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ANNUAL ENERGY OUTLOOK

WITH PROJECTIONS TO 2010

ENERGY INFORMATION ADMINISTRATION

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Contacts

The *Annual Energy Outlook* is prepared by the Energy Information Administration (EIA), Office of Energy Markets and End Use (EMEU). General questions concerning the content of the report may be addressed to W. Calvin Kilgore (202/586-1617), Director of EMEU; or John D. Pearson (202/586-6160), Director of the Energy Analysis and Forecasting Division. The *Annual Energy Outlook 1991* was a joint effort of all program offices of the EIA and was coordinated by the following representatives of each office:

Office of Energy Markets and End Use	Edward Flynn (202/586-5748)
Office of Oil and Gas	Joan Heinkel (202/586-4680)
Office of Coal, Nuclear, Electric and Alternate Fuels	Robert Schnapp (202/254-5392)
Office of Statistical Standards	Douglas Hale (202/586-2315)

Detailed questions may be addressed to the following EIA analysts:

World Oil Prices	Mark Rodekohr (202/586-1130)
Economic Growth	Ronald Earley (202/586-1398)
Energy Demand	Edward Flynn (202/586-5748)
Domestic Crude Oil Supply	William Trapmann (202/586-6408)
Refined Petroleum Product Supply and Prices	Barry Yaffe (202/586-1142)
Natural Gas Supply and Prices	Joan Heinkel (202/586-4680)
Coal Supply and Prices	Scott Sitzer (202/254-5300)
Electricity Generation and Prices	Robert Eynon (202/254-5310)
Nuclear Energy	Betsy O'Brien (202/254-5490)
Renewable Energy	Suraj Kanhouwa (202/254-5504)

A brief description of the *Annual Energy Outlook 1991* Forecasting System and a list of key contacts for each subject area are contained in Appendix F of this report.

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Annual Energy Outlook 1991

With Projections to 2010

March 1991

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

Administrator's Message

Energy Past Perspectives and Present Projections

1990 was the year in which no one could ignore the question of energy. The year began with a crisis in heating fuel markets. The Nation began what became a short and successful war, not only to end aggression but to preserve the security of a large share of the world's most abundant reserves of oil. In addition, the Nation celebrated the 20th anniversary of the first Earth Day, and with it came a renewed interest in the relationship between the environment and energy. Landmark legislation was enacted in the Clean Air Act Amendments of 1990 (CAA). More recently, President Bush introduced the National Energy Strategy (NES) which was accompanied by the first comprehensive energy legislation to be advocated by the Chief Executive in over a decade. At least forty-one other energy-related bills have been introduced in Congress at the time this report was being written.

As the Nation heads into the last few years of this century, the controversies surrounding energy supply and demand are more likely to expand than to diminish. The Energy Information Administration (EIA) offers its *Annual Energy Outlook* (*AEO*) as a way of framing the discussion. Those familiar with past *Annual Energy Outlooks* know that it proceeds from a base case and then examines what the likely bounds are to be for future energy production and use under various assumptions about prices and economic conditions. The report always assumes that there will be no change in the legislative environment from what exists at the time the *AEO* was written. This is unrealistic, but to project political activity is even more risky than looking into the crystal ball regarding energy.

As the new Administrator of EIA, reflecting on the past year and on the content of this *AEO*, there are ten conclusions about the energy situation in the United States which strike me as reference points for the discussion in the years to come.

1. Over the past decade, the real price of oil has declined in virtually every year since 1981 with dramatic decreases in 1986 and 1988. When adjusted for inflation, the price of oil today (refiner acquisition cost of imported crude oil) would need to be almost $52 per barrel in 1990 dollars to be equal to its 1981 price. The results are not surprising. With the real price of oil declining, we have consumed more of it.

2. The decline in real oil prices has been a contributing factor to economic growth in the United States. The period 1982 to 1990 was the longest period of continuous economic growth that this Nation has ever experienced during peace time. While it is impossible to segregate a single factor which is responsible for that growth, it is certain that the falling real prices of oil and energy in general contributed to that expansion. With rising incomes, energy became less and less costly for virtually all Americans.

3. Despite comments to the contrary, the United States is not an energy wastrel. When energy consumption per dollar of GNP is used as a measure, our energy efficiency has increased in every year of this past decade. In July of 1990, EIA issued a service report entitled *Indicators of Energy Efficiency and International Comparison* and concluded that the United States energy use to Gross Domestic Product (GDP) ratio had declined by an average of 2 percent every year since 1970 which was as much or more than any of the other major industrialized nations. Even in the controversial area of new car fuel economy, figures for the United States were equal to that of the other industrialized nations of the world. This year's *AEO* indicates that growth and efficiency will continue without major legislative initiatives. New car efficiency will improve by 25 to 42 percent, and industrial efficiency by 23 to 27 percent with energy use in homes improving by 9 to 18 percent. The NES and several of the bills before Congress would accelerate these impressive figures.

4. Oil production in the United States will continue to decline, and foreign dependency will continue to grow. The report which follows indicates that domestic crude production will drop from 7.2

million barrels a day to between 3.4 and 5.2 million barrels a day by the year 2010. Imports will increase from 7.3 million barrels to between 10.8 and 17.7 million barrels, with net import dependency rising from 42 to between 57 and 74 percent. These figures tend to focus upon the issues of energy security, conservation, and the search for alternative fuels.

5. The vast majority of oil reserves in the world are located outside the United States and concentrated in the Middle East. Over 65 percent of the world's crude oil reserves are to be found in the Persian Gulf with Saudi Arabia possessing almost 40 percent of them. This gives Saudi Arabia the dominant role in the setting of world oil prices, a dominance it may choose to exercise with the other nations of OPEC or as a swing producer.

6. Oil as a source of energy in the United States, continues to become increasingly concentrated in the transportation section. Almost two-thirds of our oil is used in the transportation sector and ultimately over one-third in private cars. Any program that seeks to reduce foreign dependency must have impact in that area. A variety of policy alternatives will face decision makers ranging from CAFE standards to alternate fuels to mass transit and gasoline taxes.

7. Oil dependency is not the only energy issue facing this Nation. The pages of this year's *AEO* should serve to clarify thinking on this point. EIA's projection indicates that we will need between 177 and 322 gigawatts of new electric generating capacity during this period, most of which is not now planned. While it is true that conservation could reduce this demand, perhaps significantly, the electric utility industry, which faced the problem of excess capacity during the 1970's, will have to grapple with the reverse situation for the next 20 years. The issue of nuclear power, renewable sources, and clean coal technologies to fuel this increased demand will have to be faced.

8. Energy and environmental issues are becoming increasingly inseparable. The Clean Air Act Amendments of 1990 was significant not only because it reversed a decade of inattention but because it dramatized the trade-offs between energy and environmental policy. Standards for reformulated gasolines, emissions of noxious fumes by energy producers and standards for auto emissions in certain cities, are just some of the issues which it creates. This year's report has attempted to factor in the impact of the CAA on both energy supply and demand. The debate about greenhouse gases and global warming is not likely to disappear. As this issue is clarified, legislative directions may be given which could dramatically affect the patterns of energy production and use for the decades to come.

9. Our energy future is likely to be significantly different from our energy past, but the transition will be slow. This *Annual Energy Outlook* sees that energy use will grow by 0.9 to 1.5 percent a year, but more dramatic changes in the mix of fuels consumed can be expected. Renewable energy and coal will capture a growing share of our total energy consumption. Oil and natural gas consumption will rise, but their share of total energy use will decline. This report also sees significant changes in the composition and structure of the electric utilities industry continuing. The way in which public utilities are regulated will continue to change to respond to those new structures. This trend poses challenges for both producers, suppliers, and regulators.

10. Energy will continue to become more of an international issue. This statement is buttressed not just on the United States' growing dependency on foreign oil, but also on the projection that the greatest growth in oil consumption will be in the less developed countries as they struggle to industrialize and to create an industrial base. This nation has become aware that issues such as global warming cannot be solved by a single country acting alone. Energy flows show less and less respect for national boundaries. International finance and the value of the dollar and other currencies will continue to be influenced by these expanding flows.

Throughout the years to come, EIA will continue to gather data and to analyze the trends. EIA's work will provide the foundations for the discussions of which public policies should result. As an independent agency within the Department of Energy, EIA will continue to serve both the Executive and Legislative branches, as well as the general population, as they work for the perpetuation of the common good.

Calvin A. Kent, Ph.D.
Administrator
Energy Information Administration

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Highlights

The task of updating the Nation's *long*-term outlook for energy is especially complicated at a time such as this, when a crisis in the Middle East focuses public attention naturally on *short*-term fluctuations.

It is not especially significant whether the price of oil and the month-to-month growth rate for GNP coincide with the values in this document's "Reference Case" at the moment it is issued. Over a period as long as 20 years (1990-2010), our energy mix, our domestic energy production, and our level of energy consumption are all bound to be influenced by such factors as the world oil price and our own pace of economic growth—which are, in turn, influenced by many other elements. The value of making projections in the *Annual Energy Outlook 1991* (*AEO91*) for four different sets of assumptions (detailed on page 2) is that this approach helps to explain how (and to what extent) the underlying trends perceived now in U.S. energy use might be modified as forecast assumptions are replaced by real-world data and changes. Some basic analytical observations remain largely intact across these diverse cases:

Total energy use in the United States continues to grow at around half the rate of GNP

Depending on which assumptions are made about future economic growth and energy prices, total domestic consumption of primary energy in all its forms is projected to grow by anywhere from 20 to 38 percent over the next 20 years. Population is expected to grow by only about 13 percent. Over this same period, however, the country's gross national product (GNP) is assumed to expand by between 52 and 77 percent. Thus, the outlook is for increasing "energy efficiency."

Petroleum imports increase substantially by 2010 in all cases

U.S. petroleum demand is projected to grow to somewhere between 18.9 and 24.0 million barrels per day by 2010, compared with 17.3 million barrels per day in 1989. Such increases in demand, coupled with a steady decline in domestic oil production, would result in net imports growing to between 10.8 and 17.7 million barrels per day in 2010 (compared with 7.2 million barrels per day in 1989). Annual net imports of petroleum by 2010 range in these projections from 57 to 74 percent of total domestic oil consumption (compared with 42 percent in 1989).

Domestic crude oil production continues to fall in all cases

Given current knowledge of resources and trends in the application of technology, domestic crude oil production is expected to fall off during the forecast period from 7.6 million barrels per day in 1989 to a range between 3.4 and 5.2 million barrels per day by 2010. In the higher oil price path, where prices exceed $45 per barrel (in today's dollars) by 2010, the long-term decline averages about 1.8 percent annually. When oil prices are assumed to follow a lower trajectory—rising only slightly, to about $23 in 2010—domestic production of crude oil is projected to decline at an annual rate of 3.8 percent.

Transportation and industry dominate rising oil demand

Motor gasoline daily demand grows between 0.15 and 1.95 million barrels by the end of the forecast period in the cases involving the lowest and highest energy demand, respectively. In the High Oil Price Case, improvements in energy efficiency are spurred; and consumption of motor gasoline in 2010 is only slightly higher than it was in 1989. In the High Economic Growth Case, higher oil use results from both a lower price (which dampens motivations to improve energy efficiency) and the higher levels of economic activity assumed. Growth is foreseen in all cases for diesel and jet fuels, liquefied petroleum gas (LPG) for industry, and petrochemical feedstocks.

Use of natural gas in electricity generation seen to rise, then ebb

In all cases, most of the projected increase in natural gas consumption comes from its use as a generating fuel. This explains why gas use peaks in the early years of the next decade—at levels ranging from 21.8 to 22.7 trillion cubic feet, compared with 18.8 trillion cubic feet in 1989. Then, electric utilities turn to coal for new baseload generation capacity, limiting further growth in natural gas consumption by this sector. Natural gas consumption in buildings and industry is fairly stable over the forecast—in part because of more energy-efficient equipment and better insulation, in part because of greater reliance on electricity. By 2010, natural gas consumption dips again slightly in the projections (ranging from 20.7 to 22.0 trillion cubic feet).

Coal increases its share of total U.S. energy—almost entirely as input to electricity

Annual domestic consumption of coal increases by more than 350 million short tons between 1989 and 2010 in the Reference Case. Almost all of this 40 percent rise is in the electric utility sector, which recently has accounted for more than 85 percent of all U.S. coal use. Projections of the increase in domestic coal demand range between 241 million short tons and 436 million short tons, depending on the assumptions about economic growth and energy prices used in the respective cases. Projections of total U.S. coal production in 2010 vary between 1.4 and 1.6 billion short tons, with the current annual exports of approximately 100 million short tons more than doubling by that time in all cases.

Stable electricity prices reinforce demand, leading to a need for capacity growth

A need for between 177 and 322 gigawatts of new generating capacity (utility and nonutility) is projected by 2010, because the current excess in baseload capacity vanishes and the relatively stable price of electricity (based on declines in capital expenditures that tend to offset rising fuel costs) reinforces heavier use of this energy form. Depending on whether new nuclear plants are ordered and/or the operation of existing units is extended, nuclear power capacity would range between 101 and 110 gigawatts in 20 years—with the overall nuclear share of electricity declining from 19 percent in 1990 to between 14 and 15 percent. The Nation's electric utilities will continue to rely heavily on coal; but nonutility generators are seen turning increasingly to renewable energy in the future, and their role in total supply is expected to expand.

Renewable energy use grows as emphasis shifts from hydro

Growth in renewable energy use is assumed to be uniform across all cases. It goes from 7 percent of total energy consumption in 1989 to about 11 percent of the total projected for 2010. Use is still concentrated in electric utilities (hydropower), industry (process heat from biomass), and homes (wood). Hydropower continues to account for the greatest share of renewable energy used for electricity generation over the forecast, but its share declines because hydropower is projected to show little growth. By contrast, larger shares of electricity are likely to come from geothermal energy and from the burning of municipal solid waste. Each of these two other significant contributors of renewable primary energy to the electricity sector starts from a much lower base than hydropower; but both grow by more than 8 percent per year between 1989 and 2010.

Framing the 1991 Energy Outlook

The turmoil of recent months in the Middle East, which developed quickly and had the potential for longer-range repercussions, typifies the difficulty of trying to anticipate the full range of factors and events that could shape energy markets over the next 20 years. For this reason, *AEO91* examines a *range* of scenarios. Considering and comparing the effects of three selected variations from a "Reference Case" path can offer some insights for an uncertain energy future.

Overall, fundamental forces that help determine the direction of energy markets will remain in effect, even though events in the Middle East have changed much of the focus of energy analysis to the nearer term. In some ways, recent events and high prices in the second half of 1990 may have some residual impacts on Government policy, industrial energy planners, and consumers that seem paradoxical at first glance. For example, if oil prices were to stay in the low $20's per barrel for the near term (approximately $3 higher than projected last year in *AEO90*), price projections for future years could actually be lower than projected last year. The reason is that higher oil prices over the near term would stimulate increased interest in conservation and renewable energy, and also encourage growth in domestic energy production capacity. The combined effect is that the oil market would then reach equilibrium along a slightly lower "reference" price path than the one described in *AEO90*.

1990 in Review

Total U.S. consumption of energy resources held fairly steady for the third year in a row. In light of continued growth in the Nation's overall production of goods and services, this reflected further improvement (on a year-to-year basis) in "energy intensity" (the amount of energy consumed per unit of gross national product). At the same time, however, U.S. oil imports increased again during 1990; and growth in use of electricity continued to approximate the rise in GNP.

As usual, the year's energy picture involved some special factors of the type that defy prediction. After record cold temperatures in December 1989, mild weather in the early part of 1990 combined with a slowing of economic growth to hold down energy demand. At the same time, broad expectations for low oil prices (before the Iraqi invasion of Kuwait) were a major reason for continued declines in domestic production of petroleum.

Certain other developments during 1990 (including some major legislative initiatives) could set in motion significant changes to the energy markets of the United States and the world. For example, growing concern about our energy future had brought about a decision by President Bush in 1989 to assign lead responsibility to the Department of Energy for development of a formal National Energy Strategy, which was to balance three primary goals:

- Economic growth
- Energy security
- Environmental improvement.

Administration-wide efforts to shape and refine an integrated Strategy went on throughout 1990. Now, efforts to implement key elements of the Strategy that was sent to Congress in February 1991 will undoubtedly affect the U.S. energy outlook in many ways—as may some of the many energy initiatives that have been introduced separately in Congress. During the first 2 months of 1991, a number of bills were introduced (and many more are expected) to address a wide spectrum of energy supply, consumption, regulatory, and tax issues. Except for some specific elements of the National Energy Strategy that were already in place prior to the publication of this *AEO91*, however, none of the most recent proposals is incorporated in this document's projections.

Two major pieces of Federal legislation enacted during 1990 (and which are implicitly part of the Administration's program) will have direct impacts on energy that *are* considered to a certain extent by *AEO91*. The Omnibus Budget Reconciliation Act of 1990 (Public Law 101-508) increased the Federal tax on gasoline and diesel fuel by 5 cents per gallon, effective December 1, 1990; and the Act also modified the tax treatment accorded to petroleum and natural gas production. Higher motor fuel taxes will dampen demand somewhat, while the provisions relating to production should encourage continued output from oil and gas

fields that otherwise would have been shut in because of marginal profitability.

Sweeping amendments to the Clean Air Act were signed into law on November 15, 1990. These amendments will have wide-reaching effects on energy production, conversion, and consumption. The detailed procedures for implementing the new statutory requirements are still being developed, but the effects that can be reasonably well defined at this point are noted in the relevant individual chapters of this report. The manner in which provisions of the Clean Air Amendments of 1990 are incorporated in different energy sectors and across the various scenarios of *AEO91* is summarized in Appendix E.

Description of Four Scenarios

Four scenarios (described at greater length in Appendix E) are discussed in this report. Taken as a group, they present a range of possible outcomes, which diverge over a 20-year projection. The divergence among cases results from expected responses to different energy prices, growth rates, and capital turnover.

A Reference Case, which uses baseline assumptions about economic growth (incorporating demographic analysis) and a *mid*-level trajectory for future world oil prices, is discussed in connection with each consumption sector and every energy source; but it is not being put forth as the "most likely" scenario. The purpose here of a reference forecast is to facilitate comparisons—both to the other cases in this volume and to forecasts developed by other organizations.

The three other scenarios were constructed primarily to examine the combined effects of different assumptions about world oil prices, macroeconomic growth, and conservation. In every instance, changes in price and GNP are viewed as taking place smoothly, even though history suggests that intermediate ups and downs (which may make substantial differences to an unfolding picture) are more likely in reaching a given endpoint with the same "average" results.

Most sections of this report refer to all four cases, and all four are detailed in Appendix E; but some *AEO91* figures present only the bounding projections, and case details have been omitted from the text where variations from the Reference Case are slight.

A Reference Case

The Reference Case used in *AEO91* combines the assumption of an annual economic growth rate that is commonly used as a baseline for analyzing long-term trends (2.1 percent) and a mid-level path for world oil price (essentially constant in real terms at $24 per barrel for the next few years, and rising to $34 in today's dollars by 2010). The macroeconomic assumption represents a mainstream projection—in which growth in the U.S. labor force slows, thereby constraining GNP. No new legislative initiatives are incorporated in this case. Total energy demand grows at an annual rate of 1.1 percent per year, increasing by 2010 to 22 quadrillion Btu above the 1989 level. Demand for electricity grows at a rate of 2.0 percent per year.

Low Oil Price Case

This case starts with the same baseline economic growth (2.1 percent per year), but combines it with an assumption that world oil prices will be stable at $19 per barrel (in real terms) for several years and will go no higher than $23 per barrel in the same terms by 2010. Such relatively low prices could result from improved oil production capacity around the world or from new discoveries. With oil prices this low, energy demand could be expected to increase more rapidly—by 24 quadrillion Btu above the 1989 level (1.2 percent per year between now and 2010). Electricity sales in this case still grow at about 2.0 percent per year, in much the same relation to GNP as in the Reference Case. Actually, feedback effects ultimately raise the economic growth rate slightly as a result of the generally low energy prices—to an equilibrium rate of 2.2 percent.

High Economic Growth Case

This case also assumes the same low world oil prices ($23 per barrel in today's dollars by 2010), but combines them with high macroeconomic growth (2.8 percent), as explained in more detail on page 8. Such a combination produces the highest energy demand of any of the four cases in *AEO91*. High macroeconomic growth is associated with strong industrial growth, and also with high levels of travel in all transportation modes. Electricity sales grow at 2.4 percent per year. By 2010, total U.S. demand for energy is projected to be 32 quadrillion Btu higher than in 1989—having risen by 1.5 percent per year over the 2 decades.

Table 1. A Range of Projections for 2010—Summary

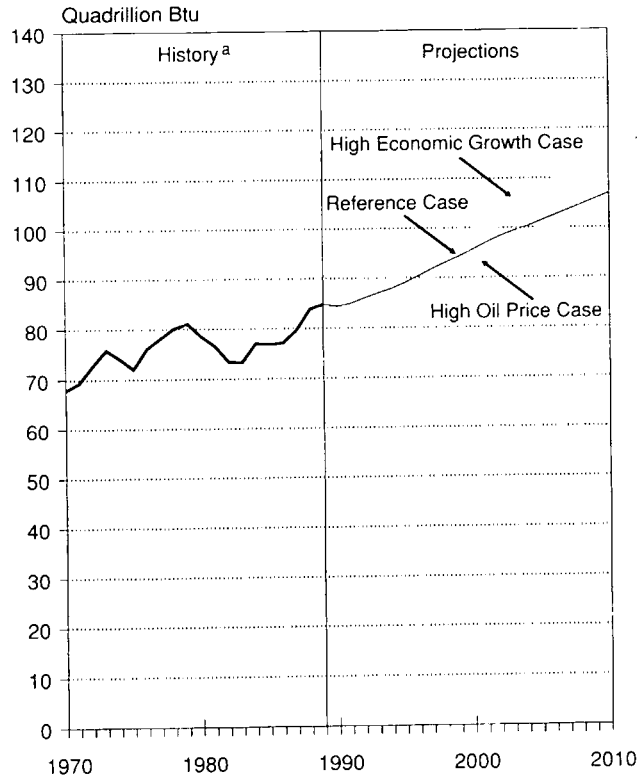
	1989	1990 (Estimated)	2010			
			Reference	Low Oil Price	High Economic Growth	High Oil Price
Primary Production (quadrillion Btu)						
Petroleum	18.4	17.6	12.4	9.8	10.1	13.9
Natural Gas	17.9	18.1	19.9	18.8	20.2	19.4
Coal	21.4	22.5	31.6	31.0	34.0	29.3
Nuclear Power	5.7	6.1	6.7	7.1	7.1	6.8
Renewable Energy/Other	6.4	6.8	11.6	11.6	11.6	11.7
Total Primary Production	**69.8**	**71.2**	**82.2**	**78.4**	**83.1**	**81.0**
Net Imports (quadrillion Btu)						
Petroleum (including SPR)	15.3	15.4	27.4	33.2	37.0	23.0
Natural Gas	1.3	1.4	3.2	3.2	3.2	2.8
Coal/Other (- indicates export)	-2.4	-2.5	-5.0	-5.1	-5.8	-4.9
Total Net Imports	**14.2**	**14.3**	**25.6**	**31.3**	**34.4**	**20.8**
Net Stock Withdrawals	0.4	-0.7	-0.2	-0.2	-0.3	-0.1
Discrepancy	0.3	-0.5	-0.7	-0.7	-0.5	-0.4
Consumption (quadrillion Btu)						
Petroleum Products	34.2	33.5	39.9	43.2	47.4	37.3
Natural Gas	19.4	19.1	22.4	21.3	22.7	21.5
Coal	18.9	18.9	25.4	24.8	27.1	23.2
Nuclear Power	5.7	6.1	6.7	7.1	7.1	6.8
Renewable Energy/Other	6.5	6.8	12.5	12.4	12.4	12.6
Total Consumption	**84.7**	**84.4**	**106.9**	**108.8**	**116.8**	**101.3**
Prices (1990 dollars)						
World Oil Price (dollars per barrel)	18.81	22.00	34.20	23.40	23.40	45.40
Domestic Natural Gas Wellhead (dollars per thousand cubic feet)	1.76	1.77	5.04	4.68	5.21	4.73
Domestic Coal Minemouth (dollars per short ton)	22.70	22.18	31.64	31.22	33.52	31.34
Average Electricity Price (cents per kilowatthour)	7.05	6.94	7.22	7.09	7.17	7.17
Economic Indicators						
Real Gross National Product (billion 1982 dollars)	4,118	4,153	6,436	6,528	7,355	6,323
(annual change, 1989-2010)	--	--	2.1%	2.2%	2.8%	2.1%
GNP Implicit Price Deflator (index, 1982=1.00)	1.263	1.314	2.909	2.928	2.874	2.910
(annual change, 1989-2010)	--	--	4.1%	4.1%	4.0%	4.1%
Real Disposable Personal Income (billion 1982 dollars)	2,869	2,891	4,129	4,169	4,639	4,084
(annual change, 1989-2010)	--	--	1.7%	1.8%	2.3%	1.7%
Index of Manufacturing Gross Output (index, 1982=1.00)	1.219	1.217	2.058	2.094	2.416	2.006
(annual change, 1989-2010)	--	--	2.5%	2.6%	3.3%	2.4%
Energy Intensity (thousand Btu per 1982 dollar of GNP)						
Oil and Gas Use	13.01	12.67	9.69	9.88	9.54	9.29
Electricity End-Use	2.18	2.22	2.11	2.10	2.00	2.00
Total Energy Use	20.57	20.32	16.61	16.67	15.88	16.02

Sources: **History (1989):** *Monthly Energy Review* (November 1990). **Projections:** Tables A1, A2, A4, A7, B1, B2, B4, B7, C1, C2, C4, C7, D1, D2, D4, and D7.

