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Energy Information Administration

International Energy Outlook 1986

Projections to 2000



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International Energy Outlook 1986

Projections to 2000

Energy Information Administration
Office of Energy Markets and End Use
U.S. Department of Energy
Washington, DC 20585

Preface

This report presents the current Energy Information Administration (EIA) assessment of the long-term outlook for international energy markets. The first issue of this series was published in 1986. This report is provided, as are other EIA reports, as a statistical service for use by managers and international energy analysts and not as a government energy plan. Current U.S. government policies and foreign government policies are assumed to hold over the projection interval, which extends to the year 2000.

This issue emphasizes oil market developments, particularly future world oil prices and oil production potential. This emphasis in no way minimizes the importance of other energy markets; moreover, the analysis recognizes that the development of alternative energy sources impacts directly on the world oil market. The world oil price projections developed in this international setting are, in turn, used as assumptions for analyses of the U.S. domestic energy market provided in EIA's *Annual Energy Outlook 1986*. Since the U.S. energy market affects and is affected by the international market, the methodology incorporates this interaction to the extent possible. The domestic energy projections shown in this report are the same as those contained in the *Annual Energy Outlook 1986*, with the exception of the outlook for domestic oil production. Because of the recent downward revision in oil production statistics for 1986, the domestic oil production projections have been updated to be consistent with those contained in EIA's January 1987 *Short-Term Energy Outlook*. These short-term production projections have been extended such that they trend back to the projections for 1995 provided in the *Annual Energy Outlook 1986*. Sources providing more detailed discussions on the U.S. domestic markets are referenced throughout the report.

The analysis of the international energy markets considers world energy growth prospects and fuel substitution possibilities. Requirements for oil are compared to oil production potential, first by non-OPEC producers, leaving the remaining requirements to be supplied by OPEC. The oil pricing behavior of OPEC is based on historical relationships between price changes and the use of available oil production capacity. As oil prices change, substitution to or away from oil is allowed to take place.

Within the analytic framework are several major assumptions which, in large part, determine the accuracy of the projections. Much professional judgement, based on recent trends, reviews of many country reports, and projections made by other energy forecasters, went into the development of forecast assumptions and into the projected overall energy balances. The major assumptions made include estimates of the annual rates of change in country ratios of total energy consumption to economic activity, oil production capacities, and the rate of incremental energy requirements met by alternatives to oil. Logically, the projections call for fairly smooth patterns of growth and changes in underlying parameters over the next 15 years. However, over the past 15 years, the world energy market has been characterized by major swings in most market indicators. The uncertainty of the projections is conveyed by the projection ranges. Point estimates are deemphasized.

Contacts

The *International Energy Outlook* is prepared by the Energy Information Administration (EIA), Office of Energy Markets and End Use (EMEU). General questions concerning the contents of the report may be referred to W. David Montgomery (202/586-1617), Director, EMEU; W. Calvin Kilgore (202/586-1130), Director, International and Contingency Information Division; and Derriel B. Cato (202/586-6574), Chief of the Analysis Branch.

Detailed questions may be referred to A. David Sandoval (202/586-6581) or the following analysts, who can be reached at the Division of International and Contingency Information (202/586-1130).

<i>International Petroleum Markets:</i>	Erik Kreil
<i>Petroleum Prices:</i>	Erik Kreil
<i>Petroleum Supply</i> <i>- History:</i>	Louis D. DeMouy
<i>- Forecast:</i>	Erik Kreil
<i>Petroleum Demand</i> <i>- History:</i>	Louis D. DeMouy
<i>- Forecast:</i>	Douglas M. MacIntyre
<i>Petroleum Reserves</i> <i>Resources:</i>	Louis D. DeMouy
<i>Petroleum Supply</i> <i>Vulnerability:</i>	G. Daniel Butler
<i>Energy Consumption</i> <i>- Regional Patterns:</i>	A. David Sandoval
<i>- Coal:</i>	Debra L. Paxson
<i>- Natural Gas:</i>	A. David Sandoval
<i>- Nuclear/Other:</i>	Michael J. Grillot
<i>International Energy</i> <i>Forecast Comparisons:</i>	Derriel B. Cato

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Executive Summary

The drop in world oil prices dominated international energy markets in 1986. Conditions that led to the price drop in 1986 were shaped by the upward price shocks of the 1970's which caused improvements in energy conservation and efficiency and the substitution away from oil that followed. A second event in 1986 that could have significant long-term effects on international energy markets was the accident at the nuclear plant at Chernobyl. Many countries are depending on nuclear power as an important alternative energy source to oil for electric generation.

The average price of imported crude oil to United States refiners (referred to as the world oil price) is expected to average between \$14 and \$15 per barrel in 1986, just over half the average price of \$27 per barrel registered in 1985. World oil prices actually dipped below \$11 per barrel in July, 1986, before firming up somewhat during the final months of the year. Oil prices have been declining since 1981, when they averaged about \$37 per barrel for the year as a whole. When adjusted for inflation and expressed in 1986 dollars, the price peak in 1981 was about \$45 per barrel. In real terms, therefore, oil prices have dropped by about two-thirds during the past 5 years.

The price decline since 1981 was caused by both reduced consumption of oil and increased production of other energy sources. Oil consumption in the market economies dropped from a high of about 52 million barrels per day in 1979 to about 46 million barrels per day by 1985.¹ World oil production (including natural gas liquids) declined by about 2.4 percent per year over this 6-year period. At the same time, production of coal, natural gas, and hydroelectric power grew at a rate of 2.4 to 2.8 percent per year, and nuclear power grew by over 14 percent per year. Thus, while production of oil was declining over this period, total primary energy production worldwide increased by about 0.7 percent per year.²

While crude oil production worldwide declined an average rate of 2.7 percent per year between 1979 and 1985, crude oil production among the Organization of Petroleum Exporting Countries (OPEC) declined by over 10 percent per year.³ OPEC, which produced half of the world's crude oil in 1979, produced only about 30 percent of the total by 1985. OPEC's largest member, Saudi Arabia, cut crude oil production the most, down by almost two-thirds over this period.

As a result of the collapse in oil prices during the first half of 1986, the outlook for oil production outside of OPEC has been reduced. In addition, some non-OPEC producers are voluntarily reducing their production in cooperation with OPEC, which in mid-December agreed to reduce its production somewhat over 7 percent and return to fixed-contract pricing beginning February 1987. Non-OPEC production declined by an estimated 100 to 200 thousand barrels per day during 1986 and is currently projected to decline by as much as an additional 200 to 300 thousand barrels per day during 1987. The decline in U.S. production during 1987 is estimated to be around 500 thousand barrels per day.

Also primarily as a result of lower oil prices in 1986, world oil consumption increased by slightly over one million barrels per day during 1986, and consumption is currently projected to increase an additional 200 to 900 thousand barrels per day in 1987. As the result of increased demand and lower non-OPEC production, the demand for OPEC oil is expected to exceed its recently established production quota, thereby, enabling OPEC production to rise during the latter half of 1987. This projected increase could tend to stabilize prices for the remainder of 1987. However, with OPEC continuing to produce below its production capacity, the potential for short-term price volatility remains high.

¹The "market economies" are defined as all countries other than the centrally planned economies of Eastern Europe, the Soviet Union, China, Cuba, Kampuchea, North Korea, Laos, Mongolia, and Vietnam.

²Total primary energy production is based on data and definitions presented in Energy Information Administration, *International Energy Annual 1985*. Fuel wood and all noncommercial fuel sources are excluded from the totals.

³The members of OPEC include Algeria, Ecuador, Gabon, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, United Arab Emirates, and Venezuela.

Two major uncertainties remain in the world oil market—one dealing with world oil stocks and the other with the Iran-Iraq war. Actions by OPEC to recapture its oil market share by increasing production in the first half of 1986 resulted in an estimated increase in world oil stocks of some 300 to 400 million barrels. This stock overhang, if used, could lead to downward pressures on oil prices, particularly if coupled with cheating by some OPEC members. With respect to the other major uncertainty, the war between Iran and Iraq has intensified recently to new highs, with Iran now posing a real threat to Iraqi production. Iraq, in turn, has limited Iranian production for the last two years with its attacks on Kharg Island.

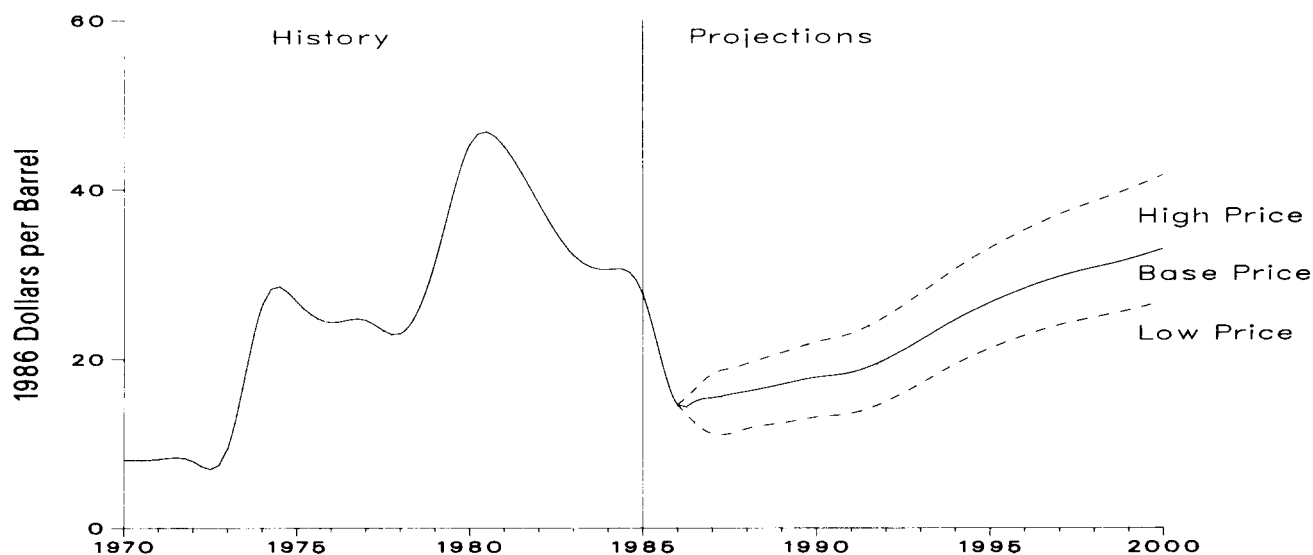
The highlights from the international energy projections are as follows:

- After dropping by almost half in 1986, to between \$14 and \$15 per barrel, this analysis indicates that real oil prices (expressed in 1986 dollars) are likely to remain volatile over the short-term with average prices rising slowly to between \$27 and \$41 per barrel by the year 2000 (Figure ES1 and Table ES1 on page 3).
- The base case outlook for the world oil market includes a bottoming out of the price drop in 1986; increases in oil demand encouraged by lower oil prices; a peaking in non-OPEC oil production in the late 1980's; and sufficient produc-

tion restraint by OPEC to avoid another price war such as that of 1986. Thus, the base case represents a "no surprises" projection. However, past experience has shown that relatively minor changes in oil supplies or demands can have a significant impact on prices, particularly in the near term.

- An excess of 9 to 10 million barrels per day in world oil production capacity should maintain downward pressure on oil prices through the 1980's. However, much of this excess capacity resides in the Persian Gulf, and unrest in that area has the potential of quickly removing this capacity from the market. Pressure on oil prices is projected to build in the 1990's, as non-OPEC production declines and OPEC production increases.
- As oil prices rise, oil's contribution to total primary energy consumption in the market economies is projected to decline. Oil's share is projected to go from 46 percent in 1985 to between 38 and 41 percent by 2000. The share for natural gas is projected to remain in the 18 to 21 percent range, while coal's share is projected to rise from about 21 percent in 1985 to between 22 to 24 percent by 2000. "Other" energy sources, including nuclear power, increase their share from 15 percent in 1985 to between 17 to 18 percent by the year 2000. Changes in the consumption of these energy sources in absolute terms are presented in Figure ES2 on page 4.

Figure ES1. World Oil Prices, 1970-2000



Note: All prices are the cost of imported crude oil to U.S. refiners.
 Sources: o History: Energy Information Administration, Annual Energy Review 1985, DOE/EIA-0384(85) (Washington, DC, 1986). o Projections: Table 1 of this report.

Table ES1. Summary of Assumptions and Projections for Market Economies

Assumptions/Projections	History		Projections	
	1984	1985	1990	2000
Assumptions				
Economic Growth Rates ^a (percent per year)	4.1	2.7	2.3-3.1	2.4-3.2
OPEC Oil Production Capacity ^b (million barrels per day)	28.2	28.4	29-31	31-35
Projections				
Oil Prices ^c (1986 dollars per barrel) ..	\$30.57	\$27.64	\$13-22	\$27-41
Oil Production ^d (million barrels per day)				
Non-OPEC	25.9	26.7	25-26	21-26
OPEC	18.6	17.2	21-26	23-33
Energy Consumption ^e				
Oil (million barrels per day)	46.7	46.4	48-52	47-55
Gas (trillion cubic feet)	36.5	37.1	39-42	47-57
Coal (million short tons)	2,028	2,083	2,300-2,400	2,800-3,300
Other ^f (quadrillion Btu)	28	30	35-37	44-49
Total Energy ^g (quadrillion Btu) ...	202	205	222-230	256-276

^aThe 1990 and 2000 projections represent average annual rates of growth from 1985 to 1990 and from 1985 to 2000, respectively.

^bProduction capacity is defined as maximum sustainable production adjusted to reflect current operable capacity in some countries.

^cOil prices are defined as the U.S. refiner acquisition cost of imported crude oil.

^dIncludes crude oil, lease condensate, natural gas liquids, other liquids, and refinery gain.

^eConsumption amounts for 1985 are preliminary.

^fIncludes nuclear, hydroelectric, geothermal, and other energy sources.

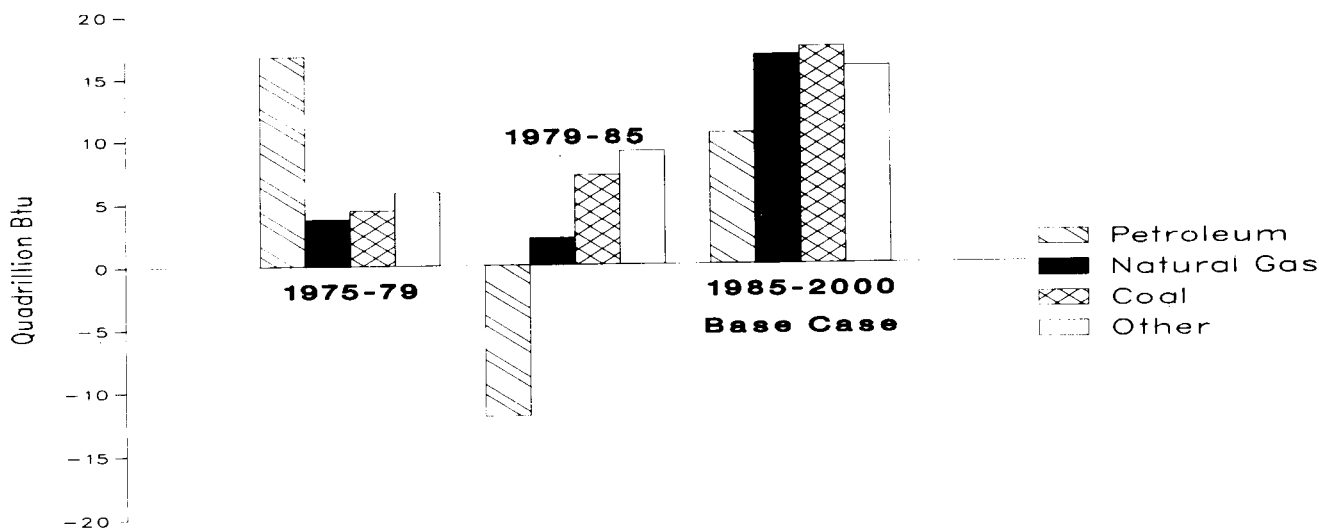
^gAverage conversion factors used to compute British thermal units (Btu) are (1) Oil - 5.6 Million Btu/barrel, (2) Gas - 1,014 Btu/cubic foot, and (3) Coal - 20.3 Million Btu/short ton.

OPEC=Organization of Petroleum Exporting Countries.

Note: Market economies include all countries except those with centrally planned economies, Eastern Europe, the Soviet Union, China, Cuba, Kampuchea, North Korea, Laos, Mongolia, and Vietnam.

Sources: o History: Energy Information Administration, Monthly Energy Review, DOE/EIA-0035(86/09), International Energy Annual 1985, DOE/EIA-0219(85), and Short-Term Energy Outlook, DOE/EIA-0202(86/4Q) (Washington, DC, 1986); Wharton Econometric Forecasting Associates, World Service Data Banks, October 1986, (Philadelphia, PA, 1986). o Projections: Tables 1, 2, 5, 7, 8, 10, 11, and 12, of this report; Energy Information Administration, Office of Energy Markets and End Use.

Figure ES2. Shifts in the Composition of Market Economies Fuel Consumption Between Periods



Note: o These bars represent the "change" during each period in specific fuel consumption. The sum of the changes equals the change in total energy consumption. The base case projection (1985-2000) shows increasing total energy consumption but a declining oil share.

Sources: o History: United Nations, 1979 Yearbook of World Energy Statistics (New York, NY, 1981); and Energy Information Administration, International Energy Annual, DOE/EIA-0219 and International Petroleum Annual, DOE/EIA-0042, selected issues (Washington, DC). o Projections: Table 8 of this report.

- Energy consumption is projected to grow from about 205 quadrillion Btu in 1985 to between 256 to 276 quadrillion Btu by 2000, or between 1.5 to 2 percent per year. Energy consumption in the developing countries is projected to grow about twice as fast as that in the industrialized countries of the Organization for Economic Cooperation and Development (OECD).⁴
- Economic growth in the market economies, which is assumed to be the major determinant of energy consumption, is projected to average just under 3 percent per year between 1985 and the year 2000. Thus, with energy consumption growing by 2 percent per year, the energy intensity of economic activity is assumed to decline by about 1 percent per year over the projection period.
- Oil consumption in the market economies is projected to be about 1.2 to 5.7 million barrels per day higher in 1990 than the 46.4-million-barrel-per-day level in 1985 and to remain in this general range thereafter, increasing at most by 9 million barrels per day from the 1985 level by the year 2000 (Table ES1 on page 3). Most of the additional oil is projected to come from OPEC, with production (including natural gas liquids) going from about 17 million barrels per day in 1985 to between 23 and 33 million barrels per day by the year 2000. Much of the growth in oil consumption is expected to occur in the developing countries.
- Natural gas consumption in the market economies is projected to grow between 1.5 and 2.9 percent per year from 1985 to 2000 and is expected to account for over a quarter of the increase in total energy consumption over this period. Natural gas consumption in the developing countries is projected to grow the most. The non-OPEC countries are expected to take greater advantage of indigenous resources in an attempt to reduce dependence on imported oil. The OPEC countries are expected to take greater advantage of the gas currently being flared in the process of oil production.
- Coal, like natural gas, is expected to account for over a quarter of the increase in total energy consumption in the market economies between 1985 and 2000, growing between 2.0 to 3.1 percent per year. Events in 1986, in addition to the oil price drop, that added uncertainty to coal prospects were the nuclear accident at Chernobyl and actual

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

and proposed sanctions against coal imports from South Africa.

- Nuclear power is projected to be the fastest growing source of energy in the market economies between 1985 and 2000, growing between 3.1 and 4.7 percent per year. The growth in nuclear power generation is expected to fall off somewhat after 1990, however, mirroring declining growth in nuclear generating capacity. Growth could be slowed further if planned additions to nuclear generating capacity are reduced or delayed by safety considerations related to the Chernobyl nuclear reactor accident.
- Other commercial energy sources, primarily hydroelectric power and geothermal, are expected to account for about a tenth of the increase in total energy consumption in the market economies between 1985 and 2000, growing slightly faster

than total energy consumption. Synthetic fuels, such as shale oil and liquefied coal, are expected to remain small contributors to total energy consumption through the year 2000, with low prices for conventional fuels reducing current incentives to invest in these resources.

The major assumptions used to make the projections presented in this report deal with such key considerations as economic growth, the energy intensity of economic activity, supply availability, and the response of consumers to changes in energy prices. The energy projections are highly dependent on these assumptions. Thus, basic assumptions are modified to provide a range of energy projections. These ranges help demonstrate the uncertainty as to how these and other factors might influence world energy markets in the future.

1. World Oil Prices

Despite the quick fall in world oil prices during 1986, it seems much more likely that prices will rise over the longer term than that they will remain low. The base case projections of the general supply and demand conditions over the next 14 years show prices rising only to about \$33 per barrel (in 1986 dollars) by the year 2000 (Table 1 on page 8). However, modification of the underlying assumptions to produce an upper and lower range of price (without such extraordinary circumstances as a major oil supply disruption) produced projections of \$41 and \$27, respectively. Due in large part to a surplus in potential oil supply, prices in real terms under all three of these cases are projected to remain at lower levels between now and the year 2000 than the price levels experienced in the early 1980's. The year 2000 price of \$27 under the low-price case, for example, is about a dollar lower than the \$28 price of 1985. The \$33 price of the base case is about the same as the average price for 1983. Even the \$41 price in 2000 under assumptions of the high-price case is about \$4 lower than was the price in 1980 and 1981, when prices reached a peak.

The low price path reflects a widely held perception that the world oil price may be returning to relatively flat pre-embargo trends, but it does not appear that this is necessarily the most likely future course. This section endeavors to interpret the assumptions that led to all of the three price paths presented while also describing the conditions that could lead to prices remaining below \$27 per barrel through 2000.

Past experience has shown that movements in world oil price can be highly unpredictable, particularly over the near term. Relatively small changes in market conditions or in policy decisions have sometimes caused major price swings. Given the political and economic uncertainties that exist in the world, there is no reason to believe that such rapid changes in oil prices will be any easier to predict in the future. Nevertheless, longer run trends in world oil supplies and demands (and in the world energy situation as a whole) can be projected

with some modest confidence from available data and from informed judgement. Such broad indications about longer term prospects for world oil prices may be useful--or at least interesting.⁵

The Price War of 1986

World oil prices declined after 1981 as a result of conservation and new oil production brought on by the high prices of the 1970's. But downward pressure increased in December 1985, when the Organization of Petroleum Exporting Countries (OPEC)⁶ abandoned efforts to support oil prices through production restraints in favor of a policy to increase market share via unofficial price cuts. Saudi Arabia in particular contributed to an inevitable price slide by increasing its production from a low of 2.3 million barrels per day in August 1985 to almost 4.7 million barrels per day by the end of 1985 (still well below that country's production peak of 10.3 million barrels per day reached in August 1981). By mid 1986, OPEC as a whole was producing over 20 million barrels per day of crude oil, compared with about 14 million barrels per day a year earlier. Prices, which had averaged about \$27 per barrel in 1985, fell to \$12 per barrel in nominal terms on average during the third quarter of 1986.

The price war of 1986 reached a climax in July, when world oil prices dropped below \$11 per barrel. When adjusted for inflation, \$11 per barrel in 1986 is not even a dollar more than the \$4 price paid for a barrel of oil in 1973, the year before the first oil crisis of the 1970's. Although prices recovered somewhat during the fourth quarter of 1986, the earlier downward pressure continued because of earlier overproduction and the high stock levels that had been built up speculatively during the summer months in the expectation that prices would rebound.

