1/ Despite the efforts to maintain research into alternate fuels technology, a number of projects sponsored or cosponsored by private industry have lost their financial support, mainly because of the oversupply and resulting decline in price of crude petroleum. 2/ Private corporations have stated that they do not feel obligated to allocate the significant amount of capital associated with the development of alternatives to crude petroleum while there is low-cost crude petroleum readily available. 3/

Conventional Energy Sources

The ability to convert from crude-petroleum-based fuels such as residual fuel oil, distillate fuel, or liquefied petroleum gas (LPG), to natural gas, coal, or other conventional sources of energy for electricity generating or other purposes depends upon the facilities available to the particular utility company or factory involved. Many U.S. public utilities have dual firing capacity and therefore readily use price as a major determinant as to their choice of primary fuel. In 1981, residual fuel oil was the most common choice of fuel for electricity-generating facilities. 4/ In 1982, as the price of crude petroleum declined both domestically and in the world market, demand for natural gas among industrial consumers correspondingly declined by approxi-

1/ Energy Security Act, Sec. 131, (b), (2), (B).
2/ "Alsands Consortium, Exxon Quit U.S., Canadian Synfuels Plans," European Chemical News, May 10, 1982, p. 32; and "U.S. Synfuels Industry: Alive and Shrinking," Chemical Business, Oct. 18, 1982, pp. 29-34.
3/ Ibid.
4/ Petroleum Economist, January 1983, pp. 22 and 23.

mately 14 percent. 1/ The American Gas Association reported that 29 percent of this decline in demand for natural gas resulted from switching to residual fuel oil or another petroleum-based fuel. 2/ Further switching between various energy sources is anticipated in the event that the price of natural gas rises above the price of low-sulfur residual fuel oil. It is expected that even previously contracted sales of natural gas, especially high-cost "new" natural gas, will be abrogated through "market out" clauses which allow for price reductions if market conditions change. 3/

Coal

The U.S coal industry has been suffering the effects of slowing demand, mainly because of the problems facing the steel industry and decreasing demand for electricity. 4/ As demand has slowed in the electricity-generating industry, construction of many coal-fired plants has been either delayed or cancelled.

Estimates of the levelized annual cost of electricity from new coal-fired plants in the United States range from 2.8 cents per kilowatt-hour to 4.4 cents per kilowatt-hour. 5/ The current operating costs of electricity-generating plants using a petroleum-based fuel are estimated to range from 4.5 cents per kiolwatt-hour upward. 6/ In many regions of the United States, the price differential is even greater between coal and petroleum-based fuels, as transportation costs for coal are mininized. In these regions it is economically preferable to replace older petroleum-fired generators with coal-fired facilities. 7/ The costs of fossil fuels as delivered to utility plants in the United States during 1978-82 are shown in the following tabulation (cents per million Btu): 8/

Year	Coal	Residual fuel oil	Natural gas
1978	111.6	212.3	143.8
1979	122.4	299.7	175.4
1980	135.1	427.9	221.4
1981	153.2	529.4	282.5
1982	164.7	475.5	340.6

1/ Daily News Record, Feb. 9, 1983, p. 18.
2/ Ibid.
3/ Hydrocarbon Processing, January 1983, pp. 23, 25.
4/ "For Coal, the Recovery Is Heating Up Slowly," Business Week, Aug. 1, 1983, pp. 89-90.
5/ Ibid.
6/ Perl, Lewis J., The Current Economics of Electric Generation from Coal in the United States and Western Europe, paper presented at the International Scientific Forum on Reassessing the World's Energy Prospects: The Critical Question, Oct. 26, 1982.
7/ Ibid.
8/ U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, June 1983, p. 94.

It has consistently been the case that coal-fired plants cost considerably less to fuel than do either natural gas-fired plants or plants based on petroleum fuels. However, other considerations, including the degree of contamination of the fuels and the efficiency of the plant, must be taken into account. In addition to these factors, when analysing the conversion of an electricity-generating plant or a factory, the cost of construction and start-up of new plant must also be considered. The cost of converting a functioning petroleum-fueled factory or power plant to coal is greater than the conversion from coal to a petroleum-based fuel. An industry analyst estimated that the price of crude petroleum would need to decline to approximately $13 to $14 per barrel before it would be economically practical to convert to a petroleum-based fuel from coal. 1/

Enhanced oil recovery

Another conventional alternative involves EOR techniques in which such materials as heated air, chemicals, or inert gases are injected into a crude petroleum reservoir in order to lower the viscosity of the crude petroleum, mobilize it, and push it toward the producing wells. This technique is known as tertiary recovery because it is most often used after primary recovery 2/ and secondary recovery 3/ techniques have exhausted the crude petroleum available via those techniques. 4/ EOR techniques are estimated to cost the producer between $21 and $46 per barrel of crude petroleum recovered. 5/

The U.S. domestic production of crude petroleum by various EOR techniques during 1982 is shown in the following tabulation (in barrels per day): 6/

Technique	Production
Steam injection	300,000
In-situ combustion	10,000
Gaseous flooding, total	72,000
Carbon dioxide	22,000
Nitrogen	3,000
Polymer flooding	3,000
Micellar-polymer flooding	1,000
Alkaline flooding	600

1/ Dale Steffes, President of Planning and Forecasting Consultants, Houston, Tex.; "Oil Price Differential Not a Major Concern to Coal, Utility Firms," Journal of Commerce, June 13, 1983, pp. 1C, 6C.

2/ Natural pressure depletion.

3/ Water flooding.

4/ "Chemicals for Enhanced Oil Recovery," Chemical Purchasing, April 1983, pp. 37-48.

5/ Ibid.

6/ Ibid.

The total production of crude petroleum by all EOR techniques in the United States during 1982 approached 400,000 barrels per day. 1/ Industry experts predict crude petroleum production ranging from 850,000 to 1.4 million barrels per day through EOR techniques by 1992, depending on the world price of crude petroleum and the existence of a price support system for EOR-produced crude petroleum similar to that already in place for synthetic fuels projects. 2/ Between 1979 and 1981, the Government helped to support EOR projects that otherwise could not have been economically feasible. This program, which allowed for 75 percent of the costs of EOR projects to be recouped, ended in 1981; since that time, fewer projects have been initiated. The industry does expect that support for EOR projects will be forthcoming. 3/

Unconventional Energy Sources

Unconventional alternatives to crude petroleum range from nuclear energy, solar energy, and other sources useful only as fuels for electrical power generation to biological sources and synfuels from coal or peat, in which the material produced in the process may also be substituted for crude-petroleum-based feedstocks for the chemical industry. All of these alternatives are price sensitive, and their further development and refinement are dependent upon the price and availability of crude petroleum.