High Oil Price Case

This case combines the assumption of the baseline economic growth rate (2.1 percent) with a high world oil price (starting at $29 and holding steady in real terms for the next few years, then rising gradually to $45 in 2010). Because the world oil price is higher than that assumed for the Reference Case, feedback effects cause the path of economic growth and the 2010 GNP level to be somewhat lower than in the Reference Case. In addition, however, this particular scenario examines the effects of an intensified commitment to energy conservation and a post-2000 shift to alternative fuel vehicles. Such a reaction might well be anticipated in the face of high world oil prices—which could result from less favorable developments in improving global capacity for petroleum production. Low energy demand results in a rise of only 17 quadrillion Btu (0.9 percent per year) over 1989's total primary energy consumption—barely half the increase projected in the High Economic Growth Case. With greater stress on conservation, electricity sales grow more slowly too—at the rate of 1.6 percent per year.

Figure 1. Total U.S. Energy Consumption, Projected to 2010 with a Range of Uncertainty



[a]Historical data include an estimate for each year to account for dispersed consumption of wood and other forms of renewable energy, in addition to the use of renewables actually measured in the utility sector.

Sources: **History:** *Annual Energy Review 1989* (May 1990). **Projections:** Tables A1, B1, C1, and D1.

Comparison with Recent Past

Over the forecast period, the average annual growth in energy consumption (Figure 1) ranges across the scenarios from 0.9 percent in the High Oil Price Case to 1.5 percent in the High Economic Growth Case, with demand for electricity continuing its strong growth relative to both petroleum and natural gas.

By comparison with these projections, total energy consumption in the United States actually increased at an annual rate of 1.1 percent per year between 1970 and 1989—reaching a level of 84.7 quadrillion Btu, the highest level in history. In all sectors other than transportation (which maintained its almost exclusive dependence on petroleum), there was a shift in the composition of demand away from other fuels and into electricity. As a result, strong growth occurred in the consumption of coal and nuclear energy for use in generating electricity.

Table 2 summarizes the breakdown among major energy sources and consumption sectors for each of the four projections in 2010, as compared with actual 1989 statistics and preliminary estimates for 1990.

Major Assumptions and Rationale

World Oil Prices

Since August 2, 1990, world oil prices have reflected the uncertainty brought about by Iraq's occupation of Kuwait and the subsequent hostilities between Iraq and the coalition forces headed by the United States. Without the uncertainties introduced by this conflict, market conditions alone (namely, a world oil surplus) could have resulted in world oil prices remaining at or below the late July 1990 level of roughly $20 per barrel (excluding inflation) well into the middle 1990's.

A reasonably prompt settlement to the Middle East crisis (bringing renewed access to the oil resources of Iraq and Kuwait) was assumed in all three price trajectories, which are illustrated in Figure 2. No effort was made in this report to forecast the near-term price changes that might actually occur, either on the high-price side or on the low-price side, as the crisis winds

Table 2. Summary of Energy Consumption by Sector and Source, with Projections for 2010
(Quadrillion Btu)

	1989	1990 (Estimated)	Alternative Projections for 2010			
			Reference	Low Oil Price	High Economic Growth	High Oil Price
Consumption by Sector						
Residential	10.58	10.24	11.66	11.67	11.97	10.37
Commercial	6.76	6.70	8.80	8.80	8.87	8.14
Industrial	24.37	24.54	29.90	30.66	33.35	29.19
Transportation	22.19	21.99	27.18	28.11	31.48	25.70
End-Use Consumption	63.90	63.47	77.54	79.24	85.67	73.40
Electrical Generation and Distribution Losses	20.79	20.92	29.36	29.56	31.13	27.90
Total Consumption of Primary Energy	84.69	84.39	106.90	108.80	116.80	101.30
Consumption by Source						
Petroleum	34.21	33.49	39.94	43.17	47.42	37.27
Natural Gas	19.37	19.11	22.41	21.33	22.71	21.50
Coal	18.91	18.90	25.38	24.82	27.09	23.18
Other[a]	12.20	12.90	19.15	19.54	19.56	19.36
Total Consumption of Primary Energy	84.69	84.39	106.90	108.80	116.80	101.30
Electricity (End Use)	9.03	9.21	13.60	13.68	14.74	12.63

[a]Includes primary energy inputs from nuclear power, hydroelectric systems, and a variety of other renewables.
Sources: **History (1989):** *Monthly Energy Review* (November 1990). **Projections:** Tables A1, A2, B1, B2, C1, C2, D1, and D2.

down. Instead, the three stable price paths depicted at various levels over the next several years reflect a range of uncertainty. The quick final resolution of the Gulf crisis and a return to relative normalcy in world oil markets would likely yield a price near the lower end of this scale.

It should be recognized that either political or market influences (or both) could push prices outside this range at any time, at least temporarily. Given this general range, however, market trends from now into the late 1990's would favor continued growth in world oil demand and increased reliance on supplies from the Organization of Petroleum Exporting Countries (OPEC). With no clear reason why these general market trends should change, growth in oil consumption and in OPEC's market share would continue through the year 2010. Thus, the projections show prices for oil rising slowly—to a level between approximately $23 and $45 per barrel by 2010 (1990 dollars).

World Oil Supply

Over the longer term, market factors and technology will increasingly determine the price of oil by influencing the intensity of energy and oil-use (demand) and the ultimate cost of production (supply). In terms of supply, oil production from non-OPEC sources among the Market Economies (thus excluding the currently evolving Centrally Planned Economies of

Eastern Europe, the Soviet Union, and China) should continue to grow through the mid-1990's but decline slowly thereafter.

With oil at any of the three price levels considered, OPEC production and its share of world oil markets will be able to grow steadily. As OPEC production absorbs excess OPEC capacity in meeting higher worldwide demand, there is less incentive for nation-members of the cartel to undercut target prices or to exceed quotas assigned to them (which would also have a price-softening effect). Thus, world oil prices rise.

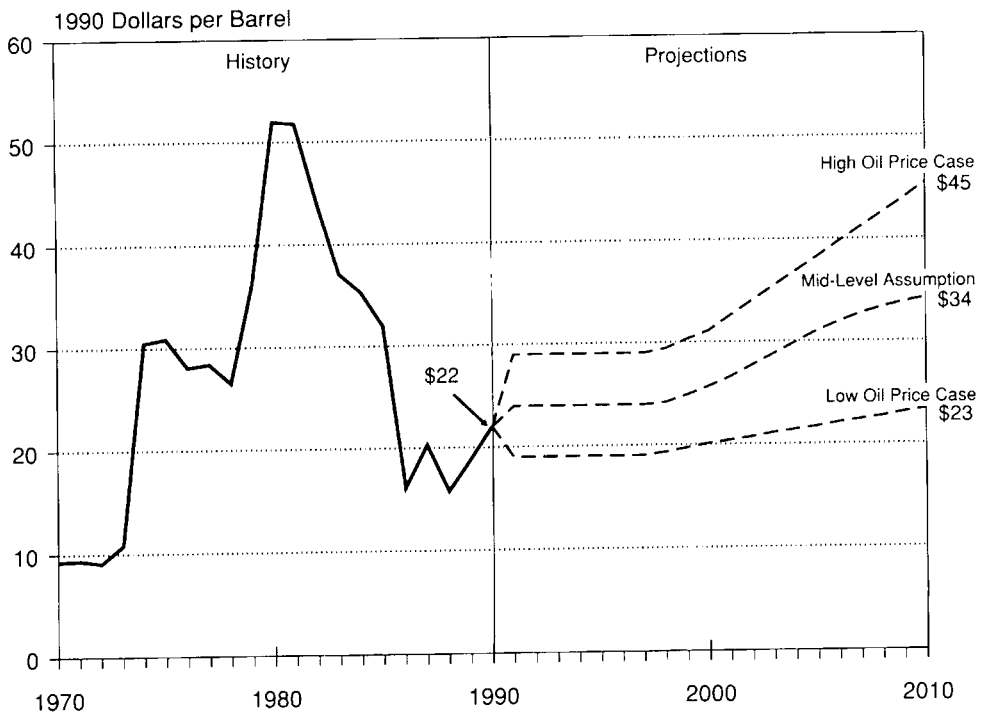
It is plausible that a low oil price path, generally similar to the one envisioned in the Low Oil Price Case for *AEO91*, could result primarily from aggressive expansion by OPEC of both production capacity and the degree to which that capacity is utilized—particularly in Saudi Arabia. This could take place while some non-OPEC countries that also export oil were trying to maintain oil-export revenues by stepping up their individual outputs.

The high oil price path, on the other hand, might result primarily from a deliberate OPEC strategy to slow down production and future capacity expansion—either for economic or political reasons, or both. At the same time, non-OPEC producers could find it difficult to raise supplies much above mid-case levels.

World oil production potential reflects the known distribution of oil resources that can be tapped economically. About two-thirds of the earth's proved oil reserves are in the Middle East, and virtually all of this amount is divided among the Persian Gulf "core" producers (Saudi Arabia, Iran, Iraq, Kuwait, and the United Arab Emirates). Non-OPEC reserves exist primarily in China, Mexico, Norway, the United States, and the Soviet Union.

Development of proved reserves should allow additional oil production in such non-OPEC countries as Syria, Colombia, India, Brazil, the United Kingdom, Norway, Oman, and Yemen; but increases in these countries will be offset by declining production in other non-OPEC countries, including the United States and the Soviet Union—which has been a major oil exporter to the Market Economies. Also influencing oil production (and, therefore, oil prices) will be improvements in the technology of locating and developing oil resources, as well as the further development of alternatives to oil. Natural gas, in particular, could have a significant impact on future

Figure 2. U.S. Refiners' Acquisition Cost of Imported Crude Oil, 1970-2010



Sources: **History:** *Annual Energy Review 1989* (May 1990). **Projections:** Tables A1, B1, and D1.

trends in the oil market. For example, natural gas is already the major fuel consumed in the Soviet Union.

World Oil Demand

On the demand side, oil consumption will grow to meet the needs of economic growth worldwide; but its share of total energy consumed should continue to diminish. Furthermore, the total energy consumed per dollar of gross domestic product (GDP) should also continue to go down in most consuming countries, as it has generally during the past 2 decades. Part of this reduced energy intensity (along with the trend toward smaller oil inputs per unit of gross domestic product) comes from heightened energy efficiency. Part of it results from changes in the mix of products and services demanded. Technological innovation will continue to be an important contributor to increased energy efficiency in the future. Consumer preferences also influence the product mix, and there would be additional effects from any broad shift toward goods and services that require less (or more) energy to produce.

Through the year 2010, the major consumers of oil will remain the highly industrialized countries and regions of the world—including the United States, the Soviet Union, Western Europe, and Japan. Much of the absolute growth in oil consumption could occur in the United States. By contrast, the Soviet Union will probably consume less oil in 2010 than it does now, as natural gas continues to grow in relative importance while domestic oil production declines.

The developing countries of the world are likely to show the fastest *rate* of growth in oil consumption, because their economic activity is expected to grow most rapidly in percentage terms. Uncertainty about the trends in both oil *and* energy consumption for many developing countries is heightened, however, by the burdens of debt they carry and by the effects of this debt on their ability to acquire additional capital. Growth in oil and energy consumption in these countries (and in the world as a whole) will also depend a great deal on the methods and technologies used to cope with the environmental costs often associated with more extensive energy use.

Domestic Economic Growth Paths

Long-term economic growth rates are determined fundamentally by the rate of expansion in an economy's resource base (primarily its labor force and the capital available to it) and by changes in factor productivity. The path of future U.S. economic growth is bounded by two primary considerations—first, the expectation that the labor force will continue to grow more slowly, and second, the great uncertainty attached to productivity growth.

Because of demographic trends, there is a consistently held view that the rate of growth for the U.S. labor force will decline steadily through 2010 and beyond. This constrains economic growth prospects significantly, even though it does not necessarily imply any decrease in per-capita income. While the labor force grew by an annual average of 2.1 percent between 1970 and 1989, yearly growth rates over the forecast period are expected to equal only about 1 percent. To the extent that projections differ, they generally reflect differing views on the potential for immigration, rather than varied expectations about the extent to which members of the existing population will participate in the active labor force.

Even with common assumptions about labor force growth, projections of future GNP growth can diverge because of differing views about the prospects for new capital formation, improvements in technology, and the extent to which education and training of the labor force meet the challenges of rapid technological change. Greater optimism about these factors leads to projections of higher rates of growth in GNP. As capital (and/or more productive technology) is substituted for labor, slower growth in the labor force can be offset by improvements in labor productivity.

Given such a spread of opinion about prospects for economic growth, this year's *AEO* focuses on two distinct economic growth paths. And this sets the stage for a fuller discussion of how high and low economic growth, respectively, would affect energy markets through 2010.

In the Reference Case, the Low Oil Price Case, and the High Oil Price Case, the economy is assumed to grow at a baseline rate of 2.1 percent from 1989 through the forecast period of 2010. The continuing slowdown in the growth of the labor force, coupled with an annual rate of increase for labor productivity of 1.2 percent, yields relatively slow aggregate growth for the economy.

Inflation (measured by the change in the implicit GNP price deflator) averages 4.1 percent—with prices increasing at a higher rate during the second decade of the forecast period. The Consumer Price Index (CPI), which may be of more concern to the average individual, rises by an average of 4.4 percent per year. Interest rates are projected to recover in the early part

of the forecast period, as the economy rebounds from the slow growth of 1990 and 1991. By 1995, interest rates then remain relatively stable, as the economy attains its long-term economic growth of 2.1 percent per year. This level is expected to be high enough so that sectors of the economy that are sensitive to the level of interest rates (such as housing and new car sales) are assumed in this case to grow slowly throughout the period between 1989 and 2010.

The rate of overall industrial growth (and the growth in each industrial subsector) is linked to the size and configuration of the aggregate economy. In the relatively low-growth Reference Case, total industrial output is expected to grow at a rate of 2.3 percent annually through 2010, while manufacturing output grows at a slightly higher rate (2.5 percent). However, the composition of growth is uneven. Production of machinery (Standard Industrial Classification 34-38) is expected to rise most rapidly (3.3 percent per year), driven fundamentally by investment and export-related demand. Production in the chemical and plastic sectors (SIC 28 and SIC 30) is expected to show steady growth throughout the forecast period. For most other sectors, growth is at or below the aggregate growth in GNP.

In the High Economic Growth Case, annual GNP growth of 2.8 percent is assumed between 1989 and 2010. While growth of the labor force follows the same pattern as above, the prognosis for change in productivity is more optimistic—assuming a positive rate of 1.9 percent per year. In this case economic growth is assumed to match the growth rate of the 1970 to 1989 period. Inflation in this case is somewhat less—an average of 4.0 percent for the implicit GNP price deflator and 4.3 percent for the CPI. Interest rates are consistently about half a percentage point below those in the baseline case. Lower interest rates, combined with a somewhat higher level of disposable income, boost the housing and auto-sales segments of the economy.

In the High Economic Growth Case, total industrial output is expected to grow at an average annual rate of 3.0 percent through 2010; manufacturing output registers 3.3 percent growth. Production of machinery (SIC 34-38) continues to lead the growth, at 4.2 percent per year. Production in the chemical and plastic sectors (SIC 28 and SIC 30) is expected to experience strong expansion too—3.5 percent annually.

It is important to keep in mind that some parts of the economy are inherently more energy-intensive than others. For instance, heavy manufacturing and the production of primary metals (for such products as motor vehicles) are high on any list. Furthermore, the use of oil, natural gas, and coal as feedstocks for some purposes involves "energy resource consumption" just as much as does the burning of these same materials for fuel.

Energy Use in the Future

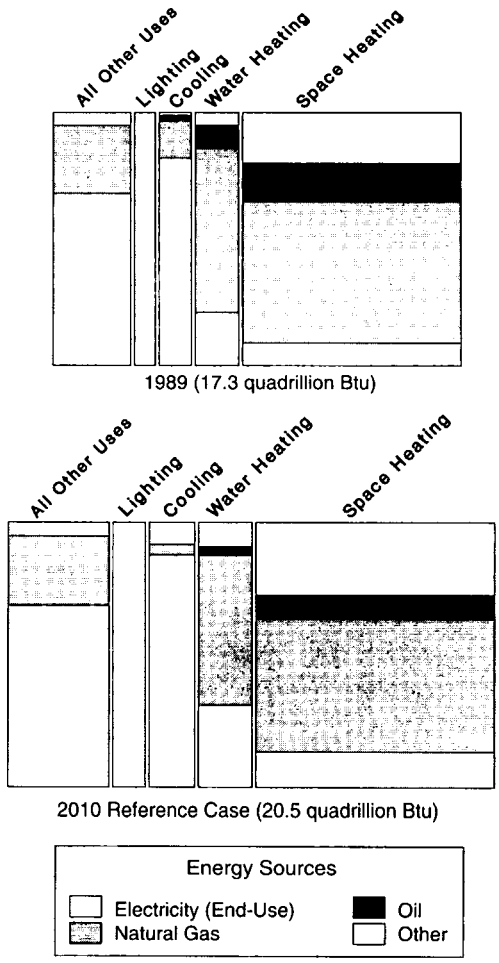
Buildings Sector

Buildings make up the largest part of the two energy consumption categories that statistical summaries customarily label "residential" and "commercial."[1] However, buildings have enough in common (and are important enough as end-users of energy) to be analyzed as a demand sector in themselves. They include individual houses and apartments, commercial business establishments, and public institutions. Energy use in this combined "buildings sector" mainly involves space heating and cooling, water heating, and lighting. Appliances *within* the buildings range from cooking stoves, refrigerators, and TV sets in homes to computers and communications equipment in offices. Energy sources for the buildings sector thus include electricity, natural gas, distillate oil, and a smattering of various minor fuels. Total consumption in 1989 was estimated at 17.3 quadrillion Btu of end-use energy, approximately 27 percent of the total. If the losses involved in generating and delivering electricity are included, the total consumption of *primary* energy amounted to 30.8 quadrillion Btu.

Figure 3 represents a way of looking at the breakdown among the major types of energy service in the buildings sector and simultaneously noting the relative significance of various energy sources—within each type of use and overall. A comparison between 1989 data and the Reference Case projection for 2010 shows graphically where the growth and change might take place. Clearly, natural gas is an important source, with its use concentrated in space and water heating. Electricity, as one might expect, is crucial for lighting, cooling, and appliances in general. The use of oil as a fuel in this sector is fairly limited.

By 2010, electricity is projected to become more significant across the board. Natural gas becomes relatively less important, although growth in the sector's overall use of energy continues to support a strong demand for this particular fuel in absolute terms. The role for oil shrinks. Finally, there is an outlook for notable growth in "other" energy sources—which include the decentralized application of various renewables, as discussed at the end of this section.

Figure 3. Comparison of Energy End-Use Patterns in the Residential/Commercial (Buildings) Sector, 1989 and 2010 (Reference Case)



Sources: Tables A11 and A12.

Total energy consumption in buildings will tend to grow over time in response to the net increase in the *number* of occupied U.S. buildings (additions to the existing stock, minus demolitions and abandonments).

[1]In some statistical series, the commercial sector includes some public services (such as lighting along streets). A discussion of energy consumption statistics and sectoral definitions is contained in *Energy Consumption by End-Use Sector*, DOE/EIA-0533 (April 1990).

Even more specifically, the growth in energy consumption is related to the increase in total floorspace.

The chief factors tending to depress energy demand in this sector are improvements in the energy efficiency of building shells and in equipment efficiency. None of these factors can be predicted with certainty; and the range of energy consumption forecasts depends on the pace of building growth assumed (often a reflection of general economic conditions) and on the success of conservation strategy expected in choosing new, more efficient technologies (along with the degree of retrofitting that might take place to make existing residences and commercial establishments more energy-efficient).

As newly constructed houses and commercial buildings are added to the existing stock, the effects on energy consumption will be mixed. Existing buildings often consume significantly more energy than new buildings in and of themselves; but new buildings tend to incorporate more energy-consuming services, such as air conditioning systems. Because of more stringent building standards, newly constructed buildings are projected overall to be more efficient than those in place now; but the slow turnover in buildings and their equipment will retard the pace at which these improvements take place nationally. Nevertheless, the characteristics of newer buildings will become progressively more important in determining consumption levels. By 2010, the Reference Case infers that about 30 percent of all residential units and 44 percent of the Nation's commercial buildings will be of post-1987 construction.

Improvements are expected in home heating and cooling technology. Heat-pump water heaters and condensing furnaces should be fully developed and available generally between now and 2010. With Federal efficiency standards for heating, cooling, and water heating technologies becoming effective early in the 1990's, all new and replacement purchases of appliances should help to raise the average efficiency level. At the same time, improvements in the integrity of building shells will reduce the requirements for both heating and cooling services. Still, future improvements in energy efficiency may not be as dramatic as at some times during the recent past. A relative lull in energy-price increases during the forecast period (with all fuel prices showing more moderate increases than in 1973-1984) lessens the incentive for conservation. The levels of improvement that have already been achieved in existing buildings also imply that some specific technologies will not be able to keep up their earlier rates of market penetration.

Range of Efficiency Improvements

The range of efficiency improvement in the use of energy by each sector across cases depends on the levels of energy prices, the rate at which new and replacement structures and equipment are introduced, and assumptions about the minimum efficiency characteristics of new and replacement equipment that are associated with each case.

A certain amount of price-induced efficiency can be expected in all sectors of energy consumption over the next 2 decades. For the four "cases" considered by *AEO91*, it will be highest in the High Oil Price Case (with a world price of more than $45 per barrel by 2010 and an explicit emphasis on conservation) and lowest in the High Economic Growth Case (where oil prices in the range of $23 per barrel do little in themselves to stem rising energy demand by all sectors as the entire economy expands much more rapidly).

Improvements in efficiency are measured in different ways for different energy applications, however, so it can be misleading simply to compare "percentages of improvement." Nevertheless, a comparison of the *ranges* in percentage change may offer some insights for policy planners.

Automobile efficiency is measured in average miles per gallon for the new car fleet. Using this gauge, the improvement by 2010 is projected to range between 25 and 42 percent, comparing the High Economic Growth Case with the High Oil Price Case.

The usual way to express industrial energy efficiency is to divide industry's total energy consumption for a given year (in a common unit of measurement that can be applied to all fuels and sources, such as quadrillion Btu) by the value of industrial output for that year (in constant dollars). In this case, the lower the numerical result (called "energy intensity") the higher the energy efficiency is deemed to be. By this standard, U.S. industrial energy efficiency is expected to improve by between 23 and 27 percent between now and the year 2010.

For both residential and commercial buildings, the standard of efficiency is somewhat similar to that in industry, except that floorspace or number of houses is substituted for the dollar value of output. Buildings that consume less energy per square foot or per home are termed more "energy efficient." The projected range in efficiency improvement for the entire stock of U.S. homes by 2010 is from 9 to 18 percent. For all commercial buildings, the outlook is for a 10- to 17-percent improvement.

A broad spectrum of energy-saving practices and technologies has been introduced over the past 10 years, often emphasizing electricity as a replacement for oil and natural gas (particularly in space and water heating). A continuation of this trend implies a reduction in the intensity of end-use energy consumption; but the demand for primary energy (which includes electricity's generation and delivery losses) will not necessarily decline as a result.