⁵In this report, the world oil price is defined as the average cost of imported crude oil to U.S. refiners. Unless otherwise noted, all prices are presented in constant 1986 dollars.

⁶The members of OPEC include Algeria, Ecuador, Gabon, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, United Arab Emirates, and Venezuela.

Table 1. World Oil Prices, 1979-2000
(1986 and Nominal Dollars per Barrel)

Year	Price Case		
	Low	Middle	High
		<u>1986 Dollars per Barrel</u>	
1979		\$31.48	
1980		45.16	
1981		45.01	
1982		38.31	
1983		32.24	
1984		30.57	
1985		27.64	
1986		14.57	
1987	\$11	15	\$18
1988	12	16	19
1989	12	17	21
1990	13	18	27
1991	14	18	23
1992	15	20	25
1993	17	22	28
1994	19	25	31
1995	21	27	33
1996	23	28	35
1997	24	30	37
1998	25	31	38
1999	26	32	40
2000	27	33	41
		<u>Nominal Dollars per Barrel</u>	
1979		\$21.67	
1980		33.89	
1981		37.05	
1982		33.55	
1983		29.30	
1984		28.88	
1985		26.99	
1986		14.57	
1987	\$11	16	\$19
1988	13	17	21
1989	14	19	23
1990	15	21	25
1991	16	22	28
1992	19	25	32
1993	23	30	37
1994	27	35	43
1995	32	40	50
1996	36	45	56
1997	40	50	62
1998	44	54	68
1999	48	59	74
2000	52	64	81

Notes: o Prices represent the U.S. refiner acquisition cost of imported crude oil.
o The inflation rates used to estimate nominal prices for 1986 through 2000 are derived using the base case GNP price deflators from Energy Information Administration, Annual Energy Outlook 1986, DOE/EIA-0383(86) (Washington, DC, 1987).

Source: o History: Energy Information Administration, Monthly Energy Review, DOE/EIA-0035 (86/09) (Washington, DC, 1986). o Projections: Energy Information Administration, Office of Energy Markets and End Use.

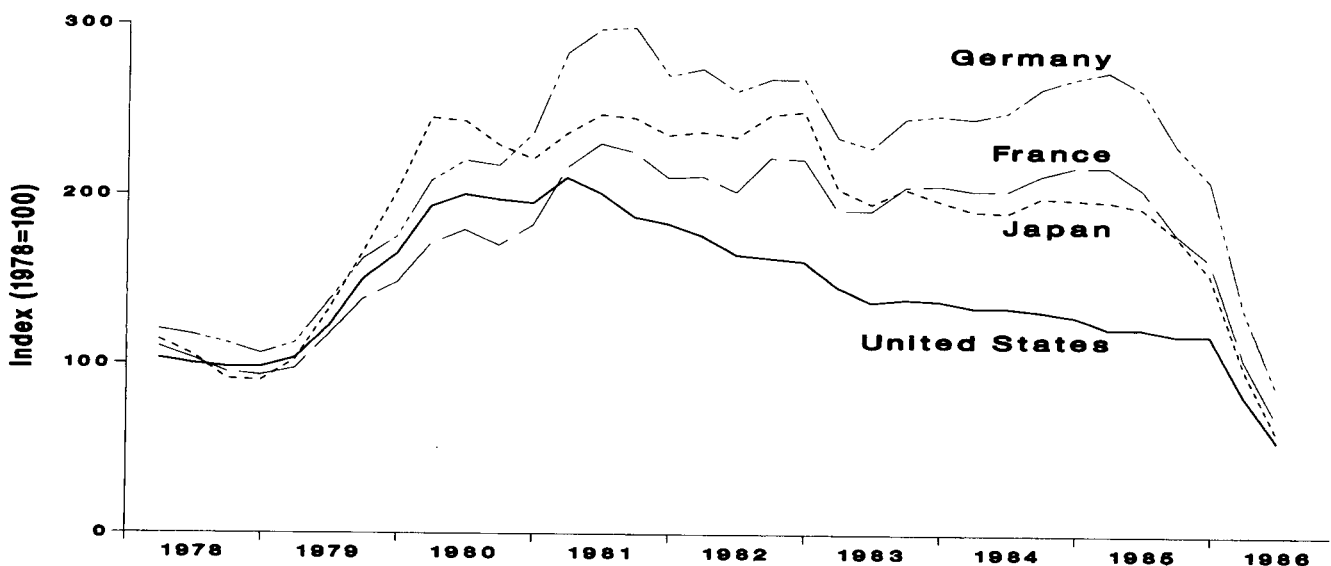
World oil market conditions were ripe for a major price adjustment in 1986. Since the oil price shocks of the 1970's, economic growth in the major industrial countries had moderated, restraining growth in demand for energy. Efforts to conserve energy and competition for petroleum from natural gas, coal, and nuclear energy had further reduced oil demand. The shift away from residual fuel oil on the part of industry and utilities was particularly pronounced. At the same time the real price of crude oil held firm outside the U.S., because it is quoted worldwide in U.S. dollars and our currency was strong during most of this period. While oil prices declined in the United States over the 1980-1985 period, other industrialized countries did not realize significant price cutbacks in oil until 1986 (Figure 1). As a result, total oil consumption in the market economies dropped from about 52 million barrels per day in 1979 to about 46.4 million barrels per day by 1985.

In addition, since the 1973 embargo certain non-OPEC countries had become major producers of petroleum. Mexico, for example, increased its oil production from less than 500 thousand barrels per day in 1973 to about 2.7 million barrels per day in 1985. The United King-

dom went from virtually no production to about 2.5 million barrels per day over the same period. Other sources of oil developed throughout the world as the result of investments inspired by high oil prices. Production (including natural gas liquids, other liquids, and refinery gain) from all non-OPEC sources went from about 21.7 million barrels per day in 1979 to about 28.5 million barrels per day by 1985, including net exports from the centrally planned economies (CPE's).⁷

In August 1986, OPEC was able to fashion a truce in the price war when its members agreed to an interim reduction in crude oil production to about 16.7 million barrels per day, down from 20.5 million barrels per day just one month earlier. Prices quickly jumped up by one-third. In October, OPEC agreed to continue production ceilings through the end of the year, setting an effective ceiling for total OPEC crude oil production at about 17 million barrels per day. In November, a special OPEC pricing conference recommended that the target for crude oil prices should be \$18 per barrel. In December, OPEC voted to cut production by 7 to 8 percent to achieve the \$18 target. Prices averaged less than \$14 per barrel during the year's final quarter.

Figure 1. Real World Oil Prices in Major Industrial Countries Based on National Currencies, 1978-86



Note: The average refiner acquisition cost of imported crude oil in the United States is used as the world oil price for each country and is converted to the national currency by using the appropriate exchange rate. Inflation rates are used to determine real prices, which are then converted to an index.
 Sources: Energy Information Administration, *Monthly Energy Review*, DOE/EIA-0035 (86/08) (Washington, DC, 1986). Data Resources, Inc., U.S. Central, Europe, and Japan data bases.

⁷The CPE's include Eastern Europe, the Soviet Union, China, Cuba, Kampuchea, North Korea, Laos, Mongolia, and Vietnam. Most oil exports are from the Soviet Union, which is the largest producer of crude oil in the world.

World Oil Price Trends

As noted above, none of the future price scenarios outlined in this study reflect the extreme market conditions that could arise from a major oil supply disruption or from an extended oil price war. Real oil prices rise steadily in both the base and the high-price case. Under conditions chosen to postulate the low-price case, real oil prices continue their recent declines but still will begin to rise after 1988. Thus, all three cases suggest that prices are destined to rise in the 1990's. In the base case and the high-price case, 1986 turns out to be the low point in a price decline that started at the beginning of this decade.

Near Term Influences

World oil prices in 1987 are assumed to depend to a large extent on the OPEC's ability to continue current restraint on its own production. For example, only a general breakdown in OPEC's recent production-limiting agreements is seen as capable of raising oil output this year to a point where oversupply, coupled

with weak worldwide demand, would push world oil prices down further. However, this is seen as a prerequisite for established conditions that would extend lower world oil prices into the 1990's.

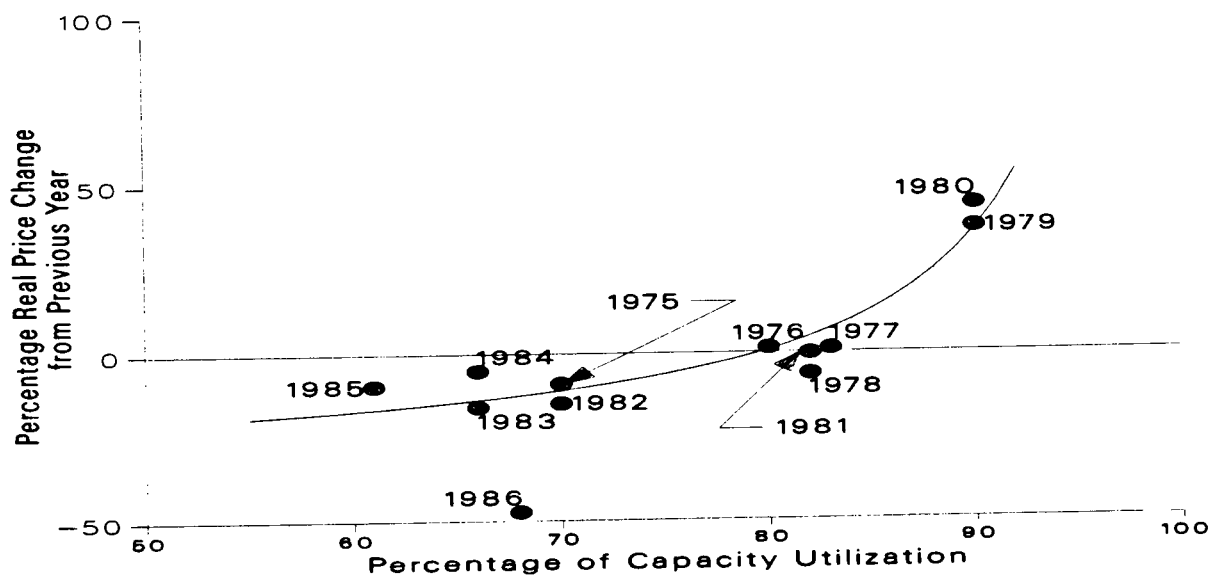
The base case, on the other hand, assumes that the OPEC accord will hold together with only limited cheating, and that world crude oil production will remain roughly in balance with slow but steady increases in demand. The high-price case assumes fairly strict adherence to oil production quotas by OPEC, but more rapid growth in oil demand through 1987 as well.

The near-term behavior underlying each of the three oil price paths helps set the stage for the respective price performances over the remainder of this century.

Longer Term Influences

In the longer term, prices in all three cases are assumed to be influenced principally by major trends of supply and demand in the world oil market. Perhaps the overriding influence on these between now and the year 2000 is the current surplus in world oil production capacity. During 1986 it was estimated that existing fields were capable of producing approximately 9 to 10 million barrels per day more in 1986 than was actually produced.

Figure 2. OPEC Pricing Behavior, 1975-1986



OPEC = Organization of Petroleum Exporting Countries.
 Note: The 1986 observation, which was not used to derive the curve, reflects Saudi Arabia's decision to switch from providing price support to increasing market share.
 Sources: Energy Information Administration, Monthly Energy Review, DOE/EIA-0035 (86/08) (Washington, DC, 1986); Central Intelligence Agency, International Energy Statistical Review, selected issues (Washington, DC).

Most of the present surplus capacity is in the OPEC countries of the Persian Gulf, and it is assumed that growth in oil demand will be met primarily from OPEC production. Judging from past experience, it also seems reasonable to assume that OPEC will endeavor to raise prices whenever its production approaches 80 percent of maximum sustainable capacity, (that is, the maximum production rate that could be sustained over a period of several months). Figure 2 on page 10 shows how OPEC pricing behavior seems to have been a function of its capacity utilization thus far.

There is relatively little excess capacity among non-OPEC countries, so their production is assumed to hold steady at about 25 to 27 million barrels per day between now and 1990 and in a range from 21 to 26 million barrels per day by the year 2000 (Table ES1 on page 3). Oil exports from the Soviet Union are assumed to decline steadily over the projection period. As non-OPEC production reaches a peak and pressures emerge for OPEC to increase its production, prices are assumed to rise. OPEC oil production is projected to rise between 1985 and 2000, going from about 17 million barrels per day in 1985 to a range of 23 to 33 million barrels per day by 2000.

The projected growth in oil demand is assumed to result from overall economic growth and from relatively low world oil prices during the next several years. For example, oil consumption in the market economies is expected to increase by more than 1 million barrels per day in 1986 and is projected to increase further by 1990, reaching a level in 1990 from 48 to 52 million barrels per day. Then, dampened by rising prices, oil consumption is projected to remain in this general range for the next 10 years, to the year 2000.

Oil prices in any given year might lie outside of the band of uncertainty indicated by the three price cases. However, price fluctuations outside of the projected range or even continued movement along either the low or high price path are not considered sustainable. The tendency would be for prices to move back within the uncertainty band within a short period of time. Overall, price increases in all three cases accelerate through the early 1990's as demands accelerate. Similarly, price increases should tend to decelerate in the late 1990's as demands level off, partially in response to these earlier price-surges. In fact, world oil prices could continue to level off beyond the year 2000, given continued substitution of nuclear power and the other fossil fuels (or even unconventional fuels, such as shale oil) for oil.

The price war of 1986 raised speculation that world oil prices might be gravitating back to a long-term trend of low and relatively steady prices so that the

equilibrium price level by the year 2000 could be even lower than the \$27 per barrel projected under the low-price case in this report. To generate a price path that low, however, basic assumptions about oil reserves on the supply side and about consumer price responses on the demand side would have to be altered.

On the supply side, prospects for new oil reserves outside of OPEC would have to improve. Such improvements might occur in the developing world, where resources may now be underestimated. Further exploration in these countries could occur, given a hospitable environment for development by major international companies. On the demand side, fuel substitution away from oil would also have to increase, presumably with extensive use of indigenous natural gas and coal resources. Finally, savings from technological efficiencies would probably have to exceed current expectations, although this seems to have little motivation with stable prices.

New discoveries of large, low-cost oil reserves simply are not expected, particularly in the major oil-consuming countries, where intensive exploration and development has already been going on for many years. At the same time, neither OPEC nor any other oil exporter is likely to restrain the price being charged for a depleting resource, particularly if demands for that resource continue to grow. This analysis already assumes that oil's share of total primary energy consumption in the market economies will drop from 46 percent in 1985 to the 40-percent range by the year 2000.⁸ Industrialized countries would have to moderate oil demands as they try to maintain historic levels of economic growth, and developing countries face a similar task as they attempt to improve past performance. Given these market pressures, prospects for a steady world oil price path in the \$20-per-barrel range are not impossible, but they are considered unlikely.

Economic Growth and Energy Intensity

Energy consumption in the market economies grew about three-quarters as fast as economic activity in the 1970's, and it is projected to maintain this relative rate of growth between 1985 and 1990 (Table 2 on page 12). Between 1990 and the year 2000, energy consumption is projected to grow only about half as fast as economic activity. The energy intensity of economic activity should decline as the result of rising energy prices, ongoing efforts to increase energy conservation and efficiency, and shifts in the industrial economies away from energy-intensive heavy manufacturing towards less energy-intensive services and new technologies.

⁸Total primary energy consumption is based on data and definitions presented in Energy Information Administration, *International Energy Annual*. Fuel wood and all noncommercial fuel sources are excluded from the totals.

Table 2. Annual Growth Rates of Real Gross Domestic Product (GDP) and Energy Consumptions/GDP Growth Ratios, Base Case 1970-2000 (Percent)

Country/Region	Average Annual GDP Growth Rates				Energy Consumption/GDP Growth Ratios			
	1970-80	1980-85	1985-90	1990-2000	1970-80	1980-85	1985-90	1990-2000
United States	2.7	2.5	2.5	2.5	0.41	-0.24	0.46	0.46
Canada	4.3	2.5	2.9	2.1	0.84	0.12	0.72	0.52
Japan	4.9	4.1	2.6	3.6	0.61	-0.01	0.73	0.42
OECD Europe	3.0	1.3	2.5	2.5	0.67	-0.08	0.76	0.44
Total OECD	3.1	2.2	2.5	2.6	0.61	-0.23	0.64	0.42
Developing Countries ...	5.3	1.1	3.1	3.9	1.34	4.09	0.90	0.79
Total Market Economies ..	3.6	2.0	2.7	2.9	0.75	0.30	0.70	0.55

OECD=Organization for Economic Cooperation and Development.

Note: Aggregate growth rates are calculated from aggregate real gross domestic product in 1980 dollars at 1980 exchange rates.

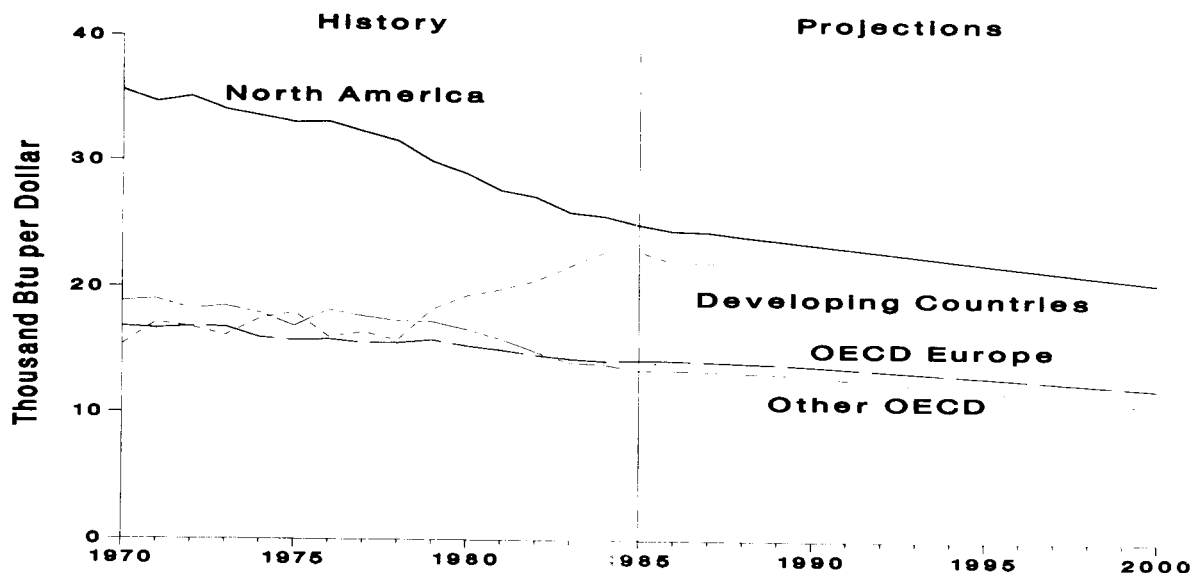
Sources: o History: United Nations, 1979 Yearbook of World Energy Statistics (New York, NY, 1981); Energy Information Administration, International Energy Annual, DOE/EIA-0219 and International Petroleum Annual, DOE/EIA-0042, selected issues (Washington, DC); and Wharton Econometric Forecasting Associates, World Service Data Banks, October 1986, (Philadelphia, PA, 1986). o Projections: Energy Information Administration, Annual Energy Outlook 1986, DOE/EIA-0383(86) (Washington, DC, 1987) and Table 9 of this report; Wharton Econometric Forecasting Associates, Wharton World Economic Model, August 1986, (Philadelphia, PA, 1986).

The energy intensity of economic activity had been declining for years in the industrial countries, with a major shift in the ratio of energy to gross domestic product (GDP) occurring in the early 1980's (Figure 3 on page 13). In contrast, the energy/GDP ratio rose in the developing countries during the early 1980's. The reason for this increase was that the consumption of energy continued to grow at an average of 4.5 percent per year between 1980 and 1985 while economic activity grew only about 1.1 percent per year. The slow rate of economic growth in the developing countries was, in turn, influenced by the relatively poor economic performance among the industrialized countries, particularly in Europe, and the adverse effect this

slow growth had on trade activity between the two groups. For example, with falling oil consumption worldwide, economic activity in the OPEC countries taken as a group actually declined during this period.

The oil intensity of economic activity in the market economies is projected to decline at a even greater rate than is total energy intensity. Countries are expected to continue their efforts to substitute other fuels--such as nuclear power, natural gas, and coal--for oil. The industrialized countries should be more successful than the developing countries at generating the capital and the technology needed to shift away from oil, particularly for purposes of electric generation. As a result,

Figure 3. Energy Consumption/GDP Ratio: Base Case, 1970-2000



OECD = Organization for Economic Cooperation and Development.
 Sources: o History: Wharton Econometric Forecasting Associates, World Service Data Banks, October 1986 (Philadelphia, PA, 1986); United Nations, 1979 Yearbook of International Statistics (New York, NY, 1981); and Energy Information Administration, International Energy Annual, DOE/EIA-0219 and International Petroleum Annual, DOE/EIA-0042, selected issues (Washington, DC). o Projections: Derived from Tables 2 and 9 of this report.

oil consumption in the OECD countries is expected to grow less than half as fast as economic activity between 1985 and 1990 and to remain relatively flat in absolute terms thereafter. In the developing countries, oil consumption is expected to grow between a quarter and a third as fast as economic activity in the 1990's.

International Financial Considerations

Lower prices can provide a strong stimulus to higher oil consumption; but, from 1980 through early 1985, only U.S. consumers had experienced a meaningful price decline because of the sharp increase in the value of the U.S. dollar--the denomination used in world oil trade. However, in March of 1985, the foreign exchange value of the U.S. dollar peaked and since then has fallen sharply against the Continental European currencies and the Japanese yen. Figure 1 on page 9 shows the importance of exchange rates in evaluating and predicting world oil consumption. This figure presents

an index of the cost of petroleum over time for the United States, Japan, Germany, and France in terms of the U.S. dollar. For the latter three countries, and many other OECD nations as well, the combination of the drop in oil prices and the weaker dollar has pushed energy costs in these nations sharply lower. For example, the deutschmark price of oil is about one-third of what it was in early 1985.

By September 1986, the effective exchange rate index of the U.S. dollar had fallen 26 percent from its peak during the second quarter of 1985 when the index stood 60 percent above its 1980 base value of 100.⁹ This decline of the U.S. dollar reflects the slowdown in U.S. economic growth from 1983 and early 1984 levels, the narrowing of interest rate differentials, the large increase in the U.S. trade deficit, and concerted action by the Group of Five (the United States, the United Kingdom, West Germany, France, and Japan) to reduce the value of the U.S. dollar. This depreciation of the dollar, combined with falling oil costs, has meant a total decline of between 57 to 60 percent in crude oil costs for those countries (Figure 1 on page 9).

⁹The effective exchange rate of the U.S. dollar against eighteen major currencies is a weighted index, with weights derived from the International Monetary Fund (IMF) multilateral exchange rate model. International Monetary Fund, *International Financial Statistics* (Washington, D.C. February 1987).

Depreciation of the U.S. dollar in international financial markets has compounded the impacts of lower world oil prices for the oil exporting nations as well. As the U.S. dollar depreciates, it weakens the purchasing power of oil exporters and, when combined with the sharply lower revenue intake from lower prices, threatens the ability of oil exporting debtor nations to service their debt. Conversely, for the oil importing countries, the weaker dollar lessens their oil bill (in their currency) and increases to that degree the competitiveness of their manufactured goods.