Nuclear energy

Nuclear energy prospects have increasingly become less economically viable for reasons both related and unrelated to the price of crude petroleum. Economic reasons for the decline in new nuclear power development and the major cost overruns now evident in the construction of new nuclear power plants are lower electricity demand growth rates, a slower growth economy, and a financially weak utilities industry. 4/ The accident at the nuclear plant located on Three Mile Island also contributed to the discredit of the entire nuclear industry. 5/ However, nuclear power technology and coal together are viewed by the majority of the U.S. power industry as the best options for relieving dependence on imported crude petroleum. If crude petroleum prices were to rise, nuclear power generation could again become an economically feasible alternative.

1/ Ibid.

2/ "Chemicals for Enhanced Oil Recovery," Chemical Purchasing, April 1983, pp. 37-48; "Enchanced Oil Recovery Chemicals Seen Growing at 12.5 Percent Rate Through 1993." Chemical Marketing Reporter, Aug. 15, 1983, p. 9; and Chemical Week, Aug. 17, 1983, p. 29.

3/ Ibid.

4/ "Troubled Nuclear Power Tries to Recover," Chemical and Engineering News, Sept. 20, 1982, pp. 11-12.

5/ Ibid., p. 12.

Renewable energy sources

Research into high technology alternatives to crude petroleum for power generation is progessing at a relatively slow pace. Investigations into the possibility of harnessing renewable sources of energy, such as solar energy, geothermal energy, and wind energy, have not progressed beyond the experimental stages. A recent study 1/ found that a practical solar energy facility using solar pond technology 2/ could generate competitively priced electricity assuming that costs for fossil fuels would continue to rise. 3/ Industry experts predict growth in solar energy development during the 1990's, mainly owing to its economic attractiveness. U.S. development of solar energy and other renewable energy sources, such as wind power, may be endangered as the energy tax credit now available for alternative energy investment expires in 1985. 4/ Investors are urging the Government to authorize a 5-year extension of the tax credit in order to provide the time for the industry to commercialize its technologies. A study of four planned projects located in southern California found that without the investment tax credit, two of the projects would become economically infeasible, and the other two were given a slim chance of becoming profitable. 5/

Synthetic fuels

Alternate energy sources which would also provide feedstocks for the chemical industry include synfuels from biomass or conventional energy sources. Studies by several major crude petroleum companies arrive at similar conclusions regarding fuel switching and synthetic fuels. 6/ These studies forecast continued energy conservation resulting in continued declines in energy consumption per unit of output. Indirectly, the further development of synthetic fuels technology would be expected to remain slow, as the continued conservation would contribute to maintaining crude petroleum prices at their current level and keeping them from increasing in real terms through the 1980's. 7/ One such study forecasts that by the year 2000, crude petroleum prices will range from $35 to $50 per barrel in 1983 dollars, thereby restricting U.S. synfuels production to a hypothetical 400,000 barrels of petroleum equivalent per day. Earlier projections, usually assuming higher crude petroleum prices, pegged potential production of synthetic fuels at 2 million barrels per day by the year 2000. 8/

1/ Study completed by the U.S. Department of Energy.

2/ Solar pond technology generates energy by taking advantage of the temperature gradient at various depths of water.

3/ "Interest in Solar Ponds Heating Up," Chemical Engineering, Mar. 7, 1983, pp. 40-41.

4/ Wall Street Journal, Apr. 13, 1983, p. 1.

5/ Ibid.

6/ Chemical Week, June 29, 1983, p. 9.

7/ Ibid.

8/ Ibid.

U.S. Government support of the synthetic fuels industry is seen as essential to the continued development of technology. The financial vice-president of the Synthetic Fuels Corp. testified before Congress in defense of the extension of the energy tax credit system for the synthetic fuels industry. 1/ He states that the original deadlines of the synthetic fuels development program, set up in the Energy Security Act of 1980, were not attainable by the industry because of the unexpected decline in crude petroleum prices. 2/ He also noted that coal gasification and liquefaction are the synfuel projects which incur the highest initial costs, and therefore are the least likely to be pursued by the industry in light of the current energy/economic situation. The long-term prospects for these projects would be the most favorable, as fuel costs are expected to be the lowest for coal-based development. 3/ Tar sands and oil shale projects are expected to be developed first as their initial costs are the lowest. Despite the long-term projection that although they may be able to supply a significant share of the energy requirements, the long-term costs involved are expected to mirror the costs of crude petroleum. 4/

Biomass

Biological alternative sources of energy range from processed waste materials to plants grown specifically for the processing into fuel materials. 5/ The major threat to the use of biological products as a source of energy remains the same today as it was during the first energy crisis when wood came into very short supply in Europe, before the advent of coal. Deforestation resulting from unplanned use of natural resources remains the greatest danger to the commercialization of biomass energy development in certain developing countries. 6/ The cost and potential, as well as the technology for biomass energy production facilities, are currently being studied. 7/ Local economic factors and resource availability, rather than world-scale factors, are more likely to have an impact on the degree that biomass energy can replace conventional energy sources.

Within the context of a study by the Energy Modeling Forum, (EMF) 8/ a working group member 9/ with specific expertise in the area of nonconventional energy alternatives to crude petroleum projected the future production

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1/ Coal Week, July 11, 1983, pp. 4-5.
2/ Ibid.
3/ Ibid.
4/ Ibid.
5/ "Wood As A Major Fuel," Petroleum Economist, October 1982, pp. 419-421; and "Energy Potential of Biomass," Petroleum Economist, November 1982, pp. 457-459.
6/ Ibid.
7/ International Energy Agency, World Energy Outlook, p. 422.
8/ The Energy Modeling Forum is administered at Stanford University within the Department of Engineering-Economic Systems and Operations Research and under the auspices of the Institute for Energy Studies. Funding is provided by the Electric Power Research Institute, the U.S. Department of Energy, and the Gas Research Institute.
9/ Sheldon Lambert, Shell Oil Co.

potentials of several of the energy alternatives. 1/ Table 19 is excerpted from an EMF summary report concentrating on world crude petroleum.

Table 19.--Alternate energy sources: Production potentials for non-Communist nations

(In million of barrels per day)

Energy source	1995	2000	2010	2020
Biomass	1.2-2.5	1.5 - 3.2	2.1-5.0	2.6-7.8
Synthetic fuels:				
Coal gasification	1.0-3.5	1.3-5.1	2.0-8.0	2.8-12.3
Coal liquefaction	0.4-1.4	0.6-3.1	0.8-4.9	1.0-7.4
Oil shale	0.4-1.5	0.6-2.5	1.0-4.1	1.4-6.0
Tar sands	0.5-1.3	0.7-1.8	0.9-2.4	1.1-3.5
Total	3.5-10.2	4.7-15.7	5.8-24.4	8.9-37.0

Source: Energy Modeling Forum, World Oil Summary Report, February 1982.

The figures in table 19 are based on a wide range of assumptions and result in a corresponding wide range of projections; however, during such a long period of time, an optimum development pattern, including technological breakthroughs may far exceed the high-bound figure of the projection.