Historical trends for fuel consumption in commercial buildings closely resemble those for residential buildings. The share of electricity has increased relative to other fuels since 1960. This has been due partly to regional shifts in economic activity (with most growth taking place in the South and West, where air conditioning is now used almost universally) and also to restrictions on the supply of natural gas during the 1970's.

In the *AEO91* projections, the use of electricity by the residential and commercial sectors increases at an annual rate of 0.8 to 1.5 percent and 1.8 to 2.4 percent, respectively—faster than either natural gas or oil use. Electric appliances continue to penetrate markets at the expense of natural gas. Electricity increases its market share particularly in space and water heating. Furthermore, floorspace grows most rapidly in regions that already have a high intensity of electricity use. In contrast, the level of natural gas use changes little over the forecast period—because the higher *number* of gas appliances is offset by their increased *efficiency*. Oil use in both residential and commercial buildings continues to decline.

Over time, heating comes to represent a more significant share of electricity use in buildings, as electric heat pumps are applied more commonly (especially in the South and West). Lighting (which is all electric) increases in terms of absolute usage, but drops from 39 percent of all electricity consumption in the commercial sector to 35 percent by 2010—as various types of electrical and electronic equipment are utilized more frequently. Cooling, which relies primarily on electricity in new units, continues to penetrate the household market and is found in up to 95 percent of all residential units in the South Census Region by the end of the forecast period. At the national level, it is projected that more natural gas will be consumed for heating than is now the case, as that fuel gains with respect to oil; but natural gas is seen as losing part of its *share* in the overall space-heating market to electricity.

The High Economic Growth Case shows the combined effects of low energy prices, higher personal incomes, and a higher rate of new construction. Taking into account the primary energy involved in supplying electricity, total consumption of energy in 2010 for this sector rises about 8.5 quadrillion Btu above the 1989 value in the *AEO91* projections. The High Oil Price Case, on the other hand, examines the impact of high energy prices and the potential for certain initiatives in energy conservation—such as increased emphasis on Federal standards for appliances, housing and commercial building construction. The *AEO91* projection suggests that this combination would cut the rate of growth for building energy consumption nearly in half as compared with the High Economic Growth Case—adding only about 4.5 quadrillion Btu in 2010 relative to 1989.

Over the forecast period, total *end-use* consumption of energy in households would actually decline slightly in the extreme case of high oil prices *and* a stronger push for conservation, while the High Economic Growth Case would see such consumption rising by an average of 0.6 percent per year. Less difference between these two cases was envisioned for commercial buildings, with the annual growth rate for total demand varying between 0.9 and 1.3 percent.

Industrial Sector

The U.S. industrial sector is a very diverse consumer of energy, in terms of both fuels and end uses. As defined in this *Annual Energy Outlook*, it includes activities in manufacturing, agriculture (including forestries and fisheries), mining, and construction. Industrial enterprises increasingly generate electricity and steam for sale as well as for their own use; and they consume energy resources in many different ways (from simple lighting and heating to complex industrial processes and use as feedstocks). About three-fifths of all the energy consumed in the industrial sector is used to provide heat and power for manufacturing; about one-tenth is consumed for nonmanufacturing heat and power; and about three-tenths is consumed as feedstocks (raw materials) and in other miscellaneous uses.

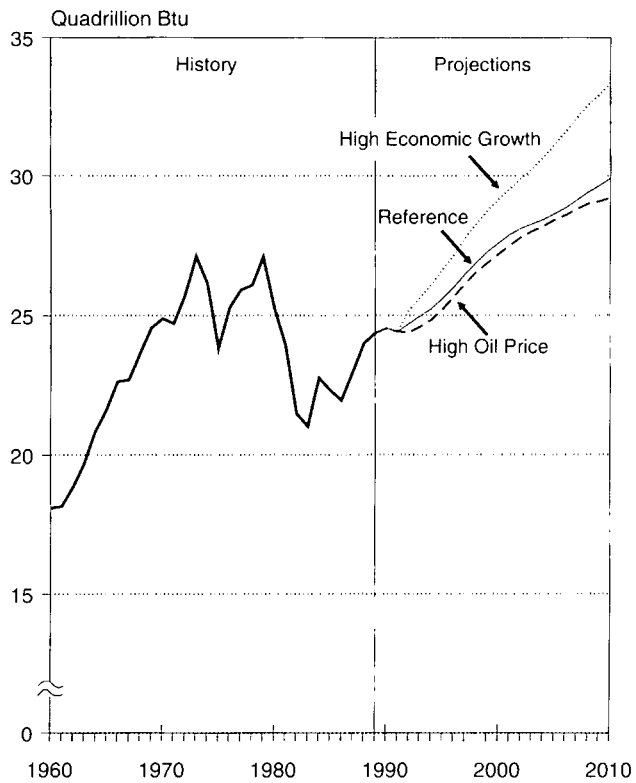
A major source of confusion in discussions of industrial energy use can lie in: (1) whether or not such noncommercial renewable fuels as timber and mill wastes are included in the tabulations (they comprise a large amount of energy for the industrial sector, but

precise data are not readily available); (2) whether the statistics include feedstock uses and/or nonmanufacturing applications of materials that could otherwise serve as fuels; and (3) whether electricity is counted as the heat equivalent of the actual end-use energy consumption or as the amount of primary energy required to generate and deliver that electricity—normally a number about three times as large. Consumption sections of *AEO91* measure electricity only as end use, but measurements of electricity elsewhere in this document depend on the stated context. The manner in which renewables, feedstocks, and nonmanufacturing consumption are included in sectoral totals within this section of *AEO91* also depends on the context.

Total energy consumption by the U.S. industrial sector generally declined after the "oil crises" of the 1970's and through the early 1980's (Figure 4). During that same period, the real value of industrial output rose substantially, however, indicating that industry was still making significant progress in reducing the intensity of its energy use (Figure 5). Part of this decreased energy intensity can be attributed to a general shift out of the traditional heavy, energy-intensive industries and into modern, high-value industries—where energy is a much smaller component of product value. But it is clear that surviving industries also achieved major efficiency improvements by modifying the ways they did things and as a result of new activities. Since the mid-1980's, the downward trend in total industrial energy consumption appears to have reversed somewhat—with the resurgence of industrial production during the economic expansion of the late 1980's. During this same period, industrial energy intensity continued downward for a while, then rose again, and most recently has shown a tendency to level off. Total industrial end-use consumption in 1989 was 24.4 quadrillion Btu. Primary energy consumption (including electricity generation and transmission losses) was about 31 quadrillion Btu.

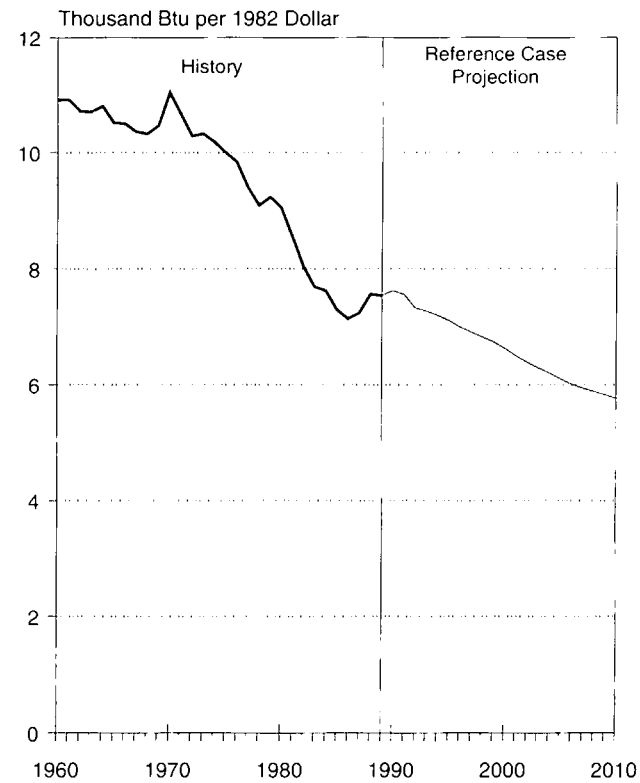
Historical trends in both consumption and intensity have varied greatly by energy source. End-use electricity consumption by industry has been increasing steadily over a very long term, although at a somewhat slower rate during part of the 1980's. Coal consumption has dropped considerably over the past 25 years, with some increase in the most recent few years. Consumption of natural gas has been decreasing slowly

Figure 4. U.S. Industrial Energy Consumption, 1960-2010



Sources: **History:** *State Energy Data Report 1988* (April 1990). **Projections:** Tables A2, B2, C2, and D2.

Figure 5. U.S. Industrial Energy Intensity, 1960-2010



Sources: **History:** *State Energy Data Report 1988* (April 1990). **Projection:** Table A13.

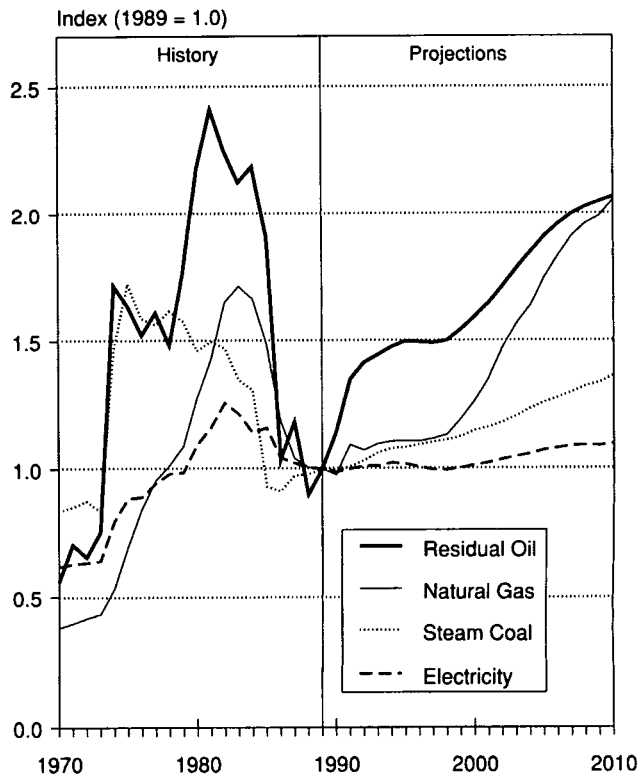
for about 15 years, but it too has shown some small increase recently. Petroleum consumption has varied over the years, relating to movements in oil prices and the changing uses of petroleum in industry. Although the available data are weak, the use of renewable energy by U.S. industry appears to have increased rather steadily, although there was some slowing during the 1980's.

In 1985, the segment of industry that consumed the greatest amount of energy for heat and power was refineries (at about 2.7 quadrillion Btu). Most of the fuel consumed there consisted of refinery-specific fuels—still gas and petroleum coke. The second largest consumer was primary metals (at about 2.4 quadrillion Btu), with about half of that consumption being made up of coking coal. The third largest consumer of heat and power was the composite group including chemicals, rubber, and plastics (at about 2.3 quadrillion Btu); just over half its use was in natural gas. These three industry-segments alone combined to account for almost two-thirds of the energy consumption in manufacturing heat and power. If specific segments of industry were viewed in terms of overall energy consumption (adding feedstock consumption to the heat and power), the production of chemicals would be the largest segment by far—over 5 quadrillion Btu. Moreover, the relative energy shares would be quite different if electricity were measured as primary energy consumption (reflecting consumption of fuels at the utility) and/or if wood and other renewable energy consumption were also included. If renewables were included, the paper industry would be one of the larger segments in total energy use.

The category of U.S. industry that produces the highest value of output is "metal durables," because machinery and equipment have a high embodied value in dollar terms. Largely because of this, the metal durables industry appears to have the lowest level of energy intensity (see box on page 10 for a definition). The most energy-*intensive* industry (considering only heat and power, end-use electricity, and no renewables) is the primary metals industry; it is followed by the stone, clay, and glass industry. Interpreting statistics about energy intensity often depends on the context from which the numbers are drawn. If feedstocks were included, the "energy intensity" in the chemical industry would be much higher. If use of electricity took into account the associated requirements for primary energy, all industries would appear to consume more; and those that are electricity-intensive would seem considerably more energy-intensive overall. If wood and other renewables were included, the energy intensity in the paper industry would be most affected. It would be much higher.

In 1989, the industrial sector consumed 24.4 quadrillion Btu of end-use energy (counting nearly 2 quadrillion Btu from renewables, but without including any of the electricity losses associated with generation, transmission, and distribution). This made U.S. industry the Nation's largest energy-consuming sector (accounting for about 38 percent of all end use). Industrial use rises in the forecast to a range of 29 to 33 quadrillion Btu in 2010, depending on the various assumptions in different cases. These average annual growth rates (0.9 to 1.5 percent) are considerably less than those assumed for GNP, which means that the industrial sector's energy intensity is still on a long-term downward trend. Future decreases in industrial energy intensity are seen as being strongly price-driven, although price increases are projected to vary greatly by source (Figure 6). The outlook for higher absolute levels of industrial energy consumption is based on forecasts that industrial output will increase faster than GNP. The *AEO91* analysis also assumes that a larger share of the GNP will be devoted to the production of goods in the investment and export categories, with less being devoted to consumer items.

Figure 6. Energy Price Indices for U.S. Industry, 1970-2010 (Reference Case)



Sources: **History:** *State Energy Price and Expenditure Report 1988* (September 1990). **Projections:** Table A3.

Electricity makes up a large part of the energy demand growth projected for the industrial sector. Those sectors of industry in which electricity is used more intensively are growing more rapidly; and new electricity-using processes and technologies are penetrating the industrial market increasingly. With electricity prices expected to rise at an annual rate of only 0.3 to 0.4 percent between 1989 and 2010, there is little economic incentive for conservation of electricity; and electricity intensity remains relatively flat throughout the forecast. Industrial use of electricity grew by 2.5 percent per year from 1970 to 1988; but this pace could even quicken because of the high rates of growth in industrial output expected. Additional electricity consumption accounts for about 1.8 to 2.8 quadrillion Btu of the 4.8 to 9.0 quadrillion Btu total increase in industrial sector consumption projected from 1989 to 2010; and, since electricity consumption was only about 3.2 quadrillion Btu in 1989, such an increase would represent a relatively large annual growth rate—averaging about 2.2 to 3.1 percent per year.

Petroleum consumption by industry is projected to increase at an average annual rate of 0.7 to 1.9 percent from 1989 to 2010, with the higher rate coming in the High Economic Growth Case, where oil prices are assumed to remain low while GNP increases at a brisk annual rate of 2.8 percent. Increasing consumption of petroleum by industry is strongly influenced by the proportion of feedstock use; and this, in turn, depends on increasing output in the chemicals sector.

Up until the past few years, consumption of natural gas by U.S. industry had been declining for a long time. Overall, the total use of natural gas by U.S. industry is now projected to be somewhat higher in 2010 than it was in 1989 (except for the Low Oil Price Case), showing an average annual increase of less than 0.4 percent across all cases for the entire period. Opportunities for faster growth are expected to be restrained somewhat by natural gas prices, which are projected to rise between 1989 and 2010 at an average rate of 3.2 to 3.6 percent per year.

The historical trend for direct coal use in industry has been generally similar—with some increases in recent years following a period of general decline. Virtually no change is projected now for the total industrial end-use of coal between now and 2010—with even the High Economic Growth Case showing an average rise of only 0.4 percent per year for steam coal, starting in 1989.

The relative share in the industrial sector of heavy and basic industries has been decreasing over time. At the same time, industry has been relying more heavily on electricity. There is less use now of equipment and processes that are fueled directly by natural gas, petroleum, and coal; and the entire industrial output mix has shifted away simultaneously from industries that use such fuels intensively. The net effect of continuing these trends is that U.S. industry is expected to be less energy-intensive overall by 2010 (including both renewables and feedstocks, but measuring electricity only in end-use terms). The energy intensity of the industrial sector in 2010 (expressed as the energy consumption per unit of industrial output) ranges from 73 percent to 77 percent of 1989 levels.

Transportation Sector

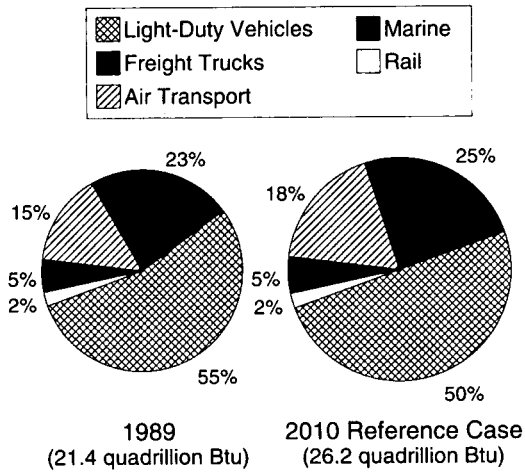
The transportation sector accounted for more than three-fifths of all U.S. demand for petroleum products in 1989, and this fraction is expected to remain stable through 2010. Although other end-use sectors have switched largely from the use of petroleum products to natural gas and electricity, transportation still depends almost entirely on oil. As of the end of 1990, substitution of other fuels was not projected to play a major role during the forecast period; and, as explained earlier, *AEO91* has not taken into account the various efficiency initiatives proposed in the newly announced National Energy Strategy or possibly relevant legislation being considered now in Congress.

The principal sources of transportation energy are motor gasoline for light-duty vehicles (automobiles and light trucks), diesel fuel and motor gasoline for freight trucks, jet fuel and aviation gasoline in aircraft, the diesel oil and electricity used by trains, and the diesel and residual oil that fuels domestic and international ships. In 1989, total consumption was 22.2 quadrillion Btu. Petroleum-based lubricants add a relatively minor amount. More than half of all transportation energy in 1989 was consumed by light-duty vehicles. Freight trucks used roughly one-fourth, and air transport accounted for most of the rest (Figure 7).

Highway and air transportation are expected to be responsible for most of the projected increase in total petroleum use by this sector between 1989 and 2010 under almost any set of conditions. But the level of oil consumption varies by 6 quadrillion Btu between the High Oil Price Case and the High Economic Growth Case. The latter envisions substantially more travel—based on its twin assumptions of high economic growth *and* low oil prices. The former anticipates greater fuel efficiency for light-duty vehicles, based on the level of fuel prices.

Motor gasoline is likely to remain the predominant highway fuel. In the High Economic Growth Case, light-duty vehicles consume about 15 quadrillion Btu of total energy—24 percent more than in the High Oil Price Case. With high oil prices, total gasoline consumption might remain almost constant, because improvements in fuel efficiency for such vehicles could closely match the increases in light-duty vehicle travel. In contrast, the High Economic Growth Case depicts a future in which low energy prices dampen fuel efficiency improvements and robust economic growth boosts travel by light-duty vehicles substantially—so that total gasoline consumption would increase by 3.6 quadrillion Btu between 1989 and 2010.

Figure 7. Energy Use in U.S. Transportation, 1989 and 2010

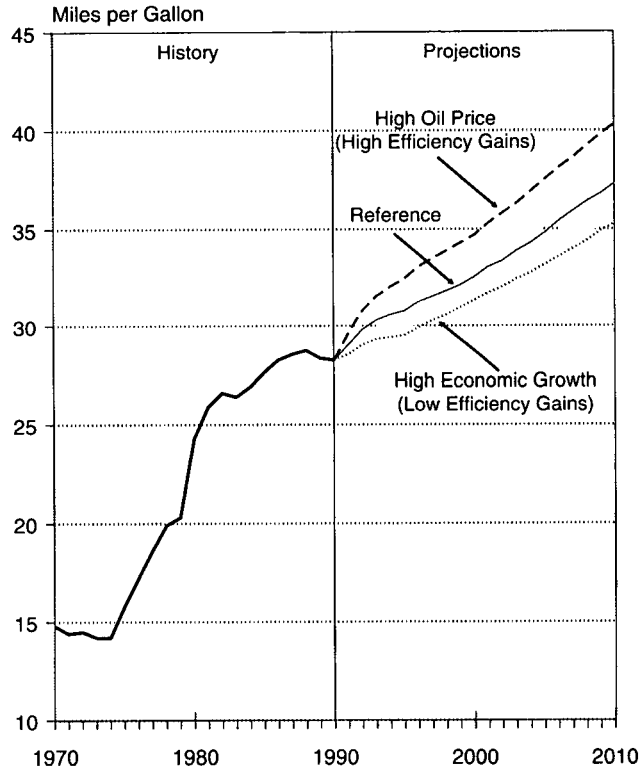


Note: This excludes natural gas used to operate pipeline pumps, as well as petroleum used in lubricants.
Source: Table A14.

Depending on the level of economic activity, highway travel by autos and light trucks is forecast to increase at an average annual rate of between 1.5 and 2.1 percent per year. Translating this range into more personal terms, between 22.7 and 25.3 vehicle-miles would be traveled each day by 2010 for each man, woman, and child in the United States (compared with the estimate of 18.9 during 1989). Thus, the total of vehicle-miles traveled (VMT) by 2010 would be between one-fifth and one-third higher than it has been in the very recent past. Although this may seem like a very sharp increase, such growth in VMT per capita is actually modest compared to recent history. Personal travel is not expected to reach a saturation point during the next 2 decades.

The fuel efficiency of light-duty vehicles available in the marketplace varies considerably. Cars with advertised "mileage" ratings well beyond 50 miles per gallon sell alongside other cars that achieve less than half this fuel efficiency. Real gasoline prices declined slightly, on average, between 1985 and 1989; and the average fuel efficiency for new cars sold has been almost constant at about 28 miles per gallon. In the High Oil Price forecast, in which oil prices more than double from average 1990 levels, average new car fuel efficiency reaches about 40 miles per gallon by 2010 with this additional economic incentive. On the other hand, if oil prices rose by only about 1.4 percent per year between 1989 and 2010 (as in the High Economic Growth Case), average new car fuel efficiency in 2010 might be just about 35 miles per gallon (Figure 8). Considering light trucks as well as passenger cars, the average fuel efficiency of the entire light-duty vehicle fleet would be 11 percent higher by 2010 with the price-stimulation of the High Oil Price conditions than it would be if the price for oil (and thus for vehicle fuel) stayed relatively flat.

Figure 8. New Car Fuel Efficiency in the United States, 1970-2010



Sources: **History:** *1970-1975*—U.S. Environmental Protection Agency, SAE Paper 840499 (March 1984); *1976-1990*—U.S. Department of Transportation, *Summary of Fuel Economy Performance* (February 1990). **Projections:** Tables A14, B14, C14, and D14.

In meeting the Federal standards of Corporate Average Fuel Economy (CAFE), auto manufacturers get credits under the Alternative Fuel Use Act of 1988 for building cars that save petroleum by using non-petroleum-based alternative fuels. However, the current CAFE standard of 27.5 miles per gallon is lower than the fuel efficiency already achieved, on average, by domestic manufacturers. As a result, such credits are not assumed by *AEO91* to bring any additional alternatively-fueled vehicles into the U.S. fleet.

The Clean Air Act Amendments of 1990, on the other hand, offer some fresh incentives for using alternative fuels. The revised Act, in general, does not mandate the use of such fuels; but it does require highway vehicles to meet more stringent emission standards. With appropriate additional equipment, conventional gasoline-powered vehicles probably *could* meet these more stringent requirements; alternative fuel vehicles may also meet the requirements. Thus, the share of alternatively fueled vehicles in 2010 ranges from about 1 percent of new light-duty vehicle sales for the High Economic Growth Case (with oil prices around $23 per barrel) to approximately 4 percent in the $45-per-barrel High Oil Price Case.

Freight trucks accounted for 23 percent of total oil use within the transportation sector during 1989, and this share remains stable over the forecast. Growth in truck travel closely follows trends in economic activity, although fuel consumption by trucks rises more slowly than GNP because fuel efficiency can be expected to keep on improving. For instance, the Reference Case assumes that diesel-powered trucks (used typically for long-haul freight travel) will improve their fuel efficiency by 14 percent between 1989 and 2010.

Diesel trucks are also being used increasingly in place of gasoline vehicles for short-haul activities. In 1989, 54 percent of all energy consumed by freight trucks came from diesel fuel. By 2010, diesel-powered trucks are expected to represent 62 percent of freight truck fuel consumption. This accounts for the robust growth of demand for diesel oil in the *AEO91* forecast.