Changes in Market Structure

Market-linked crude pricing helped fuel the dramatic price collapse in 1986 and made petroleum markets more fluid than was the case when long-term contracts at fixed official prices dominated international transactions. That pricing structure gave way to more flexible agreements such as term contracts with market-responsive pricing clauses, barter deals, and netback pricing agreements. Under a netback sales agreement, the price of crude oil is linked to the market value of the refined products, minus transportation and refining costs. By mid-1986, around 60 percent of globally traded crude was under market-linked price formulas, and all crude was priced in some market-sensitive manner. These pricing techniques created more volatility

in petroleum markets and increased the importance of spot and future markets.

Netback pricing and market competition have encouraged efforts at downstream integration by the major oil producers. Faced with declining revenues and shrinking profit margins, producing countries and major oil companies have attempted to make the structural changes needed to guarantee markets for their crude and to reduce operating expenses. These efforts were reinforced by the huge price decline of 1986. Companies have retrenched through selloffs or consolidation of operations and have redefined market position through acquisitions or mergers, moves with downstream earnings in mind. Producers and traders are moving to acquire refining and marketing operations to insure markets and stability. Venezuela, for instance, continued its efforts at downstream development with the purchase of 50 percent of Citgo in the United States. This move adds to its joint ventures in Europe. Kuwait is planning to expand its six-country European retailing effort by adding France and Germany. Kuwait's refining capacity will soon reach 670,000 barrels per day, and their goal is to refine all of their production. Diversification of sales channels and product slates could help to stabilize income and foreign exchange earnings for these producers. At the same time, low world oil prices will, no doubt, continue to encourage the traditionally integrated major oil companies to assess the profitability of each phase of their operations. Fewer refineries and more efficient marketing outlets could be the net result.

2. Oil Production Potential

The prospects for future oil supply depend largely on the size and location of the reserves and resource base. In recent years the development of oil reserves in non-OPEC countries has allowed their production to move ahead of the oil supply from OPEC. However, relative to OPEC, non-OPEC production prospects are more limited because of lower production capacity, reserve levels, and rates at which new oil is being found. Middle East OPEC countries have spare production capacity but have had to restrain production in order to support world oil prices.

World Oil Resources

The projected future availability of crude oil is based primarily on current estimates of proved reserves and a continuation of present trends in exploration activity and the expansion of production capacity. Estimates of the world's oil reserves and resources are made by engineers and geologists using various techniques for determining the likely amount of recoverable oil in an oil reservoir. The terms reserves and resources require some explanation and definition. Reserves in this report refer to "proved reserves" or oil which geological and engineering data demonstrate with reasonable certainty to be recoverable in future years from known reservoirs under existing economic and operating conditions. Resources refer to "undiscovered recoverable resources" or oil which is not yet discovered but is thought to exist in a geologic setting that is favorable for oil extraction. Estimates of oil reserves and resources are presented in Table 3 on page 16.

Because reserves and resources are based on estimation and judgment, it is important to recognize that there may be significant year-to-year shifts in the opinion of experts as to reserves and resources in a reservoir or country. Nevertheless, certain general statements can be made that are indicative of the future sources of petroleum supply.

- Recent evidence indicates that oil reserves in the market economies are about 600 billion barrels (Table 3 on page 16) and the mean value of the estimated undiscovered recoverable resources is

about 525 billion barrels (United States Geological Survey).

- Crude oil reserves increased between 1980 and 1986 in spite of real price declines and an average crude production level of only about 41 million barrels per day. From 1980 to 1986, the market economies produced an average of 15 billion barrels of crude oil per year while reserves increased by about an additional 11-12 billion barrels per year in excess of production.
- More than 3 of every 5 barrels of the market economies' oil reserves are in the Middle East (virtually all in the Persian or Arabian Gulf). Countries in OPEC account for about 4 of every 5 barrels of total reserves.
- About one-third of the market economies' undiscovered recoverable resources (mean value) are in the Middle East and Persian Gulf area. OPEC also accounts for almost half of the remaining undiscovered resources.
- Five countries--Canada, Mexico, Norway, the United Kingdom, and the United States--hold the vast majority of non-OPEC oil reserves and resources in the market economies. This group accounts for about one-sixth of reserves and about two-fifths of remaining undiscovered resources in the market economies.

The search for oil in the market economies peaked in 1981. Exploratory activity is the initial step in finding additional reserves. There were over 6,200 active rigs in December of 1981--about 4,500 of these were in the United States. By the end of 1986, there were about 2,100 active rigs in the market economies and about 960 in the United States, a decline of about 3,500 rigs in the United States. The number of crews involved in seismic exploration is also an important indicator of petroleum exploration activity. According to the Society of Exploration Geologists, there were about 1,260 active seismic crews in the market economies at the peak in 1981. Since then, the number of seismic crews declined to about 700 crews at the end of 1986. In the United States, there was a drop of about 500 crews during this period. Thus, outside the United States there has been a less dramatic decline in the number of active rigs and little change in the number of active seismic crews in recent years.

**Table 3. Crude Oil Reserves and Resources in the Market Economies
(Billion Barrels)**

Country/Region	Crude Oil Reserves ^a			Undiscovered Recoverable Resources Statistical	
	Oil and Gas Journal	World Oil	FESAP	Mean	Range ^b
	(12/31/86)	(12/31/85)	(Various Dates)		
North America	86.1	90.0	NA	194.1	104-332
Canada	6.9	6.4	NA	31.4	19-48
Mexico	54.7	55.6	27.2 (12/81)	78.2	26-170
United States	24.6	28.0	^c 30.5 (12/85)	82.9	64-105
Central & South America ..	34.1	38.2	NA	39.9	20-69
Ecuador	1.7	1.1	1.2 (12/82)	1.5	1-6
Venezuela	25.0	29.3	18.5 (12/78)	22.7	12-38
Western Europe	21.9	18.2	NA	23.4	13-49
United Kingdom	9.0	5.5	12.6 (12/81)	2.3	1-4
Other North Sea	11.2	11.2	7.0 (12/81)	17.9	9-34
Other Western Europe ...	1.7	1.5	NA	3.2	1-10
Middle East	401.9	369.1	419.2	173.9	72-337
Iran	48.8	36.7	62.5 (12/81)	26.4	11-51
Iraq	47.1	38.0	34.5 (12/81)	77.4	32-150
Kuwait ^d	94.5	74.6	95.7 (12/81)	3.2	1-7
Qatar	3.2	4.4	7.1 (12/81)	0.5	1-3
Saudi Arabia ^d	169.2	171.8	173.2 (12/81)	56.0	23-109
United Arab Emirates ...	33.1	36.6	43.0 (12/81)	6.9	3-13
Africa	55.2	56.6	NA	58.8	28-105
Algeria	8.8	5.0	10.4 (12/81)	8.2	3-17
Egypt	3.6	3.8	2.4 (12/81)	4.6	1-12
Gabon	0.6	0.7	NA	2.0	1-6
Libya	21.3	22.4	21.0 (12/81)	11.7	4-25
Nigeria	16.0	16.3	12.6 (12/75)	8.9	2-23
Other Africa	4.9	8.4	NA	23.4	10-45
Far East/Oceania	19.0	19.9	NA	33.9	16-70
Australia/New Zealand ..	1.9	1.9	NA	7.0	4-11
Indonesia	8.3	8.7	9.5 (12/82)	10.0	5-18
Total OPEC	477.5	445.6	NA	235.4	100-465
Total Market Economies ...	618.2	592.1	NA	524.0	250-950

^a Reserves include proved reserves and indicated additional reserves in this table. Some foreign countries have a less restrictive definition than EIA of proved reserves that are reported to and published by the various trade journals.

^b Includes a probability range from 95 percent to 5 percent.

^c Energy Information Administration figure published separately (see sources). This figure includes 28.4 million barrels of proved reserves and 2.0 million barrels of indicated additional reserves.

^d Includes 50 percent of the Neutral Zone reserves and resources.

NA=Not available.

OPEC=Organization of Petroleum Exporting Countries.

FESAP=Foreign Energy Supply Assessment Program.

Sources: o Oil: Oil and Gas Journal 82, 53 (December 26, 1986); World Oil 201, 3 (August 1986); Energy Information Administration, Foreign Energy Supply Assessment Program Series regional reports, selected issues, and U.S. Crude Oil, Natural Gas and Natural Gas Liquids Reserves, DOE/EIA-0216(84) (Washington, DC, 1986). o All resources: U.S. Department of the Interior, Geological Survey, Distribution and Quantitative Assessment of World Crude-Oil Reserves and Resources, Open-File Report 83-728 (Reston, VA, 1983).

These various trends suggest a base of oil for production that is sufficient today but is being depleted. Geographically, most of that base is in a few regions--North America (including Mexico), the North Sea, the Middle East, and four other OPEC countries outside of the Middle East. OPEC continues to hold the preponderance of reserves and resources; and there are no indications that this is likely to change.

Historical Oil Production Trends

Overall oil production (including natural gas liquids, other liquids, and refinery gain) in the market economies was about 44 million barrels per day in 1985. This was about a 8.4 million barrels per day decrease from the historical peak in 1979 and about 5 million barrels per day below the average production levels in 1973 when Arab oil supplies were reduced to Israel, the Netherlands, and the United States in an international oil embargo. Table 4 shows the trends in world oil supply from 1973 to 1985.

There have been significant changes in the origin and composition of oil supplies between 1973 and 1985. During this time OPEC experienced a significant loss of market share. In 1973 OPEC accounted for over 3 out of every 5 barrels of oil produced in the market economies. In 1985 OPEC provided only about 2 out of every 5 barrels of oil production. Iran and Saudi

Arabia each had major declines. Their production on a combined basis decreased by over 7 million barrels per day between 1973 and 1985. In the meantime, oil resources were developed outside OPEC; and non-OPEC oil production increased from 17.5 million barrels per day in 1973 to almost 26.7 million barrels per day in 1985. Production in the United States declined slightly over the period. The key increases occurred in countries that had not been among the major oil producers in the early 1970's--Egypt, Mexico, Norway, and the United Kingdom. Other developing countries such as Brazil, India, and Malaysia also had important production increases. Thus, there has been a general dispersion of important sources of supply that has adversely affected market domination by OPEC.

Also, the threat of oil supply cutoffs and the rapid rise of oil prices in the 1970's encouraged the development of liquid fuels (including alcohol fuels) from coal and from biomass materials such as bagasse. Two countries made significant progress in developing these fuels--South Africa and Brazil. In 1985 these countries provided over 260 thousand barrels per day of liquids for use as fuels.

Concerns about the adequacy of short-term supplies of oil have been minimized by the dispersion of oil production sources, the existence of excess production capacity (particularly in OPEC), the persistent need for revenues in many producing countries, and the slow growth in oil consumption. These factors indicate that oil supplies are likely to remain plentiful over the near term.

Table 4. Oil Supply in the Market Economies, 1973-85 (Million Barrels per Day)

Year	United States Production	Persian Gulf Production	Market Economies			
			OPEC Production	Non-OPEC Production	Net CPE Exports	Total Supply
1973	11.4	20.9	31.3	17.5	0.8	49.6
1974	11.0	21.5	31.1	17.2	0.9	49.2
1975	10.5	19.2	27.6	16.9	1.1	45.6
1976	10.3	21.8	31.2	17.1	1.2	49.5
1977	10.4	22.1	31.8	18.3	0.9	51.0
1978	10.8	21.0	30.4	19.4	1.0	50.8
1979	10.7	21.5	31.7	20.6	1.1	53.4
1980	10.8	18.5	27.7	21.5	1.2	50.4
1981	10.7	15.8	23.6	22.1	1.5	47.2
1982	10.8	12.8	19.9	23.2	1.7	44.8
1983	10.8	11.6	18.6	24.2	1.8	44.6
1984	11.1	11.4	18.6	25.9	2.1	46.7
1985	11.2	10.2	17.2	26.7	1.8	45.7

CPE=centrally planned economies.

OPEC=Organization of Petroleum Exporting Countries.

Notes: o Supply includes production of crude oil (including lease condensate), natural gas liquids, other hydrogen and hydrocarbons for refinery feedstock, refinery gains, alcohol, and liquids produced from coal and other sources. o Persian (Arabian) Gulf includes Bahrain, Iran, Iraq, Kuwait, Qatar, Saudi Arabia, and the United Arab Emirates. o Numbers may not add to totals because of independent rounding.

Sources: Energy Information Administration, *International Energy Annual 1985*, DOE/EIA-0219(85) (Washington, DC, 1986); *Monthly Energy Review*, DOE/EIA-0035 (86/10), and *Petroleum Supply Monthly*, DOE/EIA-0109 (86/11) (Washington, DC, 1987).

Future Oil Production Potential

Estimated ranges of oil production capacities for OPEC and other major producing regions are shown in Table 5 on page 19 and Figure 4 on page 20. These regions show a wide diversity in production potential. The development of oil reserves in non-OPEC countries has allowed non-OPEC production to exceed OPEC's in every year since 1982. It is expected that the non-OPEC market countries, as a whole, will not be able to continue to increase their production as they have done throughout the past decade. By the end of the 1980's, a production drop of over a million barrels per day from current levels is expected as production declines in mature fields in the British North Sea and Alaska North Slope areas as shown in Figure 5 on page 20. Further declines from marginal fields, particularly in the United States, are projected for the next few years as a result of the current depressed prices for oil. This depressed oil market will also result in the scaling back or curtailment of planned new exploration and development projects worldwide, also lowering future production capacity.

Some non-OPEC countries, however, will most likely continue to expand their production capacity in the 1990's. Mexico, which has large amounts of proved reserves and expected undiscovered reserves, could expand production by several hundred thousand barrels per day during the next decade. Non-OPEC Middle Eastern and African countries could also increase their production levels somewhat, with small increases possible from countries in the Far East and South America.

Other supply sources for the market economies are also projected to decline. Exports from centrally planned economies, which peaked at 2.1 million barrels per day in 1984, are expected to be down at 1.7 million barrels per day in 1986 and to be no more than 1 million barrels per day by the end of the 1990's. Production problems in the Soviet Union and scaled back development in China should lead to significantly lower exports from these countries.

It is in the OPEC countries that the potential for the largest production increases exists. These countries have huge reserves of oil (Table 3 on page 16), with much of it being very low cost oil to produce. OPEC production has fallen in the 1980's as world oil prices peaked, non-OPEC production increased, and consumption declined. These conditions are projected to reverse by 1990, and demand for OPEC oil should once again increase. OPEC production levels will then depend in large part upon the market strategy chosen.

Table 5. Oil Production Capacity, 1986-2000
(Million Barrels per Day)

Country/Region	Estimated	Projection		
	1986	1990	1995	2000
United States	11.0	9.5-10.3	8.1- 9.2	7.0- 9.2
Canada	1.8	1.4- 1.8	1.2- 2.0	1.2- 2.4
Mexico	3.0	3.2- 3.4	3.3- 3.7	3.5- 4.0
North Sea	4.0	3.3- 3.7	2.8- 3.4	2.6- 3.4
Other Non-OPEC	7.4	7.4- 7.7	6.4- 7.3	5.9- 7.4
Total Non-OPEC	27.2	25.1-26.6	22.3-25.1	21.0-25.8
Algeria	1.2	0.9- 1.1	0.8- 1.0	0.7- 0.9
Ecuador	0.3	0.2- 0.3	0.1- 0.2	0.1- 0.2
Gabon	0.2	0.1- 0.2	0.1- 0.2	0.1- 0.2
Indonesia	1.5	1.3- 1.5	1.2- 1.4	1.2- 1.4
Iran	3.4	3.5- 4.0	3.5- 4.5	3.1- 4.1
Iraq	1.9	2.5- 3.0	4.0- 5.0	4.5- 5.5
Kuwait ^a	2.3	2.0- 2.3	2.0- 2.3	2.0- 2.3
Libya	1.8	1.8- 2.0	1.9- 2.1	2.0- 2.2
Nigeria	2.0	1.8- 2.0	1.7- 2.0	1.6- 2.0
Qatar	0.6	0.5- 0.7	0.4- 0.6	0.3- 0.5
Saudi Arabia ^a	9.2	9.0-10.0	9.5-11.0	10.0-12.0
United Arab Emirates	2.0	2.0- 2.2	2.0- 2.2	2.0- 2.2
Venezuela	2.5	2.2- 2.5	2.1- 2.4	2.0- 2.4
Total OPEC	28.9	28.5-31.1	30.2-34.0	30.5-35.0
Net CPE Exports	1.7	1.0- 1.5	0.5- 1.5	0.0- 1.0
Total Market Economies	57.8	55.3-58.5	54.4-59.2	53.3-60.0

^a Includes 50 percent of Neutral Zone capacity.

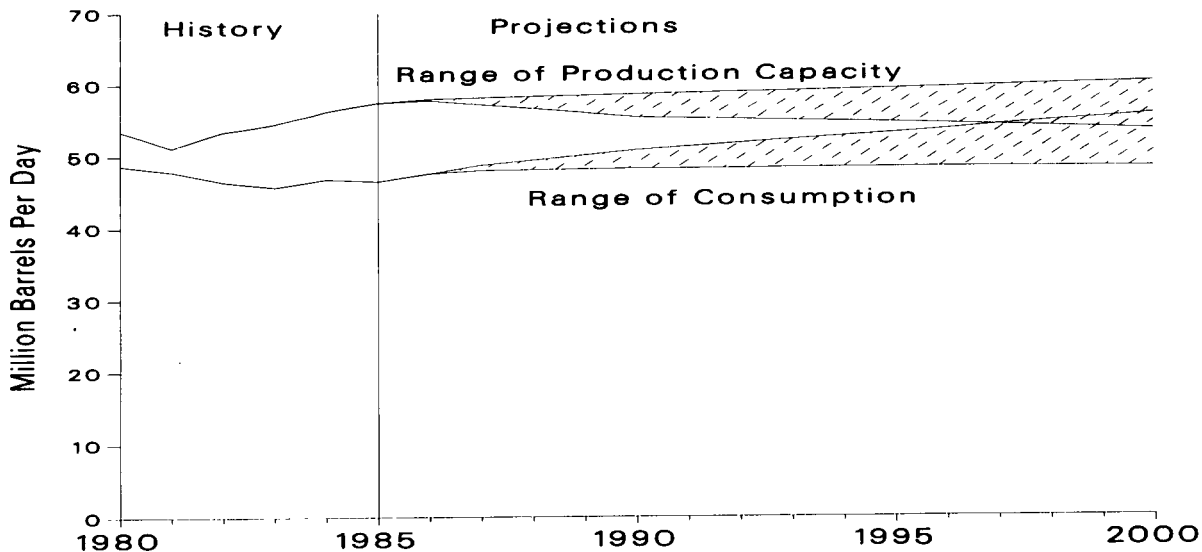
CPE=centrally planned economies.

OPEC=Organization of Petroleum Exporting Countries.

Notes: o Capacity is defined as maximum sustainable production capacity adjusted to reflect current operable capacity in selected countries. The range of U.S. production capacity is derived from production estimates from the Annual Energy Outlook 1986 plus surge production estimates of about 100,000 barrels per day. o Production includes crude oil, natural gas liquids, refinery gains, hydrogen, and other hydrocarbons. o Numbers may not add to totals because of independent rounding. o All uncertainty ranges are derived independently and do not necessarily add to totals.

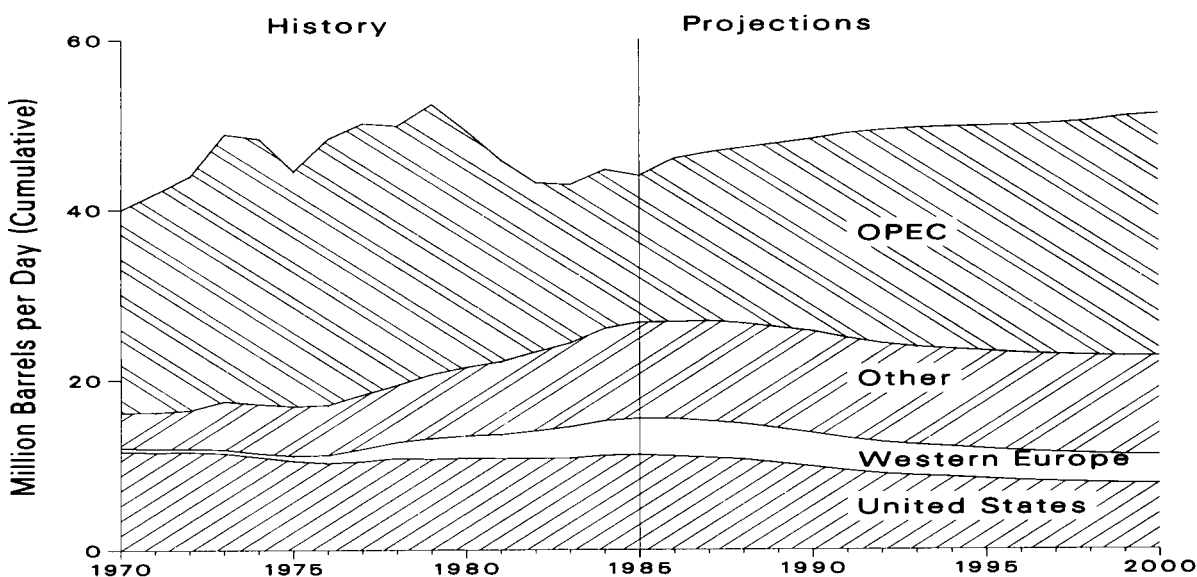
Source: Energy Information Administration, Office of Energy Markets and End Use.

Figure 4. Uncertainty Range of World Oil Production Capacity, Consumption, and Excess Production Capacity, 1980-2000



Note: The range of excess production capacity is the range of the difference between production capacity and consumption in different sensitivity cases. Current excess petroleum production capacity (mainly in OPEC) of 9-10 million barrels per day is projected to drop significantly in the 1990's.
 Sources: o History: Energy Information Administration, International Energy Annual, DOE/EIA-0219, selected issues (Washington, DC).
 o Projections: Tables 5 and 7 of this report.

Figure 5. Market Economies Oil Production: Base Case, 1970-2000



OPEC=Organization of Petroleum Exporting Countries.
 Note: Production includes natural gas liquids, other liquids, and refinery gains.
 Sources: o History: Energy Information Administration, International Energy Annual, DOE/EIA-0219, selected issues (Washington, DC).
 o Projections: Appendix Table A1 of this report.

Petroleum Supply Vulnerability

The growing concentration of remaining oil reserves and production in the Middle East (especially in the Persian Gulf) during the forecast period not only is likely to exert upward pressure on oil prices, but also could increase the potential for a serious disruption in oil supplies.

Figure 6 illustrates what effects a closure of the Strait of Hormuz occurring in 1995 could have on world oil prices. This hypothetical disruption, although considered to be highly unlikely, could result in a net loss of 8 to 9 million barrels per day, even after allowing for the use of excess production capacity and a surge in exports via alternative pipeline routes out of the Persian Gulf region.