Other Price Factors

The impact of changing crude petroleum prices also extends into more general areas of a nation's economic structure. Nations which export large quantities of crude petroleum rely heavily on revenues derived from these exports to provide necessary foreign exchange and to finance projects instituted by these nations to industrialize and diversify their economic bases. Commodity trade via certain mechanisms such as barter or countertrade is often tied to a contracted price for crude petroleum; changes in the world market price of the petroleum affect the value of all other commodities involved.

The changing internal economic conditions in both crude-petroleum-exporting nations and crude-petroleum-importing countries also affect the prices of the crude petroleum, as discussed in the following section.

Revenue

Increased demand for foreign exchange in a crude-petroleum-producing nation can be satisfied most simply by increasing their share of the world crude petroleum export market. Price competition has historically been the method primarily used for gaining market share. In February 1983, for example, the price of Nigerian crude petroleum was reduced by the Nigerian Government from $35.50 per barrel to $30.00 per barrel in order to undersell Persian Gulf

1/ Energy Modeling Forum, World Oil Summary Report, February 1982, pp. 80-82.

producers. 1/ Although Nigerian crude petroleum is looked on by the industry as being of higher quality than Persian Gulf crude because of fewer impurities and ligher consistency, the Nigerian industry was producing far below its operating capacity because of decreased world demand. Nigerian officials also indicated a determination to maintain a certain market share, even if further price reductions were deemed necessary. 2/ However, in certain other instances it is in the interest of the producing nation to maintain higher prices for their crude petroleum as a certain level of revenue per barrel of crude petroleum is necessary to maintain a financial balance and avoid financial disruptions. 3/ Further, some of these nations desire to conserve their resources and thus be somewhat assured of future revenues.

Crude-petroleum-rich nations which are now striving to develop a greater diversity in their economies generally rely upon industries which are closely allied with energy resources. 4/ A diversified economic base would allow a nation which at one time was totally dependent upon crude petroleum exports for revenue, to better withstand external petroleum pricing pressures. Development of a viable chemical industry in Saudi Arabia, for example, provides an alternative outlet for their resources of crude petroleum when market conditions for the export of the crude petroleum are unfavorable. The petroleum could be used to produce the energy needed to fuel the plants, as well as provide necessary feedstock materials. 5/

In addition to the development of a chemical industry in OPEC member nations and other crude-petroleum-producing nations, industrial development is drawing down the crude petroleum available for export to traditional importing nations. Other energy-intensive industries are concurrently being developed in order to take advantage of the ready supply of inexpensive energy resources. 6/ Revenues derived from exports of value-added petroleum products, whether they are chemical, fuel, or other energy-intensive products, may be considered substitutable for revenues at one time derived solely from exports of the crude petroleum. 7/

Trade Practices

The price of crude petroleum is sometimes linked to other commodities. Enticements to lure investments into developing industrial sectors in crude-petroleum-producing nations often have included entitlements to purchase

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1/ "Gulf States to Mull Oil Cuts," Washington Post, Feb. 22, 1983, pp. A1 and A12; and "The Collapse of World Oil Prices," Business Week, Mar. 7, 1983, pp. 92-94.

2/ Ibid.

3/ "The Collapse of World Oil Prices," Business Week, Mar. 7, 1983, pp. 92-94.

4/ The Probable Impact on the U.S. Petrochemical Industry of the Expanding Petrochemical Industries in Conventional-Energy-Rich-Nations, U.S.I.T.C. Publication 1370, April 1983, pp. 16-20.

5/ Ibid.

6/ Ibid., pp. 16-37.

7/ Ibid.

quantities of crude petroleum. 1/ In some cases, there would be a contracted price, although most often the price was not fixed, as most importers did not foresee the current market glut and resulting decline in energy prices.

The availability of crude petroleum directly affects the value of these entitlements. In a market where there is a shortage of crude petroleum, not only would the price of crude petroleum increase, but the value of fixed-price entitlements would also tend to rise. However, the value of fixed-price entitlements is far less in a market situation such as has existed since late 1981, when there is more material available in the market than is required by the customers.

Political Issues

The political situations in both crude-petroleum-exporting nations and crude-petroleum-importing nations often enter into the determination of prices paid for crude petroleum. Since 1973, there have been two major energy crises precipitated by political disruptions in the Middle East. These political affairs, in both instances, disrupted the flow of crude petroleum to the United States and other crude-petroleum-importing nations, In both instances, the price of crude petroleum increased rapidly, causing declines in demand for the crude petroleum as well as slowing down overall economic activity. These energy crises also contributed significantly toward creating worldwide economic recessions. 2/ In 1978 and 1979, the supply disruption of 3.5 million barrels per day related to the Iranian Revolution created a shortfall in the world supply of crude petroleum, effectively doubling the world price. 3/ Current fears of changes in the Persian Gulf area are centered around the Iran-Iraq War. The direction of any changes in price related to this or any other political issue results solely from the changes in availability of crude petroleum to the world export market.

The mechanics of a disruption in the supply of crude petroleum involve all sectors of the economy. Most research into the effects of such a phenomenon employ econometric modeling in order to simulate the reactions of the economy, fixed at a particular point in time, both on the price of the crude petroleum and on itself. 4/ The majority of researchers concur regarding the general effects felt by the economy, mainly to aggregate supply and demand. 5/ The aggregate supply of all goods is reduced during a crude petroleum supply disruption by two means. First, the flow of financial resources to crude-petroleum-exporting nations is increased in an effort to maintain a flow of crude petroleum to the consuming nations. Second, the immediate effect of a supply disruption of energy resources would force the domestic industry to use less energy, thereby decreasing the output of the

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1/ Ibid., pp. 42-43.

2/ International Energy Agency, World Energy Outlook, 1982, pp. 21-23.

3/ U.S. Central Intelligence Agency, International Energy Statistical Review, May 31, 1983, pp. 1-2; and U.S. Government Accounting Office, The United States Remains Unprepared for Oil Import Disruptions, Sept. 29, 1981.

4/ Ronald F. Earley, and William P. Curtis, Impacts of World Oil Market Shocks on the U.S. Economy; Literature Review, March 1983.

5/ Ibid., pp. 3-6.

economy. 1/ Although in the long run, capital is a legitimate substitute for energy, the immediate short-term effect renders the relationship ineffective.

The price increase of crude petroleum and other energy materials would precipitate a decline in aggregate demand. Producers of all manufactures which either incorporate or consume large amounts of energy would be forced to pass along much of their increased energy costs to their customers. As prices to consumers ultimately rise, the consumers' real income falls, and consumption of both energy and nonenergy goods is cut back. The redistribution of income results in an increased flow of capital toward foreign producers of crude petroleum. Economic recovery depends to a great extent on the speed with which this outflow of capital is replaced into the domestic economy in the form of exports of domestic manufacturers to the crude-petroleum-exporting nations. 2/

The exports of much of the worlds' crude petroleum is controlled by the governments of the exporting nations. As has been seen in the past, the flow of crude petroleum to export markets can be interrupted in the event of political unrest. Concerned industry sources question the stability of certain crude-petroleum-exporting nations, as the possibility of controlling significant shares of the world's energy resources is viewed as creating an incentive for political upheaval. Internal instability is also feared to be a threat to a steady production schedule and export pattern for crude petroleum. Countries in the Middle East have historically experienced problems between different segments of their populations, such as religious sects or different ethnic groups. Analysts believe that future incidents appear almost unavoidable; the technological advances and development of modern infrastucture brought about by the increased revenues from crude petroleum exports have accentuated the differences between the various groups. 3/

In addition to the supply disruptions related to outward acts of violence, philosophical differences among oil exporters have frequently jeopardized price stability. These problems exist between OPEC and non-OPEC crude petroleum producers which are looking to increase their share of the market despite a stagnant market, as well as among members of OPEC. 4/ The consequences which could result if one or more producers decreased their price significantly in order to capture additional market share have deterred this behavior through much of 1983, although price cutting is always a possibility. 5/

1/ Ibid.