About 15 percent of the transportation sector's oil consumption was used to fuel aircraft in 1989. This share is expected to increase as jet travel continues to grow. In recent years, air travel has grown at more than twice the rate of GNP and more than six times the rate of population growth. Over the forecast period, commercial air travel is expected to grow at an average annual rate of about 3.7 percent per year in the Reference Case; and total jet fuel consumption is expected to reach 4.6 quadrillion Btu—a larger percentage of a substantially bigger transport-fuel "pie." This estimate is particularly sensitive to the rate of macroeconomic growth. In the High Economic Growth Case, when real GNP is assumed to grow at an average annual rate of 2.8 percent, commercial air travel grows at an annual rate of 5.0 percent; total consumption of jet fuel alone would reach 5.8 quadrillion Btu in 2010.

Renewable Energy Use in Dispersed Applications

Projecting the future for renewable energy is difficult, as less is known about renewables than other energy sources, and their future is highly dependent on the rate of technological advance and political policy, both of which are highly unpredictable. Various forms of renewable energy (hydro, geothermal, solar, and so on) are used to generate electricity at centralized locations, from which it can be transmitted and distributed to end users as demand dictates. This application of renewables is clearly a constituent of energy *supply*, so it is treated later in this report. However, renewable energy is also consumed directly to some extent in each of the end-use sectors (residential, commercial, industrial, and transportation). Technologies for dispersed applications include: active and passive solar systems, groundwater heat pumps, wind turbines, photovoltaics, wood, and the production of ethanol from corn.

AEO91 uses a single set of projections in all of its cases for dispersed and nonelectric uses of energy from renewables. The projected contributions from renewable technologies may well be less sensitive to the changes in economic growth and world oil prices assumed in this report than to such technology-specific elements as their own individual cost and performance characteristics, a variety of environmental issues (land availability, recycling efforts, clean air goals, apprehensions about possible global warming, and so on), tax incentives, and infrastructure constraints. These, however, are beyond the projective scope of this report.

In practice, the success of renewables in penetrating various markets will be contingent upon improvements in technology, costs and performance over time, the acceptance of the respective technologies by consumers, and the regulatory climate, as well as the state of the domestic economy and the level of conventional fuel prices. For the purposes of this report, the total use of renewables in dispersed applications is projected to increase from 2.8 quadrillion Btu in 1989 to 5.6

quadrillion Btu in 2010, reflecting an annual average growth rate of 3.5 percent.

Wood is used in both the residential and the industrial sectors. Its use is concentrated in the paper and lumber industries—in the form of direct combustion of wood residues. Residential wood-burning for home heating is another important application. Overall, wood in these two sectors accounts for slightly more than three-fourths of the total dispersed renewable energy use.

Decentralized technologies for using solar energy (which involves both active and passive applications) and geothermal energy are used principally in the residential and commercial sectors. These technologies hold considerable prospects for growth and commercialization. By the end of 2010, even though most individual applications may be small in scale, their total combined contribution could well reach 1 quadrillion Btu for the Nation.

In the transportation sector, alcohol fuels from biomass (principally corn) constitute a potentially important "dispersed" application. The analysis for *AEO91* assumes that most of the increase in use of alcohol fuels will be for motor gasoline blending; alcohols and alcohol-based ethers are used to enhance octane ratings and to raise the oxygen content of gasoline in accord with environmental regulations. The current contribution of alcohol fuels to overall energy use is still comparatively small. Future development will be influenced by various environmental considerations, energy security concerns, and the use of alternative oxygenates, such as methanol (which would probably be produced first in large commercial quantities by using natural gas—rather than biomass or coal—as the major feedstock). Despite the uncertainties concerning renewables, *AEO91* makes it clear that renewables will be an important and growing component in the Nation's energy future. The precise path which that growth will take is less clear.

Oil and Gas Outlook

The Outlook for Petroleum

Crude Oil Production

Domestic crude oil production is broken down into three major categories: Lower 48 Onshore, Lower 48 Offshore, and Alaska. Total domestic output had risen slightly in the years just preceding 1986, primarily because of increases in Alaskan and offshore production. The large drop in oil prices during the first half of 1986 led to a significant fall in production from the Lower 48 States, a trend that continued through 1990. Alaskan production actually rose slightly through 1988, however, as long-awaited projects (such as the Endicott and Lisburne fields) began commercial production. This increased flow from Alaska offset some of the decline from the Lower 48 States before Alaskan production also began to decline.

In the latter part of 1990, the pattern of general decline in domestic oil production was broken, at least briefly, in response to the dramatic events in the Middle East. Overall domestic production increased by nearly 200,000 barrels a day between the third and fourth quarters of 1990, with a rise in Alaskan production playing an important role. This was in sharp contrast to the 2 previous years, when there were declines in total U.S. production from the third to the fourth quarters.

U.S. oil production is expected to decline over the forecast period in all the cases considered in the *AEO91*. In the Reference Case, it falls off at a rate of about 2.6 percent per year—to a level of 4.4 million barrels per day by 2010. Assumptions of the High Oil Price Case could slow the decline in production to an annual rate of 1.8 percent—resulting in a production level of 5.2 million barrels per day in 2010. If prices were significantly lower than those in the Reference Case (the lowest level assumed in *AEO91* was about $23 per barrel by 2010), production could drop by as much as 3.8 percent per year, so that by the end of the forecast period the United States would be producing 3.4 million barrels of petroleum per day.

Crude oil production from Alaska comprised more than 24 percent of the estimated 1990 total for the whole

Oil and Gas Resource Uncertainty

The outlook for U.S. oil and gas production is affected greatly by a number of factors—including the available recoverable resource base, restrictions on access to domestic resources, and the kinds and levels of technology applied.

Geologic uncertainty about the actual volume of the recoverable resources that are available stems from limitations in knowledge of the true state of nature; and this results in a range of possible estimates—each with an associated likelihood of being valid. Furthermore, the volumes of domestic petroleum and natural gas that will actually be recovered over time may be either higher or lower than the estimates used in this analysis, with obvious implications for the outlook.

Volumetric recovery depends on many and varied influences upon energy markets, including Federal energy policies and industry achievements in the area of technological development. Domestic exploration for some new fields (and even the development of some known fields) is restricted by extensive statutory provisions and previous administrative actions. The principal areas currently closed to leasing include Wilderness Areas, the 1002 Study Area of the Arctic National Wildlife Refuge (ANWR), and selected areas of the Outer Continental Shelf. Some other areas may be affected by limitations on access for oil and gas activity, but the levels of economically recoverable resources they are estimated to contain are relatively low.

These factors do not all affect the estimates of ultimate resource recovery equally. EIA estimates of economically recoverable oil and gas resources indicate that access restrictions affect 4.4 percent of estimated recoverable petroleum liquids resources, and 5.3 percent of recoverable natural gas resources, given base technology assumptions (*The Domestic Oil and Gas Recoverable Resource Base: Supporting Analysis for the National Energy Strategy*, SR/NES/90-05). Assuming that access restrictions continue, advances in technology increase the EIA estimates of recoverable oil and gas resource volumes by 42.4 and 44.1 percent, respectively.

United States. Since 1977, most Alaskan oil has come from the giant Prudhoe Bay oil field. This field reached the end of its maximum flow in 1989, and new production projects are unlikely to offset its decline for some time. Most incremental production is not expected from northern Alaska before the year 2000, because actual production lags behind the start of work on new fields by 10 to 15 years. The falloff in overall Alaskan production is projected to be arrested only in the latter years of the projections.

An annual drop of 4.1 percent in Alaskan production in the Reference Case is the main reason why total U.S. production drops at a 2.6-percent rate. The High Oil Price Case would limit Alaska's production decline to a long-range average of 2.2 percent annually, with some recovery after 2000. The Low Oil Price Case, however, shows an uninterrupted decline throughout, averaging 6.8 percent per year between 1989 and 2010.

The Lower 48 States show annual declines of 2.3 and 1.7 percent, respectively, for onshore and offshore production in the Reference Case. Onshore wells in the Lower 48 States currently contribute about 63 percent of domestic crude oil production; but this has declined by 26 percent since 1970, and the trend is expected to continue. The rate of decline in onshore production from 1989 through 2010 ranges from 1.8 to 3.3 percent, depending on the assumed oil prices—with the Reference Case decline being 2.3 percent. In both the Reference Case and the High Oil Price Case, the share of Lower 48 onshore production coming from Enhanced Oil Recovery (EOR) grows from 13 percent to 24 percent between 1989 and 2010. If lower world oil prices are assumed, EOR projects are affected more than conventional production. For the High Economic Growth Case, EOR production contributes only 16.6 percent of Lower 48 onshore volumes in 2010.

Environmental restrictions that affect leasing in offshore regions, as specified by President Bush and the Congress during 1990, are expected to reduce potential production over the forecast. The impact of these restrictions beyond the end of this decade will depend on the ultimate treatment of those regions excluded from leasing until 2000 by the President's decision as well as by economics. *AEO91* assumes that access will be permitted after 2000 to sites with the greatest hydrocarbon-bearing potential.

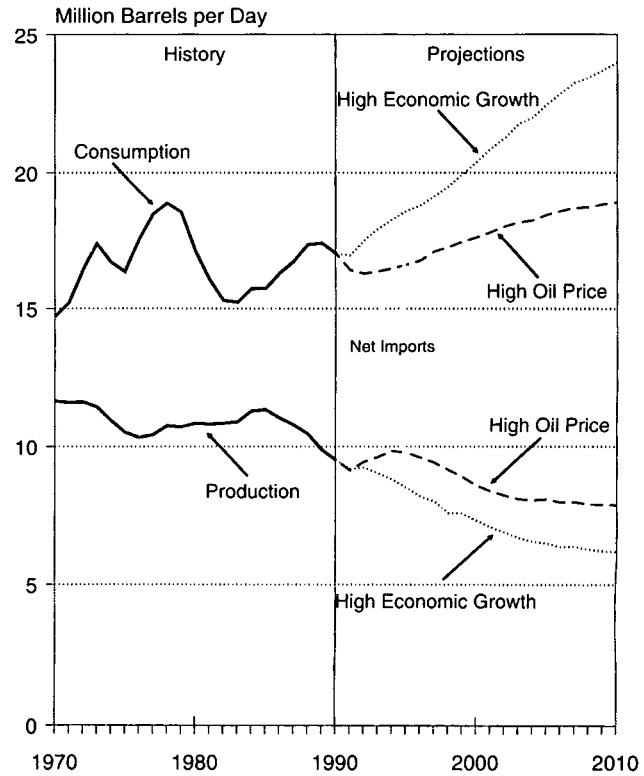
Production from all offshore regions (Federal and State) is expected to decline generally throughout the 20-year period in all cases. The single exception to this pattern occurs in 1994, when large projects in the offshore Pacific begin operation—raising total flow levels. Offshore production falls between 1989 and 2010 at an average annual rate ranging from 1.3 to 2.3 percent. The offshore share of total production rises from 13.0 percent in 1989 to a level ranging from 14.5 to 18.0 percent in 2010—for the High Oil Price Case and the High Economic Growth Case, respectively. Even though offshore production falls off, most other production sources decline even more rapidly.

Natural gas plant liquids (propane, butane, and other liquid fuels extracted in the process of producing pipeline-quality natural gas) also contribute substantially to the total domestic supply of petroleum liquids, providing more than 20 percent of that supply by 2010. Other domestic sources (such as synthetic crude oil) provide a small but growing part of supply by 2010.

Petroleum Imports

While domestic petroleum production is declining under all *AEO91* assumptions, U.S. demand for petroleum products is projected to grow—at average rates between 0.4 and 1.6 percent per year. This would

Figure 9. Petroleum Production and Consumption, 1970-2010



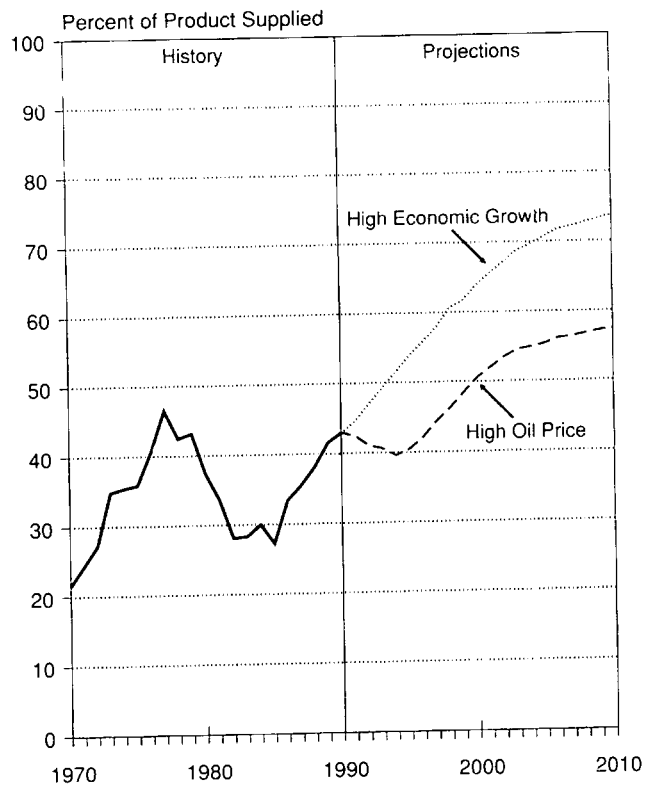
Sources: **History:** *1970-1988—Annual Energy Review 1989*; *1989—Petroleum Supply Annual.* **Projections:** Tables C8 and D8.

place the Nation's requirements for oil between 17.5 and 20.4 million barrels per day in 2000 and between 18.9 and 24.0 million barrels per day by 2010. During 1989, this country used about 17.3 million barrels per day. Except in the instance of the High Economic Growth Case (which assumes the lowest oil prices, coupled with rapid economic expansion), petroleum demand is projected to grow more slowly than U.S. energy consumption overall.

Net petroleum imports of crude oil and refined products (imports minus exports) are forecast to increase from 7.2 million barrels per day in 1989 to between 10.8 and 17.7 million barrels per day in 2010. Net imports would account for between 57 and 74 percent of U.S. petroleum demand (Figure 10). This contrasts with a 1989 import dependence level of 42 percent. The import quantities are greatest when crude oil prices are low and economic growth is strong. In the Reference Case and the Low Oil Price Case, imports in 2010 reach 13.0 and 15.8 million barrels per day, respectively.

Throughout the forecast period the majority of imports are in the form of crude oil rather than refined products (which include both finished products and unfinished oils). In all but the High Oil Price Case, however, the importation of refined products increases at a faster rate than that of crude oil. This reflects the assumption that crude oil refining capacity in this country (measured by atmospheric distillation capacity) will grow little beyond its January 1, 1990, level of 15.6 million barrels per day. Almost any increase in distillation capacity is expected to come through additions to existing refineries or reactivation of capacity that has been shut down. With the domestic production of crude oil declining, there is less incentive to build new refineries here—especially since environmental restrictions make it difficult to get approval for sites and also increase the difficulties of operating them. Thus, rising domestic demand for refinery products is likely to be met more by imports.

Figure 10. Percentage of U.S. Oil Consumption Supplied by Net Imports, 1970-2010



Sources: **History:** *1970-1988—Annual Energy Review 1989*; *1989—Petroleum Supply Annual.* **Projections:** Tables C8 and D8.

At the same time, U.S. refiners are expected to modify existing facilities and expand certain downstream refining operations extensively to satisfy State and Federal environmental regulations that apply to both refinery operations and their final products. There will be more ether, isomerization, and alkylation units to produce gasoline components and more new hydroprocessing and hydrocracking units to convert unfinished oils into streams of lighter, cleaner hydrocarbons. Although it can be assumed that refineries in the Caribbean and the rest of the world will provide *some* additional finished products for U.S. consumers, it also seems likely that U.S. refiners and marketers will import unfinished oils and blendstocks in many cases so they can process them further or blend them into products satisfying U.S. standards. As imports of crude oil and products increase, greater pressure will be placed on the U.S. transportation and distribution systems. Siting and permitting of import terminals, pipelines, and storage facilities to accommodate the higher import levels, particularly in the High Economic Growth Case and the Low Oil Price Case, present a significant challenge in the face of increased emphasis on environmental concerns.

Petroleum Product Demand and Prices

Transportation is expected to remain the leading use of petroleum products throughout the forecast period, accounting for almost two-thirds of U.S. oil demand in all cases. The industrial sector is the second largest consuming sector; under high and mid-level oil price assumptions it experiences the strongest growth in petroleum demand because of the continued growth in demand for petrochemical feedstocks and distillate fuel oil. Under the low oil price assumptions, when residual fuel oil prices are more competitive with other fossil fuel prices, the electric utility sector has the

Table 3. Petroleum Supply, Disposition, and Prices, with Projections for 2010
(Quantities in Million Barrels per Day)

	1989	1990 (Estimated)	Alternative Projections for 2010			
			Reference	Low Oil Price	High Economic Growth	High Oil Price
World Oil Price (1990 dollars per barrel)	**18.81**	**22.00**	**34.20**	**23.40**	**23.40**	**45.40**
Production						
Crude Oil[a]	7.61	7.23	4.42	3.36	3.37	5.18
Other[b]	1.61	1.61	2.10	1.92	2.07	2.04
Net Imports (including SPR)[c]	**7.20**	**7.28**	**12.98**	**15.79**	**17.67**	**10.84**
Total Product Supplied[d]	**17.33**	**16.95**	**20.27**	**21.84**	**23.98**	**18.87**
Motor Gasoline	7.33	7.23	8.08	8.50	9.28	7.48
Distillate	3.14	3.02	3.87	4.02	4.46	3.60
Jet Fuel	1.49	1.51	2.22	2.30	2.82	2.09
Product Prices (1990 dollars per gallon)						
Motor Gasoline (including taxes)	1.07	1.19	1.53	1.42	1.42	1.84
Distillate	0.92	1.04	1.35	1.23	1.24	1.65
Jet Fuel	0.61	0.78	1.00	0.89	0.89	1.29

[a]Includes lease condensate.
[b]Mainly natural gas liquids.
[c]SPR = Strategic Petroleum Reserve.
[d]Total product supplied includes residual fuel and other petroleum products not listed below.
Sources: **History (1989):** *Petroleum Supply Annual 1989* and *Petroleum Marketing Monthly* (prices) plus taxes. **Projections:** Tables A3, A8, B3, B8, C3, C8, D3, and D8.

strongest rate of demand growth. All cases show a drop in residential and commercial sector demand for petroleum products, particularly home heating oil, because of switching to renewable energy sources and electricity.

Gasoline continues to dominate U.S. petroleum consumption throughout the forecast period, reaching levels of 7.5 to 9.3 million barrels per day in 2010. This compares with 1989 levels of 7.3 million barrels per day. The use of alternative transportation fuels (such as compressed natural gas, alcohol fuels, and electricity) begins to show up in the forecasts after 2000, but represents only about 1 percent of transportation demand in 2010. The decline in motor gasoline's *share* of transportation demand (from 62 percent in 1989 to 54-55 percent in 2010) takes place largely because of expanding demand for jet fuel and diesel fuel. Jet fuel is projected to experience the strongest relative increase in demand of any product in the transportation sector.

The composition of gasoline and on-highway diesel fuels will change during the next 20 years as a result of the new Clean Air Act Amendments. Starting in November 1992, gasoline sold in about 40 U.S. localities that have been unable to meet Federal standards in regard to carbon monoxide in the atmosphere will have to contain a minimum of 2.7 percent oxygen (by weight) for at least 4 winter months. Beginning in 1995, all gasoline sold in the 9 areas that are farthest from satisfying the standards for ground-level ozone (one of the causes of smog) must be "reformulated." Although the exact conditions for certifying reformulated gasoline are yet to be specified in implementing regulations, the objectives are to diminish the quantity of volatile organic compounds and toxic

pollutant emissions by requiring reductions in these components and setting minimum oxygen levels. (The use of oxygenates envisioned in *AEO91* corresponds to the requirements and dates of the Clean Air Act, but also reflects an assumption that by 2010 *all* U.S. gasoline will be reformulated to contain at least 2.0 percent oxygen. In order to meet ozone standards, many localities may opt to require reformulation; and motor fuel suppliers will probably simplify production and distribution by standardizing gasolines.) In addition, by fall 1993, on-highway diesel fuel must contain lower levels of sulfur and aromatics than are permitted in other distillate fuels.

All these new regulations will change the basic composition of the leading petroleum products and reduce the possibilities of making them interchangeable across seasons, locations, and uses. This affects refiners, shippers, storers, importers, and marketers; and the changes are expected to increase supply costs in addition to the costs of production. Some of the new Clean Air Act Amendments also increase the demand by electric utilities and other power generators for residual (heavy) fuel oil that is low in sulfur.

The average price for all petroleum products is projected to go up, at a rate that ranges between 1.4 and 2.9 percent per year. It rises in all of the cases considered in *AEO91*, because crude oil prices and the demand for products both increase.

Prices for certain individual products also reflect special circumstances. For example, part of the reason that the projected prices for motor gasoline and on-highway diesel fuel are higher than 1989 prices is because of the increase in the Federal motor fuels tax that went into effect in December 1990, the scheduled increase in California gasoline taxes, and the higher refining and distribution expenses anticipated to satisfy the more rigorous environmental requirements described above. Because regulations regarding the deadline and exact requirements for many new Clean Air Act components have yet to be written—and because the cost impacts themselves are debatable—the estimated price impact of the 1990 amendments used for the *AEO91* analysis may differ from the ultimate actual Clean Air Act costs.

Motor gasoline is the largest selling petroleum product in the United States. Its real price is expected to increase from about $1.07 per gallon in 1989 to somewhere between $1.42 and $1.84 per gallon by 2010, depending chiefly on the world oil price. On-highway diesel fuel, which cost about $1.05 in 1989, is projected to range between $1.40 and $1.81 per gallon. These prices include State and Federal taxes, but exclude local taxes. The price of home heating oil is lower than that of diesel oil used for vehicles over this time period, because home fuels are not subject to motor fuels taxes or sulfur limitations and the demand for heating oil is declining. Jet fuel prices, which averaged about 61 cents a gallon in 1989, are forecast to increase by between 28 and 68 cents per gallon. The strong demand for jet fuel will augment the increase in world oil prices.

Residual fuel oil is now the least expensive major petroleum product. Its price is likely to go up faster than other product prices, however, because utilities and industrial buyers will be shifting from high-sulfur to low-sulfur specifications. In the High Oil Price Case, residual fuel oil prices are expected to exceed natural gas prices, but they drop below natural gas in all other cases. Residual fuel oil prices range between $27.54 and $46.47 per barrel in 2010.

The Outlook for Natural Gas

Natural Gas Supply

For the foreseeable future, domestic natural gas supplies are projected to be adequate to satisfy most domestic consumption requirements. The average wellhead price of natural gas is expected to remain fairly level throughout much of the 1990's, given the relative abundance of gas that is available from lower cost sources. The stable gas prices projected for most of the coming decade are low in relation to oil prices; and this leads to more demand for natural gas and correspondingly higher production of the fuel. By 2000, however, depletion of some of these lower cost resources may require wellhead prices to rise more rapidly as an increasing portion of supply is produced from less conventional or other higher cost sources. Estimates of the wellhead price of natural gas in 2010 for the *AEO91* cases range from $4.68 to $5.21 per thousand cubic feet (Figure 11).

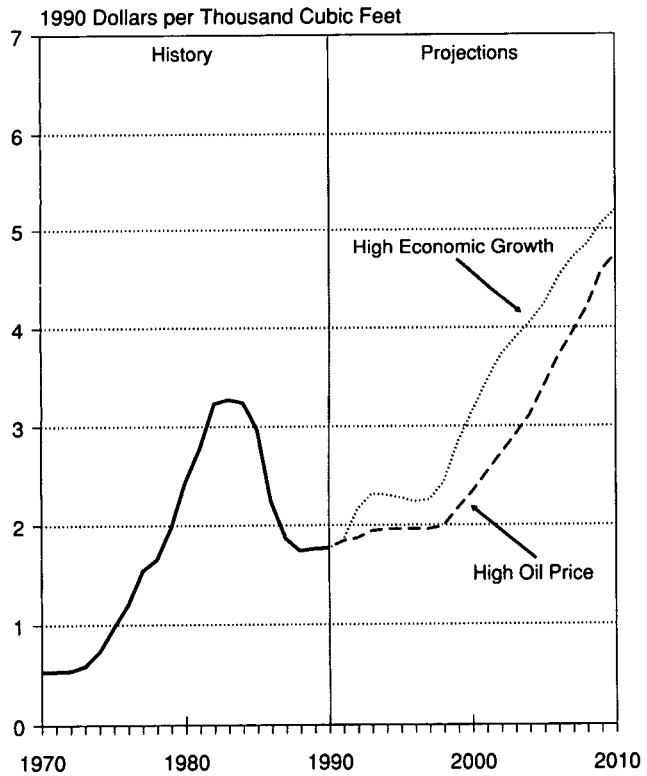
Production in the Lower 48 States is projected by EIA to peak after 2000—with maximum production from the Lower 48 States occurring in 2001 and 2005 in the High Economic Growth Case and the High Oil Price Case, respectively. Greater demand for energy in general in the High Economic Growth Case pushes wellhead prices up faster and higher—bringing domestic production to a peak at 20.5 trillion cubic feet (compared with 19.5 trillion cubic feet in the High Oil Price Case). Unlike the trends in U.S. oil production, production of natural gas in the Lower 48 is projected

to be higher than the 1989 level for each of the outlook years.