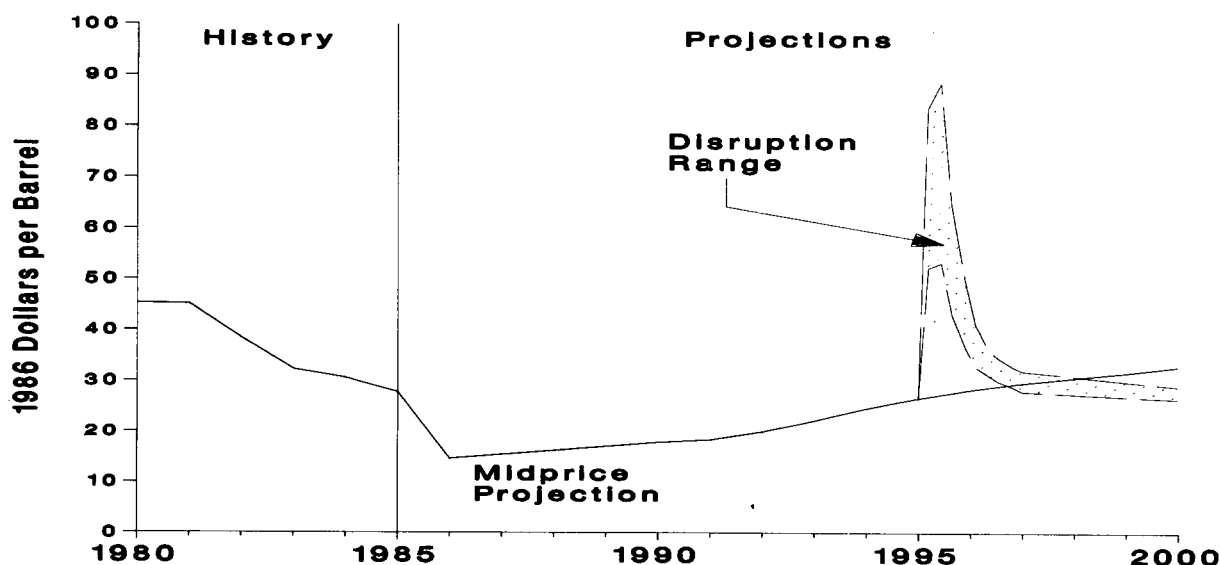
The hypothetical disruption begins on January 1, 1995 and lasts for 6 months. This example assumes that the United States responds to the disruption by drawing down the Strategic Petroleum Reserve at maximum rates at the same time that other countries in the market economies draw down their own government-controlled stocks.

Figure 6 shows that a hypothetical net disruption of 8-9 million barrels per day could increase oil prices to

between \$55 and \$90 per barrel, depending upon what is assumed about commercial inventory behavior and the responsiveness of demand to price increases (i.e., elasticity of demand). The wide range of uncertainty reflects the substantially different ways in which the market may respond to a disruption in oil supplies. If suppliers and end-users draw down commercial inventories in an effort to fill the supply gap, while consumers reduce energy use in response to higher prices, the economic effects of the disruption would be dampened and prices would tend toward the lower end of the range. Conversely, if consumption remains close to pre-disruption levels while commercial inventories are built up in anticipation of future price increases (due to uncertainty over the disruption's duration or magnitude), the economic effects of the disruption would be intensified and prices would tend toward the higher end of the range.

The aftermath of such a supply disruption is also highly uncertain. When oil supplies are restored (assumed in this example to occur in the third quarter of 1995), world oil prices could actually fall below base case levels. A cyclical pattern of price changes might then develop as a result of the continuing effects on oil demand in the post-disruption period, caused by past high prices and reduced economic activity. The actual price levels described in this analysis are of less interest than this erratic pattern of price movements and its potential adverse affects on the world economy.

Figure 6. Range of World Oil Prices with Hypothetical Disruption in Supply, 1980-2000



Note: This disruption price range is based on a hypothetical distribution that assumes that world oil availability is cut by 8 to 9 million barrels per day on January 1, 1995, for a period of 6 months.
 Sources: o History: Energy Information Administration, *Annual Energy Review 1985*, DOE/EIA-0384(85) (Washington, DC, 1986).
 o Midprice Projection: Tables 1 of this report.

3. Oil Consumption Trends

Oil consumption in the market economies is expected to increase significantly over the near term, with slower growth occurring in the 1990's as oil prices rise (Figure 7). Lower world oil prices in the late 1980's are expected to be a major factor in determining the future course of oil consumption. Economic growth is expected to be another important factor, especially among the developing countries. Oil consumption in the developing countries taken as a group is projected to be fairly steady between 1985 and 2000, with an annual growth rate of between 1 percent and 2 percent per year. In contrast, the annual growth rate for the OECD countries averages between -0.2 and 1 percent per year. The net effect is that oil consumption in the market economies is expected to rise from 46.4 million barrels per day in 1985 to between 47 and 55 million barrels per day in the year 2000 (Table 6 on page 24 and Table 7 on page 25).

As mentioned earlier, world oil prices dropped dramatically in 1986. As a result, the demand for oil in the market economies is expected to be one million barrels per day higher in 1986 than in 1985. The price drop in 1986 set in motion a string of events that will likely affect oil consumption into the 1990's. Low prices, for example, could encourage people to conserve less and shift back to oil, reversing their actions of recent years. As consumer habits change, oil demands could exceed low-cost oil supplies. If this happens, the price of oil could increase substantially. In our projections, this acceleration begins to occur in the early 1990's. Such price increases would likely encourage people to conserve, and oil consumption would level off again. This cyclical interaction with prices is reflected in the oil consumption projections.

Figure 7. Market Economies Oil Consumption: Base Case, 1970-2000

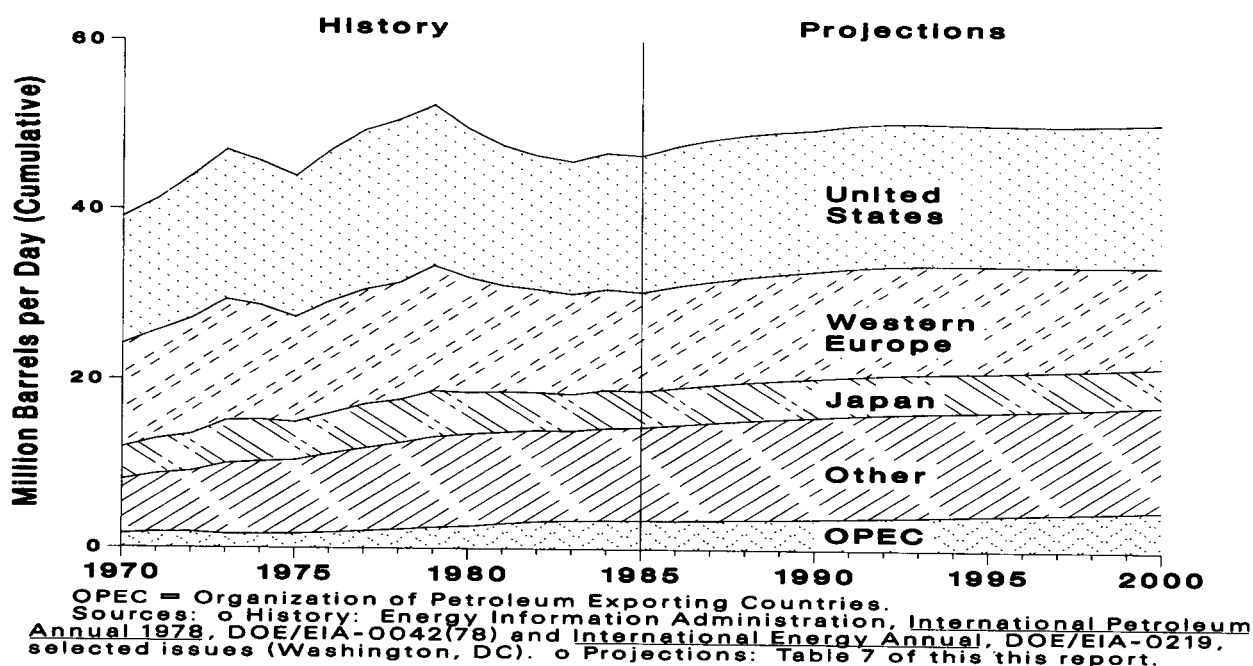


Table 6. Oil Consumption in the Market Economies, 1973-85
(Million Barrels per Day)

Year	United States ^a	Other OECD	Total OECD	Non-OECD	Total Market Economies
1973	17.3	22.3	39.6	7.3	46.9
1974	16.7	21.4	38.1	7.6	45.7
1975	16.3	20.2	36.5	7.9	44.5
1976	17.5	21.4	38.8	8.5	47.3
1977	18.4	21.9	40.3	9.1	49.4
1978	18.8	21.9	40.8	9.8	50.5
1979	18.5	23.1	41.6	10.4	52.0
1980	17.1	21.6	38.6	11.1	49.7
1981	16.1	20.3	36.3	11.5	47.9
1982	15.3	19.3	34.6	11.8	46.4
1983	15.2	18.7	33.9	11.8	45.7
1984	15.7	18.9	34.7	12.1	46.7
1985	15.7	18.5	34.3	12.2	46.4

^aGeographic coverage is the 50 States and the District of Columbia. U.S. Territories are included in "Other OECD."

OECD=Organization for Economic Cooperation and Development.

Notes: Numbers may not add to totals because of independent rounding.

Sources: Energy Information Administration, International Energy Annual 1985, DOE/EIA-0219(85)(Washington, DC, 1986); Monthly Energy Review, DOE/EIA-0035 (86/10), and Petroleum Supply Monthly, DOE/EIA-0109 (86/11) (Washington, DC, 1987).

Table 7. Oil Consumption in the Market Economies, 1984-2000
(Million Barrels per Day)

Country/Region	History		Projections			
	1984	1985	1990		2000	
	Actual	Preliminary	Base	Range	Base	Range
United States ^a	15.7	15.7	16.1	15.5-17.1	17.4	16.3-18.7
Canada	1.5	1.5	1.6	1.6- 1.8	1.6	1.4- 1.8
Japan	4.6	4.3	4.6	4.5- 4.8	4.6	4.2- 5.0
OECD Europe	11.8	11.7	12.6	12.0-13.4	11.8	10.5-13.4
United Kingdom	1.8	1.6	1.7	1.7- 1.9	1.6	1.5- 1.8
France	1.9	1.8	2.0	1.9- 2.1	1.9	1.7- 2.1
West Germany	2.3	2.4	2.5	2.4- 2.7	2.4	2.1- 2.7
Italy	1.6	1.7	1.8	1.7- 1.9	1.7	1.5- 1.9
Netherlands	0.6	0.6	0.7	0.6- 0.7	0.6	0.6- 0.7
Other Europe	3.6	3.6	3.9	3.7- 4.1	3.6	3.3- 4.1
Other OECD	1.0	1.1	1.2	1.1- 1.2	1.1	0.9- 1.2
Total OECD	34.7	34.3	36.1	34.7-38.2	36.5	33.5-39.9
OPEC	3.4	3.4	3.7	3.6- 3.7	4.8	4.4- 5.2
Other Developing Countries	8.7	8.8	9.6	9.3-10.1	10.0	9.3-10.8
Total Market Economies ..	46.7	46.4	49.4	47.6-52.1	51.3	47.4-55.5

^aGeographic coverage is the 50 States and the District of Columbia. United States 1985 amount is actual. U.S. Territories are included in "Other OECD."

OECD=Organization for Economic Cooperation and Development.

OPEC=Organization of Petroleum Exporting Countries.

Notes: o Numbers may not add to totals because of independent rounding. o All uncertainty ranges are derived independently and do not necessarily add to totals.

Sources: o History: Energy Information Administration, International Energy Annual 1985, DOE/EIA-0219(85) and Monthly Energy Review, DOE/EIA-0035(86/09) (Washington, DC, 1986).

o Projections: Energy Information Administration, Office of Energy Markets and End Use.

Oil Consumption in the OECD Countries

There have been important shifts during the 1973 to 1985 period in the consumption behavior of the industrialized countries in the OECD. These countries experienced significant declines in oil demand between 1980 and 1983, following the second price shock in 1979-80. Consumption increased in 1984 due to the coal strike in the United Kingdom and colder than normal weather, but demand decreased once again in 1985. In 1973, the OECD consumed almost 40 million barrels per day of petroleum, or over 8 out of every 10 barrels of oil consumed in the market economies. In 1985, the OECD consumed approximately 34 million barrels per day, though their proportion of demand in the market economies declined only slightly (to about 3 out of every 4 barrels of oil used in the market economies). The United States' oil consumption declined by over 3 million barrels per day from the peak consumption year in 1978 and by about 1.6 million barrels per day from 1973. Throughout the period the United States' economy used about 1 out of every 3 barrels consumed in the market economies. Oil consumption by most countries in the OECD declined in the 1973-to-1985 period.

There is a general consensus that alternatives to oil have been pursued not only in response to market forces but also for political and national security reasons. However, with the 1986 price drop making alternatives to oil less economically sound, the pursuits for alternatives to oil may have been delayed for several years. Based on the projected range of uncertainty, oil consumption in the OECD countries in 2000 is projected to be from about 1 million barrels per day less to about 6 million barrels per day more than the 1985 level of 34.3 million barrels per day. Much of the potential increase is projected to occur by 1990. There are several reasons for such a growth profile. If oil prices remain low over the next several years, oil will remain more competitive and market incentives for switching to alternative energy sources may be diminished. However, as non-OPEC oil production begins to diminish, oil prices are projected to increase, creating the opposite set of market forces in the 1990's.

Government policies toward national security could also act to constrain growth in oil consumption. In particular, Japan's stated goal is to diversify energy

mix while simultaneously increasing energy efficiency and conservation. If successful, oil consumption in Japan could remain level even though economic growth is projected to be the highest among the OECD countries. French policy toward nuclear power development combined with projected increases in natural gas imports may lead to further decreases in oil consumption, even with higher than average economic growth. The United States oil consumption growth depends heavily on market uncertainty of coal and nuclear power generation as well as natural gas reserve depletion. In all regions, oil's share of energy is projected to continue to decline; but, with the notable exception of the Netherlands where gas consumption is highest, oil is projected to be the primary fuel source. Much of the latter is a consequence of the need for petroleum in the transportation sector and for petrochemical processes.

Oil Consumption in the Developing Countries

Oil consumption in the developing countries (including OPEC) is projected to increase between 12 and 31 percent between 1985 and 2000 (Table 7 on page 25). The developing countries as a group are projected to account for much of the increase in oil consumption in the market economies during this period. The OPEC countries taken together are projected to have the highest growth in oil consumption, ranging between 2 to 3.4 percent per year.

Though heavily dependent on oil as a primary energy source, the developing countries are expected to make every effort to exploit domestically produced energy sources in order to reduce oil imports and conserve foreign exchange. However, efforts to reduce oil dependency will be hampered by the inability of many countries to pay for the projects needed to create energy alternatives--such capital intensive projects as nuclear power plants and natural gas pipelines. Thus, many countries of Latin America, Asia, and Africa face an uncertain future with respect to acquiring the energy needed for economic growth. Even with the sharp drop in the price of oil, the current account situation in many countries remains serious, for many commodity-exporting nations have seen the volume and price of their exports decline as well.

4. World Energy Consumption

Total primary energy consumption in the market economies is projected to grow at an average rate of 1.5 to 2 percent per year between 1985 and the year 2000. The energy projections indicate a decline in relative importance for oil as an energy source in the market economies. Indeed, oil's contribution to total primary energy consumption in the market economies has already declined significantly, going from just over 50 percent of the total in 1980 to about 46 percent by 1985. By the year 2000, oil's share of total energy consumption is projected to range between 38 to 41 percent. Thus, its contribution to total energy consumption could decline by over 10 percentage points between 1980 and the year 2000.

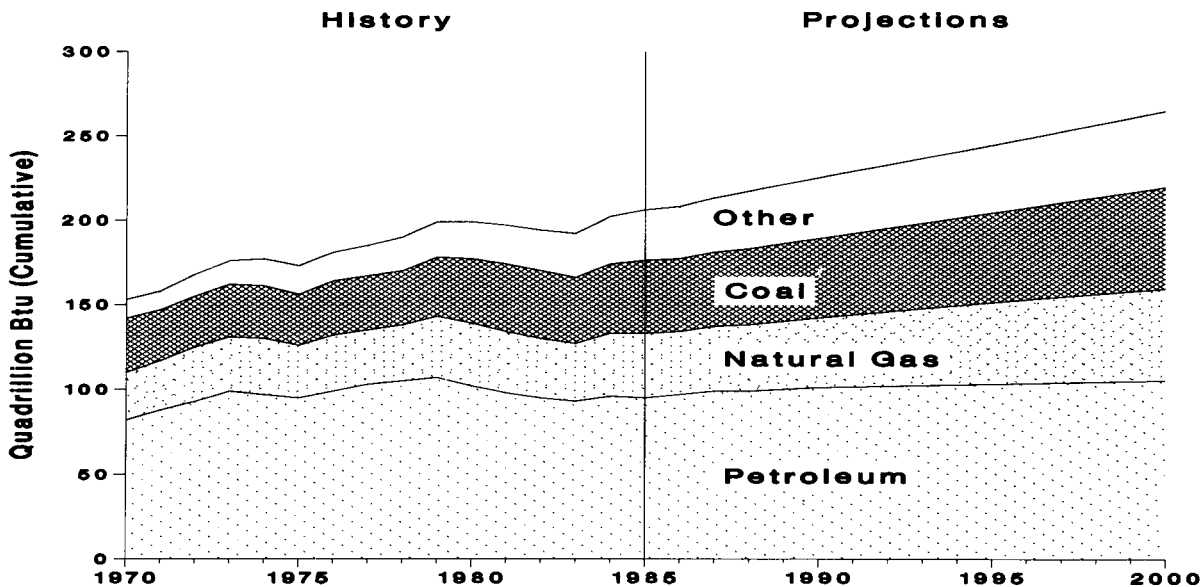
In contrast to oil, the other fossil fuels--natural gas and coal--are projected to increase in relative importance over the projection period, particularly coal. However, nuclear power is assumed to be the fastest growing

energy source in the market economies between now and the year 2000. Projections of total primary energy consumption by energy source are presented in Figure 8 and Table 8 on page 28.

Regional Energy Consumption Patterns

Economic growth and falling energy prices encouraged increased total primary energy consumption in the market economies in 1985, and it is estimated that these factors have encouraged further growth in energy consumption in 1986 as well. Contributing most to increased energy consumption in the market economies was nuclear power, which grew by a gigantic 19 percent in 1985. In absolute terms, coal contributed

Figure 8. Market Economies Consumption of Energy by Type: Base Case 1970-2000



Sources: o History: United Nations, *1979 Yearbook of World Energy Statistics* (New York, NY, 1981); and Energy Information Administration, *International Energy Annual*, DOE/EIA-O219 and *International Petroleum Annual*, DOE/EIA-0042, selected issues (Washington, DC). o Projections: Table 8 of this report.

Table 8. Energy Consumption in the Market Economies by Fuel, 1984-2000
(Quadrillion Btu)

Energy Source	History		Projections			
	1984	1985	1990		2000	
	Actual	Preliminary	Base	Range	Base	Range
Oil	96	95	101	97-106	105	97-113
Gas	37	38	41	39- 43	54	47- 57
Coal	41	43	47	46- 49	60	57- 67
Other Fuels	28	30	36	35- 37	46	44- 49
Total Energy	202	205	225	222-230	265	256-276

Notes: o Energy totals exclude fuel wood and all noncommercial fuel sources. o Numbers may not add to totals because of independent rounding. o All uncertainty ranges are derived independently and do not necessarily add to totals. o Average conversion factors for the Market Economies for 1984-2000 are the following: (1) Oil - 5.6 Million Btu/barrel, (2) Gas - 1,014 Btu/cubic foot, and (3) Coal - 20.3 Million Btu/short ton.

Sources: o History: Energy Information Administration, International Energy Annual 1985, DOE/EIA-0219(85) and Monthly Energy Review, DOE/EIA-0035(86/09) (Washington, DC, 1986).
o Projections: Energy Information Administration, Office of Energy Markets and End Use.

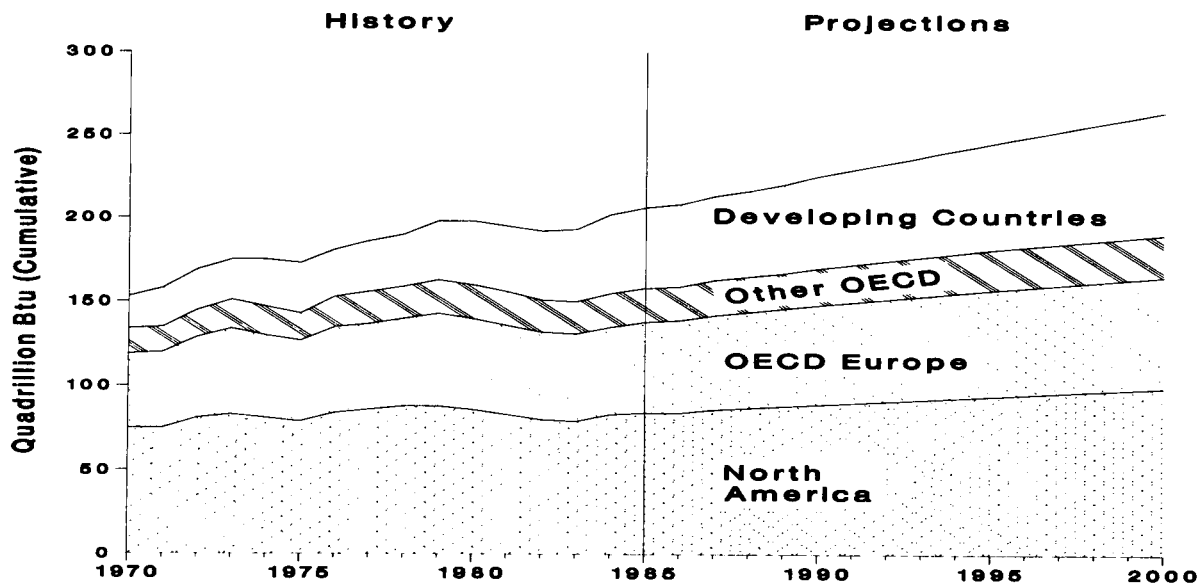
almost as much as nuclear, up about 1.4 quadrillion Btu in 1985 compared to about 2 quadrillion Btu for nuclear. Regionally, about a third of 1985 energy growth occurred in the developing countries. Among the OECD countries, the most growth in 1985 energy consumption occurred in Canada, the United Kingdom, and West Germany. Energy consumption in the United States declined by less than half a percent in 1985 and is estimated to have increased by about a half a percent in 1986.

As in 1985, energy consumption between 1985 and the year 2000 is projected to grow the most in the developing countries (Figure 9 on page 29). Energy consumption is projected to grow between 2.8 and 3.8 percent per year in OPEC and between 2.4 and 3.3 percent in the other developing countries taken as a whole. In contrast, growth in energy consumption in the OECD countries is projected to average between 1.1 and 1.5 percent per year between 1985 and 2000 (Table 9 on page 30). Again, different assumptions about economic growth explain much of the variance in projected energy consumption growth, particularly in the 1990's. During this 10-year period, economic growth in the developing countries is expected to grow about one and a half times as fast as that in the OECD countries.

The transition from agricultural to industrial economies in many developing countries is expected to foster accelerated economic growth. In turn, increased industrial activity in these countries is expected to require increased energy usage. Further, energy use associated with such consumer goods as automobiles and household appliances is generally lower among the developing countries than among the OECD countries. Expansion of these markets would increase energy use per capita. Expanding electrification, a process that is highly energy intensive, would also contribute to increased energy consumption in many of the developing countries. However, a major uncertainty with respect to economic growth in certain developing countries is their heavy debt burden and the ability of the international financial community to address these problems.

In contrast to the developing countries, much of the new growth in economic activity among the industrialized countries is expected in the services and high-technology sectors, both of which require less energy for a given value of output. Conservation and energy-efficiency gains made in the 1980's should continue to hold down energy growth in the 1990's. Growth in oil consumption should be further constrained by ongoing investments in fuel-switching and fuel-substitution capabilities.