2/ Ibid.

3/ "Sunnis? Shiites? What's That Got To Do With Oil Price," Forbes, Apr. 12, 1982, pp. 90-92; "Playing the New Oil Game," Fortune, June 13, 1982, pp. 58-64.

4/ "OPEC May Face Trouble in the Long Run Despite Oil-Demand Rise Expected Soon," Wall Street Journal, June 27, 1983, p. A3; "The Screws Keep Tightening On OPEC," Business Week, Aug. 1, 1983, p. 23.

5/ "OGJ Newsletter," Oil & Gas Journal, July 25, 1983.

POSSIBLE IMPLICATIONS OF FUTURE WORLD CRUDE PETROLEUM PRICE CHANGES ON CERTAIN SECTORS OF THE UNITED STATES

In considering the full impact that changes in crude petroleum prices have on U.S. trade, industry output, and employment, it is necessary to simulate the U.S. economy on a macroeconomic level. The impact of certain price scenarios including a price "shock" scenario can be analyzed.

Summary of Published Projections

Crude petroleum price projections are regularly performed by independent industry observers as well as by U.S. Government agencies in order to plan business stategies and to design government policies. Comparisons between the different projected pricing scenarios are usually difficult since the exogenous variables put into the models would need to be precisely equivalent. Inflation provides another complication to comparisons between the various price predictions. Additionally, the influence of outside political events may be superimposed on a scenario in order to determine the effect on price.

U.S. Government

Between 1976 and 1982, the Energy Information Administration (EIA) provided projections of worldwide prices of crude petroleum within the context of the Annual Report to Congress. In April 1983, the first issue of the Annual Energy Outlook replaced the volume of the Annual Report to Congress and included the update of its annual projections through 1990. The following tabulation shows the most recent price projections for world crude petroleum prices 1/ of the EIA. 2/

Year	Price scenarios		
	Low	Mid	High
1982	34	34	34
1983	28	30	32
1984	23	26	30
1985	21	25	34
1986	21	28	38
1987	22	32	41
1988	24	34	43
1989	26	36	45
1990	28	37	48

1/ Constant 1982 dollars.

2/ U.S. Department of Energy, Energy Information Administration, 1982 Annual Energy Outlook, April 1983, pp. x and 28-30.

The Office of Policy, Planning, and Analysis of the U.S. Department of Energy (DOE) is required to present to Congress an annual update of the series of energy projections and analysis presented initially in a supplement to the National Energy Policy Plan (NEPP) 1/ The most recent edition includes projections through the year 2010 and was published in October 1983. 2/ Table 20 shows the three world crude petroleum price scenarios based on low, mid range, and high U.S. economic growth as projected by DOE.

Table 20.--Crude petroleum prices: Projections through 2010

(1982 dollars per barrel, except as noted)

Year 1/	Low-growth scenario	Midrange scenario	Midrange scenario 2/	High growth scenario
1982	$33.50	$33.50	3/ $33.50	$33.50
1983	4/	27.40	28.60	4/
1984	4/	25.90	28.60	4/
1985	24.70	25.90	30.10	25.50
1986	4/	25.90	32.20	4/
1987	4/	27.10	35.90	4/
1988	4/	29.20	41.10	4/
1989	4/	30.90	46.00	4/
1990	31.20	31.90	50.00	32.50
1995	45.70	46.50	4/	47.50
2000	56.20	57.40	4/	59.20
2005	68.90	72.20	4/	74.50
2010	81.00	83.60	4/	85.80

1/ Data for 1982 are estimated, data for 1983-2010 are projections.
2/ Nominal dollars per barrel.
3/ Appears alternately as $33.59 and $33.50.
4/ Not available.

Source: U.S. Department of Energy, Energy Projections to the year 2010, October 1983.

In addition to steady growth price scenarios, other projections which take into account alterations in policy or political change do not follow smooth paths. These projections, which include crude petroleum price shocks or supply interruptions, often show periods during which the price of crude petroleum changes rapidly. However, most studies of this nature, which were executed during periods of differing world economic conditions and differing crude petroleum supply conditions, resulted in similar price scenarios. Although the degree of impact varied, the econometric models used in these studies invariably projected a pattern which began with a rapid price increase. This period was commonly followed by a slower price settling

1/ The document entitled Energy Projections to the Year 2000 was submitted to Congress in July 1982, as a requirement under Public Law 95-91.

2/ U.S. Department of Energy, Energy Projections to the Year 2010, October 1983, pp. 3-5 and 5-1.

behavior in which the world price of crude petroleum adjusted itself (a basic assumption of most models since future policy changes are not often considered) via market factors such as supply and demand.

A study conducted by the U.S. Congressional Research Service 1/ examined possible changes in the world price of crude petroleum in the context of the macroeconomic effects a supply disruption would have on the United States and six other Western industrialized economies. The hypothetical supply interruptions were set in different historical economic situations. The first disruption was hypothesized to have begun on April 1, 1980, "a time of economic growth and prior to the emergence of some significant trends in energy conservation, substitution, and filling of petroleum reserves." 2/ The second disruption scenario was set to begin on January 1, 1982, during an "economic environment . . . of recession; resulting in significant reduced demand for oil." Dependence on petroleum in general, and Persian Gulf petroleum in particular, had been reduced between 1981 and 1982; excess crude petroleum productive capacity increased by 400 percent during 1981-82; and the two largest crude-petroleum-consuming nations, the United States and Japan, increased their stockpiles of crude petroleum by a factor of between 2 and 3 times. 3/ Both of these scenarios designated the disruption to last for one year.

Results gleaned from the modeling exercise for the two disruption scenarios are detailed in the following chart:

Disruption as of Apr. 1, 1980	Disruption as of Jan. 1, 1982
1. Supply shortfall of 7.1-7.7 million barrels per day, or 20-25 percent of crude petroleum demand for industrialized countries. 1/	1. Supply shortfall of 5.0-5.3 million barrels per day, or 18-19 percent of crude petroleum demand for industrialized countries. 1/
2. Crude petroleum prices would increase from the base price of $30 per barrel to between $90 and $300 per barrel.	2. Crude petroleum prices would increase from $34 per barrel to between $65 and $130 per barrel.
3. Production of all goods and services declines by 12-27 percent; and employment declines by 15-30 percent.	3. Production and employment both decline by 3-8 percent.