Most domestic natural gas historically has been produced and consumed in the Lower 48 States. In 1989, roughly 98 percent of all U.S. gas production flowed from Lower 48 wells. Onshore production contributed 71 percent of the Lower 48 total, and the onshore share grows to roughly 85 percent by 2010 in all cases. The average annual decline in offshore production between 1989 and 2010 ranges from 2.9 to 3.0 percent.

The relative increase in onshore production from the Lower 48 stems at least in part from the introduction of Unconventional Gas Recovery (UGR). UGR techniques allow production of gas from "tight formations" with low permeability. Unconventional natural gas production is expected to increase throughout the forecast period; and by 2010 more than 4 trillion cubic feet of domestic gas is expected to come from these resources in all cases. By the end of the *AEO91* horizon, gas from the North Slope of Alaska should also be economic to market in the Lower 48 under the wellhead prices projected in all cases (but not earlier than 2007). The Alaska Natural Gas Transportation System is expected to reach capacity levels between 0.8 and 1.3 trillion cubic feet per year; and North Slope production is expected to utilize the system fully.

Figure 11. Average Wellhead Price of Natural Gas, 1970-2010



Sources: **History:** *1970-1988—Annual Energy Review 1989*; *1989—Natural Gas Annual 1989*. **Projections:** Tables C9 and D9.

Gas from foreign sources will be increasingly important; and by 2010 net imports may supply as much as 15 percent of the total domestic consumption. Significant increases in pipeline imports (particularly from Canada) as well as liquefied natural gas (LNG) imports are projected. Among the cases, imports vary from 2.7 to 3.1 trillion cubic feet in 2010. Canadian pipeline imports rise through 1995 with the construction of additional capacity, such as the recently approved Iroquois project to deliver natural gas to the U.S. Northeast. Pipeline capacity from Canada is assumed to reach 2.0 trillion cubic feet per year in each of the cases. The estimated volume of economically recoverable Canadian gas resources that remain is expected to limit the overall volume of imports; but, in all except the final years of each case, import flows are maintained at 2.0 trillion cubic feet per year.

LNG imports are expected to increase substantially—growing from 42 billion cubic feet in 1989, to levels of 0.6 to 0.8 trillion cubic feet in 2010. Limits on the tanker capacity available for transoceanic shipping constrain the amount of LNG that may be received over the next few years; but this relative shortage in carriers is expected to vanish by the mid-1990's at the latest. The two idle LNG import facilities in the United States are projected to be restored to operation during the 1990's, but *AEO91* does not include any expansion in capacity from new construction.

Natural Gas Consumption

Consumption of natural gas over the next 20 years is expected to show substantial increases, growing at annual rates ranging from 0.5 to 0.8 percent. By the year 2000, consumption of natural gas is projected to range from 20.8 trillion cubic feet in the Low Oil Price Case to 22.4 trillion cubic feet in the High Economic Growth Case. Subsequently it should level off or decline slightly, to range in 2010 between 20.7 and 22.0 trillion cubic feet and thus remain 10 to 17 percent above 1989 levels. Consumption of natural gas by electric utilities and industry leads growth across all cases, but several factors move to stem consumption in the early part of the next decade.

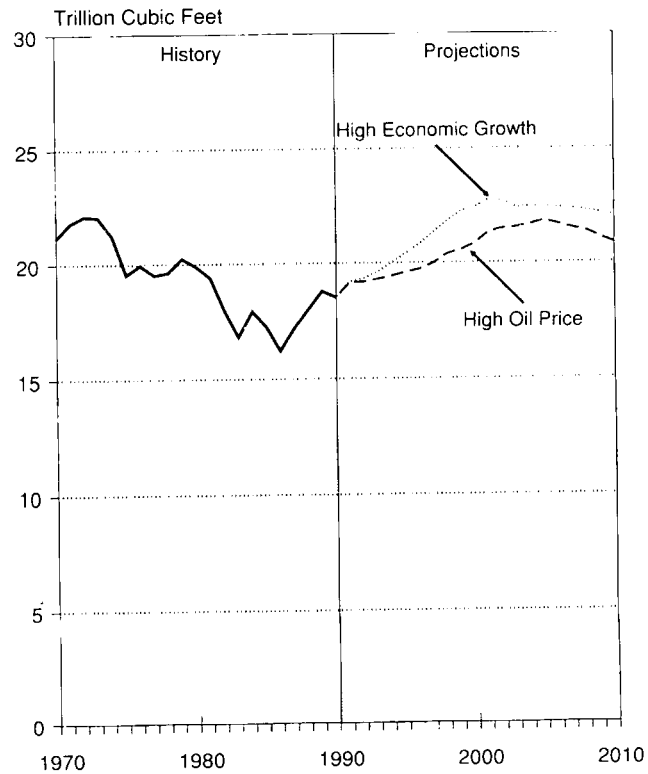
Use of natural gas to generate electricity is projected to increase from 2.8 trillion cubic feet in 1989 to a range of

5.3 to 5.7 trillion cubic feet by 2005. Increases of this magnitude represent the principal factor driving total gas consumption upward. The rise in gas use by electric utilities reflects a substantial increase in combined-cycle generating capacity in response to the need for supply options with short lead times. In the latter part of the forecast period, however, electric utilities are expected to move back to baseload coal-fired generation again. Thus, the outlook for continued growth in this sector of gas consumption becomes less likely.

Industrial use of natural gas follows a path similar to electric utility consumption, but peaks earlier (around the turn of the century) at levels ranging from 7.4 to 7.7 trillion cubic feet. The highest use of natural gas in the industrial sector (7.7 trillion cubic feet in the year 2000) is seen in the High Oil Price Case, as the high price of petroleum products makes gas more attractive as a substitute. Nonetheless, industrial consumption of natural gas declines by nearly 0.7 trillion cubic feet between 2000 and 2010 in this case. Increasing electricity use in certain industrial processes is seen reducing industry's reliance on natural gas. Maximum industrial use of natural gas in the High Economic Growth Case is 7.6 trillion cubic feet, in the years 1998-2000. Consumption declines gradually thereafter under this case's assumptions, reaching 7.4 trillion cubic feet in 2002 and then leveling off.

In the Reference Case and the High Economic Growth Case, residential and commercial consumption of natural gas remains relatively stable throughout the forecast period. In the High Oil Price Case, stricter appliance and other efficiency standards dampen any increase for the commercial sector and significantly reduce residential consumption of this fuel. By 2010, consumption in the residential sector is projected to be 4.6 trillion cubic feet in the Reference Case and the High Economic Growth Case, contrasting with a low of 3.9 trillion cubic feet in the High Oil Price Case. In the latter case, consumption peaks at 4.7 trillion cubic feet, but then drops by more than 0.7 trillion cubic feet as improvements in the efficiency of gas appliances take fuller effect.

Figure 12. Natural Gas Consumption, 1970-2010



Sources: **History:** *1970-1988—Annual Energy Review 1989*; *1989—Natural Gas Annual 1989*. **Projections:** Tables C9 and D9.

The use of compressed natural gas (CNG) in vehicles is projected to grow modestly over the forecast period in response to provisions of the Clean Air Act Amendments of 1990. In the High Oil Price Case (when economic competition with conventional vehicle fuels could be maximized), the transportation sector could consume as much as 100 billion cubic feet per year by 2010.

Table 4. Natural Gas Supply, Consumption, and Prices, with Projections for 2010
(Quantities in Trillion Cubic Feet)

	1989	1990 (Estimated)	Alternative Projections for 2010			
			Reference	Low Oil Price	High Economic Growth	High Oil Price
Production	**17.26**	**17.40**	**19.08**	**17.88**	**19.23**	**18.68**
Net Imports	**1.28**	**1.36**	**3.09**	**3.09**	**3.09**	**2.68**
Total Consumption[a]	**18.79**	**18.53**	**21.73**	**20.68**	**22.02**	**20.84**
Residential	4.77	4.38	4.55	4.53	4.60	3.91
Commercial	2.71	2.57	2.89	2.88	2.85	2.75
Industrial	6.83	6.97	6.79	6.78	7.42	7.08
Electric Utilities	2.78	2.84	5.54	4.69	5.19	5.16
Transportation	0.00	0.00	0.06	0.02	0.02	0.10
Wellhead Price (1990 dollars per thousand cubic feet)	**1.76**	**1.77**	**5.04**	**4.68**	**5.21**	**4.73**
Average Delivered Prices (1990 dollars per thousand cubic feet)						
Residential	5.89	5.86	9.17	8.80	9.33	8.86
Commercial	4.95	4.92	8.29	7.92	8.45	7.98
Industrial	3.08	3.01	6.35	5.99	6.52	6.02
Electric Utilities	2.53	2.30	5.65	5.32	5.82	5.33
Transportation	0.00	0.00	9.23	8.86	9.40	8.91
Average to All Sectors	4.07	3.93	7.09	6.79	7.26	6.71

[a]Total consumption includes lease and plant fuel and pipeline fuel not listed below.
Sources: **History (1989):** *Natural Gas Annual 1989.* **Projections:** Table A9, B9, C9, and D9.

Coal Outlook

A Growing Share of U.S. Energy Production and Consumption

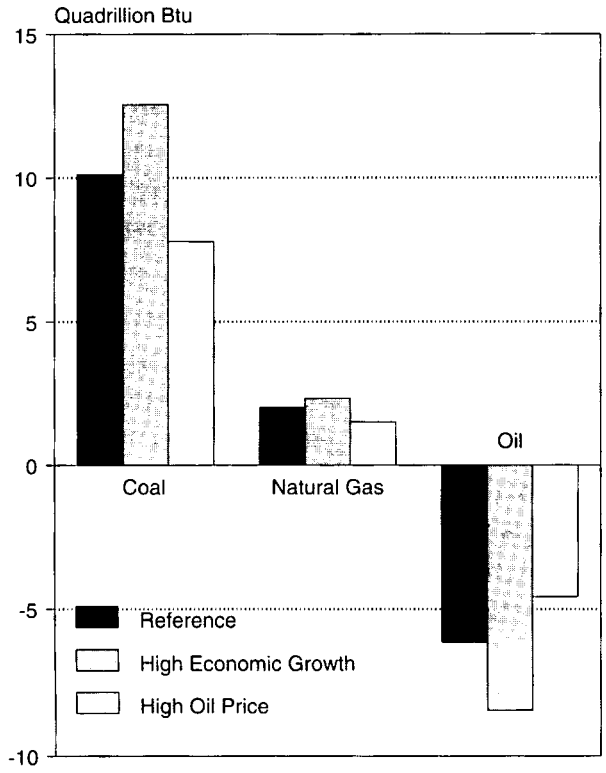
Coal Production

Coal accounts for a greater share of U.S. energy production than any other fuel, having surpassed petroleum in 1984. Its importance is projected to be even greater by 2010 (Figure 13). Depending on future world oil prices and the level of economic growth, coal's share of total U.S. energy production increases from 31 percent in 1989 to a range of between 36 and 41 percent by 2010.

From 981 million short tons in 1989, coal production in the Reference Case rises by 1.3 percent per year during the 1990's, and by 2.8 percent per year during the latter half of the forecast—reaching 1.5 billion short tons by 2010 (Table 5). Coal production rises to just under 1.4 billion short tons in the High Oil Price Case, and to over 1.6 billion short tons in the High Economic Growth Case. The Low Oil Price Case is not discussed explicitly here because its assumptions produce results for coal that vary little from those of the Reference Case.

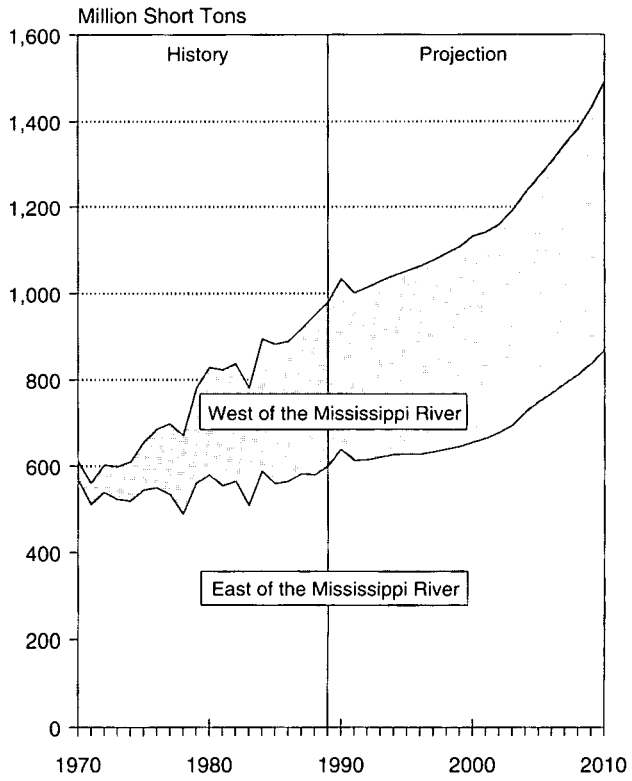
During the past 2 decades, the development of large surface mines in Wyoming and lignite mines in Texas catapulted the West's production share from 7 percent in 1970 to 39 percent in 1989; but the general regional breakdown of future U.S. coal production should balance out at a fairly stable ratio from now on (the Reference Case is shown in Figure 14). Mines located

Figure 13. Change in Annual U.S. Production of Fossil Fuels, 1989-2010



Sources: Tables A1, C1, and D1.

Figure 14. East-West Division of Coal Production, 1970-2010 (Reference Case)



Sources: **History:** *Annual Energy Review 1989.* **Projections:** Table A10.

Table 5. Coal Supply, Disposition, and Prices, with Projections for 2010
(Million Short Tons)

	1989	1990 (Estimated)	Alternative Projections for 2010		
			Reference	High Economic Growth	High Oil Price
Production	**981**	**1,035**	**1,492**	**1,604**	**1,372**
Exports	**101**	**107**	**252**	**282**	**250**
Imports	**3**	**2**	**11**	**11**	**11**
Stock Withdrawals[a]	**14**	**-29**	**-8**	**-10**	**-4**
Consumption					
Residential/Commercial	6	6	5	5	5
Industrial	76	77	83	84	83
Coke Plants	41	37	32	32	32
Electric Utilities	766	772	1,124	1,205	1,010
Total	**889**	**893**	**1,244**	**1,325**	**1,130**
Discrepancy[b]	7	8	-1	-1	0
Prices (1990 dollars per short ton)					
Average at Minemouth	22.70	22.18	31.64	33.52	31.34
Average Delivered	32.56	31.75	43.38	45.11	42.39

[a]A negative (-) represents an increase to inventories.
[b]Balancing item: the sum of production, net imports, and stock withdrawals minus total consumption.
Note: Totals may not equal sum of components due to independent rounding.
Sources: Tables A10, C10, and D10.

west of the Mississippi River are projected to yield approximately 40 percent of total U.S. coal production in all three cases throughout the forecast.

Coal Consumption

Because the Nation relies so heavily on petroleum-based fuels for transportation, coal represents a smaller fraction of total U.S. energy consumption than of domestic energy production. Coal accounted for 22 percent of total energy consumption in 1989, and its share is projected by *AEO91* to rise to 23 or 24 percent by 2010. Electric utilities, the largest coal-consuming sector by far, account for virtually all of the growth in domestic coal consumption. From 766 million short tons in 1989, utility coal consumption increases to 1.1 billion short tons by 2010 in the Reference Case. During the 1990's, growth in utility coal consumption will come mostly from a fuller utilization of existing coal-fired capacity. After 2000, however, additions of some 70 gigawatts in coal-fired capacity account for most of the additional coal consumption by utilities that is anticipated.

Assumptions of higher or lower growth in total energy demand have relatively little effect on the amount of coal consumption projected in electricity generation until the latter half of the forecast. During the 1990's, different levels of electricity demand are expected to be met primarily by variations in oil- and gas-fired generation. After 2000, with new additions in coal-fired capacity, coal becomes more responsive to increases in electricity demand. By 2010, compared with 1.1 billion short tons in the Reference Case, utility coal consumption rises to 1 billion short tons in the High Oil Price Case (when economic growth lags) but goes to 1.2 billion short tons in the High Economic Growth Case.

Nonutility power generation is also expected to increase, with their coal-fired capability growing from

6 gigawatts in 1989 to between 17 and 27 gigawatts by 2010 (22 gigawatts in the Reference Case). Nearly all of this growth occurs after 2000.

Industrial consumption of coal (other than for metallurgical purposes) is expected to remain near the 1989 level of about 75 million short tons through 2005, as a steady decline in conventional demand for steam coal is offset by growing use of coal for cogeneration (the simultaneous production of electricity and either process heat or process steam). However, by 2010, industrial steam coal consumption is boosted to 83 million short tons as production of coal-based synthetic fuels begins to expand appreciably. Domestic demand for metallurgical coal should remain fairly constant at about 40 million short tons through 2000, then gradually slide to 32 million short tons by 2010 as coking facilities are retired and no new facilities are built (due to environmental restrictions). The forecast for industrial coal consumption is virtually the same in all three cases, because most of the variation in industrial energy demand is handled by other fuels.

Growth in Exports

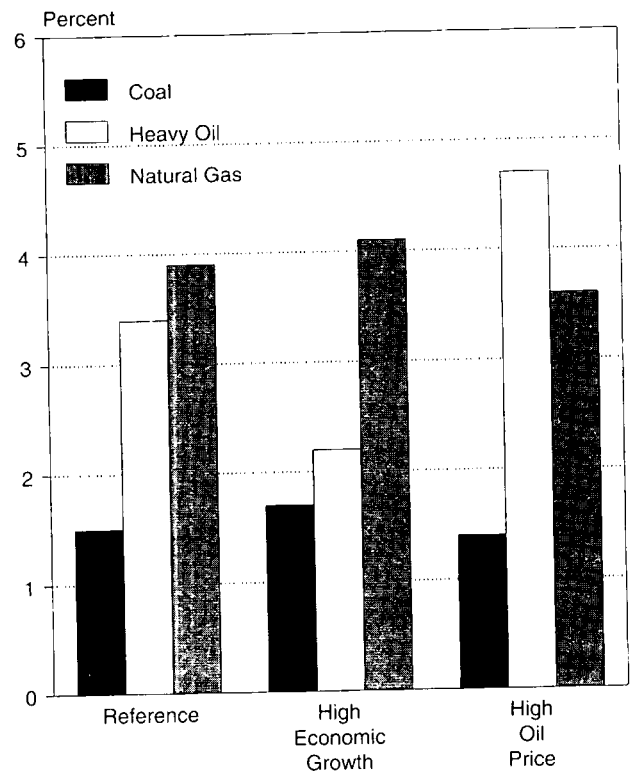
Economic reforms in Europe (such as eliminating coal production subsidies and the privatization of electricity generation), together with worldwide growth in the use of electricity, are expected to cause global coal trade to surge. With U.S. producers capable of capturing much of the additional Western European steam coal market over the forecast due to constraints on other coal-producing countries, U.S. coal exports are projected to more than double—from 101 million short tons in 1989 to approximately 250 million short tons by 2010 in both the Reference Case and the High Oil Price Case. In the High Economic Growth Case, exports rise even more—to 282 million short tons. While U.S. exports of steam coal thus rise rapidly, metallurgical coal exports are expected to fall. New steelmaking technologies will reduce coking coal requirements, and world production of crude steel is expected to grow very slowly.

Price Advantage Over Other Fuels

Projected minemouth coal prices rise in real terms throughout the forecast period, recovering from a steady decline that started in 1978. Increases in coal mine productivity should level off, and excess production capacity should dissipate. In the Reference Case, minemouth prices for coal escalate at the rate of 1.6 percent per year, rising from about $23 per short ton in 1989 to $32 by 2010. With only a moderate rise in the costs of coal transportation during the next 2 decades, the average delivered price of coal rises at a slightly lower rate—going from about $33 per short ton in 1989 to somewhat over $43 by 2010. In the High Oil Price Case, less demand for coal (a result of the generally lower demand for energy) induces slightly lower coal prices than in the Reference Case, while the higher energy demand of the High Economic Growth Case produces coal prices that are approximately $2 per ton higher than in the Reference Case.

However, coal prices rise less than other fuel prices in all cases (Figure 15). The Nation's abundant coal reserves can be mined at costs that should rise very gradually. Even in the High Economic Growth Case, which assumes a low world oil price, the delivered price of coal to electric utilities rises more slowly than the delivered price of heavy fuel oil. This is the primary reason why coal can increase its dominance in supplying fuel to the electric utility sector.

Figure 15. Annual Growth Rates of Fuel Prices to Electric Utilities, 1989-2010



Sources: Tables A3, C3, and D3.

Variables in Coal's Future

There are certain factors that are sure to have important effects on the coal industry, although the breadth, intensity, and timing of those impacts are highly uncertain. These include the way the Clean Air Act Amendments are implemented, the development of coal-based synthetic fuels, the entire complex area of world coal trade, and the possible effects on coal mining employment from technological and productivity changes. An even more difficult factor to project is the degree to which concerns about possible climatic change might limit the burning of coal (along with other fossil fuels that produce large amounts of a "greenhouse gas," carbon dioxide), through more strenuous energy conservation efforts or by any other means—such as a tax based on the carbon content of fossil fuels.

Effects of the Clean Air Act Amendments of 1990

Mine output in low-sulfur coal regions is expected to increase more strongly than in high-sulfur coal regions during the 1990's. This favorable outlook for low-sulfur coal is based on the inherent flexibility of the new acid rain legislation, which essentially favors some switching from high-sulfur to low-sulfur coal at existing coal-fired units. After 2000, the demand for high-sulfur coal should rebound, as more new coal-fired plants may choose to use stack gas scrubbers or one of the advanced "clean coal" technologies.

Electric utilities will be free to meet their emissions constraints by any of several methods—including the use of scrubbers, burning low-sulfur coal, adopting a new clean coal technology, trading emissions allowances, using fuels other than coal, and buying power from nonutilities. Therefore, the ultimate impact of the 1990 Amendments to the Clean Air Act on coal consumption and production (particularly the split between low-sulfur and high-sulfur coal) remains highly uncertain.

Coal-Based Synthetic Fuels

At present, the Great Plains Coal Gasification Plant in North Dakota produces most of the coal-based synthetic fuels in this country. This plant, which consumes approximately 6 million tons of lignite each year, should continue to operate through the forecast period; and its output is projected to increase substantially after 2005, when synthetic gas becomes more competitive as projected prices of natural gas rise.

The extent of other synthetic fuels production by 2010 will be affected by perceptions of future oil prices in the years to come and by the level of Government support for the development of synfuels technologies. Twenty years from now, even coal liquefaction could be commercially viable at the oil prices projected in this report.

World Coal Trade

The principal reasons why international coal trade is projected to grow are: (1) rapidly increasing demand for electricity in Asia, (2) the expected elimination of coal-production subsidies in Europe, (3) various constraints on supplies of natural gas for electricity generation, combined with uncertain prospects for nuclear power, and (4) more opportunities for Western countries to export coal to the former Eastern bloc countries, especially the former East Germany. The timing and extent of most of these developments involve issues of internal politics and international agreement; they are subject to a great deal of uncertainty.

Productivity and Employment in U.S. Coal Mining

The overall employment level in U.S. coal mines is determined by two basic factors: the amounts of coal to be produced and the level of productivity (the output per miner). Both are difficult to forecast, particularly the latter.