Figure 9. Market Economies Consumption of Energy by Region: Base Case 1970-2000



OECD = Organization for Economic Cooperation and Development.
 Sources: o History: United Nations, 1979 Yearbook of World Energy Statistics (New York, NY, 1981); and Energy Information Administration, International Energy Annual, DOE/EIA-0219 and International Petroleum Annual, DOE/EIA-0042, selected issues (Washington, DC). o Projections: Table 9 of this report.

Any decline in oil use would likely be most pronounced in sectors where fuel substitution is readily achieved, such as nuclear power for oil in the utility sector, and least pronounced in sectors with less technical flexibility, such as motor transportation. Oil is expected to remain relatively more important in many developing countries, however, either because of its availability, such as in the Persian Gulf countries, or because of the lack of capital to make fuel-switching investments.

The economic makeup of the OECD countries differs not only from that of most developing countries, but it differs among the countries of the OECD as well. Countries with highly energy intensive economies in place could, conceivably, conserve the most energy over time. Using the ratio of total primary energy requirement (TPER) to gross domestic product (GDP) as the measure of intensity, Canada, Luxembourg, and the United States currently have the most energy intensive economies among the OECD countries. Countries with the lowest energy intensive economies are Switzerland, Denmark, and Japan.¹⁰

The 1985 TPER/GDP ratio for Canada, for example, was estimated to be about three times as great as that for Switzerland. The 1985 ratio for the United States was about twice that of Japan. Japan has reduced its TPER/GDP ratio by 31 percent since the first oil price shock of 1973-1974. Over the same period, the United States reduced this measure of energy intensity by 23 percent. Europe demonstrated less progress, reducing its ratio by 15 percent. The energy intensity of economic activity in Australia remained almost constant over this period while that in New Zealand actually rose. Greece, Spain, and Portugal were the only other countries to increase the energy intensity of overall economic activity over this period.

However, Greece, Spain, and Portugal, along with Turkey, continue to use less energy per capita than do any of the other OECD countries. The contrast in per capita energy use among the OECD countries is enormous. As of 1984, the TPER/Per Capita ratio in Canada was over 11 times as great as that in Turkey. The U.S. ratio was about two-and-a-half times that in Japan and in Europe taken as a group. These differences in energy intensities are indicative of the potential for change in energy consumption and energy conservation among the OECD countries.

¹⁰TPER/GDP, TPER/Per Capita, and Oil/GDP ratios for the period 1973 through 1985 are presented in International Energy Agency, *Energy Policies and Programmes of IEA Countries, 1985 Review*, (Paris, France, 1986).

Table 9. Energy Consumption in the Market Economies, 1984-2000
(Quadrillion Btu)

Country/Region	History		Projections			
	1984	1985	1990		2000	
	Actual	Preliminary	Base	Range	Base	Range
United States ^a	74.1	73.9	78.6	78.5- 80.3	87.3	83.5- 90.5
Canada	9.2	9.6	10.7	10.5- 10.9	11.9	11.4- 12.4
Japan	15.6	15.7	17.3	16.9- 17.7	20.1	19.2- 21.0
OECD Europe	52.3	53.7	59.1	57.9- 60.5	66.3	63.5- 69.3
United Kingdom	7.9	8.6	9.4	9.3- 9.7	10.5	10.0- 10.9
France	8.1	8.2	9.1	8.9- 9.3	10.2	9.8- 10.7
West Germany	11.4	11.8	13.1	12.9- 13.4	14.3	13.7- 14.9
Italy	5.9	6.0	6.8	6.6- 6.9	7.9	7.5- 8.3
Netherlands	2.9	3.0	3.2	3.2- 3.3	3.6	3.4- 3.7
Other Europe	16.0	16.0	17.5	17.1- 17.9	19.9	19.1- 20.8
Other OECD	4.0	4.1	4.5	4.4- 4.8	5.2	5.0- 5.6
Total OECD	155.2	157.1	170.2	168.4-173.8	190.8	186.3-197.7
OPEC	11.0	10.9	12.2	11.9- 12.4	17.8	16.5- 19.2
Other Developing Countries	35.6	36.8	42.7	41.7- 43.9	56.3	52.8- 60.0
Total Market Economies ..	202	205	225	222-230	265	256-276

^aGeographic coverage is the 50 States and the District of Columbia. United States 1985 amount is actual. U.S. Territories are included in "Other OECD."

OECD=Organization for Economic Cooperation and Development.

OPEC=Organization of Petroleum Exporting Countries.

Notes: o Numbers may not add to totals because of independent rounding. o All uncertainty ranges are derived independently and do not necessarily add to totals.

Sources: Energy Information Administration, International Energy Annual 1985, DOE/EIA-0219(85) and Monthly Energy Review, DOE/EIA-0035(86/09) (Washington, DC, 1986).

o Projections: Energy Information Administration, Office of Energy Markets and End Use.

Interestingly, Portugal, Greece, and Turkey are also estimated to have had the highest Oil/GDP ratios among the OECD countries in 1985. Their level of dependence on oil might indicate the same difficulty, as among many developing countries, in generating the investment capital needed to shift away from oil. Oil dependence, as measured by the Oil/GDP ratio,

actually grew in Portugal between 1973 and 1985, but Portugal was the only OECD country to demonstrate such growth over this period. In contrast, Japan cut its Oil/GDP ratio in half between 1973 and 1985 and is projected to continue this shift away from oil. Japan, like the OECD as a whole, is expected to substitute nuclear power, coal, and natural gas for oil whenever possible.

Energy Consumption by Economic Sector

Projections of energy consumption by fuel and by major economic sector for the OECD countries are presented in Appendix C. Energy consumption in the residential-commercial sector is projected to grow the fastest in the OECD countries, from 1.7 to 1.8 percent per year between 1985 and 2000. Comparable growth rates for the industrial and transportation sectors are 1.2 to 1.6 percent and 0.1 to 0.6 percent, respectively. Consumption of electricity accounts for much of the increase in energy consumption in the residential-commercial and industrial sectors. The fuel mix used to produce increasing levels of electric power should continue to change over the next 15 years, with nuclear increasing and oil decreasing in relative importance. Oil remains the dominant fuel in the transportation sector, but gains in automobile efficiency should help to keep consumption growth down in this sector as well.

Prospects for Coal

During 1986 three unrelated developments occurred that may have both short- and long-term effects on the world coal market. These events which increased the uncertainty in projecting the future course of the world coal market were:

- falling world oil prices,
- sanctions against South African coal imports,
- and the Chernobyl nuclear accident.

The availability of abundant supplies of low-cost oil in the 1960's led most countries to substitute oil for coal as the primary fuel for industrial and utility boilers. The picture changed in the 1970's when sharp increases in world oil prices resulted in renewed interest in coal, an economical and secure fuel source.

The sharp decline in world oil prices which began in early 1986 will also have an impact on the demand for coal shown in Table 10. On the positive side, low oil prices could stimulate economic growth which, in turn, could lead to increased electricity demand to be met to a large degree by coal-fired generating capacity. On the negative side, low-priced oil could recapture some

of the electric utility or industrial markets from coal. A rapid erosion of coal markets, however, is not likely. The immediate effect of low oil prices has been to depress coal prices in the spot market, as utilities use more oil-fired capacity. For example, a Danish utility revised its 1986 fuel mix towards more oil, and the result was steam coal offered to the utility at \$29 per ton on a spot basis, compared to the 1985 average price of \$44 for imported coal to members of the European Economic Community (EEC).¹¹

Also affecting prices and coal trade is the growing social and political unrest in South Africa, a country with the fourth largest reserves of hard coal in the world.¹²(The United States, the Soviet Union, and China, respectively, are the top three countries in estimated coal reserves.) A few countries such as the United States and Denmark have already banned coal imports from South Africa, and others such as France and possibly Japan are not renegotiating South African coal contracts. Though South Africa is the lowest-cost supplier of steam coal to the European market, the EEC is also studying Community-wide sanctions on trade with South Africa. During 1986, South Africa resorted to discounting its coal prices in an effort to counter political opposition in Europe. The events in South Africa may have continuing effects on coal trade if South Africa's social and political problems are not resolved.

Finally, due to the Chernobyl nuclear accident, many countries are reviewing their long-term nuclear generating plans. This process could have indirect effects on longer-term coal demand by electric utilities. As in recent years, most of the increased coal demand is expected to occur in the electric utility sector.

During the 1960's through the mid-1970's, most of the coal traded in world markets was used for metallurgical processing, such as for steel making. However, the growth in coal trade in recent years has resulted primarily from increased demand for steam coal used for combustion in thermal processes.¹³ Future increases in coal demand will likely result from rising demand for steam coal by electric utilities and, to a lesser extent, for coal by industrial users. The cement industry in many countries has already converted to coal, but growth in demand could continue since other energy-intensive industries like chemicals, paper, and food processing are just beginning to convert. Metallurgical coal demand, on the other hand, is directly related to the long-term needs of the iron and steel industry which has stagnated in recent years and is not expected to expand significantly in future years. Industrial coal demand is only expected to increase slightly by the year 2000.

¹¹ *Coal Week International*, August 13, 1986, p.3.

¹²Energy Information Administration, *International Energy Annual 1985*, DOE/EIA-0219(85) (Washington, D.C. October 1986) Table 25, p. 74.

¹³International coal trade is explored in detail in the forthcoming report: *Annual Prospects for World Coal Trade 1987*, DOE/EIA-0363(87) (Washington, DC, 1987).

During 1985, electric utilities consumed about 70 percent of all coal in the OECD countries. This share is projected to increase to over 75 percent by 2000, with consumption projected to increase between 2.2 and 3.0 percent per year between 1985 and 2000. Whereas industrial demand for coal in the OECD represented about 25 percent of total coal consumption in 1985, its share of OECD consumption is actually expected to decline to between 19 and 24 percent by 2000.

The notable exception to this coal consumption pattern within the OECD is Japan. In 1985, the industrial sector consumed 72 percent of Japan's coal while electric utilities consumed only 28 percent. Japan has an active program for replacing oil-fired electricity plants with coal-fired plants. It is expected that coal consumption in Japan will be split about equally between the electric utilities and industry by the year 2000.

Much of Mediterranean Europe is expected to have significant increases in coal consumption, but Italy should have the major increase. The focus of Italy's National Energy Plan of 1981, revised in 1985, was to reduce dependency on oil by substituting coal and nuclear power. The projected average annual growth rate of between 6 and 8 percent per year in Italy's coal consumption reflects anticipated needs by new coal-fired electric utility plants. The government is experiencing considerable public opposition to both nuclear and coal-fired generating plants. Therefore, this projected growth could be optimistic.

Total OECD coal consumption is projected to grow between 1.7 and 2.5 per year through 2000, increasing coal's share of total energy consumption from 21 percent in 1985 to between 23 and 24 percent by 2000. Growth is expected to occur mainly in the Pacific Rim and Mediterranean European countries. However, coal's share of total energy consumption in several OECD countries is expected to remain relatively flat or to actually decline. Although France has a program for systematic replacement of coal-fired generating capacity as additional nuclear capacity is brought on line, there is considerable uncertainty surrounding additional nuclear generation capacity. This uncertainty is reflected in coal-fired electricity generation. As a result, coal's share of total energy consumption in France is projected either to fall from 12 percent in 1985 to about 6 percent by 2000 or increase to 19 percent by 2000. Though coal is currently the predominant fuel source for power generation in the United Kingdom and some new capacity is under construction, many existing coal plants are slated for retirement through the 1990's. Similarly, new electricity generating facilities in Canada are expected to be either nuclear or hydroelectric. Heavy government subsidies and long-term contracts with the utility and industrial sectors should hold coal's share of West Germany's energy consumption to between 30 and 34 percent throughout the projection period.

The prospects for coal growth outside the OECD are more favorable, although uncertain. In the developing countries, coal's share of total energy consumption is projected to increase from approximately 25 percent in 1985 up to 30 percent by 2000.

Table 10. Coal Consumption in the Market Economies, 1984-2000
(Million Short Tons)

Country/Region	History		Projections			
	1984	1985	1990		2000	
	Actual	Preliminary	Base	Range	Base	Range
United States ^a	791	818	888	881-894	1,105	1,086-1,126
Canada	60	54	65	62-73	71	66-95
Japan	113	120	131	127-135	179	155-195
OECD Europe	539	575	612	577-655	751	664-875
United Kingdom	63	111	113	111-115	126	122-144
France	51	47	45	33-68	41	27-97
West Germany	226	205	244	237-266	276	266-318
Italy	24	26	40	36-43	67	59-81
Netherlands	12	11	12	12-14	15	14-23
Other Europe	163	175	158	148-166	224	185-256
Other OECD	62	51	67	59-83	89	80-112
Total OECD	1,564	1,618	1,763	1,733-1,827	2,196	2,097-2,364
OPEC	3	3	7	6-7	19	18-21
Other Developing Countries	461	462	528	522-581	735	704-942
Total Market Economies ..	2,028	2,083	2,298	2,265-2,410	2,950	2,824-3,307

^aGeographic coverage is the 50 States and the District of Columbia. United States 1985 amount is actual. U.S. Territories are included in "Other OECD."

OECD=Organization for Economic Cooperation and Development.

OPEC=Organization of Petroleum Exporting Countries.

Notes: o Numbers may not add to totals because of independent rounding. o All uncertainty ranges are derived independently and do not necessarily add to totals.

Sources: o History: Energy Information Administration, International Energy Annual 1985, DOE/EIA-0219(85) and Monthly Energy Review, DOE/EIA-0035(86/09) (Washington, DC, 1986). o Projections: Energy Information Administration, Office of Energy Markets and End Use.

Prospects for Natural Gas

Natural gas consumption in the market economies is forecast to increase from an estimated 37.1 trillion cubic feet in 1985 to a projected range of 38.8 to 41.9 trillion cubic feet by 1990 and 46.6 to 56.6 trillion cubic feet by the year 2000 (Table 11 on page 35). Growth rates through the year 2000 could average from 1.5 to 2.9 percent per year. Natural gas is estimated to account for about 18.5 percent of total energy consumption in 1985. At the low end of the range, natural gas could experience a slight loss of market share to other fuels by 1990, but would regain the lost share by 2000. At the high end of the range, natural gas would maintain its current share through 1990, then increase its market share up to 21 percent by 2000. The primary factors influencing future natural gas consumption are economic growth, natural gas prices relative to other fuels, and capital investments in gas distribution systems. Slow economic growth, fuel-switching away from natural gas to other fuels, and delays or cancellations of projects to develop natural gas infrastructure to serve new customers would result in consumption levels toward the low end of the projected range. Conversely, higher economic growth rates, competitive prices for natural gas, and a high level of investment in natural gas distribution systems would result in consumption levels toward the upper end of the projected range.

The forecast presented here reflects the different factors that are likely to influence energy markets in each of the major consuming countries and regions of the noncommunist world. In addition to those factors already mentioned, consumption of natural gas may be encouraged by the availability of domestic reserves which if exploited could conserve oil reserves or reduce oil imports, fuel-switching due to environmental considerations favoring natural gas over less clean-burning fuels, and technological innovations such as natural gas air conditioning systems. On the other hand, the existence of mature markets with little room for expanding the number of gas customers, concerns about supply security where domestic reserves are either limited or non-existent, the availability of expanded coal or nuclear power generation capacity, and improvements in energy efficiency could limit, or in some cases reduce, the future consumption of natural gas.

The United States, the largest consumer of natural gas in the market economies, has a mature and well-developed market. Fuel switching from natural gas to oil caused by the oil price collapse of 1986 has caused a short-term drop in natural gas consumption, but demand could begin to recover by the late 1980's. Consumption is expected to range from 17.0 to 17.7 trillion

cubic feet in 1990, reaching 17.8 to 18.2 trillion cubic feet by the year 2000. The slow growth relative to total energy reflects increased reliance on coal and nuclear power generation and improvements in efficiency, which tend to offset increases associated with the addition of any new customers or increases in economic activity. The United States has historically been almost totally self-sufficient in natural gas supply, importing small quantities from Canada--a secure and nearby supply source. As U.S. domestic reserves are gradually depleted, the United States could become more dependent on imports from Canada and possibly elsewhere for future increases in demand.

Canada has an expanding domestic market for natural gas, and is a major producer and net exporter as well. Expected increases in consumption of natural gas may be attributed to economic growth, combined with extension of the nationwide grid system to more remote residential and commercial customers and the development of distribution networks for industrial users. To the extent that lower oil prices lead to postponements or cancellations of these types of projects, demand could tend toward the lower end of the range shown on Table 11 on page 35.

Japan, the largest importer of liquefied natural gas (LNG), produces a minuscule amount of natural gas domestically as well. Japan's relatively high rate of growth in natural gas consumption throughout the forecast period is mainly due to continued economic growth and a preference for imported LNG over imported crude oil for environmental reasons. LNG is used mainly for power generation, and is expected to become more important in the electric utility sector as Japan continues to substitute LNG for oil due to its cleaner burning properties. Although Japan will inevitably remain import dependent, its reliance on a diversity of suppliers is designed to minimize the risk of supply interruptions or shortages. The list of current suppliers includes Brunei, Indonesia, Malaysia, Alaska, and Abu Dhabi. This list will include Australia by 1990 under a 1986 agreement, and could also include Qatar, Thailand, the Soviet Union, and others at some time within this forecast period.

Natural gas consumption in Europe is expected to increase at an average annual rate of 0.5 to 2.6 percent through 2000. The relatively slow growth at the low end of the range is due to the availability of lower priced oil and the addition of nuclear generating capacity, resulting in a decrease in the percent of European energy demand met by natural gas. By 1995, natural gas could recover its 1985 share of 16 percent of total energy consumption, with the expected rebounding of oil prices that could encourage fuel-switching back to nonpetroleum fuels. This trend is expected to continue at an even faster pace through the year 2000, when the natural gas share of European energy consumption could reach almost 18 percent at the high end of the range of estimates.

Table 11. Natural Gas Consumption in the Market Economies, 1984-2000
(Trillion Cubic Feet)

Country/Region	History		Projections			
	1984	1985	1990		2000	
	Actual	Preliminary	Base	Range	Base	Range
United States ^a	18.0	17.3	17.5	17.0-17.7	17.9	17.8-18.2
Canada	1.9	2.1	2.3	2.1- 2.5	2.8	2.3- 3.1
Japan	1.4	1.5	1.7	1.6- 1.8	2.3	1.9- 2.5
OECD Europe	8.2	8.5	8.9	8.3- 9.5	11.3	9.2-12.5
United Kingdom	1.9	2.0	2.1	2.0- 2.2	2.8	2.4- 3.0
France	1.0	1.1	0.5	0.1- 0.9	1.0	0.5- 1.3
West Germany	2.0	2.0	2.6	2.2- 2.7	3.3	2.6- 3.5
Italy	1.2	1.2	1.3	1.2- 1.3	1.6	1.4- 1.7
Netherlands	1.4	1.5	1.6	1.5- 1.6	1.9	1.7- 2.0
Other Europe	0.8	0.7	0.7	0.6- 0.8	0.8	0.7- 0.9
Other OECD	0.5	0.6	0.6	0.6- 0.7	0.9	0.7- 1.1
Total OECD	29.9	29.9	31.0	29.9-32.0	35.2	32.3-36.9
OPEC	3.0	2.9	3.4	2.7- 4.1	5.9	4.8- 7.3
Other Developing Countries	3.6	4.3	6.2	4.7- 6.6	12.5	7.5-13.4
Total Market Economies ..	36.5	37.1	40.6	38.8-41.9	53.6	46.6-56.6

^aGeographic coverage is the 50 States and the District of Columbia. United States 1985 amount is actual. U.S. Territories are included in "Other OECD."

OECD=Organization for Economic Cooperation and Development.

OPEC=Organization of Petroleum Exporting Countries.

Notes: o Numbers may not add to totals because of independent rounding. o All uncertainty ranges are derived independently and do not necessarily add to totals.

Sources: o History: Energy Information Administration, International Energy Annual 1985, DOE/EIA-0219(85) and Monthly Energy Review, DOE/EIA-0035(86/09) (Washington, DC, 1986). o Projections: Energy Information Administration, Office of Energy Markets and End Use.

The outlook for natural gas consumption in Western Europe varies from country to country within the region:

- In the United Kingdom, widespread installation of natural gas central heating systems, the availability of secure supply from domestic reserves and nearby European exporters, and economic growth could encourage increases in consumption.
- In France, start-up of new nuclear power plants, coupled with the availability of relatively low-priced oil, could reduce natural gas consumption to a minuscule amount at the low end of the range of estimates by 1990. Demand is expected to recover somewhat after 1990, due to economic growth, but is unlikely to recoup all of the share previously lost to other fuels.
- West Germany is expected to experience the highest European growth rate, mainly due to the expansion of its nationwide grid system. Its share of total energy supplied by natural gas is expected to increase from 16 percent in 1985 to between 18 and 22 percent by 2000.
- Italy is expected to maintain gas consumption at about the 1985 level through 1990, decreasing its reliance on natural gas as most of its additional energy requirements for this period are met by coal and nuclear. Consumption is expected to increase at a more rapid pace through 2000. At the high end of the range of estimates, Italy could increase its reliance on natural gas to more than the 1985 level by 2000.
- The Netherlands, with a mature market and adequate domestic reserves, is expected to maintain its consumption at close to the 1985 level through 1990 and to increase consumption moderately thereafter.
- Elsewhere in Europe, natural gas consumption is expected to remain at about current levels through 1990, possibly increasing in the late 1990's. Increases in coal and nuclear consumption could outpace those for natural gas, largely due to the relatively high investment costs for transportation and distribution systems, which are the prerequisite to creating or expanding markets for natural gas.

Western European natural gas requirements are currently supplied by indigenous production for local use (about 50 percent), intra-OECD trade (almost 30 percent), and non-OECD trade (about 20 percent). The Netherlands, United Kingdom, West Germany, and Italy are the largest producers for their own domestic requirements; the Netherlands and Norway are the principal Western European exporters; and the Soviet Union and Algeria are the main suppliers from outside the OECD. These same sources are expected to continue to supply gas throughout the forecast period, with a small shift in the relative importance of each

source. As demand increases, the incremental requirements are likely to be met by supplies from outside the OECD, where the largest reserves are located. Nevertheless, Western Europe is expected to continue to rely on indigenous production and intra-OECD trade for about two-thirds of the region's projected requirements.

The prospects for future supplies to Western Europe are positive, given the availability of reserves, spare capacity in current exporters' natural gas pipelines and LNG facilities, planned pipeline extensions, and the potential for expanding pipeline capacities. Deliveries from Norway's Troll and Sleipner fields are scheduled to begin in the 1990's under an agreement among a European consortium that includes West Germany, France, Belgium, and the Netherlands. In addition, Nigeria and Qatar are considering exporting LNG, and Iran has been exploring the possibilities of pipeline exports to Europe.

The expected growth in other OECD consumption is mainly because of an expanding domestic market in Australia in parallel with development of its domestic reserves. LNG exports from Australia to Japan are planned to begin in 1990.

By far the most rapid rates of increase in natural gas consumption are forecast to occur in OPEC and other developing countries. Short-term growth in OPEC countries could be tempered, however, by the currently lower oil prices that limit revenues available for natural gas infrastructure investments. In the longer run, however, OPEC is expected to accelerate domestic use of natural gas both to reduce flaring of associated gas during oil production and to reduce domestic consumption of oil to make more crude oil available for export.