1/ Countries chosen for this study were participants in the 1979 Tokyo Summit: United States, Canada, France, West Germany, Italy, Japan, and the United Kingdom.

1/ U.S. Congressional Research Service, Western Vulnerability To A Disruption of Persian Gulf Oil Supplies: U.S. Interests and Options, Report 83-24F, Mar. 24, 1983.

2/ Ibid., abstract.

3/ Ibid., pp. iii-v.

The study also projects two alternative Government responses to the supply interruption which affect the determination of the crude petroleum prices. In one scenario, the worldwide negative effects of the disruption, including increases in the price of crude petroleum, would be moderated, as the U.S. Government would actively cooperate with other nations within the context of the International Emergency Program (IEP) of the International Energy Agency. A U.S. Government decision to "reject participation in the IEP probably would unleash a general free-for-all among oil-importing countries to increase, at virtually any price, their share of non-Persian Gulf supplies. The international economic implications of such an eventuality--the possible financial collapse of some less wealthy Western countries, the breakdown of international trade and financial structures, and the added impact on employment and production throughout the West--would probably be far more severe than if the IEP were made to operate.

It appears the allied efforts in dealing with such a crisis would better serve Western economic and security interests than would go-it-alone policies. Go-it-alone policies would likely be counterproductive for any of the Western industrialized nations." 2/

Other Price Projections

It may be safely assumed that most companies involved in energy-intensive industries are sufficiently interested in the future of crude petroleum pricing to engage in the exercise of projecting future crude petroleum prices. The companies following this practice either perform the analyses themselves, or employ outside consultants, research groups, or industry associations in order to obtain impartial data. Representative projections from different sources 1/ are highlighted in the following tabulation of projected world prices for crude petroleum (in 1982 dollars per barrel):

1/ Ibid., p. ix.

2/ Differences between the studies may in part be relative to the world crude petroleum market situation during the period of the particular study.

Source	1990	2000	2010
British Government 1/	-	35-75	-
International Energy Agency 2/	-	32-52	-
Chase Econometrics 3/	34	42	-
DRI 4/	36	51	-
Wharton 5/	35	-	-
Energy Modeling Forum 6/	39-69	45-97	75-138
AGA 7/	37	45	-
GRI 8/	39	47	-

1/ "Oil Prices in the Long-Term," Interdepartmental study, London, December 1982.
2/ World Energy Outlook, 1982.
3/ Chase Econometrics, U.S. Macroeconomic Long-Term Forecasts, First Quarter, 1983.
4/ Data Resources, Inc., Energy Review, spring 1983.
5/ Wharton Econometric Forecasting Associates, Wharton Long-Term Forecast, April 1983.
6/ Energy Modeling Forum, World Oil Summary Report, February 1982.
7/ American Gas Association, "TERA Analysis," Feb. 8, 1983.
8/ Gas Research Institute, "1982 GRI Baseline Projection of U.S. Energy Supply and Demand, 1981-2000," October 1982.

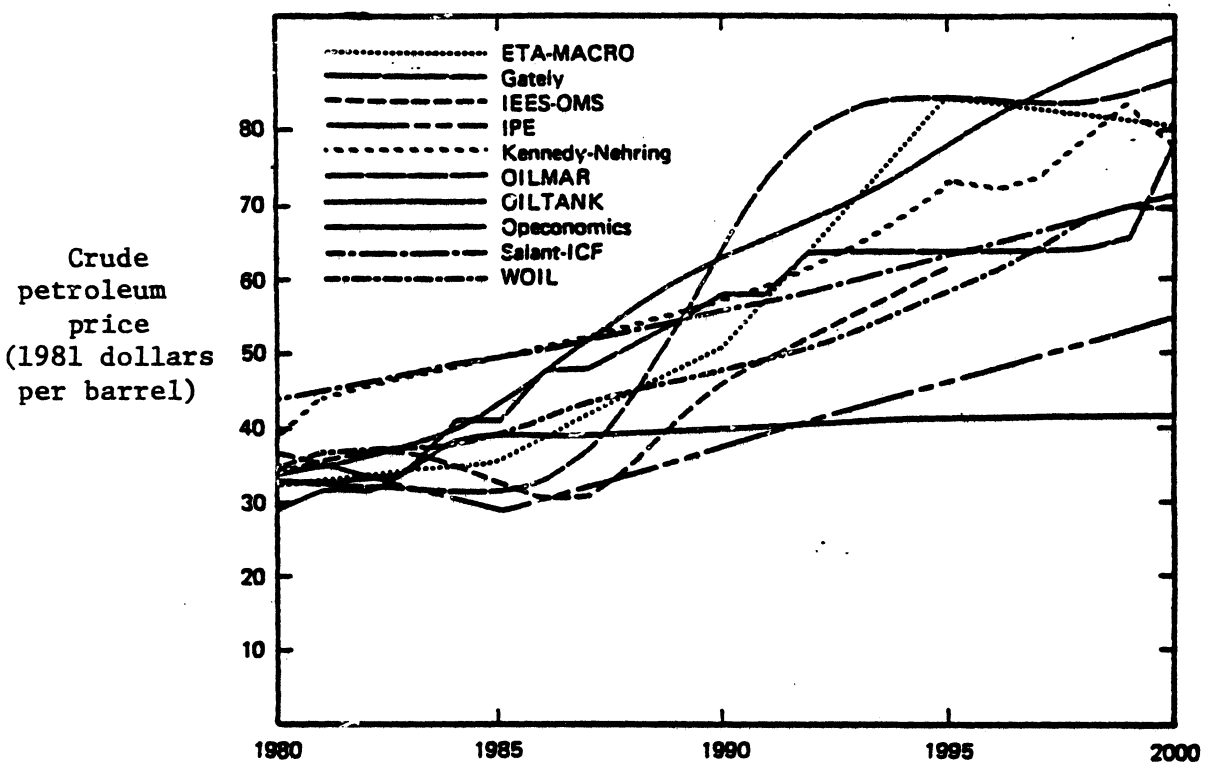
Figure 1 is taken from a publication by the Energy Modeling Forum. It shows pathways of world crude petroleum price projections of 10 different econometric models. 1/ These projections of a reference case situation, published in February 1982, serve to illustrate the variation in projections of different models which are using as input the same set of economic assumptions.

The models highlighted in the following figure represent two types of models, one of which depends only upon past and current information; the other type takes into account its own future projection of at least one sector (assuming perfect foresight). Although the paths differ significantly, a general upward trend is apparent throughout each of the projections.