Coal mining productivity hit record levels in the 1980's, because of trends toward more efficient (generally larger) mines, increased mechanization, and fewer strikes by coal miners. All of these factors helped the industry to overcome the productivity declines that followed promulgation of health and safety regulations and reclamation laws during the 1970's. Productivity gains are assumed to level off in the future. Nevertheless, productivity is still expected to increase at a faster rate than production through 2000, so that employment would fall from 130,000 miners in 1989 to about 123,000 in 2000 under the assumptions of both the Reference Case and the High Oil Price Case. In the High Economic Growth Case, employment is steady, with the number of miners declining by only 600 from the 1989 level by the turn of the century.

As coal production outpaces the gains in labor productivity during the latter half of the forecast, however, a rebound in employment is projected. By 2010, employment ranges from 132,000 mining jobs in the High Oil Price Case to 152,000 jobs in the High Economic Growth Case.

Electricity Outlook

There are many issues that affect planning for future electricity supplies. These issues are regulatory requirements, recently enacted environmental legislation, difficulties in siting and licensing new plants, the potential revival of the nuclear power industry, and pressures to trim energy demand. Not all of these issues can be incorporated into the projections; it is assumed, for instance, that plant siting and licensing difficulties will be resolved. It should also be emphasized that end users of electricity are somewhat insulated from the industry's supply and planning difficulties because the electric power industry is regulated, and thus regulatory authorities structure electricity prices so as to mitigate the impacts of events that might otherwise cause large price increases. Recognizing the uncertainties associated with economic growth and world oil prices, this forecast provides a range of projections (Table 6) based on three sets of varying assumptions, rather than a single set of base case forecasts. The Low Oil Price Case is not displayed in this section as the electricity projections in that case do not differ significantly from those of the Reference Case. Because the electric industry is not a major consumer of oil, the lower oil price path assumption has little impact on the electricity projections.

Electricity Demand

Domestic electric power sales grew from 1985 to 1989 at the comparatively high average rate of more than 3.3 percent per year. Extreme weather conditions and a strong economy helped to boost this rate initially; but, more recently, a slowing economy and uncertain economic conditions have weakened the growth of power sales. Future increases in electricity sales are expected to be moderate. As a result of the different macroeconomic and demand assumptions, electricity sales are expected to grow at an average rate of between 1.6 and 2.4 percent per year. The Reference Case projects an intermediate rate of 2 percent annually.

Economic uncertainties and moderate economic growth may prompt electric power suppliers to plan conservatively for the years ahead. Electricity sales to all economic sectors are expected to increase, but not uniformly. Annual residential sales of electricity show potential growth of 0.8 to 1.5 percent per year from 1989 through 2010, while sales to the commercial and industrial sectors could grow by between 1.8 and 3.1 percent annually. Industrial sales are expected to experience the fastest growth in all cases because of increasing penetration of electricity-using technologies and processes in the industrial markets.

Electricity Supply

Utilities and other electricity suppliers have many options for providing a reliable supply of electricity. In the short term, there are no new plans to build large plants, because existing generating capacity and capacity additions that have already been announced are expected to provide sufficient electricity through the mid-1990's. Instead, many utilities will buy wholesale power—either from other domestic electricity suppliers (including nonutilities as well as other utilities with excess capacity) or will import electricity from Canada and Mexico. By 2000, nonutilities are expected to provide between 200 and 250 billion kilowatthours of electricity to utilities annually, while utilities may import another 55 billion kilowatthours of electricity each year. Such nonutility purchases and power imports together would account for about 8 percent of the net energy for load of utilities in 2000. Utilities may also consider refurbishing older units and extending their service lives in order to meet the anticipated demand growth.

Demand-side management and conservation programs will serve to trim the expected increase in load to a certain extent. A recent report prepared for the Electric Power Research Institute (EPRI) estimated that utility demand-side management and conservation programs will most likely lead to a reduction in overall electricity consumption of 3.0 percent by 2000 and 5.7 percent by 2010.[2] However, the EPRI report expressed considerable uncertainty about the estimate, placing the possible impacts by 2000 at anywhere between 0.9 and 9.8 percent.

[2]Electric Power Research Institute, *Impact of Demand-Side Management on Future Customer Electricity Demand: An Update* (Palo Alto, CA, August 1990).

Table 6. U.S. Electric Power Projections for 2010

	1989	1990 (Estimated)	2010		
			Reference	High Economic Growth	High Oil Price
Net Demand[a] (billion kilowatthours)					
Sales by Utilities	2,647	2,700	3,985	4,321	3,702
Nonutility[b] Self-Generation	95	96	131	149	127
Net Energy for Load (billion kilowatthours)	2,886	2,920	4,300	4,659	3,995
Net Electricity Imports	11	2	68	68	68
Purchase from Nonutilities	90	105	358	408	318
Generation by Utilities	2,785	2,813	3,874	4,183	3,609
Generation by Fuel Type—Utility and Nonutility (billion kilowatthours)					
Coal	1,587	1,592	2,312	2,504	2,062
Oil/Gas	506	488	879	1,022	809
Nuclear	529	575	611	654	623
Renewables/Other[c]	348	361	561	560	561
Total	2,970	3,014	4,363	4,739	4,055
Capacity—Utility (gigawatts)					
Coal	296	298	374	400	336
Oil/Gas	196	197	252	285	228
Nuclear	98	100	101	110	104
Renewables/Other[c]	95	95	103	103	103
Total	685	689	830	898	772
Capacity—Nonutility (gigawatts)					
Coal	6	6	22	27	17
Oil	1	1	2	2	2
Gas	14	17	25	31	22
Renewables/Other[c]	16	17	40	40	40
Total	37	41	89	100	81
Cumulative Utility Retirements from 12/31/89 (gigawatts)	—	1	49	46	46
Cumulative Additions from 12/31/89 (gigawatts)	—	9	245	322	177
Utility Announced	—	5	50	50	50
Utility	—	0	143	209	83
Nonutility	—	4	52	64	44
Average Electricity Prices[d] (1990 cents per kilowatthour)					
Capital	3.1	3.1	2.3	2.3	2.1
Fuel	1.8	1.8	2.9	2.9	3.0
Operating and Maintenance	2.1	2.1	2.1	2.0	2.1
Total	7.1	6.9	7.2	7.2	7.2

[a]Demand is expressed net of demand-side management. The High Oil Price Case assumes more conservation than the Reference Case, thus causing lower sales in the High Oil Price Case, even with identical economic growth in the two cases.

[b]Nonutilities include cogenerators, small power producers, independent power producers, and all other sources that produce electricity for self-use or for delivery to the grid, except electric utilities.

[c]Includes conventional and pumped storage hydroelectric, geothermal, wood, wood waste, municipal solid waste, other biomass, solar, and windpower, plus a small quantity of petroleum coke. For nonutilities, this category also includes waste heat, blast furnace gas, coke oven gas, and anthracite culm.

[d]Prices represent average revenue per kilowatthour of sales over all customer classes.

Note: Totals may not equal sum of components due to independent rounding.

Sources: Tables A4, A5, C4, C5, D4, and D5.

When it does become necessary to build new capacity (later in the 1990's), power suppliers are expected to add small combined-cycle and combustion turbine plants to meet the need for peaking and intermediate load capacity. Assuming that regulatory hurdles and siting and licensing difficulties can be overcome, between 73 and 104 gigawatts of new capacity should be built by 2000. More than one-third of this amount will be fueled by natural gas.

By the second half of the forecast period, it will become necessary for domestic electricity suppliers to resume the construction of baseload plants in most regions. Electricity suppliers will need between 177 and 322 gigawatts of new generating capacity by 2010. Power purchases from domestic nonutility sources will continue to play a key role in electricity supply, as will power imports from Canada and Mexico. By 2010, from approximately 320 to 410 billion kilowatthours of electricity may be furnished by nonutilities, and power imports are projected in the Reference Case to rise to 68 billion gigawatthours. These two sources together would then account for about 10 percent of the net energy for load of electric utilities. Utilities are expected to retire less than 50 gigawatts of generating capacity over the next 20 years; and most of the units being retired will probably be small, fossil-fueled steam plants.

Capacity additions over the next 20 years will profoundly affect the generation fuel-mix of the future. Between one-third and one-half of the new capacity added before 2000 is assumed to be gas–fired, causing natural gas to climb from a generating share of about 10 percent in 1989 to between 14 and 18 percent by 2000. Gas-fired generating capacity fills the need for intermediate and peak-load power, balancing out the current surplus of baseload capacity. In addition, the short lead times on orders of gas turbines and the expectation that natural gas prices will remain relatively low in the near future make gas-fired generating plants a logical choice in many situations.

During the first decade of the next century, however, about half of the 105 to 220 gigawatts of new capacity projected is likely to be coal-fired. There will be a need by then for new baseload generating capacity (for which coal has been especially well suited), and coal prices will almost certainly be relatively low.

Construction of these new coal plants should restore coal's share of total power generation by 2010 to 1989 levels (about 53 percent), after it has declined to approximately 50 percent in 2000. As a result of the increase in generating capacity fueled by natural gas, gas-fired generation could overtake nuclear power generation as the second-largest electricity contributor, with a 16-percent share by 2010 in the Reference Case. Nuclear generation, which increases only slightly over the projection period, should continue to provide approximately 14 to 15 percent of the Nation's electricity by 2010, down from 18 percent in 1989. Renewable sources (still consisting principally of hydropower) contribute 12 to 14 percent to total electricity generation in the *AEO91* projections, while oil continues to account for only a small portion of total power generation—4 to 6 percent.

It is still uncertain how the ownership of capacity to be built during the next 20 years will be divided between traditional utilities and nonutility sources. Nonutilities include cogenerators (generally large industrial power consumers who generate electricity for their own needs and sell the excess power to local utilities) as well as independent power producers. The Public Utility Regulatory Policies Act of 1978 (PURPA) encouraged the growth of nonutility sources by obliging utilities to buy the power produced by nonutilities who qualify under the criteria of the law at the cost avoided by the utilities through those purchases. Today, nonutilities form an important segment of the electricity supply market, and their significance is expected to increase in the future. Of the 73 to 104 gigawatts of new capacity expected by 2000, more than one-third is projected to be built and owned by nonutility sources. By 2010, potentially one-fifth of the total 177 to 322 gigawatts of new capacity will be owned and operated by nonutilities (Figure 16).

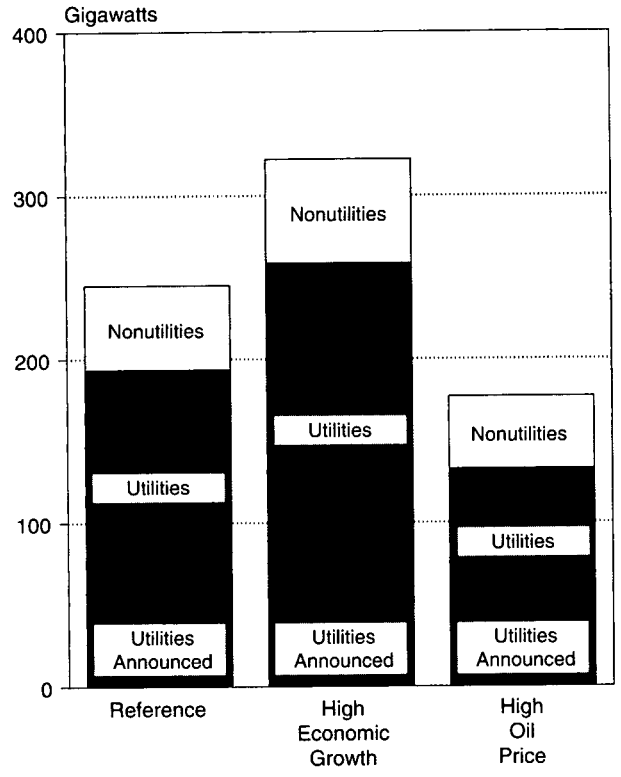
Electricity Prices

EIA's model for forecasting prices mimics the methods regulators actually use in setting rates. The effect of these methods is to spread the costs of investments over many years[3] and protect ratepayers from sudden surges that might otherwise occur. The price of electricity is actually an aggregate of three basic components: fuel costs, operating and maintenance (O&M) expenses, and capital expenditures. Ratemakers determine revenue required for each of these components separately.

The fuel component in utility rates is calculated by taking the estimated total allowed expense for fuels to generate electricity (fuel-related revenue requirements) and dividing that figure by anticipated electricity sales. The O&M component is derived using the same

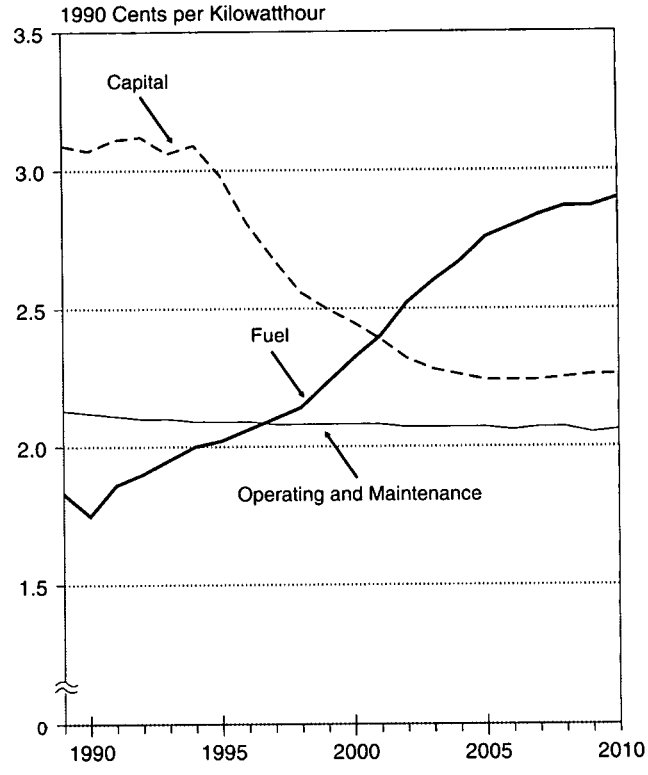
[3]The full cost of a new generating plant is normalized and recovered over a substantial length of time, generally 30 years.

Figure 16. Prospective Additions by 2010 to U.S. Generating Capacity



Sources: Tables A5, C5, and D5.

Figure 17. Components of Electricity Price for the Reference Case, 1989-2010



Source: Table A4.

method. The capital cost component is a little less straightforward; it actually comprises three subcomponents: the estimated allowed return on the ratebase[4] (i.e, the return to investors), annual depreciation, and taxes.

Nationally, electricity prices are expected to increase only slightly over the forecast period. However, the relative weights of the components that make them up are expected to change substantially (Figure 17). The fuel component increases at an average rate of 2 percent in real terms from 1989 through 2010, because the costs to utilities of all fuels (but especially of natural gas) are expected to increase. The O&M price component varies little, because the revenue requirements for O&M increase at about the same rate as sales. The capital component decreases steadily between the mid-1990's and the early years of the next century, keeping the increased fuel component from driving electricity prices higher.

The Nation's total ratebase is expected to decrease from $381 billion in 1990 to $342 billion in 2000 (in 1990 dollars). This decline, an annualized 0.1-percent drop in the real rate of growth, is expected for three reasons:

- Few new capital-intensive baseload plants are coming on-line between now and 2000.
- The cost of more than 40 percent of the capacity that will be on-line in 2000 will have been fully recovered by then.
- Additions to capacity will generally involve extending the operational lives of existing plants. The cost of life extension is approximately 20 percent of the cost of building completely new power plants.

With new baseload plants coming on-line after the turn of the century, the ratebase will increase to $416 billion by 2010, representing a 2-percent annualized rate of growth, which is the same as the annual rate of growth in electricity sales. Factors that cause the capital component to grow less than historically are that new plants are not expected to be as expensive to build as

[4]The ratebase is the sum of all capitalized assets on which the ratemaking commission allows the utility to earn a return.

those brought on-line during the early and mid-1980's, the forecasts assume that supply meets demand and that no excess capacity is built, and more than 70 percent of the capacity on-line in 2010 will have been fully cost-recovered. Plants built before 2005 will rely on existing generating technologies, whose construction costs are expected to remain constant in real terms. After 2005 new and more efficient generating technologies should become available and be used; but the capital-related costs of these technologies are projected to be no higher than those of existing technologies.

Little variation is seen in the price of electricity across the cases considered by *AEO91*. This is because the capital component of price offsets the fuel component, both across cases and over time. The High Economic Growth Case results in faster sales growth than does the High Oil Price Case, causing the capital component to be lower. At the same time, however, the High Economic Growth Case results in increased expenditures for fuel; and this tends to offset differences in the capital components. Specifically, the High Economic Growth Case results in greater consumption of natural gas, because this case involves higher electricity demand.

Nuclear Power

At the end of 1990, there were 111 operable nuclear units in the United States, with a total net generating capacity of 99.6 gigawatts. During the year, two new units (with a total capacity of 2.3 gigawatts) had begun operation, while one unit (the 873-megawatt Rancho Seco) was retired. Of the nine units still remaining in the construction pipeline, six (totaling 7.4 gigawatts) have been deferred indefinitely. Three (totaling 3.5 gigawatts) are actively under construction and are expected to begin operation by 1995.

Several events of 1990 could affect significantly the licensing of nuclear units and the availability of a repository for high-level nuclear waste. In July, the Nuclear Regulatory Commission (NRC) published a *proposed* rule for establishing procedures by which utilities may apply to renew a nuclear unit's operating license when the original or revised 40-year license term expires. This ruling is expected to take effect essentially by 1994, and many utilities are then expected to apply for license renewals of up to 20 years.

On the other hand, the U.S. Court of Appeals in 1990 struck down the pre-operational hearing provision of a 1989 NRC administrative rule, which provided for combining the issuance of a construction permit and an operating license. The Court ruled that, upon request, the NRC must provide a pre-operational public hearing after construction is complete—to deliberate any issues raised about the plant's conformance with the Atomic Energy Act and any significant new information. The Court found that reform of the hearing process was the responsibility of the Congress. Currently, one bill (S. 341) has been introduced in the U.S. Senate and another is being prepared by the Department of Energy, as part of the National Energy Strategy, to streamline the licensing process. While S. 341 acknowledges that a combined license can be issued under the existing Atomic Energy Act, the Department of Energy version goes further by explicitly establishing the provision of a combined license. Both bills would limit the scope of any post-construction hearing.

Vendors, utilities, and the NRC continue to work on other provisions of the 1989 rulemaking that concern standardized reactor designs and their certification, as well as certification of potential plant sites in advance. Current expectations are that the first set of standardized designs (the so-called evolutionary designs) could be approved by the NRC in the 1993-to-1995 timeframe. More advanced designs, which include passive safety features, could be approved by about 1996-1998.

The lack of a permanent repository for high-level nuclear waste (spent fuel) continues to be a problem for the industry. The location selected by Congress for further study and characterization is the Yucca Mountain site in Nevada. Thus far, that State has resisted further consideration of the site, primarily by denying site-access permits. The President has appointed, and the Senate has confirmed, a Nuclear Waste Negotiator—who will attempt to find a State or Native American tribe that is willing to host a repository or a monitored retrievable storage facility at a technically qualified site. Also, the NRC has amended its regulations to authorize the onsite storage of spent fuel at the nuclear power plants where it originates, using approved dry-storage casks under a general license.

Figure 18 shows how the contribution of nuclear utilities has grown during the past 20 years and how it might grow during the next 20—depending on various assumptions *AEO91* makes in conjunction with the Reference Case and its other projections. While nuclear capacity was not projected explicitly by the modeling framework, the operable dates for units under construction or expected to be constructed were established individually.

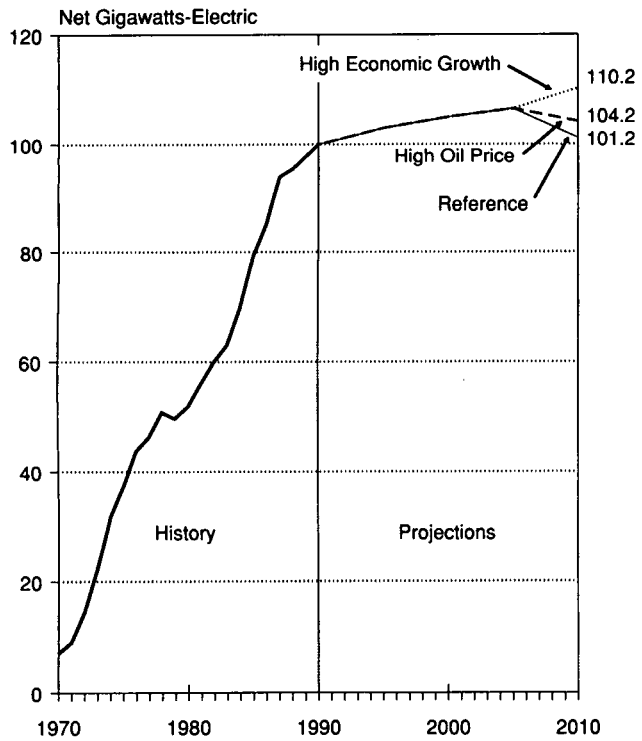
The Reference Case assumes that there are no changes to current laws and regulations—and that, therefore, certain reforms deemed necessary for new nuclear orders are not realized. For example, there would be no licensing reform, since it must be legislated. Also, existing units could not undertake life extension, a process that requires the adoption of final NRC regulations. These restrictions, in turn, affect public acceptability and plant economics. As a result of such restrictions, the Reference Case projects the lowest nuclear capacity of any *AEO91* scenario (101.2 gigawatts). This capacity is projected to generate 611 billion kilowatthours in 2010, which would be about 14 percent of all U.S. electricity generation.

The High Oil Price Case assumes that 50 percent of all existing units will elect to undertake a 20-year life extension, and that all such extension applications (for units whose current licenses expire before 2011) will be approved by the NRC. It also assumes, however, that no new plant orders will be placed in time for them to start operation by 2010. This assumption is made in the light of the low economic growth that accompanies a high world oil price and of the remaining barriers to new nuclear orders. In this case, projected nuclear capacity increases from 99.6 gigawatts in 1990 to 105.4 gigawatts in 2000 and then declines to 104.2 gigawatts in 2010. This case includes six units (totaling 2.6 gigawatts) that are not life-extended and thus retire between 2000 and 2010. Nuclear generation in the High Oil Price Case increases from 529 billion kilowatthours in 1989 to 623 billion kilowatthours in 2010. The nuclear share of electricity generation declines from about 18 percent in 1989 to about 15 percent in 2010.

The High Economic Growth Case goes farther. It assumes that utilities resume orders in the late nineties and that these units become operable in the years 2006 through 2010. In each of those years, two 600-megawatt light-water reactors of advanced design become operable. This case assumes additionally that 70 percent of existing reactors are life-extended. Implicit in this case is the assumption that the following major obstacles to new nuclear orders have been overcome: (1) public concerns about operational safety, (2) concerns about the disposal of radioactive waste, (3) uncertainty in licensing and regulatory processes, and (4) uncertainty about performance, economics, and financial risk.

Under these circumstances, nuclear capacity increases to 110.2 gigawatts in 2010 and the total generation increases from 529 billion kilowatthours in 1989 to 654 billion kilowatthours in 2010. Because other non-nuclear plants come on-line in the High Economic Growth Case, however, the nuclear share of total electricity declines from about 18 percent in 1989 to about 14 percent in 2010.

Figure 18. Growth of Domestic Nuclear Generating Capacity, 1970-2010



Sources: **History:** *Annual Energy Review 1989.* **Projections:** Tables A5, C5, and D5.

Renewable Energy

Renewable energy resources are those that replenish themselves naturally. These include hydropower, geothermal, solar thermal, ocean thermal, photovoltaic, wind and biofuels. Biofuels include wood, municipal solid waste, landfill and sewer gas, and biomass-based liquid fuels (either ethanol or methanol). These resources span a broad spectrum, from mature and stable technologies to technologies and applications that either are maturing (and just beginning to be applied in energy production for specialized markets) or are still in the early stages of development.

In 1989, renewable energy output from all sources totaled 6.2 quadrillion Btu—or approximately 9 percent of the 70 quadrillion Btu of primary energy produced in the United States. Fifty-six percent of this renewable energy (3.5 quadrillion Btu) was used to produce

electricity. The other 44 percent represented nonelectric renewable energy produced and used by the residential, commercial, industrial, and transportation sectors; it was discussed earlier in this report (page 16).

Of all renewable resources used in electric power generation during 1989, hydroelectric power accounted for almost 83 percent. Municipal solid waste and biomass contributed a little less than 6 percent each—for about 11 percent together. Geothermal, solar thermal, and wind accounted for the remaining 6 percent.