Other non-OPEC oil producers, such as Mexico, are expected to pursue a similar strategy of encouraging domestic fuel-switching to natural gas. Developing countries that currently import oil are expected to increase consumption of natural gas supplied from domestic production or nearby exporters as they strive to reduce dependence on imported oil. The extent to which these new markets develop will depend largely on the availability of financing from government revenues, private investments, and international organizations. Activities currently underway include:

- Brazil is promoting natural gas development to take advantage of its domestic reserves, and is also exploring the possibility of importing LNG from Algeria. Also under study is a proposal to set up a 3-nation gas grid serving Brazil, Argentina, and Uruguay.
- South Korea has a 20-year contract to import LNG from Indonesia beginning in 1987. The LNG would be used initially for electricity generation, but the contract could be expanded to supply the potentially large residential, commer-

cial, and industrial markets that currently rely on naphtha-based town gas systems.

- A pipeline project in India, scheduled for completion by early 1989, is designed to supply natural gas to six fertilizer and power plants.
- Burma, Thailand, Malaysia, and Singapore have also taken steps toward developing natural gas markets.

Prospects for Other Energy Sources

The consumption of energy derived from nuclear, hydroelectric, and geothermal sources by the market economies is projected to increase from an estimated level of 29.8 quadrillion Btu in 1985 to between 43.5 and 48.8 quadrillion Btu in 2000, or at an average annual growth rate of between 2.6 and 3.3 percent (Table 12 on page 38). As a result, the share of total energy consumption contributed by these sources is projected to increase from 14.5 percent in 1985 to between 17.0 and 17.7 percent in 2000.

Renewed concerns about the safety of nuclear reactors in the wake of the April 1986 Chernobyl reactor accident make the outlook for nuclear power growth in some of the market economies more uncertain now than it was at the end of 1985. It is already clear that post-Chernobyl concerns have been at least partly responsible for decisions to delay government approval of and/or actual orders for planned reactor units in Belgium, Finland, the Netherlands, Switzerland, and Taiwan. In Italy, three referendums aimed at limiting the construction of new nuclear power plants will be placed before voters on June 14. Post-Chernobyl concerns also have contributed to a reconsideration of the possibility of phasing out existing nuclear power plants in at least two countries. The government of Switzerland has announced that it will conduct a study of the consequences of closing the country's five existing nuclear reactors, and the Swiss Social Democratic Party is seeking a third national referendum on phasing out existing nuclear power plants and barring the construction of new plants. Also, the government of Sweden has asked for a study of three alternatives that would

accelerate the current plan to phase out Sweden's 12 existing reactors gradually by 2010.

The projections of nuclear power consumption discussed below are based on analyses that did not specifically consider these potential impacts of post-Chernobyl concerns on reactor construction or reactor phaseout.¹⁴ It is important to note, however, that the assumptions concerning new reactor construction used in developing the lower range projections of nuclear consumption are generally consistent with the potential negative impacts on new reactor construction mentioned above. In addition, although the lower range projections were developed using the assumption that both Sweden and Switzerland continue to operate their existing reactors, a complete phase out of these reactors would not reduce the lower range projections of aggregate market economy consumption by more than 5 percent.

Nuclear power is projected to be the fastest growing source of energy for the market economies between 1985 and 2000. Consumption of nuclear power is projected to increase from an estimated level of 12.8 quadrillion Btu in 1985 to between 20.4 and 25.7 quadrillion Btu in 2000, or at an average annual growth rate of between 3.2 and 4.8 percent. Consumption growth is projected to mirror the declining growth rate of nuclear generating capacity in the latter part of the projection interval. Thus, the growth rate of nuclear power consumption is projected to fall from between 5.4 and 7.0 percent for the period 1985 to 1990, to between 2.0 and 3.6 percent for the period 1990 to 2000. Also, despite its rather rapid rate of growth over the projection period, nuclear power will continue to contribute a relatively small share of total energy consumption in the market economies. Nuclear power was estimated to account for about 6.3 percent of total energy consumption in 1985 and is projected to account for between 8.0 and 9.3 percent in 2000.

The increase in nuclear power consumption is not projected to be uniform across the countries and regions of the market economies during the projection period. In fact, three countries--the United States, France, and Japan are projected to account for between 56 and 65 percent of the projected increase in nuclear power consumption by the market economies between 1985 and 2000.

¹⁴The projections of nuclear power consumption in the United States are from the Energy Information Administration *Annual Energy Outlook 1986*, DOE/EIA-0383(86) (Washington, DC, 1987). The projections of foreign nuclear power consumption are based on the analysis underlying the projections of nuclear capacities presented in the Energy Information Administration, *Commercial Nuclear Power: Prospects for the United States and the World*, DOE/EIA-0438(86) (Washington, DC, 1986).

Table 12. Consumption of Other Energy Sources in the Market Economies, 1984-2000 (Quadrillion Btu)

Country/Region	History		Projections			
	1984	1985	1990		2000	
	Actual	Preliminary	Base	Range	Base	Range
United States ^a	7.4	7.7	9.6	9.6- 9.7	10.6	10.6-10.6
Canada	3.1	3.4	3.7	3.6- 3.7	4.4	4.3- 4.6
Japan	2.1	2.4	2.9	2.9- 3.1	4.0	3.6- 4.8
OECD Europe	9.6	10.5	12.8	12.4-13.1	16.5	15.4-18.0
United Kingdom	0.7	0.7	1.2	1.1- 1.2	1.4	1.3- 1.6
France	2.3	2.5	3.6	3.4- 3.7	4.6	4.3- 5.4
West Germany	1.1	1.5	1.5	1.5- 1.7	1.8	1.7- 1.9
Italy	0.7	0.7	0.7	0.7- 0.8	1.1	0.9- 1.1
Netherlands	0.1	0.1	0.1	0.1- 0.1	0.1	0.1- 0.2
Other Europe	4.8	5.1	5.8	5.7- 5.8	7.5	7.2- 8.0
Other OECD	0.4	0.4	0.4	0.4- 0.4	0.5	0.5- 0.5
Total OECD	22.6	24.4	29.6	28.9-30.0	35.9	34.4-38.5
OPEC	0.3	0.4	0.5	0.5- 0.5	0.8	0.8- 0.8
Other Developing Countries	4.8	5.1	6.1	6.1- 6.2	8.8	8.4- 9.6
Total Market Economies ..	27.8	29.8	36.1	35.3-36.6	45.5	43.5-48.8

^aGeographic coverage is the 50 States and the District of Columbia. United States 1985 amount is actual. U.S. Territories are included in "Other OECD."

OECD=Organization for Economic Cooperation and Development.

OPEC=Organization of Petroleum Exporting Countries.

Notes: o Other energy sources include nuclear, hydroelectric, geothermal, and other renewables. o Numbers may not add to totals due to independent rounding. o All uncertainty ranges are derived independently and do not necessarily add to totals.

Sources: o History: Energy Information Administration, International Energy Annual 1985, DOE/EIA-0219(85) and Monthly Energy Review, DOE/EIA-0035(86/09) (Washington, DC, 1986). o Projections: Energy Information Administration, Office of Energy Markets and End Use.

In the United States a significant amount of nuclear generating capacity is projected to be brought on line through 1990, with additions dropping off sharply in the last decade of this century. As a result, nuclear power consumption is projected to increase by between 43 and 44 percent between 1985 and 1990 and then only increase by between 12 and 13 percent between 1990 and 2000.

France, which was estimated to be the second largest consumer of nuclear power among the market economies in 1985, is projected to retain that position throughout the projection period, as a result of its aggressive nuclear reactor construction program. Nuclear power's share of French energy consumption was estimated to have been about 23 percent in 1985 and is projected to increase to between 37 and 44 percent in 2000. France currently exports a significant amount of nuclear electric power to other European countries and plans to increase these exports as it adds additional nuclear generating capacity. Estimates of these exports have been included in the projections of nuclear power consumption for the United Kingdom, West Germany, Italy, the Netherlands, and the "Other Europe" region.

Japan, which was estimated to rank third in nuclear power consumption among the market economies in 1985, also has a strong commitment to future growth in nuclear generating capacity. Nuclear power consumption is projected to increase by between 42 and 118 percent between 1985 and 2000, and to account for between 11 and 16 percent of Japanese energy consumption at the end of the period.

The consumption of hydroelectric and geothermal energy by the market economies is projected to grow from 16.9 quadrillion Btu in 1985 to 23.1 quadrillion Btu in 2000, or at an average annual growth rate of about 2.1 percent.¹⁵ As a result, their share of total energy consumption is projected to increase from 8.3 percent in 1985 to 8.7 percent in 2000.

Much of the growth in hydroelectric power capacity and consumption is projected to occur in the developing countries, especially in Latin America and Asia. The member countries of OPEC together with the countries included in the "Other Developing Countries" group are projected to account for about 45 percent of the projected increase in the consumption of hydroelectric and geothermal energy by the market economies between 1985 and 2000. Examples of new hydroelectric power projects in Latin America include the Guri Dam project in Venezuela, a 10,000 megawatt facility completed in late 1986, and the Itaipu Dam project, a 12,000 megawatt facility currently being completed by Brazil and Paraguay on the Parana River. In Asia, Indonesia recently completed its largest hydroelectric power plant, a 700-megawatt unit at Saguling in West Java, and Pakistan has recently awarded contracts for one of the world's largest hydroelectric power installations to be built in Tarpela.

Countries in the "Other Europe" region are projected to account for about 28 percent of the projected increase in the consumption of hydroelectric and geothermal energy by the market economies between 1985 and 2000. One example of a new hydroelectric power project planned in the "Other Europe" region is the Kayraktepe station, a 420-megawatt facility to be developed by Turkey on the Goksu River. As a result of such projects, hydroelectric and geothermal power is projected to account for over 25 percent of the energy consumed in the "Other Europe" region in 2000.

Hydroelectric power is expected to continue to be very important in Canada where it is projected to account for almost 27 percent of total energy consumption in 2000. Meanwhile, very little growth in the consumption of hydroelectric and geothermal power is projected to occur in the United States between 1985 and 2000.

¹⁵Sensitivity ranges were not developed for the consumption of hydroelectric and geothermal energy.

5. Comparison of International Energy Projections

Forecasts of energy supply and demand may differ for many reasons. Much of the variation can be attributed to differences in underlying assumptions concerning future world oil prices, economic growth rates, demand elasticities, and other key determinants of supply and demand. Differences in analytical approaches and forecasting model structures also result in different sets of projections, although the implications of these types of differences are more difficult to detect and quantify. Additional deviations may arise from differences in definitions, in conversion factors, and in the timing of the analysis.

The projections presented in this *International Energy Outlook* reflect EIA's current understanding of the world energy market and changes that are likely to evolve in the future. These projections have been updated from those in the 1985 *International Energy Outlook* based on the major downward revision to world oil price forecasts and other changes that have occurred in the interim. This chapter presents a comparison of the 1986 EIA base case given in this report with the 1985 *International Energy Outlook* base case and other widely used energy forecasts.

Comparison of EIA Projections

As indicated in Table 13 on page 42, energy demand in the market economies is projected to grow somewhat less than in the 1985 *International Energy Outlook*. Pro-

jections of oil consumption in 1995 have not changed significantly in spite of the lowered world oil price forecast. This results from similar production capacity supply constraints in the two reports. However, the impact of lowered world oil prices affect the source of supply. Non-OPEC production has been lowered by two million barrels per day, while OPEC production has been increased by the same amount.

Comparison of Alternative Projections

Not unlike the EIA forecasting method, the three key demand driving variables of most forecasts are economic activity, oil prices (including exchange rates), and lagged conservation effects of previous price shocks. Although generally only base-case estimates are shown, it is recognized that considerable uncertainty surrounds these point estimates. Growth rates are provided in percentages in Table 14 on page 43 to avoid forecast differences caused by variations in historical data bases and differences in conversion factors. In general, the estimates include refinery processing gains. With few exceptions, the alternative projections are highly consistent. Namely, the projections assume that energy/GDP growth ratios will continue to decline over time and average 0.6 to 0.75 for the market economies. Oil consumption as a share of total energy consumption is projected to continue to decline, particularly in the industrialized countries by all forecasters.

Table 13. Comparison of 1985 and 1986 EIA Energy and Oil Projections for the Market Economies: Base Case, 1995

Projection	International Energy Outlook 1985	International Energy Outlook 1986
<u>Energy Consumption</u> (quadrillion Btu)		
United States ^a	84.3	83.1
Japan	18.7	18.7
OECD Europe	63.2	62.8
Other Countries	81.2	80.2
Total	247.4	244.8
<u>Petroleum Consumption</u> (million barrels per day)		
United States ^a	16.5	16.5
Japan	4.4	4.6
OECD Europe	12.2	12.6
Other Countries	16.8	16.7
Total	49.9	50.4
Stock Additions	0.2	0.1
<u>Petroleum Supply</u> (million barrels per day)		
OPEC	24.4	26.4
United States	8.8	8.3
Other Non-OPEC	16.4	14.9
Total Production	49.6	49.6
Net Imports from CPE	0.5	0.9
Total Available Supply	50.1	50.5

^aGeographic coverage is the 50 States and the District of Columbia. U.S. Territories are included in "Other Countries."

CPE=centrally planned economies.

OECD=Organization for Economic Cooperation and Development.

OPEC=Organization of Petroleum Exporting Countries.

Note: Numbers may not add to totals because of independent rounding.

Source: Energy Information Administration, International Energy Outlook 1985, DOE/EIA-0484(85) (Washington, DC, 1986).

Table 14. Comparison of Energy Projections for the Market Economies, 1990, 1995, and 2000
(Million Barrels per Day of Oil Equivalent)

Projection	Consumption				Petroleum Production	
	Energy	Oil	(Growth Rate) ^a		OPEC	Other
			Energy	Oil		
1985 EIA Estimate	100.5	46.4	NA	NA	17.2	26.7
1990 Projections (1985 to 1990)						
EIA IEO 1986	110.4	49.4	1.9	1.3	22.9	25.2
Ashland (August 1986) ...	104.2	49.8	1.2	1.8	22.8-25.3	23-25
Chevron (June 1986)	NA	48.0-51.7	NA	0.7-2.2	18.2-25.4	NA
Conoco (Sept. 1986)	107.0	49.0	2.2	2.0	NA	NA
DRI Winter 1986-1987 ...	NA	49.9	NA	1.7	23.7	25.3
1995 Projections (1990 to 1995)						
EIA IEO 1986	120.0	50.4	1.7	0.4	26.4	23.2
Ashland (August 1986) ...	114.0	52.8	1.8	1.2	28.3-30.8	21-23
DRI Winter 1986-1987 ...	NA	51.8	NA	0.8	28.6	22.8
2000 Projections (1990 to 2000)						
EIA IEO 1986	129.9	51.3	1.6	0.4	28.3	22.6
Ashland (August 1986) ..	125.9	52.6	1.9	0.6	28.1-32.6	19-23
Chevron (June 1986)	NA	NA	2.1	1.0	26.5	20.4 ^b
Conoco (Sept. 1986)	125.0	53.0	1.5	1.0	28.0	18.5 ^b
DRI Winter 1986-1987 ...	NA	53.1	NA	0.6	32.1	21.5

^aFor the 1990 projections, these are the growth rates from 1985 to 1990; for the 1995 projections, from 1990 to 1995; and for the 2000 projections, from 1990 to 2000. Estimates where available are taken from source or computed using source base year estimate.

^bExcludes refinery processing gain of approximately 1.0 and natural gas liquids of 4.0-5.0 million barrels per day (including OPEC).

NA=Not available.

OPEC=Organization of Petroleum Exporting Countries.

Note: Except where noted, production includes crude oil, natural gas liquids, other liquids, and refinery gain.

Sources: o Ashland: World Energy Outlook Through 1995 (Ashland, KY, 1986). o Conoco: World Energy Outlook Through 2000 (Wilmington, DE, 1986). o Data Resources, Inc.: International Energy Bulletin (Lexington, MA, 1986). o Energy Information Administration: International Energy Outlook 1986, DOE/EIA-0484(86) (Washington, DC, 1987). o Chevron Corp.: World Energy Outlook (San Francisco, CA, 1986).

Appendix A

International Petroleum Balance

Table A1. Oil Consumption and Production in the Market Economies: Base Case, 1979-2000
(Million Barrels per Day)

Supply and Disposition	History							Projections							
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1995	2000	
Consumption															
United States ^a	18.5	17.1	16.1	15.3	15.2	15.7	15.7	16.1	16.3	16.1	16.1	16.2	16.5	17.4	
Canada	1.9	1.9	1.8	1.6	1.5	1.5	1.5	1.5	1.6	1.6	1.6	1.6	1.7	1.6	
Japan	5.5	5.0	4.8	4.6	4.4	4.6	4.3	4.4	4.5	4.5	4.6	4.6	4.6	4.6	
OECD Europe ^b	14.7	13.5	12.5	12.1	11.8	11.8	11.7	12.0	12.2	12.4	12.5	12.6	12.6	11.8	
Other OECD	1.0	1.0	1.1	1.1	1.0	1.0	1.1	1.2	1.2	1.2	1.2	1.2	1.1	1.1	
Total OECD	41.6	38.6	36.3	34.6	33.9	34.7	34.3	35.2	35.7	35.7	35.9	36.1	36.5	36.5	
OPEC	2.4	2.7	3.1	3.3	3.3	3.4	3.4	3.4	3.5	3.5	3.6	3.7	4.2	4.8	
Other Countries	8.0	8.3	8.5	8.5	8.4	8.7	8.8	9.0	9.2	9.3	9.5	9.6	9.8	10.0	
Total Consumption ..	52.0	49.7	47.9	46.4	45.7	46.7	46.4	47.5	48.3	48.5	49.0	49.4	50.4	51.3	
Production															
United States ^a	10.7	10.8	10.7	10.8	10.8	11.1	11.2	10.9	10.3	10.1	9.7	9.4	8.3	7.7	
Canada	1.8	1.8	1.6	1.6	1.7	1.8	1.8	1.8	1.8	1.7	1.7	1.6	1.6	1.7	
OECD Europe	2.4	2.6	2.8	3.2	3.7	4.1	4.3	4.4	4.3	4.2	4.1	4.0	3.5	3.4	
OPEC	31.7	27.7	23.6	19.9	18.6	18.6	17.2	19.4	19.3	21.2	22.1	22.9	26.4	28.3	
Other Countries	5.7	6.3	6.9	7.6	8.1	8.9	9.4	9.4	9.9	10.0	10.1	10.2	9.8	9.8	
Total Production ..	52.3	49.2	45.7	43.1	42.8	44.6	43.9	46.0	45.6	47.1	47.6	48.1	49.6	50.9	
Net CPE Exports	1.1	1.2	1.5	1.7	1.8	2.1	1.8	1.7	1.6	1.5	1.4	1.4	0.9	0.5	
Stock Withdrawals and Discrepancies ...	-1.0	-0.9	0.4	1.6	1.1	0.0	0.8	-0.2	1.0	-0.1	-0.1	-0.1	-0.1	-0.1	

^aGeographic coverage is the 50 States and the District of Columbia. United States 1985 amounts are actual.

^bIncludes Australia, New Zealand, and the U.S. Territories.

CPE=centrally planned economies.

OECD=Organization for Economic Cooperation and Development.

OPEC=Organization of Petroleum Exporting Countries.

Notes: o Numbers may not add to totals because of independent rounding. o Production includes crude oil, natural gas liquids, refinery gains, hydrogen, and other hydrocarbons.

Sources: o History: Energy Information Administration, Monthly Energy Review, DOE/EIA-035(86/07) and International Energy Annual 1985, DOE/EIA-0219 (Washington, DC, 1986); Organization for Economic Cooperation and Development/International Energy Agency, Quarterly Oil Statistics, Fourth Quarter 1985 (Paris, France, 1986); Petroleum Economics Limited, Quarterly Supply/Demand Outlook (London, England, 1986). o Projections: Energy Information Administration, Office of Energy Markets and End Use.

Appendix B

Energy Consumption Projections

Table B1. Energy Consumption in the Market Economies, 1984-2000
(Quadrillion Btu)

Country/Region	History		Projections					
	1984	1985	1990		1995		2000	
	Actual	Preliminary	Base	Range	Base	Range	Base	Range
United States ^a	74.1	73.9	78.6	78.5- 80.3	83.1	82.2- 85.6	87.3	83.5- 90.5
Canada	9.2	9.6	10.7	10.5- 10.9	11.3	11.0- 11.7	11.9	11.4- 12.4
Japan	15.6	15.7	17.3	16.9- 17.7	18.7	18.1- 19.4	20.1	19.2- 21.0
OECD Europe	52.3	53.7	59.1	57.9- 60.5	62.9	60.9- 65.2	66.3	63.5- 69.3
United Kingdom	7.9	8.6	9.4	9.3- 9.7	10.0	9.6- 10.3	10.5	10.0- 10.9
France	8.1	8.2	9.1	8.9- 9.3	9.7	9.4- 10.1	10.2	9.8- 10.7
West Germany	11.4	11.8	13.1	12.9- 13.4	13.8	13.3- 14.3	14.3	13.7- 14.9
Italy	5.9	6.0	6.8	6.6- 6.9	7.3	7.1- 7.7	7.9	7.5- 8.3
Netherlands	2.9	3.0	3.2	3.2- 3.3	3.4	3.3- 3.5	3.6	3.4- 3.7
Other Europe	16.0	16.0	17.5	17.1- 17.9	18.7	18.1- 19.4	19.9	19.1- 20.8
Other OECD	4.0	4.1	4.5	4.4- 4.8	4.9	4.8- 5.2	5.2	5.0- 5.6
Total OECD	155.2	157.1	170.2	168.4-173.8	181.0	178.1-186.5	190.8	186.3-197.7
OPEC	11.0	10.9	12.2	11.9- 12.4	14.7	14.0- 15.4	17.8	16.5- 19.2
Other Developing Countries	35.6	36.8	42.7	41.7- 43.9	49.1	47.0- 51.5	56.3	52.8- 60.0
Total Market Economies ..	202	205	225	222-230	245	239-253	265	256-276

^aGeographic coverage is the 50 States and the District of Columbia. United States 1985 amount is actual. U.S. Territories are included in "Other OECD."

OECD=Organization for Economic Cooperation and Development.

OPEC=Organization of Petroleum Exporting Countries.

Notes: o Numbers may not add to totals because of independent rounding. o All uncertainty ranges are derived independently and do not necessarily add to totals.

Sources: o History: Energy Information Administration, International Energy Annual 1985, DOE/EIA-0219(85) and Monthly Energy Review, DOE/EIA-0035(86/09) (Washington, DC, 1986). o Projections: Energy Information Administration, Office of Energy Markets and End Use.