However, these price projections were all completed and released prior to the March 1983 OPEC Ministerial Conference during which production quotas were set and the benchmark price of crude petroleum was lowered to $29 per barrel. More recent private studies present probable petroleum pricing scenarios similar to those most recently released by the Government. One domestic petroleum company foresees U.S. economic recovery boosting demand for petroleum, but retaining conservation and fuel-switching as price moderating forces. 2/ A second study by another domestic petroleum firm found the major part of the reduced demand for petroleum resulted from conservation

1/ Energy Modeling Forum, World Oil Summary Report, February 1982, pp. 11-31.
2/ "A 20-year Preview: Oil, Plentiful; Synfuels, Scarce," Chemical Week, June 29, 1983, p. 9.

Figure 1.--Crude petroleum: World price projections for the reference case



Source: Energy Modeling Forum, World Oil Summary Report, February 1982.

activities. 1/ The first study forecasts crude petroleum prices remaining at $29 per barrel (1983 dollars) through 1984, rising moderately through 1990, and then rising at a slightly faster rate than inflation through the year 2000. By the year 2000, the price of crude petroleum is forecast to range somewhere between $35 and $50 per barrel (1983 dollars). 2/

Projected Effects

Changes in the price of crude petroleum as projected by various sources infer certain changes in the status of both U.S. and world economic indicators. Reliance upon the "free-market distribution" system in the event of market disruptions, including the refusal to even consider standby measures to assure farmers and essential businesses adequate fuel, 3/ would result in increases in crude petroleum prices, possibly to $90 per barrel, thereby creating a decline in production of all goods, services, and employment of 3-8 percent for the nations involved 4/ as a group. 5/ 6/ Resulting retail prices for such consumer petroleum products as gasoline and home-heating oil are projected to increase to more than $3 and $4 a gallon. These price increases, as projected, would have the effect of lowering prospective domestic consumption by 18 percent. 7/

An earlier study examined the effects of a crude petroleum supply disruption on the U.S. Gross National Product (GNP) and other macroeconomic variables. 8/ The following tabulation summarizes some of the result of the study: 9/

1/ Ibid.

2/ Ibid.

3/ "Has the U.S. Left Itself Open to a New Oil Shock," Business Week, Oct. 17, 1983, p. 51; and "U.S. to Let Market Handle Oil Crisis," Washington Post, Sept. 23, 1983, p. A3.

4/ Nations chosen for this study were participants in the 1979 Tokyo Summit: United States, Canada, France, West Germany, Italy, Japan, and the United Kingdom.

5/ U.S. Congressional Research Service, Western Vulnerability To A Disruption of Persian Gulf Oil Supplies: U.S. Interests and Options, Report 83-24F, Mar. 24, 1983.

6/ "Threat of Persian Gulf Oil Cutoff Still Strong--U.S. Congressional Researchers," Platts Oilgram News, Sept. 20, 1983, p. 3.

7/ "Oil-Crisis Test Yields 'Economic Disaster,'" Washington Post, Sept. 9, 1983, p. A1.

8/ U.S. Department of Energy, Energy Information Administration, Macroeconomic Effects of Petroleum Supply Interruptions, March 1979; this study made use of econometric modeling exercises by Data Resources, Inc., and Wharton Econometric Forecasting Associates.

9/ The study assumes that, in all cases shown here, the supply interruption began in 1980 and lasted for a one-year period.

Domestic price and allocations controls	World price increase	SPR drawdown rate	Net supply shortfall	Decline in real GNP, 1980 1/
	Percent	Million barrels per day		Percent
Yes	100	0	2.00	2-5
Yes	200	0	4.00	7-9
Yes	300	0	6.00	15-18
Yes	68	2.00	0	1-2
Yes	271	2.05	3.95	6-9
Yes	261	2.74	3.26	4-8
Yes	271	2.05	3.95	4-8
Yes	261	2.74	3.26	3-7

1/ Each of these figures indicate an approximate range, not an exact value.

These results form a reasonable basis to understand the macroeconomic effects of a supply interruption. The decline in GNP is projected to be moderated by a drawdown of the SPR to completely replace the missing imports. However, if the supply shortfall cannot be completely compensated for by the SPR, significant declines in domestic GNP would occur. This study also indicates that in the case where domestic price and allocation controls are instituted by the Government, there would be a greater decline than if market forces were allowed to operate.

Price Scenarios

For the purposes of this study, four independent price scenarios were developed. The scenarios do not take into account any changes in Government policy which could affect the price of domestic or foreign crude petroleum. The middle-price scenario or base case was developed by analyzing the international market on the basis of projections of the U.S. Department of Energy and various industry estimates. The low- and high-price scenarios are derivations from the middle scenario. The annual prices in these three scenarios do not reflect any price shocks but instead only take into account supply pressures generated in the market place by such factors as changes in demand, the growth of alternative fuels, and general worldwide economic pressures. The price shock scenario reflects a major disruption in the supply of crude petroleum which results in a rapid increase in price during a short period of time. The projected future prices are based on events of the past. The following tabulation presents the four price scenarios for the base year of 1982 and projections for 1990 and 1995 (in 1982 dollars per barrel of crude petroleum):

Year	Low-price scenario	Middle-shock scenario	High-price scenario	Price-shock scenario
1982 1/	$33.35	$33.35	$33.35	$33.35
1985	21.00	26.00	33.00	54.00
1990	26.00	31.00	41.00	90.00
1995	37.00	47.00	55.00	75.00

1/ Actual price

To measure the effects on the U.S. economy of price increase scenarios, three models were used: 1/

(1) Data Resources, Inc, (DRI) macro model of the U.S. economy and the Interindustry, 400-Sector Classification model;
(2) The Glenn Hubbard-Robert Fry, of Harvard University, model; and
(3) The Alan Manne-Paul Preckel, of Stanford University, intertemporal equlibrium model of energy, international trade, and capital flows (3RT).

These models take into account various econometric forcasting variables such as the linkages within the world market between the world price of crude petroleum and how it is affected by a supply disruption; the elasticity of crude petroleum demand with respect to the change in world prices; monetary and fiscal policy reactions to disruptions; and the lag time of the model's equations for reactions by the U.S. economy to the disruptions.

Net Trade

The trade balances for crude petroleum and natural gas show a significant decrease from the low-to-high-price and price shock scenarios in both 1990 and 1995 (table 21). 2/ Under each scenario, the United States has a negative

1/ It should be noted that the value of econometric model is to provide a benchmark for policymakers. Model results are good predicators of possible future effects only if the relationships which have existed in the past hold true in the future. Model results should be interpreted as indicating the direction and magnitude but not the precise size of price changes.

2/ These price scenarios were run through DRI's quarterly macroeconomic model of the U.S. economy which forecasts about 1,000 different measures of economic activity in order to obtain imports and exports of crude petroleum for each year under each price scenario. These results were used as input for the DRI Interindustry Service which contains annual time series on current and constant dollar shipments and price indices for 400 industry groupings of the U.S. economy roughly based on a 4-digit SIC level, in order to generate U.S. imports and exports under each price scenario. Once these projections for imports and exports were derived, the trade balances for key sectors of the U.S. economy considered to be energy intensive were calculated.

trade balance in terms of crude petroleum and natural gas, however, thatnegative trade balance improves as the world price for crude petroleum increases. As was witnessed with past price increases, imports of crude petroleum decreased because of a switch to alternative fuels and conservation methods employed by consumers.