AEO91 uses only a single set of projections in all of its cases for the renewable energy used to produce electricity, because the major renewable sources of electricity generation (hydropower, geothermal energy, and the use of municipal solid waste as boiler fuel) are not very sensitive to the ranges of change in economic growth and in world oil prices considered in the four cases. The projected further penetration of the generation market by renewable technologies depends mostly on issues such as licensing new facilities, recycling efforts, water availability, location of resources (in relation to needs and infrastructure), and fiscal incentives.

AEO91 assumes that the contribution to electric power generation from renewable energy will grow at an annual average of 2.2 percent—slightly above the overall growth rate for all generation in the Reference Case. But it also projects that the mix of renewable energy sources that feed into electricity will change considerably by 2010.

Nonhydropower generation is expected to account for nearly half (44 percent) of the total by that time. Environmental concerns, operational inefficiencies, and difficulties with regulatory licensing and relicensing are the principal factors assumed to constrain much improvement or expansion of available hydroelectric resources. The other major renewable energy sources (geothermal, municipal solid waste, and solar thermal technologies) are projected to exhibit substantial average growth rates during the 1989-2010 period (ranging between 8 and 10 percent annually); but all of these start from relatively low bases.

Counting both the renewable electricity generating capacity that is owned by utilities and that owned by nonutilities, the total is expected to increase from 88 gigawatts in 1989 to 116 gigawatts in 2010. Biofuels (including municipal solid waste, wood, and wood wastes) contribute almost 44 percent (12.4 gigawatts) of this projected increase. They are followed by geothermal power, which adds another 29 percent. Hydroelectric, wind, solar thermal, and photovoltaic resources account in combination for the balance (approximately 7.8 gigawatts).

It is difficult to project whether ownership of renewable electricity generating facilities in the future will be dominated by utilities or by the independent power producers (IPPs), the qualifying facilities (QFs), or even the industrial cogenerators. Based on capacity additions in recent years and reports of expected future additions, however, EIA expects *non*utilities to provide the majority of new generating capacity fueled by renewable energy sources during the 1990-2010 period.

Comparison of These Projections with Other Forecasts

This section of the *Annual Energy Outlook 1991* compares eight alternate energy projections for the year 2010 (Table 7). It contrasts the EIA Reference Case, Low Oil Price Case, High Economic Growth Case, and High Oil Price Case scenarios with forecasts by DRI/McGraw-Hill (DRI), the WEFA Group (WEFA), the Gas Research Institute (GRI), and the American Gas Association (AGA). The external forecasts, which include two macroeconomic service studies and two independent gas sector studies, were chosen for comparison because they all provided estimates for 2010. Other independent oil, electricity and coal forecasts were considered but not included because they either did not extend to the year 2010 or provided only limited coverage of certain energy sectors.

All the external forecasts are based on scenarios of moderate but steady increases in world oil prices, allowing for both economic growth and growth in oil consumption. Future U.S. economic growth is expected to be slower than it has been in recent history, partly because of higher oil prices and partly because of slower growth in the size of the labor force. Non-OPEC oil production declines during the forecast period, so OPEC output increases to service a steadily growing share of the world oil market. The current crisis in the Middle East is generally believed to be of short duration, after which the world oil market should return to the oil price track that preceded the crisis. By 2010, mid-case estimates of world oil prices are generally assumed to double from the pre-crisis level.

Oil Price and Macroeconomic Assumptions

World oil price assumptions in all of the non-EIA forecasts fall within the range of approximately $23 to $45 per barrel established by the various *AEO91* cases. All of the non-EIA forecasts are generally comparable to the EIA Reference Case, with WEFA being about $3 per barrel lower and the other forecasters $1 to $3 per barrel higher.

Macroeconomic growth assumptions of the four non-EIA forecasts are similar to the baseline forecast used by EIA. The GNP growth rate assumed in EIA's High Economic Growth Case (2.8 percent) is substantially higher than any of the other forecasts. Assumptions of inflation levels by DRI, WEFA, and AGA were slightly higher than the *AEO91* range of 4.0 to 4.1 percent; GRI's was 4.8 percent. Assumptions about growth in real disposable personal income all fall within the *AEO91* band of 1.7 to 2.3 percent. The higher growth rate associated with the WEFA and AGA forecasts is consistent with the higher growth rate projected for GNP.

Price Forecasts

The non-EIA assumptions of world oil price fall within the range established by the four cases in *AEO91*. The outlook for natural gas prices is determined by expectations about gas supply and demand. Natural gas prices will begin a consistent rise by the late 1990's, given the steady growth in demand projected. DRI and GRI both project natural gas wellhead prices in the area of $5.50, slightly above those in the *AEO91* cases. WEFA's projection falls within the range of the *AEO91* cases, whereas AGA has the lowest projection for the wellhead price—$3.47 per thousand cubic feet. This is more than $1.20 per thousand cubic feet lower than any other forecast presented in this comparison. The AGA expects improved drilling technology to recover more gas in the future at less cost.

Across the forecasts, coal prices at the minemouth increase by about 50 percent between 1989 and 2010, settling in a range between $31.22 and $33.52 per short ton. DRI and AGA did not provide projections for minemouth prices. Higher transportation costs and greater requirements for reducing emissions are two primary factors that contribute to the higher prices.

Electricity prices are projected by all the forecasters except WEFA to remain relatively flat at around 7 cents per kilowatthour. Increased utility reliance on relatively inexpensive coal over the forecast period and declining capital costs per kilowatthour generated restrain electricity prices. As a result of a variety of factors, WEFA's electricity price forecast is approximately 1 cent per kilowatthour above the others.

Table 7. Comparison of Forecasts—Summary for 2010

	1989	Alternative Projections for 2010							
		AEO91				Other Forecasts			
		Reference	Low Oil Price	High Economic Growth	High Oil Price	DRI	WEFA	GRI	AGA
Prices (1990 dollars)									
World Oil Price (dollars per barrel)	18.81	34.20	23.40	23.40	45.40	36.74	31.40	35.30	37.82
Natural Gas Wellhead (dollars per thousand cubic feet)	1.76	5.04	4.68	5.21	4.73	5.40	4.86	5.55	3.47
Coal (minemouth) (dollars per short ton)	22.70	31.64	31.22	33.52	31.34	n/a	32.04	31.80	n/a
Electricity (average) (cents per kilowatthour)	7.05	7.22	7.09	7.17	7.17	7.14	8.46	6.78	7.63
Macroeconomic Growth (average annual percent change, 1989-2010)									
Real GNP	([a])	2.1	2.2	2.8	2.1	2.1	2.3	2.2	2.3
Inflation Rate	([a])	4.1	4.1	4.0	4.1	4.3	4.4	4.8	4.4
Personal Income	([a])	1.7	1.8	2.3	1.7	1.7	2.1	1.8	2.1
Supply (Domestic Production)									
Crude Oil and Natural Gas Liquids (million barrels per day)	9.2	6.0	4.9	5.0	6.8	6.3	5.9	8.0	n/a
Crude Oil (million barrels per day)	7.6	4.4	3.4	3.4	5.2	4.7	4.4	6.4	n/a
Natural Gas[b] (trillion cubic feet)	17.4	19.3	18.2	19.6	18.8	19.4	16.5	20.4	22.0
Coal (million short tons)	981	1,492	1,466	1,604	1,372	1,270	1,463	1,371	n/a
Utility Electricity Generation (billion kilowatthours)	2,785	3,874	3,911	4,183	3,609	3,739	3,995	3,722	n/a
Net Imports									
Petroleum (million barrels per day)	7.2	13.0	15.8	17.7	10.8	13.9	13.2	14.5	n/a
Natural Gas (trillion cubic feet)	1.3	3.1	3.1	3.1	2.7	3.3	3.0	2.7	2.4
Coal (million short tons)	-98	-240	-240	-270	-238	-127	-103	-126	n/a
U.S. Oil Import Dependence (%)	42	64	73	74	57	65	66	63	n/a
Domestic Consumption									
Petroleum Products (million barrels per day)	17.3	20.3	21.8	24.0	18.9	21.3	20.0	23.2	16.9
Motor Gasoline	7.3	8.1	8.5	9.3	7.5	8.7	7.7	8.2	n/a
Jet Fuel	1.4	2.2	2.3	2.8	2.1	2.0	2.3	2.1	n/a
Distillate Fuel	3.1	3.9	4.0	4.5	3.6	4.2	4.0	4.7	n/a
Residual Fuel Oil	1.4	1.5	2.2	2.2	1.4	1.7	2.1	3.3	n/a
Natural Gas (trillion cubic feet)	18.8	21.7	20.7	22.0	20.8	22.5	19.6	22.6	24.5
Coal (million short tons)	889	1,244	1,220	1,325	1,130	1,139	1,276	1,238	1,094
Electricity Sales (billion kilowatthours)	2,647	3,985	4,009	4,321	3,702	3,546	3,939	3,892	4,308
Total Energy Demand (quadrillion Btu)	**84.7**	**106.9**	**108.8**	**116.8**	**101.3**	**n/a**	**n/a**	**111.8**	**n/a**
Excluding Dispersed Renewables	82.0	101.3	103.2	111.2	95.7	100.9	99.1	106.4	94.5

[a]During 1989 the Gross National Product was approximately $5.20 trillion ($4.12 trillion in 1982 dollars). The implicit price deflator for that year (indexed to 1982) was 1.263. Real disposable personal income amounted to $2.87 trillion in 1982 dollars.

[b]Includes supplemental gas.

Sources: See references at the end of this section.

Energy Demand Projections

All the non-EIA forecasts of total energy demand, except that of AGA, fall within the EIA case range of 95.7 to 111.2 quadrillion Btu, but reflect the variations in projected oil prices and assumptions about economic growth. AGA's forecast of total energy demand (less dispersed renewables), at 94.5 quadrillion Btu, closely corresponds to the *AEO91* High Oil Price Case. WEFA and DRI forecasts correspond to the Reference Case.

Virtually all of the oil consumption forecasts, including the breakdown of consumption into oil products, were within the *AEO91* range and were comparable with the Reference Case. One exception is GRI, which comes closer to the High Economic Growth Case. GRI believes that the potential for oil conservation is small, based on a low price track for oil, and that oil prices will be competitive with those for gas. Only GRI's forecasts of residual and distillate fuel oil consumption are outside of the *AEO91* range and are significantly higher than EIA's High Economic Growth Case. According to GRI, this reflects high demand for distillate fuel oil (in the form of diesel fuel) for the transportation sector. The high demand forecast for residual fuel oil in the utility and industrial sectors is based on GRI's judgment that residual fuel oil prices will be closely competitive with those of natural gas. DRI has the lowest forecast for jet fuel consumption in 2010.

All forecasters agreed that higher oil prices in the late 1990's will permit both higher prices for gas and greater use of gas. This should make future gas development more profitable. They also agreed that the greatest growth in gas demand will occur in the electric utility sector (where it doubles from 1989 levels) in response to the favorable prices relative to oil, a shift to greater use of combined-cycle plants, and new Clean Air Act requirements that restrict the use of high-sulfur coal. WEFA is less optimistic than many forecasters concerning the growth of demand for natural gas for electricity generation, as well as the extent to which natural gas consumption will increase to meet the requirements of the Clean Air Act. AGA forecast the highest demand for natural gas, reflecting its projection of higher gas use across the consumption sectors. AGA projects 1.2 quadrillion Btu of natural gas use by gas vehicles in 2010.

Demand for electricity generally tracks economic growth. Electricity sales are expected to slow as the underlying drivers of the economy also slow. The forecasts reflect rising demand for electricity in the industrial sector as electricity-using technologies increasingly penetrate and there is more growth in those segments of industry that use electricity intensively. DRI's baseline projection of electricity demand was slightly below that in the High Oil Price scenario of *AEO91*. WEFA and GRI projections of electricity demand were close to the *AEO91* Reference Case. DRI's electricity demand projection was based on its expectation that intensity of electricity use will decline because gains in efficiency will more than offset electrification trends. AGA's forecast of electricity demand is close to the *AEO91* High Economic Growth Case, with the residential sector's demand for electricity showing the largest absolute increase.

Coal demand tracks rising demand for electricity and the long-term move to coal-based technology. The GRI and WEFA projections of coal consumption are close to the *AEO91* Reference Case, while AGA and DRI's projections are comparable to the EIA High Oil Price. AGA projection of coal demand is the lowest, while its projection of electricity demand is the highest. AGA believes that new environmental restrictions favor increased gas demand in the electric utility sector, reflecting AGA's belief that the share of gas in generating fuel use will grow by 71 percent over the forecast period while coal's share will grow by only 16 percent.

Energy Supply Projections

Declining U.S. petroleum production will necessitate increasing oil imports. With the exception of GRI, all the non-EIA forecasts of U.S. oil production were within the *AEO91* range of between 3.4 and 5.2 million barrels per day. GRI's oil production projection was more than 1 million barrels per day above that in the High Oil Price Case. Projections of net oil imports ranged from 10.8 to 17.7 million barrels per day, with all the non-EIA forecasts within the *AEO91* range. GRI's oil import level was 1.5 million barrels per day higher than the EIA Reference Case, in line with its forecast of oil demand—which was almost 3 million barrels per day higher.

Differences in projections of natural gas production reflected varying estimates of the price levels for gas and oil that will induce additional exploration and development as currently known U.S. gas reserves shrink. All forecasts agree that natural gas imports will more than double during the next 20 years. GRI and AGA projected the highest levels of natural gas production. In the case of GRI, this is balanced by lower gas imports. GRI noted that environmental policy changes are already influencing fuel choices in

favor of gas. WEFA's projection of natural gas production is the lowest, even below 1989 production of 17.3 trillion cubic feet. The WEFA outlook is based on several factors, which include a decline in gas demand as electricity becomes more competitive (particularly in the industrial sector), coupled with gas prices that are not strong enough to justify extensive exploration and development to replace current proved reserves as they are exploited.

Forecasts of coal production are based primarily on electricity demand. It is generally assumed that there are no long-term capacity constraints and that coal production can meet domestic demand plus exports. EIA's coal production forecasts are also significantly influenced by high coal exports, particularly in the High Economic Growth Case. EIA projects strong demand for U.S. steam coal in northern Europe—because of the expected elimination of coal production subsidies there, the privatization of electricity generation, and significant constraints on the availability of coal from the U.S.S.R., Poland, and other traditional suppliers. The low DRI forecast for coal production is in line with a lower forecast of electricity sales in 2010. Forecasts of increases in electricity generation range from 30 to 50 percent over the forecast period, with all the non-EIA forecasts falling in the *AEO91* range.

References

Energy Information Administration, this volume.

DRI/McGraw-Hill, *Energy Review*, Winter 1990-91.

Gas Research Institute, *GRI Baseline Projection of US Energy Supply and Demand 1991 Edition*, August 1990.

The WEFA Group, *Energy Analysis Quarterly*, Winter 1991.

The WEFA Group, *U.S. Long Term Economic Outlook*, Third Quarter 1990, Volume 1, Trend/Moderate Growth Scenario.

American Gas Association, *AGA-TERA Base Case Analysis* (Arlington, VA, December 1990).

Appendix A

Reference Case Projections

Table A1. Total Energy Supply, Disposition, and Prices (Quadrillion Btu per Year, Unless Otherwise Noted)

Supply, Disposition, and Prices	Reference Case						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Production							
Crude Oil and Lease Condensate [1]	16.24	15.46	14.59	11.72	10.18	10.12	-2.2
Natural Gas Plant Liquids	2.15	2.14	2.15	2.32	2.33	2.24	.2
Dry Natural Gas [2]	17.91	18.11	18.89	20.35	20.63	19.91	.5
Coal	21.36	22.54	22.67	24.04	27.17	31.59	1.9
Nuclear Power	5.69	6.14	6.21	6.47	6.70	6.67	.8
Renewable Energy [3]	6.43	6.81	7.75	8.90	10.33	11.64	2.9
Total	69.78	71.20	72.26	73.82	77.34	82.16	.8
Imports							
Crude Oil [4]	12.58	12.94	13.68	18.62	19.92	20.01	2.2
Petroleum Products	4.48	4.21	5.07	5.42	7.45	9.22	3.5
Natural Gas [5]	1.32	1.40	2.37	2.64	3.04	3.19	4.3
Other Imports [6]	.22	.11	.52	.78	1.07	1.27	8.8
Total	18.60	18.66	21.64	27.46	31.48	33.68	2.9
Exports							
Coal	2.61	2.64	2.80	3.44	4.99	6.29	4.3
Petroleum	1.81	1.71	1.60	1.66	1.74	1.84	.1
Total	4.42	4.35	4.40	5.10	6.73	8.12	2.9
Net Stock Withdrawals	.44	-.67	-.20	-.19	-.16	-.20	-
Discrepancy [7]	.29	-.45	-.25	-.35	-.50	-.65	-
Consumption							
Petroleum Products [8]	34.21	33.49	34.22	36.70	38.45	39.94	.7
Natural Gas	19.37	19.11	20.63	22.31	22.96	22.41	.7
Coal	18.91	18.90	19.93	20.73	22.29	25.38	1.4
Nuclear Power	5.69	6.14	6.21	6.47	6.70	6.67	.8
Renewable Energy/Other [9]	6.50	6.76	8.06	9.41	11.02	12.48	3.2
Total	84.69	84.39	89.05	95.63	101.40	106.90	1.1
Net Imports - Petroleum	15.25	15.44	17.15	22.37	25.63	27.39	2.8
Prices (1990 dollars per unit)							
World Oil Price ($ per barrel) [10]	18.81	22.00	24.00	25.70	31.00	34.20	2.9
Natural Gas Wellhead Price ($ per Mcf)	1.76	1.77	2.12	2.61	4.09	5.04	5.1
Coal Minemouth Price ($ per ton)	22.70	22.18	24.69	27.12	29.99	31.64	1.6

[1] Includes other hydrocarbons, ethanol, and synthetic crude oil.
[2] Includes synthetic gas.
[3] Includes utility and nonutility electricity from hydroelectric, geothermal, wood and wood waste, municipal solid waste, other biomass, wind, photovoltaic and solar thermal sources; non-electric energy from renewable sources such as active and passive solar systems, groundwater heat pumps, and wood; alcohol fuels from renewable sources; and in addition to renewables, electricity from waste heat.
[4] Includes imports of crude oil for the Strategic Petroleum Reserve.
[5] Represents net imports.
[6] Includes coal, coal coke (net), electricity (net), and methanol.
[7] Balancing item. Includes unaccounted for supply, losses, and gains.
[8] Includes natural gas plant liquids, crude oil consumed as a fuel, and nonpetroleum based liquids, such as ethanol.
[9] Includes utility and nonutility electricity from hydroelectric, geothermal, wood and wood waste, municipal solid waste, other biomass, wind, photovoltaic and solar thermal sources; non-electric energy from renewable sources such as active and passive solar systems, groundwater heat pumps, and wood; alcohol fuels from renewable sources; and in addition to renewables, electricity from waste heat, plus net coal coke imports, and net electricity imports.
[10] Average refiner acquisition cost for imported crude oil.
Note: Totals may not equal sum of components due to independent rounding.
Sources: 1989: Calculated from values in Tables A4 through A10 using the conversion factors in Appendix G. 1990: preliminary estimates. Projections: Energy Information Administration, AEO 1991 Forecasting System run IGMDCA.D0116914.

Table A2. Energy Consumption by End-Use Sector and Source (Quadrillion Btu per Year)

Sector and Source	Reference Case						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Residential							
Distillate Fuel	1.06	1.05	0.93	0.79	0.69	0.60	-2.7
Kerosene	.10	.11	.09	.07	.06	.05	-3.1
Liquefied Petroleum Gas	.46	.43	.40	.36	.32	.29	-2.2
Natural Gas	4.91	4.51	4.86	4.86	4.81	4.69	-.2
Coal	.06	.06	.06	.06	.06	.06	-.1
Renewable Energy [1]	.89	.92	1.03	1.21	1.54	1.95	3.8
Electricity	3.09	3.17	3.45	3.64	3.83	4.02	1.3
Total	10.58	10.24	10.81	10.99	11.30	11.66	.5
Commercial							
Distillate Fuel	.57	.56	.53	.49	.45	.42	-1.5
Kerosene	.04	.04	.03	.03	.02	.02	-3.1
Motor Gasoline [2]	.11	.11	.13	.13	.14	.15	1.4
Residual Fuel	.26	.25	.21	.18	.15	.13	-3.1
Natural Gas	2.80	2.65	2.85	2.93	2.97	2.98	.3
Other [3]	.17	.17	.14	.12	.11	.09	-2.9
Renewable Energy [1]	.05	.08	.13	.21	.36	.56	12.1
Electricity	2.77	2.85	3.20	3.56	3.98	4.46	2.3
Total	6.76	6.70	7.22	7.66	8.19	8.80	1.3
Industrial [4]							
Distillate Fuel	1.21	1.02	1.32	1.52	1.66	1.79	1.9
Liquefied Petroleum Gas	1.68	1.58	1.77	1.99	2.20	2.39	1.7
Motor Gasoline [2]	.19	.19	.21	.23	.25	.26	1.5
Petrochemical Feedstocks	.93	.97	1.07	1.24	1.39	1.53	2.4
Residual Fuel	.64	.61	.66	.71	.75	.79	1.0
Other Petroleum [5]	3.66	3.85	3.53	3.58	3.59	3.63	.0
Natural Gas [6]	8.14	8.39	8.53	8.94	8.50	8.18	.0
Metallurgical Coal	1.10	1.01	1.08	1.00	.92	.85	-1.2
Steam Coal	1.70	1.68	1.68	1.67	1.69	1.83	.4
Net Coal Coke Imports	.03	.01	-.03	.04	.10	.14	7.5
Renewable Energy [1]	1.91	2.04	2.35	2.68	3.04	3.43	2.8
Purchased Electricity	3.16	3.18	3.43	3.97	4.55	5.08	2.3
Total	24.37	24.54	25.59	27.58	28.63	29.90	1.0
Transportation							
Distillate Fuel	3.72	3.71	4.05	4.44	4.87	5.28	1.7
Jet Fuel	3.06	3.09	3.31	3.74	4.13	4.57	1.9
Motor Gasoline [2]	13.75	13.56	13.51	14.06	14.63	15.08	.4
Residual Fuel	.77	.74	.68	.76	.84	.91	.8
Other Petroleum [7]	.23	.24	.25	.27	.30	.32	1.6
Pipeline Fuel Natural Gas	.65	.63	.69	.75	.77	.78	.9
Compressed Natural Gas	.00	.00	.00	.01	.03	.06	-
Alcohol Fuels	.00	.00	.00	.01	.07	.14	-
Electricity	.02	.02	.02	.02	.03	.04	4.0
Total	22.19	21.99	22.50	24.06	25.67	27.18	1.0
Electric Utilities [8]							
Distillate Fuel	.10	.08	.08	.19	.19	.15	1.7
Residual Fuel	1.58	1.22	1.40	1.86	1.77	1.55	-.1
Natural Gas	2.87	2.93	3.70	4.82	5.87	5.72	3.3
Steam Coal [9]	15.96	16.06	17.04	17.94	19.57	22.60	1.7
Nuclear Power	5.69	6.14	6.21	6.47	6.70	6.67	.8
Renewable Energy/Other [10]	3.62	3.71	4.58	5.25	5.92	6.25	2.6
Total	29.82	30.14	33.02	36.53	40.03	42.93	1.8
Primary Energy Consumption							
Distillate Fuel	6.67	6.42	6.92	7.44	7.86	8.24	1.0
Kerosene	.14	.15	.12	.10	.09	.07	-3.1
Jet Fuel	3.06	3.09	3.31	3.74	4.13	4.57	1.9
Liquefied Petroleum Gas	2.24	2.11	2.25	2.42	2.60	2.75	1.0
Motor Gasoline	14.05	13.86	13.85	14.42	15.02	15.49	.5
Petrochemical Feedstocks	.93	.97	1.07	1.24	1.39	1.53	2.4
Residual Fuel	3.24	2.82	2.95	3.51	3.51	3.38	.2
Other Petroleum [11]	3.87	4.07	3.75	3.83	3.86	3.92	.1
Natural Gas	19.37	19.11	20.63	22.31	22.96	22.41	.7
Metallurgical Coal	1.10	1.01	1.08	1.00	.92	.85	-1.2
Steam Coal	17.81	17.89	18.86	19.74	21.37	24.54	1.5
Net Coal Coke Imports	.03	.01	-.03	.04	.10	.14	7.5
Nuclear Power	5.69	6.14	6.21	6.47	6.70	6.67	.8
Renewable Energy/Other [12]	6.47	6.75	8.08	9.35	10.85	12.20	3.1

- See footnotes at end of table.