Table B2. Oil Consumption in the Market Economies, 1984-2000
(Million Barrels per Day)

Country/Region	History		Projections					
	1984	1985	1990		1995		2000	
	Actual	Preliminary	Base	Range	Base	Range	Base	Range
United States ^a	15.7	15.7	16.1	15.5-17.1	16.5	15.5-17.5	17.4	16.3-18.7
Canada	1.5	1.5	1.6	1.6- 1.8	1.7	1.5- 1.9	1.6	1.4- 1.8
Japan	4.6	4.3	4.6	4.5- 4.8	4.6	4.4- 5.0	4.6	4.2- 5.0
OECD Europe	11.8	11.7	12.6	12.0-13.4	12.6	11.5-13.9	11.8	10.5-13.4
United Kingdom	1.8	1.6	1.7	1.7- 1.9	1.7	1.6- 1.9	1.6	1.5- 1.8
France	1.9	1.8	2.0	1.9- 2.1	2.0	1.8- 2.2	1.9	1.7- 2.1
West Germany	2.3	2.4	2.5	2.4- 2.7	2.5	2.3- 2.8	2.4	2.1- 2.7
Italy	1.6	1.7	1.8	1.7- 1.9	1.8	1.7- 2.0	1.7	1.5- 1.9
Netherlands	0.6	0.6	0.7	0.6- 0.7	0.7	0.6- 0.7	0.6	0.6- 0.7
Other Europe	3.6	3.6	3.9	3.7- 4.1	3.9	3.6- 4.3	3.6	3.3- 4.1
Other OECD	1.0	1.1	1.2	1.1- 1.2	1.1	1.0- 1.2	1.1	0.9- 1.2
Total OECD	34.7	34.3	36.1	34.7-38.2	36.5	34.1-39.4	36.5	33.5-39.9
OPEC	3.4	3.4	3.7	3.6- 3.7	4.2	4.0- 4.4	4.8	4.4- 5.2
Other Developing Countries	8.7	8.8	9.6	9.3-10.1	9.8	9.3-10.5	10.0	9.3-10.8
Total Market Economies ..	46.7	46.4	49.4	47.6-52.1	50.4	47.4-54.0	51.3	47.4-55.5

^aGeographic coverage is the 50 States and the District of Columbia. United States 1985 amount is actual. U.S. Territories are included in "Other OECD."

OECD=Organization for Economic Cooperation and Development.

OPEC=Organization of Petroleum Exporting Countries.

Notes: o Numbers may not add to totals because of independent rounding. o All uncertainty ranges are derived independently and do not necessarily add to totals.

Sources: o History: Energy Information Administration, International Energy Annual 1985, DOE/EIA-0219(85) and Monthly Energy Review, DOE/EIA-0035(86/09) (Washington, DC, 1986). o Projections: Energy Information Administration, Office of Energy Markets and End Use.

Table B3. Coal Consumption in the Market Economies, 1984-2000
(Million Short Tons)

Country/Region	History		Projections					
	1984	1985	1990		1995		2000	
	Actual	Preliminary	Base	Range	Base	Range	Base	Range
United States ^a	791	818	888	881-894	1,021	1,011-1,032	1,105	1,086-1,126
Canada	60	54	65	62-73	71	66-90	71	66-95
Japan	113	120	131	127-135	151	137-158	179	155-195
OECD Europe	539	575	612	577-655	673	611-748	751	664-875
United Kingdom	63	111	113	111-115	122	118-131	126	122-144
France	51	47	45	33-68	43	30-79	41	27-97
West Germany	226	205	244	237-266	256	248-286	276	266-318
Italy	24	26	40	36-43	53	46-61	67	59-81
Netherlands	12	11	12	12-14	13	13-18	15	14-23
Other Europe	163	175	158	148-166	187	161-205	224	185-256
Other OECD	62	51	67	59-83	82	74-100	89	80-112
Total OECD	1,564	1,618	1,763	1,733-1,827	1,997	1,930-2,106	2,196	2,097-2,364
OPEC	3	3	7	6-7	12	12-13	19	18-21
Other Developing Countries	461	462	528	522-581	628	614-755	735	704-942
Total Market Economies ..	2,028	2,083	2,298	2,265-2,410	2,638	2,561-2,866	2,950	2,824-3,307

^aGeographic coverage is the 50 States and the District of Columbia. United States 1985 amount is actual. U.S. Territories are included in "Other OECD."

OECD=Organization for Economic Cooperation and Development.

OPEC=Organization of Petroleum Exporting Countries.

Notes: o Numbers may not add to totals because of independent rounding. o All uncertainty ranges are derived independently and do not necessarily add to totals.

Sources: o History: Energy Information Administration, International Energy Annual 1985, DOE/EIA-0219(85) and Monthly Energy Review, DOE/EIA-0035(86/09) (Washington, DC, 1986). o Projections: Energy Information Administration, Office of Energy Markets and End Use.

Table B4. Natural Gas Consumption in the Market Economies, 1984-2000
(Trillion Cubic Feet)

Country/Region	History		Projections					
	1984	1985	1990		1995		2000	
	Actual	Preliminary	Base	Range	Base	Range	Base	Range
United States ^a	18.0	17.3	17.5	17.0-17.7	18.0	18.0-18.2	17.9	17.8-18.2
Canada	1.9	2.1	2.3	2.1- 2.5	2.7	2.2- 2.9	2.8	2.3- 3.1
Japan	1.4	1.5	1.7	1.6- 1.8	2.0	1.8- 2.1	2.3	1.9- 2.5
OECD Europe	8.2	8.5	8.9	8.3- 9.5	9.9	8.6-10.7	11.3	9.2-12.5
United Kingdom	1.9	2.0	2.1	2.0- 2.2	2.4	2.2- 2.5	2.8	2.4- 3.0
France	1.0	1.1	0.5	0.1- 0.9	0.7	0.4- 1.0	1.0	0.5- 1.3
West Germany	2.0	2.0	2.6	2.2- 2.7	2.9	2.4- 3.1	3.3	2.6- 3.5
Italy	1.2	1.2	1.3	1.2- 1.3	1.4	1.3- 1.5	1.6	1.4- 1.7
Netherlands	1.4	1.5	1.6	1.5- 1.6	1.7	1.6- 1.8	1.9	1.7- 2.0
Other Europe	0.8	0.7	0.7	0.6- 0.8	0.7	0.7- 0.9	0.8	0.7- 0.9
Other OECD	0.5	0.6	0.6	0.6- 0.7	0.8	0.7- 0.9	0.9	0.7- 1.1
Total OECD	29.9	29.9	31.0	29.9-32.0	33.4	31.6-34.6	35.2	32.3-36.9
OPEC	3.0	2.9	3.4	2.7- 4.1	4.5	3.7- 5.5	5.9	4.8- 7.3
Other Developing Countries	3.6	4.3	6.2	4.7- 6.6	9.3	6.1- 9.8	12.5	7.5-13.4
Total Market Economies ..	36.5	37.1	40.6	38.8-41.9	47.2	43.0-49.1	53.6	46.6-56.6

^aGeographic coverage is the 50 States and the District of Columbia. United States 1985 amount is actual. U.S. Territories are included in "Other OECD."

OECD=Organization for Economic Cooperation and Development.

OPEC=Organization of Petroleum Exporting Countries.

Notes: o Numbers may not add to totals because of independent rounding. o All uncertainty ranges are derived independently and do not necessarily add to totals.

Sources: o History: Energy Information Administration, International Energy Annual 1985, DOE/EIA-0219(85) and Monthly Energy Review, DOE/EIA-0035(86/09) (Washington, DC, 1986). o Projections: Energy Information Administration, Office of Energy Markets and End Use.

Table B5. Nuclear Consumption in the Market Economies, 1984-2000
(Terrawatt Hours)

Country/Region	History		Projections					
	1984	1985	1990		1995		2000	
	Actual	Preliminary	Base	Range	Base	Range	Base	Range
United States ^a	328	384	547	547-548	586	586-586	615	615-615
Canada	51	60	87	76-87	87	87- 98	102	95-123
Japan	121	144	174	165-187	212	199-259	238	204-314
OECD Europe	461	554	706	663-740	799	758-865	926	824-1069
United Kingdom	51	57	87	79-87	87	86- 87	103	87-110
France	152	184	283	260-291	328	312-365	376	346-449
West Germany	91	122	121	121-141	141	141-141	153	143-161
Italy	15	14	16	16-21	28	16- 28	40	25-44
Netherlands	6	6	5	5-5	5	5- 9	10	9-18
Other Europe	147	171	194	183-194	210	198-235	244	214-287
Other OECD	0	0	0	0-0	0	0-0	0	0-0
Total OECD	961	1141	1513	1452-1560	1684	1630-1808	1881	1738-2121
OPEC	0	0	0	0-0	0	0-0	0	0-0
Other Developing Countries	49	62	104	99-109	135	107-159	191	156-271
Total Market Economies	1009	1203	1618	1551-1670	1819	1736-1966	2072	1895-2392

^a Geographic coverage is the 50 States and the District of Columbia. United States 1985 amount is actual. U.S. Territories are included in "Other OECD."

OECD=Organization for Economic Cooperation and Development.

OPEC=Organization of Petroleum Exporting Countries.

Notes: o Numbers may not add to totals because of independent rounding. o All uncertainty ranges are derived independently and do not necessarily add to totals.

Sources: o History: Energy Information Administration, International Energy Annual 1985, DOE/EIA-0219(85) and Monthly Energy Review, DOE/EIA-0035(86/09) (Washington, DC, 1986). o Projections: Energy Information Administration, Office of Energy Markets and End Use.

Table B6. Consumption of Other Energy Sources in the Market Economies, 1984-2000
(Quadrillion Btu)

Country/Region	Actual	Preliminary	Base		
	1984	1985	1990	1995	2000
United States ^a	3.9	3.5	3.7	3.8	3.9
Canada	2.5	2.7	2.7	2.8	3.2
Japan	0.8	0.9	1.1	1.2	1.4
OECD Europe	4.7	4.7	5.3	5.9	6.6
United Kingdom	0.1	0.1	0.1	0.1	0.2
France	0.7	0.7	0.7	0.7	0.7
West Germany	0.2	0.2	0.2	0.2	0.2
Italy	0.5	0.5	0.5	0.5	0.6
Netherlands	0.0	0.0	0.0	0.0	0.0
Other Europe	3.2	3.3	3.8	4.4	5.0
Other OECD	0.4	0.4	0.4	0.5	0.5
Total OECD	12.3	12.2	13.2	14.3	15.6
OPEC	0.3	0.4	0.5	0.6	0.8
Other Developing Countries	4.3	4.4	5.0	5.8	6.7
Total Market Economies	16.9	17.0	18.6	20.7	23.1

^aGeographic coverage is the 50 States and the District of Columbia. United States 1985 amount is actual. U.S. Territories are included in "Other OECD."

OECD=Organization for Economic Cooperation and Development.

OPEC=Organization of Petroleum Exporting Countries.

Notes: o Other energy sources include hydroelectric, geothermal, and other renewables.
o Numbers may not add to totals because of independent rounding.

Sources: o History: Energy Information Administration, International Energy Annual 1985, DOE/EIA-0219(85) and Monthly Energy Review, DOE/EIA-0035(86/09) (Washington, DC, 1986).

o Projections: Energy Information Administration, Office of Energy Markets and End Use.

Appendix C

**Organization for
Economic
Cooperation and
Development
Members Energy
Demand by Sector**

Table C1. Consumption by Major Fuels and End-Use Sectors: United States
(Quadrillion Btu)

Sector and Fuel	1985	1990		1995		2000	
		Base	Range	Base	Range	Base	Range
Industrial							
Petroleum	7.7	8.1	7.8- 8.5	8.2	7.9- 8.6	8.5	8.2- 8.9
Natural Gas	7.1	7.2	7.0- 7.3	6.9	6.8- 7.0	6.7	6.6- 6.9
Coal	2.8	2.9	2.8- 3.0	2.9	2.8- 3.0	3.1	2.9- 3.2
Electricity	9.4	10.6	10.6-10.6	12.5	12.5-12.5	13.6	13.6-13.6
Total	27.0	28.8	28.4-29.2	30.5	30.5-31.1	31.9	30.9-32.4
Transportation							
Petroleum	19.5	20.2	19.3-21.1	19.8	18.8-20.9	20.5	19.2-21.7
Natural Gas	0.5	0.5	0.5- 0.5	0.5	0.5- 0.5	0.5	0.5- 0.5
Coal	0.0	0.0	0.0- 0.0	0.0	0.0- 0.0	0.0	0.0- 0.0
Electricity	0.0	0.0	0.0- 0.0	0.0	0.0- 0.0	0.0	0.0- 0.0
Total	20.1	20.7	20.3-21.4	20.3	19.6-21.4	21.0	19.4-22.1
Residential/Commercial							
Petroleum	2.6	2.8	2.7- 2.9	2.7	2.5- 2.9	2.5	2.3- 2.6
Natural Gas	7.1	7.4	7.4- 7.5	7.5	7.4- 7.5	7.3	7.1- 7.6
Coal	0.2	0.2	0.2- 0.2	0.2	0.2- 0.2	0.2	0.2- 0.2
Electricity	17.0	18.8	18.8-18.8	21.8	21.8-21.8	24.5	24.5-24.5
Total	26.8	29.2	29.1-29.9	32.2	32.0-32.4	34.5	33.6-34.7
Electric Utilities							
Petroleum	1.1	0.8	0.6- 1.3	1.9	1.4- 2.4	3.2	2.8- 4.3
Natural Gas	3.2	3.0	2.7- 3.1	3.7	3.6- 3.8	4.0	3.6- 4.2
Coal	14.5	16.0	15.9-16.1	18.6	18.5-18.7	20.3	20.0-20.6
Nuclear/Other ^a	7.7	9.6	9.6- 9.7	10.2	10.2-10.2	10.6	10.6-10.6
Total	26.5	29.4	28.8-30.2	34.4	33.7-35.1	38.1	37.0-39.7
Primary Energy Consumption							
Petroleum	30.9	31.8	30.4-33.8	32.6	30.7-34.8	34.7	32.5-37.6
Natural Gas	17.9	18.1	17.6-18.3	18.6	18.6-18.7	18.5	18.4-18.8
Coal	17.5	19.1	18.9-19.2	21.7	21.5-21.9	23.6	23.1-24.0
Nuclear/Other ^a	7.7	9.6	9.6- 9.7	10.2	10.2-10.2	10.6	10.6-10.6
Total	73.9	78.6	78.5-80.3	83.1	82.2-85.6	87.3	83.5-90.5

^a Includes hydroelectric, geothermal, and other renewables.

Note: o Geographic coverage is the 50 States and the District of Columbia. Numbers may not add to totals because of independent rounding. All uncertainty ranges are derived independently and do not necessarily add to totals.

Sources: o History: Energy Information Administration, Monthly Energy Review, DOE/EIA-0035(86/11) (Washington, DC, 1987). o Projections: Energy Information Administration, Office of Energy Markets and End Use.

Table C4. Consumption by Major Fuels and End-Use Sectors: OECD Europe
(Quadrillion Btu)

Sector and Fuel	Estimate	1990		1995		2000	
	1985	Base	Range	Base	Range	Base	Range
Industrial							
Petroleum	7.4	8.0	7.7- 8.6	8.1	7.4- 9.1	7.5	6.7- 8.5
Natural Gas	3.3	3.4	3.1- 3.6	3.7	3.2- 4.0	4.3	3.4- 4.6
Coal	3.3	3.6	3.4- 4.2	3.8	3.3- 4.9	3.9	3.1- 5.7
Electricity	10.2	11.5	11.2-11.7	12.9	12.3-13.5	14.5	13.6-15.4
Total	24.2	26.6	26.2-27.2	28.6	27.6-29.9	30.2	29.0-32.0
Transportation							
Petroleum	9.8	10.9	10.4-11.7	10.7	9.9-12.0	10.2	9.1-11.7
Natural Gas	0.0	0.0	0.0- 0.0	0.0	0.0- 0.0	0.0	0.0- 0.0
Coal	0.0	0.0	0.0- 0.0	0.0	0.0- 0.0	0.0	0.0- 0.0
Electricity	0.5	0.5	0.5- 0.6	0.6	0.6- 0.6	0.7	0.6- 0.7
Total	10.3	11.5	11.3-11.8	11.4	11.0-12.0	10.9	10.5-11.7
Residential/Commercial							
Petroleum	4.7	5.0	4.8- 5.4	5.0	4.6- 5.6	5.0	4.5- 5.7
Natural Gas	3.9	4.0	3.7- 4.3	4.6	3.9- 4.9	5.2	4.2- 5.7
Coal	0.9	0.9	0.8- 1.0	0.8	0.7- 1.1	0.7	0.6- 1.0
Electricity	9.8	11.1	10.8-11.4	12.5	12.0-13.1	14.2	13.2-15.1
Total	19.3	21.0	20.8-21.3	22.9	22.3-23.4	25.1	24.2-25.6
Electric Utilities							
Petroleum	2.3	2.1	2.0- 2.2	2.1	1.9- 2.3	1.7	1.4- 1.9
Natural Gas	1.2	1.3	1.3- 1.4	1.5	1.3- 1.7	1.7	1.4- 2.0
Coal	6.5	6.9	6.5- 7.4	8.0	7.0- 8.8	9.5	7.7-11.2
Nuclear/Other ^a	10.5	12.8	12.4-13.3	14.5	14.0-15.2	16.5	15.4-18.0
Total	20.5	23.1	22.2-24.3	26.1	24.2-28.0	29.4	25.9-33.1
Primary Energy Consumption							
Petroleum	24.2	26.1	24.9-27.8	26.0	23.9-28.8	24.4	21.8-27.7
Natural Gas	8.4	8.7	8.1- 9.3	9.8	8.5-10.5	11.2	9.1-12.2
Coal	10.7	11.4	10.8-12.3	12.6	11.5-14.1	14.1	12.4-16.6
Nuclear/Other ^a	10.5	12.8	12.4-13.3	14.5	14.0-15.2	16.5	15.4-18.0
Total	53.7	59.1	57.9-60.5	62.9	60.9-65.2	66.2	63.5-69.3

^a Includes hydroelectric, geothermal, and other renewables.

OECD = Organization for Economic Cooperation and Development.

Note: Numbers may not add to totals because of independent rounding. All uncertainty ranges are derived independently and do not necessarily add to totals.

Source: Energy Information Administration, Office of Energy Markets and End Use.

Table C5. Consumption by Major Fuels and End-Use Sectors: Other OECD
(Quadrillion Btu)

Sector and Fuel	Estimate	1990		1995		2000	
	1985	Base	Range	Base	Range	Base	Range
Industrial							
Petroleum	0.5	0.5	0.5- 0.6	0.5	0.4- 0.5	0.5	0.4- 0.5
Natural Gas	0.6	0.7	0.6- 0.7	0.8	0.7- 0.9	1.0	0.8- 1.1
Coal	0.1	0.0	0.0- 0.0	0.0	0.0- 0.0	0.0	0.0- 0.3
Electricity	0.8	0.9	0.9- 0.9	1.0	1.0- 1.1	1.1	1.1- 1.2
Total	2.0	2.1	2.1- 2.2	2.3	2.3- 2.4	2.5	2.5- 2.9
Transportation							
Petroleum	1.3	1.4	1.3- 1.4	1.4	1.2- 1.5	1.4	1.2- 1.5
Natural Gas	0.0	0.0	0.0- 0.0	0.0	0.0- 0.0	0.0	0.0- 0.0
Coal	0.0	0.0	0.0- 0.0	0.0	0.0- 0.0	0.0	0.0- 0.0
Electricity	0.0	0.0	0.0- 0.0	0.0	0.0- 0.0	0.0	0.0- 0.0
Total	1.3	1.4	1.3- 1.4	1.4	1.4- 1.5	1.4	1.3- 1.5
Residential/Commercial							
Petroleum	0.0	0.0	0.0- 0.0	0.0	0.0- 0.0	0.0	0.0- 0.0
Natural Gas	0.0	0.0	0.0- 0.0	0.0	0.0- 0.0	0.0	0.0- 0.0
Coal	0.0	0.0	0.0- 0.0	0.0	0.0- 0.0	0.0	0.0- 0.0
Electricity	0.9	1.0	1.0- 1.0	1.1	1.1- 1.2	1.3	1.2- 1.4
Total	0.9	1.0	1.0- 1.0	1.1	1.2- 1.2	1.3	1.3- 1.4
Electric Utilities							
Petroleum	0.3	0.3	0.3- 0.4	0.3	0.3- 0.4	0.3	0.3- 0.4
Natural Gas	0.0	0.0	0.0- 0.0	0.0	0.0- 0.0	0.0	0.0- 0.0
Coal	1.0	1.1	1.0- 1.4	1.4	1.2- 1.7	1.6	1.4- 1.7
Nuclear/Other ^a	0.4	0.4	0.4- 0.4	0.5	0.5- 0.5	0.5	0.5- 0.5
Total	1.7	1.8	1.7- 2.2	2.2	2.0- 2.6	2.4	2.2- 2.6
Primary Energy Consumption							
Petroleum	2.1	2.3	2.1- 2.3	2.2	2.0- 2.3	2.2	1.9- 2.3
Natural Gas	0.6	0.7	0.6- 0.7	0.8	0.7- 0.9	1.0	0.8- 1.1
Coal	1.0	1.1	1.0- 1.4	1.4	1.2- 1.7	1.5	1.4- 1.9
Nuclear/Other ^a	0.4	0.4	0.4- 0.4	0.5	0.5- 0.5	0.5	0.5- 0.5
Total	4.1	4.5	4.4- 4.8	4.9	4.8- 5.2	5.2	5.0- 5.6

^a Includes hydroelectric, geothermal, and other renewables.

OECD= Organization for Economic Cooperation and Development.

Note: "Other OECD" includes Australia, New Zealand, and the U.S. Territories. Numbers may not add to totals because of independent rounding. All uncertainty ranges are derived independently and do not necessarily add to totals.

Source: Energy Information Administration, Office of Energy Markets and End Use.

Table C6. Consumption by Major Fuels and End-Use Sectors: Total OECD
(Quadrillion Btu)

Sector and Fuel	Estimate 1985	1990		1995		2000	
		Base	Range	Base	Range	Base	Range
Industrial							
Petroleum	19.7	21.0	20.2-22.2	21.2	19.8-22.8	20.8	19.1- 22.4
Natural Gas	12.2	12.5	12.0-12.9	12.6	11.7-13.1	13.2	11.8- 13.8
Coal	8.6	8.9	8.5- 9.7	9.2	8.3-10.8	9.4	8.2- 11.7
Electricity	26.5	29.7	29.3-30.2	34.2	33.3-35.1	38.1	36.6- 39.8
Total	67.0	72.2	71.8-73.5	77.2	75.9-79.6	81.5	79.7- 84.5
Transportation							
Petroleum	34.6	36.9	35.2-38.7	36.5	34.1-39.0	36.5	33.3- 39.2
Natural Gas	0.5	0.5	0.5- 0.5	0.5	0.5- 0.5	0.5	0.5- 0.5
Coal	0.0	0.0	0.0- 0.0	0.0	0.0- 0.0	0.0	0.0- 0.0
Electricity	0.7	0.8	0.8- 0.8	0.9	0.8- 0.9	1.0	0.9- 1.0
Total	35.8	38.2	37.5-39.3	37.8	36.8-39.5	38.0	36.5- 39.3
Residential/Commercial							
Petroleum	9.0	9.6	9.3-10.2	9.7	8.9-10.6	9.5	8.6- 10.4
Natural Gas	12.2	12.9	12.6-13.3	13.6	12.7-14.0	14.1	12.5- 14.8
Coal	1.1	1.1	1.1- 1.2	1.0	0.9- 1.3	0.9	0.8- 1.2
Electricity	32.3	36.2	35.8-36.6	41.5	40.6-42.4	46.8	45.3- 48.3
Total	54.6	59.8	59.0-60.0	65.8	65.6-66.3	71.2	70.8- 71.7
Electric Utilities							
Petroleum	5.7	5.3	4.9- 6.0	6.3	5.4- 7.1	7.1	6.2- 8.6
Natural Gas	5.7	5.7	5.3- 6.0	7.3	6.8- 7.8	8.1	7.0- 8.9
Coal	23.7	26.1	25.6-26.9	30.6	29.5-31.8	34.7	32.8- 36.8
Nuclear/Other ^a	24.4	29.6	28.9-30.2	32.4	31.9-33.9	35.9	34.4- 38.5
Total	59.5	66.7	64.7-69.1	76.6	73.6-80.6	85.8	80.4- 92.8
Primary Energy Consumption							
Petroleum	69.0	72.9	69.7-77.0	73.6	68.5-79.3	73.9	67.4- 80.4
Natural Gas	30.5	31.7	30.4-32.6	34.0	32.1-35.2	35.9	32.8- 37.5
Coal	33.3	36.2	35.4-37.3	40.8	39.4-43.0	45.0	42.8- 48.3
Nuclear/Other ^a	24.4	29.6	28.9-30.2	32.4	31.9-33.9	35.9	34.4- 38.5
Total	157.1	170.3	168.4-173.8	180.8	178.1-186.5	190.7	186.3-197.7

^a Includes hydroelectric, geothermal, and other renewables.