The petroleum refining and related products industry also shows an improvement in its negative trade balances in 1990 and 1995 as the world price of crude petroleum increases (table 22). Again, as a result of conservation methods and a switch to alternative fuels the level of imports would be expected to decrease as the price of crude petroleum increases. Also, U.S. production would be expected to decrease as the refiners acquisition cost for crude petroleum increases; and the products produced would likely be used domestically rather than exported.

The trade balances for energy-intensive industries such as the chemicals and allied products industry, in terms of value, remain fairly constant in 1990 and 1995 between the low and high price scenarios (table 23). However, a severe change in the price of crude petroleum results in a more significant impact on trade balance. Table 24, which shows the U.S. trade balance in 1990 and 1995 for selected energy-intensive sectors under each of the three price scenarios, indicates that an increase in price for crude petroleum results in increases in the negative trade balances for the more energy-intensive industries.

Table 21.--Crude petroleum and natural gas: U.S. trade balance for the low, middle, and high price scenarios, 1990 and 1995

(In billions of constant dollars)

Year	Low-price scenario	Middle-shock scenario	High-price scenario	Price-shock scenario
1990	-115.567	-98.949	-75.572	-24.421
1995	-185.726	-157.554	-131.219	-53.316

Source: Data Resources, Inc.

Table 22.--Petroleum refining and related products: U.S. trade balance for the low, middle, and high price scenarios, 1990 and 1995

(In billions of constant dollars)

Year	Low-price scenario	Middle-shock scenario	High-price scenario	Price-shock scenario
1990	-25.840	-20.761	-13.715	0.194
1995	-38.859	-29.819	-22.191	-4.105

Source: Data Resources, Inc.

Table 23.--Chemicals and allied products: U.S. trade balance for the low, middle, and high price scenarios, 1990 and 1995

(In billions of constant dollars)

Year	Low-price scenario	Middle-shock scenario	High-price scenario	Price-shock scenario
1990	12.556	12.581	12.531	13.166
1995	22.778	22.339	21.315	7.356

Source: Data Resources, Inc.

Table 24.--Selected sector: U.S. trade balance for the low, middle, and high-price scenarios, 1990 and 1995

(In billions of constant dollars)

DRI sector	Low-price scenario		Middle-price scenario		High-price scenario		Price-shock scenario	
	1990	1995	1990	1995	1990	1995	1990	1995
Coal mining	7.739	14.566	7.674	14.247	7.538	13.769	5.895	9.167
Chemical and fertilizer mineral materials	-.123	-.102	-.13	-.170	-.148	-.297	-600	-1.985
Inorganic and organic chemicals	6.681	13.009	6.72	12.473	6.681	11.334	3.413	-2.437
Fertilizers	-.746	1.343	.732	1.254	.7	1.100	.114	-.785
Agricultural chemicals, n.e.c	.399	.670	.394	.725	.382	.664	.161	-.071
Gum and wood chemicals	.269	.485	.267	.476	.262	.463	.112	.165
Chemical preparations	1.349	2.415	1.335	2.326	1.301	2.176	.742	.609
Plastics materials and resins	4.261	7.449	4.231	7.311	4.168	7.110	3.420	4.798
Synthetic rubber	1.088	1.724	1.081	1.690	1.062	1.642	.857	1.060
Cellulosic manmade fibers	.103	.157	.102	.152	.1	.144	.067	.054
Organic fibers, non-cellulosic	.7	1.166	.694	1.134	.681	1.082	.523	.587
Paving mixtures and blocks	.008	.014	.008	.014	.088	.013	.007	.011
Asphalt felts and coatings	.067	.130	.07	.132	.074	.172	.080	.116
Blast products and steel mills	-11.649	-19.736	-11.687	-20.329	-11.79	-21.591	-15.565	-33.301
Primary aluminum	-4.943	-9.591	-4.962	-9.811	-5.009	-10.269	-6.614	-16.191
Primary nonferrous metals, n.e.c	-5.732	-9.956	-5.68	-9.904	-5.592	-9.960	-11.204	-21.607
Motor vehicles	-28.261	-36.992	-27.35	-35.489	-25.941	-34.893	-18.020	-29.607
Paper mills	-4.784	-7.446	-4.798	-7.641	-4.834	-8.072	-5.579	-11.475
Paperboard mills	-1.645	2.630	1.635	2.587	1.613	2.521	1.476	2.021
Primary copper	.044	-.070	.044	-.013	.022	-.175	-.690	-2.329

Source: Data Resources, Inc.

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GNP and Trade

The trade sector of the Hubbard-Fry model was emphasized for this study. 1/ In the model, the current account (the value of exports less the value of imports) is affected but not necessarily dependent on imports and the GNP. For example, the industrialized nations of the world most dependent upon imports of crude petroleum were not generally those nations whose current accounts deteriorated most sharply in the 1970's. Although higher crude petroleum prices adversely affected trade, GNP was also affected, resulting in positive effects on the current account 2/

Under the three price scenarios, the current account in nominal dollars is in deficit for most of the period because the scenarios have prices increasing at a faster rate than the price index for exports of American goods (table 25). The current account in constant (1972) dollars is in the greatest surplus under the high-price scenario since, under the scenario, demand for crude petroleum decreases most sharply resulting in negative effects on the U.S. economy and reduced imports (tables 25 and 26). Exports are not particularly sensitive to crude petroleum price fluctuations primarily because it is assumed that OPEC should somewhat counter balance the recession in other nations by increasing their exports. In the long term, at a point where the value of these variables reaches a state of equilibrium, the paths of the scenarios converge.

Table 25.--Low, middle, and high-price scenarios: GNP, exports, imports, the crude petroleum bill, and the current account, 1990 and 1995 1/

(In billions of dollars)

Variable	1990			1995		
	Low	Middle	High	Low	Middle	High
GNP	1,957.1	1,949.9	1,936.1	2,218.7	2,207.7	2,172.2
Exports	681.9	700.5	730.8	1,245.1	1,277.9	1,291.6
Imports	729.5	739.9	755.2	1,274.6	1,306.9	1,298.2
Crude petroleum bill	152.1	160.9	171.4	272.6	295.3	297.8
Current account	-47.6	-39.3	-24.5	-29.5	-29	-6.7

1/ Variables are expressed in nominal dollars.

Source: Hubbard-Fry model.

1/ The Hubbard-Fry model is an econometric model of the U.S. economy and the world crude petroleum market designed to quantify short-term economic costs of crude petroleum supply disruptions. Hubbard and Fry maintain that their projections for world crude petroleum price paths during supply disruptions are lower than those of other conventional models. This is the result of prices in the Hubbard and Fry model which are determined endogenously within the model.

2/ Jeffrey D. Sachs, "The Current Account and Macroeconomic Adjustment in the 1970's," Brookings Papers on Economic Activity, No. 1, 1981, p. 201.

Table 26.--Low, middle, and high-price scenarios: Exports, imports, the crude petroleum bill, and the current account, 1990 and 1995 1/

(In billions of dollars)

Variable	1990			1995		
	Low	Middle	High	Low	Middle	High
Exports	193.5	194.0	194.5	254.8	253.5	249.8
Imports	167.6	164.0	159.0	195.5	191.9	190.5
Crude petroleum bill	34.8	35.3	35.9	41.6	43.2	43.5
Current account	25.9	30.1	35.6	59.3	61.7	59.3

1/ Variable are expressed in real or constant 1972 dollars.

Source: Hubbard-Fry model.

GNP and crude petroleum production

It is expected that the OECD nations would be likely to show the highest average annual share of GNP growth from 1982 to the year 2000 under the low-price scenario since these nations are net importers of crude petroleum. 1/ The OECD shows crude petroleum production decreases (table 27) under the low- and middle-price scenarios and a slight production increase under the high-price scenario, primarily because when the price of crude petroleum is high, producers recoup expenses related to exploration and production. When prices are low, the OECD nations are more likely to import larger quantities of crude petroleum to compensate for losses in domestic production, thus resulting in negative trade balances in the subject years (table 28).

Under the middle-price scenario, both price and production maximize the GNP for the OPEC nations (table 27), because world consumption of crude petroleum would likely increase. The high-price scenario results in low GNP growth because of low production which would likely be a response to increased conservative and use of alternative fuels by the consuming nations of the world. Since the OPEC nations are net exporters of crude petroleum, positive

1/ The 3RT model groups market economies into three regions: OECD countries, OPEC, and NODC. A key input into the 3RT model is the potential GNP growth rates for each region. These assumed growth rates through the year 2000 are as follows (in percent):

OECD	3
OPEC	6
NODC	6

For the puposes of this study, three world price scenarios for crude petroleum were explored:

Low-price scenario	$18 per barrel
Middle-price scenario	$30 per barrel
High-price scenario	$45 per barrel

trade balances appear only under the low-price scenarios for each of the subject years (table 28).

The NODC nations show the highest GNP and production growth under the high-price scenario (table 27). These nations, such as Mexico, China, and the CERN's in the Far East, depend heavily upon revenues derived from the exportation of crude petroleum to repay international loans and finance the development of other domestic industries. Therefore, the higher prices per barrel of crude petroleum result in higher revenues for foreign exchange. The NODC nations show positive trade balances under all three price scenarios (table 28). In the short term, the highest positive trade balance appears under the low-price scenario in 1990 and is attributable to the fact that these nations are expected to export large quantities of crude petroleum, whereas their level of imports should remain low because most of the population of these nations are outside the money market.

Table 27.--The share of average annual growth 1/ for GNP and crude petroleum production, by regions under the low, middle, and high-price scenarios

Region	GNP			Crude petroleum production		
	Low	Middle	High	Low	Middle	High
OECD	3.14	3.05	2.98	-1.12	-1.12	0.21
OPEC	7.12	7.35	7.07	5.51	4.17	2.42
NODC	5.12	5.33	5.51	3.44	4.31	4.76
Total world	3.73	3.72	3.68	3.47	2.79	2.23

1/ Calculated from 1982 to the year 2000.

Source: 3RT model.

Table 28.--Trade balances under a low, middle, and high-price scenario in 1990, 1995, and the year 2000, by area

Area	Trade balance								
	1990			1995			2000		
	Low	Middle	High	Low	Middle	High	Low	Middle	High
	Billions of 1982 dollars								
OECD	-82.2	-34.5	41.2	-22.5	-3.2	45.7	-6.9	-3.7	22.0
OPEC	34.1	-0.3	-68.2	11.9	-10.8	-69.9	1.2	-11.7	-52.1
NODC	48.2	34.9	27.4	10.6	14.0	24.1	5.7	15.4	30.0

Input/Output Model

The U.S. Department of Labor input/output model can be used to calculate the change in U.S. industry output and employment resulting from any given hypothetical change in final demand for a domestically produced commodity. The model is based on the input/output relations existing in the U.S. economy in 1977 and 1981 productivity factors (employment-output ratios). 1/

The estimates of the effect on production of the net trade can vary with different assumptions about the elasticities of demand and supply. For this study a one-to-one ratio is assumed between net trade changes and production changes. This assumption implies an infinite supply elasticity or a zero demand elasticity, or that any increase in imports replaces domestic production; domestic prices, consumption, exchange rates, and other variables are assumed to be unaffected by changes in imports and exports.

Changes in industry output and employment provided by the input/output model are upper limits. A decrease in demand will be reflected by the model as a decrease in output and employment.

Changes in Industry Output

The net trade figures obtained from DRI were used as input into the BLS model. The model indicates that a decrease in net trade of $30 billion between the middle and low-price scenarios in 1990 could occur in conjunction with a $62 billion decrease in the output of the entire U.S. economy; a decrease of $20 billion in the crude petroleum and natural gas industry; and a $5.6 billion decrease in the petroleum refining and related products industry. An increase in net trade of $40 billion between the middle and high-price scenarios could occur in conjunction with output increases of $82 billion for the entire U.S. economy; $28 billion in the crude petroleum and natural gas industry; and $8 billion in the petroleum refining and related products industry.

A 1995 net trade decrease of $44 billion between the middle and low-price scenarios would indicate possible decreases of $89 billion in the output of the entire U.S. economy; $37 billion in the crude petroleum and natural gas industry; and $9.6 billion in the petroleum refining and related products industry. At the same time, an increase of $20 billion in net trade between the middle and high-price scenarios could lead to possible increases of $38 billion in the output of the entire economy; $32 billion in the crude petroleum and natural gas industry; and $7.5 billion in the petroleum refining and related products industry.

1/ It should be noted that to the extent that the input/output relationships have changed since 1977, the model results will not reflect the current situation. Also, the price scenarios presented previously relate to the 1990-95 period and the actual input/output relations and labor productivity in 1990 and 1995 will most likely differ from those in the model.

Changes in Industry Employment

The model indicates that a decrease in the net trade balance of $30 billion in 1990 could lead to decreases in employment of 1 million jobs in the entire U.S. economy; 294,000 jobs in the crude petroleum and natural gas industry; and 33,000 jobs in the petroleum refining and related products industry. At the same time, a $40 billion increase in net trade could witness increases of 1.7 million jobs in the entire U.S. economy; 407,000 jobs in the crude petroleum and natural gas industry; and 46,000 jobs in the petroleum refining and related products industry.

By 1995, losses of 1.7 million jobs in the entire economy, 528,000 jobs in the crude petroleum and natural gas industry, and 57,000 jobs in the petroleum refining and related products industry could occur in conjunction with a net trade decrease of $44 billion. Increased employment of 344,000 jobs in the entire economy, 400,000 jobs in the entire U.S. economy, 400,000 jobs in the crude petroleum and natural gas industry, and 45,000 jobs in the petroleum refining and related products industry occur together with a net trade increase of $20 billion.