OECD= Organization for Economic Cooperation and Development.

Note: Numbers may not add to totals because of independent rounding. All uncertainty ranges are derived independently and do not necessarily add to totals.

Source: Energy Information Administration, Office of Energy Markets and End Use.

Appendix D

International Energy Production Data

Table D1. International Production of Crude Oil, 1970-1985
(Million Barrels per Day)

Organization of Petroleum Exporting Countries (OPEC)																
Year	Indonesia	Iran	Nigeria	Saudi Arabia ¹	Venezuela	Other OPEC	Total OPEC	Canada	China	Mexico	United Kingdom	United States	U.S.S.R.	Other Non-OPEC	Total World	Non-Communist World
1970	0.85	3.83	1.08	3.80	3.71	10.14	23.41	1.26	0.60	0.49	(2)	9.64	6.97	2.92	45.29	37.36
1971	0.89	4.54	1.53	4.77	3.55	10.05	25.33	1.35	0.78	0.49	(2)	9.46	7.44	2.99	47.84	39.29
1972	1.08	5.02	1.82	6.02	3.22	9.93	27.09	1.53	0.90	0.51	(2)	9.44	7.88	2.91	50.26	41.31
1973	1.34	5.86	2.05	7.60	3.37	10.77	30.99	1.80	1.09	0.47	(2)	9.21	8.33	3.68	55.57	45.69
1974	1.38	6.02	2.26	8.48	2.98	9.61	30.73	1.68	1.32	0.57	(2)	8.77	8.86	3.84	55.77	45.13
1975	1.31	5.35	1.78	7.08	2.35	9.29	27.16	1.44	1.49	0.71	0.01	8.37	9.47	4.10	52.76	41.33
1976	1.50	5.88	2.07	8.58	2.29	10.42	30.74	1.30	1.67	0.83	0.25	8.13	9.99	4.28	57.19	45.06
1977	1.69	5.66	2.09	9.25	2.24	10.37	31.30	1.32	1.87	0.98	0.77	8.24	10.49	4.54	59.52	46.68
1978	1.64	5.24	1.90	8.30	2.17	10.56	29.81	1.31	2.08	1.21	1.08	8.71	10.95	4.72	59.87	46.36
1979	1.59	3.17	2.30	9.53	2.36	11.98	30.93	1.50	2.12	1.46	1.57	8.55	11.19	5.03	62.35	48.60
1980	1.58	1.66	2.06	9.90	2.17	9.52	26.89	1.44	2.11	1.94	1.62	8.60	11.46	5.17	59.23	45.23
1981	1.61	1.38	1.43	9.82	2.10	6.31	22.65	1.29	2.01	2.31	1.81	8.57	11.55	5.36	55.55	41.55
1982	1.34	2.21	1.30	6.48	1.90	5.64	18.87	1.27	2.05	2.75	2.07	8.65	11.62	5.62	52.90	38.79
1983	1.34	2.44	1.24	5.09	1.80	5.67	17.58	1.36	2.12	2.69	2.29	8.69	11.68	6.24	52.65	38.39
1984	1.41	2.17	1.39	4.66	1.80	6.05	17.48	1.44	2.30	2.78	2.48	8.88	11.58	6.89	53.83	39.50
1985	1.26	2.20	1.47	3.39	1.67	6.08	16.07	1.47	2.48	2.74	2.53	8.97	11.25	7.44	52.95	38.75

¹ Saudi Arabia includes one-half of the production in the Partitioned Zone (formerly Neutral Zone).

² Less than 5,000 barrels per day.

Note: Amounts include lease condensate and exclude natural gas plant liquids.

Sources: Organization of Petroleum Exporting Countries, Annual Statistical Bulletin 1979 (Vienna, Austria); and Energy Information Administration, International Petroleum Annual 1978, DOE/EIA-0042 and International Energy Annual, DOE/EIA-0219, selected issues (Washington, DC)

Table D2. International Coal Production, 1973-1985
(Million Short Tons)

Region/Country	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
North, Central, and South America													
Canada	23	23	28	28	32	34	37	40	44	47	50	63	67
United States	599	610	655	685	697	670	781	830	824	838	782	896	884
Other	12	15	15	16	17	17	24	24	22	25	25	28	28
Total	634	648	697	729	746	721	842	894	890	910	857	987	979
Western Europe													
Germany, West	238	244	238	247	229	228	239	239	241	247	236	233	231
Spain	14	15	15	16	19	22	24	32	38	43	44	44	44
Turkey	12	11	12	11	13	15	22	18	19	24	32	38	35
United Kingdom	143	121	142	137	135	136	135	141	138	137	127	55	100
Yugoslavia	36	37	39	41	43	44	46	52	58	60	65	72	72
Other	65	60	63	66	67	64	63	61	67	66	67	68	70
Total	508	488	509	518	506	509	529	543	561	577	571	510	552
Eastern Europe and U.S.S.R.													
Bulgaria	30	27	31	28	28	28	31	33	32	35	36	36	36
Czechoslovakia	120	122	127	130	134	136	137	136	137	139	140	143	142
Germany, East	272	269	272	273	280	279	282	285	294	304	309	327	343
Poland	216	222	233	241	250	258	264	254	219	250	258	267	275
U.S.S.R.	736	755	773	784	796	798	792	790	776	792	789	785	798
Other	57	59	61	57	58	61	65	68	72	73	69	77	77
Total	1,431	1,454	1,494	1,513	1,546	1,560	1,571	1,566	1,529	1,593	1,601	1,635	1,671
Africa													
South Africa, Republic of	69	73	77	85	94	100	114	127	144	151	161	179	180
Other	6	5	6	6	6	6	7	6	5	6	6	5	5
Total	75	78	82	91	100	106	121	133	149	157	167	184	185
Middle East, Far East, and Oceania													
Australia	94	94	98	109	111	114	119	116	130	140	146	153	170
China	520	548	570	586	606	681	698	684	683	734	788	870	937
India	89	96	109	116	115	116	118	125	142	148	158	168	171
Other	97	98	105	101	103	104	108	112	114	116	113	117	123
Total	800	836	882	912	935	1,015	1,043	1,037	1,069	1,138	1,205	1,308	1,401
World Total	3,447	3,505	3,665	3,763	3,833	3,911	4,105	4,173	4,198	4,375	4,402	4,623	4,788

Note: Sum of components may not equal total because of independent rounding.

Source: Energy Information Administration, International Energy Annual, DOE/EIA-0219 and Monthly Energy Review, DOE/EIA-0384, selected issues (Washington, DC).

Table D3. International Production of Natural Gas (Dry), 1973-1985
(Trillion Cubic Feet)

Region/Country	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
North, Central, and South America													
Argentina	0.24	0.26	0.27	0.27	0.28	0.28	0.26	0.28	0.35	0.40	0.44	0.49	0.50
Canada	2.45	2.42	2.45	2.46	2.59	2.47	2.66	2.65	2.47	2.45	2.52	2.61	2.83
Mexico	0.50	0.52	0.52	0.51	0.54	0.67	0.81	1.01	1.03	1.11	1.10	1.04	1.05
United States	21.73	20.71	19.24	19.10	19.16	19.12	19.66	19.40	19.18	17.76	16.03	17.39	16.38
Venezuela	0.40	0.42	0.42	0.40	0.39	0.40	0.46	0.49	0.52	0.60	0.58	0.61	0.61
Other	0.51	0.35	0.30	0.33	0.40	0.53	0.61	0.53	0.44	0.43	0.47	0.61	0.63
Total	25.83	24.68	23.19	23.07	23.36	23.48	24.46	24.36	23.99	22.75	21.14	22.75	22.00
Western Europe													
Germany, West	0.71	0.73	0.67	0.68	0.68	0.72	0.73	0.67	0.68	0.59	0.62	0.66	0.61
Italy	0.54	0.54	0.52	0.55	0.48	0.48	0.46	0.42	0.49	0.51	0.46	0.49	0.48
Netherlands	2.50	2.87	3.21	3.50	2.93	2.50	2.72	3.38	3.15	2.67	2.58	2.65	2.84
Norway	0.00	0.00	0.01	0.01	0.09	0.39	0.76	0.88	0.89	0.90	0.86	0.93	0.94
United Kingdom	1.00	1.21	1.26	1.32	1.38	1.30	1.31	1.23	1.22	1.36	1.40	1.42	1.49
Other	0.40	0.41	0.40	0.40	0.45	0.38	0.41	0.44	0.40	0.41	0.42	0.44	0.42
Total	5.15	5.76	6.07	6.46	6.01	5.77	6.39	7.02	6.83	6.44	6.34	6.59	6.78
Eastern Europe and U.S.S.R.													
Romania	0.93	0.96	1.04	1.14	1.20	1.07	1.20	1.20	1.24	1.35	1.40	1.34	1.36
U.S.S.R.	8.35	9.20	10.22	11.33	12.22	13.14	14.36	15.37	16.43	17.68	18.93	20.74	22.71
Other	0.68	0.70	0.69	0.80	0.83	0.89	0.76	0.77	0.82	0.76	0.85	0.94	0.97
Total	9.96	10.86	11.95	13.27	14.25	15.10	16.32	17.34	18.49	19.79	21.18	23.02	25.04
Middle East and Africa													
Algeria	0.17	0.20	0.21	0.28	0.21	0.66	0.55	0.41	0.77	0.94	1.31	1.36	1.40
Iran	0.52	0.57	0.57	0.58	0.55	0.50	0.54	0.25	0.21	0.25	0.31	0.48	0.50
Other	0.61	0.58	0.82	0.84	1.01	1.14	1.45	1.36	1.76	1.28	1.33	1.60	1.70
Total	1.30	1.35	1.60	1.70	1.77	2.30	2.54	2.02	2.74	2.47	2.95	3.44	3.60
Far East and Oceania													
Australia	0.14	0.17	0.18	0.21	0.24	0.26	0.28	0.32	0.38	0.38	0.39	0.40	0.41
China	0.25	0.29	0.33	0.36	0.41	0.50	0.51	0.50	0.45	0.38	0.43	0.44	0.47
Brunei	0.07	0.15	0.19	0.25	0.29	0.30	0.29	0.32	0.34	0.32	0.33	0.30	0.30
Indonesia	0.03	0.04	0.08	0.13	0.20	0.20	0.39	0.63	0.66	0.67	0.78	1.06	1.20
Pakistan	0.13	0.15	0.16	0.16	0.18	0.19	0.23	0.29	0.32	0.35	0.34	0.35	0.35
Other	0.30	0.29	0.33	0.37	0.41	0.39	0.31	0.32	0.42	0.57	0.69	0.92	0.98
Total	0.92	1.09	1.27	1.48	1.73	1.84	2.01	2.38	2.57	2.67	2.96	3.47	3.71
World Total	43.15	43.74	44.10	45.98	47.14	48.50	51.73	53.11	54.62	54.12	54.57	59.27	61.12

Note: Sum of components may not equal total because of independent rounding.

Source: Energy Information Administration, International Energy Annual, DOE/EIA-0219 and Monthly Energy Review, DOE/EIA-0384, selected issues (Washington, DC).

Table D4. International Hydroelectric Power Generation, 1973-1985
(Billion Kilowatthours)

Region/Country	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
North, Central, and South America													
Argentina	3	5	5	5	6	8	11	15	15	17	18	20	20
Brazil	58	66	74	82	94	103	115	127	130	140	150	164	170
Canada	193	211	202	213	220	234	243	251	263	255	263	283	301
Colombia	8	9	10	10	11	12	13	15	18	18	19	20	20
Mexico	16	17	15	17	19	16	18	17	25	23	21	24	25
United States	275	304	303	287	224	284	283	279	264	312	335	324	284
Venezuela	6	7	9	11	12	12	13	15	15	16	18	20	20
Other	17	19	20	21	21	23	25	28	29	31	33	33	35
Total	577	637	638	646	606	692	721	747	757	812	857	888	875
Western Europe													
Austria	19	22	24	20	25	25	28	29	31	31	30	29	32
Finland	10	13	12	9	12	10	11	10	13	13	13	13	12
France	48	57	60	49	76	69	67	69	73	71	71	67	64
Germany, West	15	18	17	14	17	18	18	21	20	19	19	18	17
Italy	39	39	42	41	53	47	48	49	45	44	44	45	44
Norway	72	76	77	81	72	80	88	83	92	92	105	105	102
Portugal	7	8	6	5	10	11	12	8	5	7	8	10	11
Spain	29	31	26	22	40	41	47	31	23	28	29	33	33
Sweden	59	57	57	54	53	57	60	59	60	55	64	67	70
Switzerland	29	29	34	27	36	33	32	34	36	37	36	31	33
Yugoslavia	16	21	19	20	24	25	26	28	25	23	22	25	26
Other	14	15	17	19	20	22	24	25	26	29	25	30	28
Total	358	384	391	362	437	436	461	444	450	449	466	473	472
Eastern Europe and U.S.S.R.													
Romania	8	8	9	8	9	11	11	13	13	12	10	11	11
U.S.S.R.	121	131	125	134	146	168	170	182	185	173	179	201	250
Other	9	11	11	11	13	13	13	15	14	13	14	14	14
Total	137	150	145	154	168	191	195	210	212	198	203	226	275
Middle East and Africa													
Egypt	5	6	7	8	9	9	9	10	10	10	10	10	11
Zambia	5	6	6	7	9	8	9	9	10	10	10	10	10
Other	27	29	30	34	37	39	46	50	43	42	41	36	35
Total	37	40	43	49	54	56	64	68	63	62	61	56	56

Table D4. (Continued)

Region/Country	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Far East and Oceania													
Australia	12	14	15	15	14	15	16	17	15	14	13	13	15
China	38	43	45	51	47	44	50	58	65	74	86	86	86
India	29	28	33	35	38	47	45	46	49	48	49	54	55
Japan	71	84	85	88	76	74	84	91	90	83	87	73	81
Korea, North	12	14	16	17	17	19	20	22	23	25	26	27	27
New Zealand	14	14	17	15	14	16	15	16	19	18	19	20	19
Other	16	17	19	21	20	21	27	28	28	30	32	39	42
Total	191	213	230	241	226	236	257	278	289	292	312	312	325
World Total	1,301	1,425	1,445	1,450	1,491	1,611	1,698	1,747	1,771	1,813	1,899	1,955	2,003

Note: Data include industrial and utility generation of hydroelectric power.

Note: Sum of components may not equal total because of independent rounding.

Source: Energy Information Administration, International Energy Annual, DOE/EIA-0219, selected issues (Washington, DC).

Table D5. International Net Nuclear Electric Power Production, 1973-1985
(Billion Kilowatthours)

Region/Country	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
North America													
Canada	17.4	14.6	12.6	17.1	25.4	31.3	36.5	38.4	41.1	40.4	50.4	51.1	59.7
United States	83.5	114.0	172.5	191.1	250.9	276.4	255.2	251.1	272.7	282.8	293.7	327.6	383.7
Total	100.8	128.6	185.1	208.2	276.3	307.7	291.6	289.5	313.8	323.2	344.1	378.7	443.4
Central and South America													
Argentina .....	.0	1.0	2.4	2.4	1.6	2.8	2.6	2.2	2.7	1.8	3.2	4.3	5.5
Brazil .....	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	.2	2.0	3.2
Total .....	.0	1.0	2.4	2.4	1.6	2.8	2.6	2.2	2.7	1.8	3.4	6.3	8.7
Western Europe													
Belgium .....	.0	.1	6.4	9.5	11.3	11.9	10.8	11.9	12.2	14.8	22.8	26.3	32.8
Finland .....	.0	.0	.0	.0	2.5	3.1	6.3	6.6	13.7	15.7	16.6	17.6	17.8
France	11.0	14.0	17.4	14.8	17.0	29.0	37.9	58.2	100.0	103.4	137.0	181.6	212.8
Germany, West	11.3	11.4	20.6	23.3	34.0	34.1	40.1	41.5	50.7	60.2	61.5	88.0	119.4
Italy	3.0	3.2	3.6	3.6	3.2	4.2	2.5	2.1	2.6	6.5	5.5	6.5	6.7
Netherlands	1.1	3.1	3.2	3.7	3.5	3.9	3.3	4.0	3.5	3.7	3.4	3.6	3.7
Spain	6.2	6.9	7.2	7.2	6.2	7.3	6.4	4.9	9.0	8.3	10.2	21.9	26.6
Sweden	2.0	1.6	11.4	15.2	18.9	22.6	20.0	25.4	35.8	36.8	38.5	48.7	55.7
Switzerland	5.9	6.7	7.3	7.5	7.7	7.9	11.3	13.6	14.4	14.2	14.8	15.5	21.3
United Kingdom	26.6	32.3	29.0	35.0	36.2	34.8	36.6	35.3	36.9	41.9	47.5	51.4	56.7
Yugoslavia .....	.0	.0	.0	.0	.0	.0	.0	.0	.3	2.4	3.7	4.2	3.8
Total	67.1	79.3	106.1	119.7	140.5	158.8	175.1	203.5	279.0	308.1	361.4	465.4	557.3
Eastern Europe and U.S.S.R.													
Bulgaria .....	.0	.9	2.4	4.7	5.6	5.6	5.9	5.9	8.7	10.2	11.7	12.1	11.3
Czechoslovakia .....	.2	.5	.2	.4	.1	.1	1.8	4.3	4.5	5.5	5.8	6.9	7.0
Germany, East .....	.3	2.1	2.6	5.0	4.9	6.3	9.3	11.3	11.3	10.3	11.6	12.2	12.3
Hungary .....	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	2.3	2.4	6.2
U.S.S.R.	11.1	17.1	19.2	23.8	32.3	42.5	52.1	69.3	64.6	76.0	104.3	134.9	140.0
Total	11.7	20.5	24.4	33.9	42.9	54.5	69.1	90.7	89.0	102.1	135.8	168.5	176.8
Middle East .....	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Africa													
South Africa .....	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	4.0	5.5
Total .....	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	4.0	5.5

Table D5. (Continued)

Region/Country	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Far East and Oceania													
India	1.8	2.4	2.4	3.0	2.6	2.2	3.0	2.7	2.9	2.0	2.7	3.9	4.3
Japan	9.0	17.2	21.1	35.0	26.7	50.5	58.9	78.7	79.3	99.3	103.6	120.8	144.4
Korea, South .....	.0	.0	.0	.0	.1	2.2	3.0	3.3	2.8	3.6	8.5	11.2	15.7
Pakistan .....	.4	.6	.5	.5	.3	.2	(*)	.1	.2	.1	.2	.3	.2
Taiwan .....	.0	.0	.0	.0	.1	2.5	6.0	7.8	10.1	12.4	18.0	23.1	27.3
Total	11.2	20.1	24.0	38.5	29.8	57.6	71.0	92.6	95.3	117.4	133.1	159.3	191.9
World Total	190.8	249.5	341.9	402.8	491.2	581.3	609.4	678.5	779.8	852.6	977.7	1,182.2	1,383.6

(*) Denotes less than 50 million kilowatthours.

Note: Figures are reported for net generation as opposed to gross. Net figures exclude the energy consumed by the generating plants.

Note: Sum of components may not equal total because of independent rounding.

Source: Energy Information Administration, International Energy Annual, DOE/EIA-0219, selected issues (Washington, DC).

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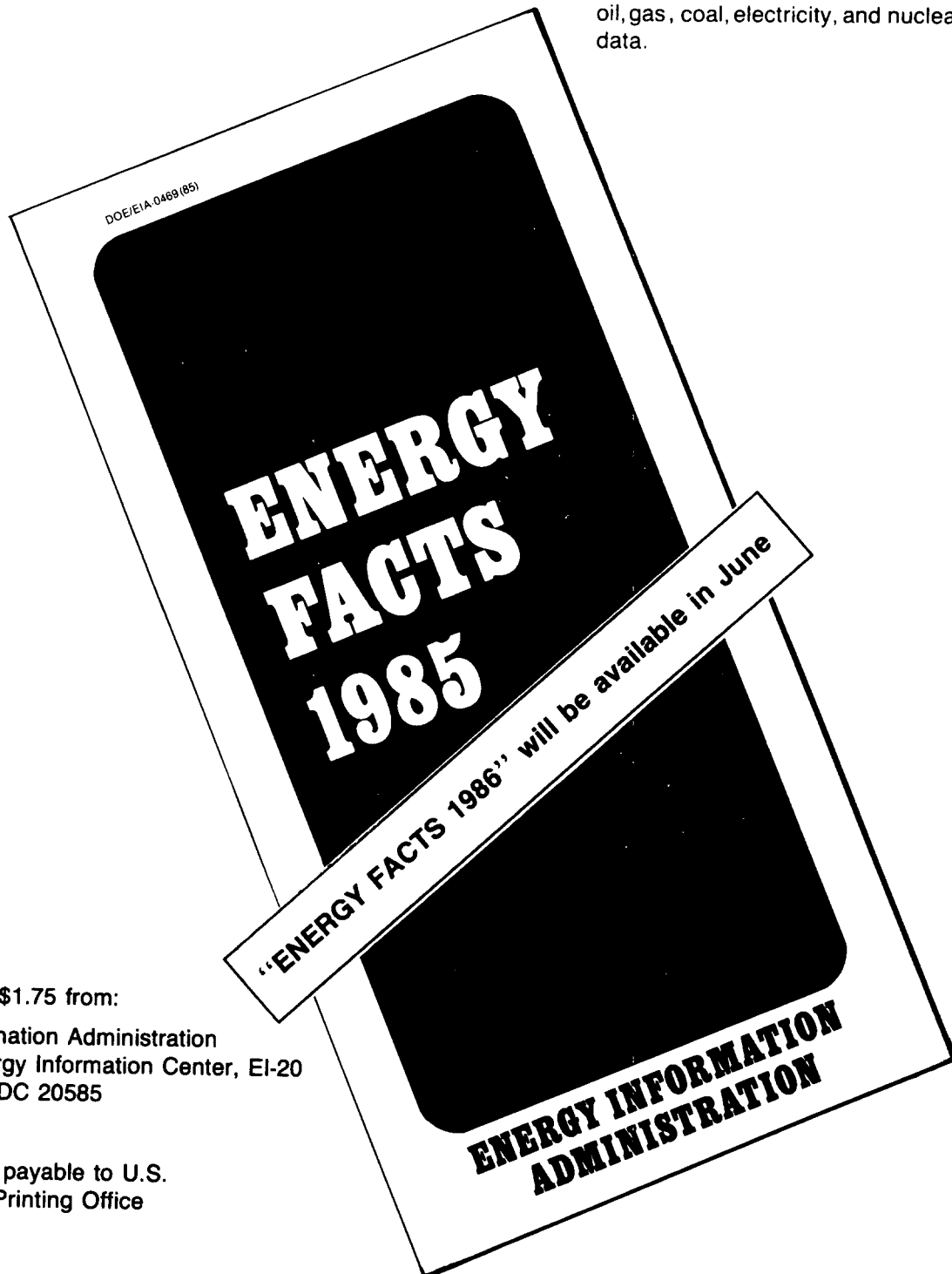
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