Table A2. Energy Consumption by End-Use Sector and Source (Continued) (Quadrillion Btu per Year)

Sector and Source	Reference Case						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Primary Energy Consumption							
Alcohols	0.00	0.00	0.00	0.01	0.07	0.14	-
Total	84.69	84.39	89.05	95.63	101.40	106.90	1.1
Electricity Consumption (all Sectors)	9.03	9.21	10.10	11.20	12.39	13.60	2.0
Industrial Electricity							
Gross Consumption	3.48	3.51	3.76	4.35	4.96	5.53	2.2
Self-generation - Own Use	.32	.33	.33	.38	.41	.45	1.6
Purchased Electricity	3.16	3.18	3.43	3.97	4.55	5.08	2.3

[1] Includes electricity generated by the sector for self-use from hydroelectric, geothermal, wood and wood waste, municipal solid waste, other biomass, wind, photovoltaic and solar thermal sources, and non-electric energy from renewable sources such as active and passive solar systems, groundwater heat pumps, and wood.
[2] Includes ethanol blended into gasoline.
[3] Includes liquefied petroleum gas and coal.
[4] Includes consumption by cogenerators.
[5] Includes petroleum coke, asphalt, road oil, lubricants, and miscellaneous petroleum products.
[6] Includes lease and plant fuel.
[7] Includes aviation gas, liquefied petroleum gas, lubricants, and miscellaneous petroleum products.
[8] Includes consumption of energy by electric utilities, independent power producers, and small power producers that sell power to the grid.
[9] Includes consumption by independent power producers.
[10] Includes electricity generated to serve the grid from hydroelectric, geothermal, wood and wood waste, municipal solid waste, other biomass, wind, photovoltaic and solar thermal sources, plus waste heat, and net electricity imports.
[11] Includes unfinished oils, natural gasoline, motor gasoline blending components, aviation gasoline, lubricants, asphalt, road oil, and miscellaneous petroleum products.
[12] Includes electricity generated to serve the grid and for self use from renewable sources, non-electric energy from renewable sources, excluding alcohol fuels, electricity generated from waste heat, and net electricity imports.

Note: Totals may not equal sum of components due to independent rounding.

Sources: 1989: Energy Information Administration, *Monthly Energy Review*, DOE/EIA-0035(90/08) (Washington, DC, November 1990). Calculated from values in Tables A4 through A10 using the conversion factors in Appendix G. 1990: preliminary estimates. Projections: Energy Information Administration, AEO 1991 Forecasting System run IGMDCA.D0116914.

Table A3. Energy Prices by End-Use Sector and Source (1990 Dollars per Million Btu)

Sector and Source	Reference Case						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Residential	11.92	12.23	12.81	13.18	14.71	15.85	1.4
Primary Energy	6.21	6.30	6.50	6.90	8.23	9.07	1.8
Petroleum Products	7.86	8.21	8.16	8.54	9.63	10.29	1.3
Distillate Fuel	6.73	7.64	7.32	7.66	8.65	9.24	1.5
Kerosene	7.34	8.30	8.69	8.92	9.67	10.10	1.5
Liquefied Petroleum Gas	10.60	9.56	10.00	10.44	11.73	12.52	.8
Natural Gas	5.72	5.69	6.06	6.54	7.98	8.90	2.1
Steam Coal	2.17	2.15	2.34	2.50	2.72	2.91	1.4
Electricity	24.10	23.74	24.41	23.77	24.74	25.44	.3
Commercial	12.24	12.50	13.14	13.33	14.68	15.82	1.2
Primary Energy	4.76	4.96	5.32	5.78	7.13	8.00	2.5
Petroleum Products	4.88	5.70	5.91	6.36	7.49	8.20	2.5
Distillate Fuel	4.75	5.65	5.33	5.69	6.69	7.29	2.1
Residual Fuel	2.81	3.15	4.07	4.32	5.13	5.56	3.3
Kerosene	4.98	5.96	6.11	6.36	7.12	7.58	2.0
Other Petroleum [1]	8.02	9.17	9.54	10.06	11.37	12.14	2.0
Natural Gas	4.80	4.77	5.20	5.68	7.12	8.04	2.5
Steam Coal	2.15	2.13	2.32	2.48	2.71	2.89	1.4
Electricity	22.91	22.49	22.65	21.55	21.97	22.44	-.1
Industrial	5.26	5.54	6.01	6.48	7.74	8.51	2.3
Primary Energy	3.52	3.87	4.29	4.69	5.80	6.46	2.9
Petroleum Products	4.56	5.41	5.90	6.20	7.16	7.73	2.5
Distillate Fuel	4.74	5.60	5.27	5.61	6.61	7.20	2.0
Liquefied Petroleum Gas	4.37	5.76	6.43	6.84	8.11	8.88	3.4
Motor Gasoline [2]	8.57	9.51	9.72	10.24	11.53	12.28	1.7
Residual Fuel	2.60	2.97	3.90	4.15	4.95	5.38	3.5
Other Petroleum [3]	4.69	5.40	5.99	6.23	7.03	7.51	2.3
Natural Gas [4]	2.99	2.92	3.31	3.79	5.24	6.16	3.5
Metallurgical Coal	1.96	1.92	2.09	2.25	2.48	2.62	1.4
Steam Coal	1.64	1.63	1.78	1.89	2.07	2.24	1.5
Electricity	15.28	15.01	15.40	15.32	16.18	16.61	.4
Transportation	7.63	8.58	8.82	9.21	10.33	10.96	1.7
Primary Energy	7.62	8.57	8.80	9.20	10.32	10.94	1.7
Petroleum Products	7.62	8.57	8.80	9.20	10.32	10.94	1.7
Distillate Fuel [5]	7.59	8.36	9.02	9.36	10.35	10.94	1.8
Jet Fuel [6]	4.57	5.84	5.51	5.85	6.88	7.48	2.4
Motor Gasoline [2]	8.55	9.51	9.72	10.24	11.53	12.27	1.7
Residual Fuel	2.50	3.05	3.72	3.98	4.72	5.13	3.5
Other Petroleum [7]	9.84	11.05	12.96	13.21	14.02	14.50	1.9
Natural Gas	.00	.00	6.15	6.59	8.03	8.95	-
Electricity	24.14	23.42	23.85	23.41	24.36	24.70	.1
Total End-Use Energy	8.00	8.50	8.94	9.29	10.54	11.33	1.7
Primary Energy	5.73	6.29	6.58	7.01	8.22	8.94	2.1
Electricity	20.67	20.34	20.79	20.06	20.71	21.15	.1
Electric Utilities							
Fossil Fuel Average	1.77	1.74	2.02	2.29	2.76	2.96	2.5
Petroleum Products	3.04	3.43	4.36	4.62	5.43	6.00	3.3
Distillate Fuel	4.41	5.37	4.98	5.34	6.35	6.93	2.2
Residual Fuel	2.95	3.30	4.32	4.55	5.33	5.91	3.4
Natural Gas	2.45	2.23	2.72	3.17	4.59	5.48	3.9
Steam Coal	1.52	1.51	1.66	1.79	1.94	2.09	1.5
Average Price to All Users [8]							
Petroleum Products	6.58	7.49	7.78	8.09	9.18	9.83	1.9
Distillate Fuel [5]	6.64	7.53	7.74	8.07	9.11	9.74	1.8
Jet Fuel [6]	4.57	5.84	5.51	5.85	6.88	7.48	2.4
Kerosene	6.67	7.63	8.00	8.22	8.95	9.39	1.6
Liquefied Petroleum Gas	5.78	6.67	7.17	7.46	8.64	9.33	2.3
Motor Gasoline [2]	8.55	9.51	9.72	10.24	11.53	12.27	1.7
Residual Fuel	2.76	3.15	4.07	4.33	5.09	5.56	3.4

- See footnotes at end of table.

Table A3. Energy Prices by End-Use Sector and Source (Continued)
(1990 Dollars per Million Btu)

Sector and Source	Reference Case						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Average Price to All Users [8]							
Other Petroleum Products [9]	4.93	5.65	6.34	6.59	7.41	7.90	2.3
Natural Gas	3.95	3.81	4.19	4.58	5.96	6.88	2.7
Coal	1.56	1.55	1.70	1.83	1.98	2.13	1.5
Electricity	20.67	20.34	20.79	20.06	20.71	21.15	.1

[1] Average price for liquefied petroleum gas, motor gasoline, and miscellaneous petroleum products.
[2] Average price for all grades. Includes Federal and State taxes and excludes county and local taxes.
[3] Average price for petrochemical feedstocks and miscellaneous petroleum products.
[4] Excludes uses for lease and plant fuel.
[5] Includes Federal and State taxes on diesel fuel and excludes county and local taxes.
[6] Kerosene-type jet fuel.
[7] Average price for liquefied petroleum gas and miscellaneous petroleum products.
[8] Weighted averages of end-use fuel prices are derived from the prices shown in each sector and the corresponding sectoral consumption. For each sector, electricity and natural gas prices are derived by dividing total revenues by sales.
[9] Average price for petrochemical feedstocks and miscellaneous petroleum products.

Sources: 1989 prices for gasoline, distillate, jet fuel, residual fuel, liquefied petroleum gas, and kerosene are based on prices in the Energy Information Administration, *Petroleum Marketing Annual 1989*, DOE/EIA-0487(89) (Washington, DC, December 1990). 1990 prices for these products are preliminary estimates based on data from the Energy Information Administration, *Petroleum Marketing Monthly*, DOE/EIA-0380 (Washington, DC, January 1990 through October 1990). 1989 and 1990 prices for all other petroleum products are derived from the Energy Information Administration, *State Energy Price and Expenditures Report: 1988*, DOE/EIA-0376(88) (Washington, DC, September 1990), applying the growth rate of the world oil price. Projections: Energy Information Administration, AEO 1991 Forecasting System run IGMDCA.D0116914.

Table A4. Electricity Supply, Disposition, and Prices (Billion Kilowatthours, Unless Otherwise Noted)

Supply, Disposition, and Prices	Reference Case						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Electric Utilities							
Generation by Fuel Type							
Coal	1,554	1,558	1,643	1,731	1,841	2,194	1.7
Petroleum	158	122	140	193	184	160	.0
Natural Gas	267	270	340	432	569	576	3.7
Nuclear Power	529	575	570	594	614	611	.7
Pumped Storage Hydroelectric	-9	-9	-10	-10	-11	-11	1.2
Renewable Sources/Other [1]	285	298	320	332	341	344	.9
Total	2,785	2,813	3,002	3,271	3,540	3,874	1.6
Net Imports	11	2	41	55	65	68	9.1
Nonutilities [2]							
Generation by Fuel Type							
Coal	33	34	42	43	97	118	6.3
Petroleum	3	3	4	4	5	5	2.9
Natural Gas	78	93	103	133	135	138	2.8
Renewable Sources/Other [1]	72	72	113	153	198	228	5.6
Total	185	201	262	334	435	489	4.7
Sales to Utilities	90	105	166	223	315	358	6.8
Generation for Own Use	95	96	95	110	121	131	1.6
Electricity Sales by Sector							
Residential	906	928	1,010	1,068	1,124	1,179	1.3
Commercial/Other [3]	815	839	943	1,050	1,176	1,318	2.3
Industrial	926	933	1,006	1,164	1,333	1,489	2.3
Total	2,647	2,700	2,959	3,282	3,632	3,985	2.0
End-Use Prices [4]							
(1990 cents per kilowatthour)							
Residential	8.22	8.10	8.33	8.11	8.44	8.68	.3
Commercial/Other [3]	7.82	7.67	7.73	7.36	7.50	7.66	-.1
Industrial [5]	5.22	5.12	5.25	5.23	5.52	5.67	.4
Average	7.05	6.94	7.09	6.85	7.06	7.22	.1
Price Components [4]							
(1990 cents per kilowatthour)							
Capital Component	3.09	3.07	2.98	2.45	2.24	2.26	-1.5
Fuel Component	1.83	1.75	2.02	2.32	2.76	2.90	2.2
O&M Component	2.13	2.12	2.09	2.08	2.07	2.06	-.2
Total	7.05	6.94	7.09	6.85	7.06	7.22	.1

[1] Includes conventional hydroelectric, geothermal, wood, wood waste, municipal solid waste, other biomass, solar and wind power, plus a small quantity of petroleum coke. For nonutilities, also includes waste heat, blast furnace gas, and coke oven gas.

[2] Includes cogenerators, small power producers, independent power producers, and all other sources, except electric utilities, which produce electricity for self use or for delivery to the grid.

[3] Other includes sales of electricity to Government, railways, and street lighting authorities.

[4] Prices represent average revenue per kilowatthour of sales over all customer classes.

[5] Weighted average, including transportation. Weights used are consumption levels by sector.

O&M = Operating and Maintenance

Note: Totals may not equal sum of components due to independent rounding.

Sources: 1989, except for nonutilities and prices: Energy Information Administration, *Electric Power Annual 1989*, DOE/EIA-0348(89) (Washington, DC, January 1991). 1990 generation: Energy Information Administration, *Short-Term Energy Outlook*, DOE/EIA-0202(91/1Q) (Washington, DC, January 1991). 1989 and 1990 nonutilities, prices, and all projections: Energy Information Administration, AEO 1991 Forecasting System run IGMDCA.D0116914.

Table A5. Electricity Generating Capability (Thousand Megawatts)

Summer Capability [1]	Reference Case						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Electric Utilities							
Capability							
Coal Steam	296.2	297.5	300.2	303.2	316.2	373.9	1.1
Other Fossil Steam [2]	144.6	145.3	139.9	132.7	125.8	122.1	-.8
Combined Cycle	5.1	5.2	6.4	10.3	39.5	50.0	11.5
Combustion Turbine/Diesel	46.0	46.6	53.4	65.1	71.8	79.5	2.6
Nuclear Power	98.2	99.6	103.1	105.4	106.5	101.2	.1
Pumped Storage Hydroelectric	17.2	17.2	19.8	19.8	19.8	19.8	.7
Renewable Sources/Other [3]	77.3	77.5	80.1	81.8	82.9	83.4	.4
Total	684.6	688.9	703.0	718.3	762.4	830.1	.9
Cumulative Planned Additions [4]							
Coal Steam	.0	1.7	8.6	17.3	19.0	19.2	-
Other Fossil Steam	.0	.0	.5	.5	.5	.5	-
Combined Cycle	.0	.1	1.3	4.4	4.4	4.4	-
Combustion Turbine/Diesel	.0	.6	5.3	10.8	10.9	10.9	-
Nuclear Power	.0	2.3	5.8	8.3	9.5	9.5	-
Pumped Storage Hydroelectric	.0	.0	2.6	2.7	2.7	2.7	-
Renewable Sources/Other [3]	.0	.1	2.3	2.7	2.8	2.8	-
Total	.0	4.8	26.4	46.6	49.7	49.9	-
Cumulative Unplanned Additions [4]							
Coal Steam	.0	.0	.0	.0	14.4	74.8	-
Other Fossil Steam	.0	.0	.0	.0	.0	.0	-
Combined Cycle	.0	.0	.0	.8	30.0	40.5	-
Combustion Turbine/Diesel	.0	.0	2.6	9.0	16.9	24.7	-
Nuclear Power	.0	.0	.0	.0	.0	.0	-
Pumped Storage Hydroelectric	.0	.0	.0	.0	.0	.0	-
Renewable Sources/Other [3]	.0	.1	.6	1.8	2.8	3.3	-
Total	.0	.1	3.1	11.7	64.1	143.4	-
Cumulative Total Additions	.0	4.9	29.5	58.3	113.8	193.3	-
Cumulative Retirements	.0	1.4	11.9	25.4	36.7	48.6	-
Nonutilities [5]							
Capability							
Coal	5.8	5.9	7.7	8.0	17.3	21.6	6.5
Petroleum	.9	1.0	1.2	1.5	1.7	2.0	3.6
Natural Gas	13.8	16.7	18.6	23.8	24.3	24.8	2.8
Renewable Sources/Other [3]	16.1	16.8	21.3	27.5	34.7	40.1	4.4
Total	36.7	40.5	48.8	60.8	78.0	88.6	4.3
Cumulative Additions	.0	3.8	12.1	24.0	41.3	51.9	-

[1] Net summer capability is the steady hourly output that generating equipment is expected to supply to system load (exclusive of auxiliary power), as demonstrated by tests during summer peak demand.

[2] Includes oil-, gas-, and dual-fired capability.

[3] Includes conventional hydroelectric, geothermal, wood, wood waste, municipal solid waste, other biomass, solar, and wind power, plus a small quantity of petroleum coke. For nonutilities, also includes waste heat, blast furnace gas, and coke oven gas.

[4] Cumulative additions after December 31, 1989.

[5] Includes cogenerators, small power producers, independent power producers, and all other sources, except electric utilities, which produce electricity for self use or for sales to the grid.

Note: Totals may not equal sum of components due to independent rounding.

Sources: 1989 utility capability: Energy Information Administration, *Electric Power Annual 1989*, DOE/EIA-0348(89) (Washington, DC, January 1991). 1990 utility capability: Energy Information Administration, Form EIA-860, *Annual Electric Generator Report*. 1989 and 1990 nonutility capability and all projections: Energy Information Administration, AEO 1991 Forecasting System run IGMDCA.D0116914.

Table A6. Renewable Energy (Quadrillion Btu per Year, Unless Otherwise Noted)

Electricity and Non-Electric	Reference Case						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Electricity							
Capability (gigawatts)							
Conventional Hydropower	75.48	75.67	77.94	78.36	78.36	78.46	0.2
Geothermal	2.47	2.59	3.25	6.25	9.65	10.65	7.2
Municipal Solid Waste	1.98	2.10	3.75	6.16	8.79	10.81	8.4
Biomass/Other Waste	5.31	5.46	6.21	7.02	7.90	8.88	2.5
Solar Thermal	.33	.43	.43	.43	.81	1.78	8.4
Solar Photovoltaic	.00	.00	.01	.01	.01	.01	2.1
Wind	1.93	1.95	2.46	3.50	4.40	5.30	4.9
Total	87.51	88.20	94.05	101.70	109.90	115.90	1.3
Generation (billion kilowatthours)							
Conventional Hydropower	276.90	302.20	312.40	314.60	314.60	314.80	.6
Geothermal	15.05	15.98	20.67	43.37	70.63	78.52	8.2
Municipal Solid Waste	13.31	13.48	24.66	41.54	60.06	74.22	8.5
Biomass/Other Waste	29.54	30.36	34.57	39.11	44.01	49.55	2.5
Solar Thermal	.69	.90	.90	1.16	2.30	5.06	10.0
Solar Photovoltaic	.00	.00	.00	.00	.00	.00	2.2
Wind	3.38	3.42	4.32	8.22	10.68	12.97	6.6
Total	338.90	366.30	397.50	448.00	502.30	535.10	2.2
Consumption/Displacement							
Conventional Hydropower	2.88	3.14	3.25	3.27	3.27	3.27	.6
Geothermal	.16	.17	.21	.45	.73	.82	8.2
Municipal Solid Waste	.20	.22	.50	.76	1.05	1.27	9.2
Biomass/Other Waste	.20	.20	.23	.26	.29	.33	2.5
Solar Thermal	.01	.01	.01	.01	.02	.05	10.0
Solar Photovoltaic	.00	.00	.00	.00	.00	.00	2.3
Wind	.04	.04	.04	.09	.11	.13	6.6
Total	3.48	3.78	4.25	4.85	5.48	5.88	2.5
Non-Electric Renewable Energy							
Residential, Commercial, and Industrial							
Hydropower	.00	.00	.00	.00	.00	.00	-
Geothermal	.00	.00	.02	.07	.18	.39	-
Biofuels	2.63	2.77	3.14	3.58	4.05	4.54	2.6
Solar Thermal	.05	.07	.09	.13	.30	.54	11.6
Solar Photovoltaic	.00	.00	.00	.00	.00	.00	-
Wind	.00	.00	.00	.00	.00	.00	-
Transportation							
Ethanol	.07	.08	.10	.12	.14	.14	3.5
Total	2.75	2.92	3.35	3.90	4.68	5.62	3.5
Total Renewable Energy	6.23	6.70	7.61	8.74	10.17	11.50	3.0

Note: Totals may not equal sum of components due to independent rounding.

Sources: 1989 and 1990: Energy Information Administration, Office of Coal, Nuclear, Electric and Alternate Fuels. Projections: Energy Information Administration, AEO 1991 Forecasting System run IGMDCA.D0116914.

Table A7. Macroeconomic Indicators (Billion 1982 Dollars, Unless Otherwise Noted)

Indicator	Reference Case						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
GNP Implicit Price Deflator (Index, 1982=1.000)	1.263	1.314	1.553	1.886	2.341	2.909	4.1
Real Gross National Product	4,118	4,153	4,601	5,211	5,830	6,436	2.1
Real Disposable Personal Income	2,869	2,891	3,121	3,444	3,785	4,129	1.7
Index of Manufacturing Gross Output (Index, 1982=1.000)	1.219	1.217	1.368	1.610	1.840	2.058	2.5
AA Utility Bond Rate (percent)	9.55	9.65	9.52	9.08	8.82	8.71	-
90-Day U.S. Government Treasury Bill Rate (percent)	8.11	7.51	6.11	5.77	5.51	5.48	-
Energy Intensity (thousand Btu per 1982 $ of GNP)	20.57	20.32	19.35	18.35	17.40	16.61	-1.0

Note: Totals may not equal sum of components due to independent rounding.
Sources: 1989: Data Resources Incorporated (DRI), USCEN Databank. 1990: DRI Control0191. Projections: Energy Information Administration, AEO 1991 Forecasting System run IGMDCA.D0116914.

Table A8. Petroleum Supply and Disposition Balance (Million Barrels per Day, Unless Otherwise Noted)

Supply and Disposition	Reference Case						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
World Oil Price (1990 dollars per barrel) [1]	18.81	22.00	24.00	25.70	31.00	34.20	2.9
Production							
Crude Oil [2]	7.61	7.23	6.79	5.36	4.59	4.42	-2.6
Alaska	1.87	1.75	1.32	.90	.67	.78	-4.1
Lower 48	5.74	5.48	5.47	4.45	3.92	3.64	-2.1
Natural Gas Plant Liquids	1.55	1.54	1.55	1.67	1.68	1.62	.2
Other Domestic [3]	.06	.07	.19	.27	.35	.48	10.5
Processing Gain [4]	.66	.67	.64	.66	.64	.63	-.2
Total	9.88	9.51	9.16	7.95	7.26	7.15	-1.5
Imports (including SPR) [5]							
Crude Oil	5.84	6.01	6.35	8.62	9.25	9.29	2.2
Refined Products	2.22	2.08	2.51	2.67	3.68	4.56	3.5
Total	8.06	8.09	8.86	11.29	12.93	13.85	2.6
Exports							
Crude Oil	.14	.11	.10	.08	.07	.08	-2.5
Refined Products	.72	.70	.66	.71	.75	.79	.4
Total	.86	.81	.76	.78	.82	.87	.1
Net Imports (including SPR)	7.20	7.28	8.10	10.51	12.11	12.98	2.8
Primary Stock Changes							
Net Withdrawals [6]	.12	-.16	-.02	-.03	-.02	-.01	-
SPR Fill Rate Additions (-) [5]	-.06	-.02	-.05	-.05	.00	.00	-
Total Primary Supply [7]	17.14	16.62	17.19	18.38	19.34	20.12	.8
Unaccounted for Crude	.20	.34	.15	.15	.15	.15	-1.4
Refined Petroleum Products Supplied							
Motor Gasoline [8]	7.33	7.23	7.22	7.50	7.83	8.08	.5
Jet Fuel [9]	1.49	1.51	1.61	1.82	2.01	2.22	1.9
Distillate Fuel	3.14	3.02	3.25	3.49	3.70	3.87	1.0
Residual Fuel	1.41	1.23	1.29	1.53	1.53	1.47	.2
Other [10]	3.96	3.97	3.97	4.20	4.41	4.62	.7
Total	17.33	16.95	17.34	18.53	19.49	20.27	.7
Refined Petroleum Products Supplied							
Residential and Commercial	1.41	1.38	1.25	1.11	.99	.89	-2.2
Industrial [11]	4.32	4.25	4.46	4.85	5.19	5.51	1.2
Transportation	10.86	10.76	10.98	11.67	12.44	13.13	.9
Electric Utilities [12]	.74	.57	.65	.90	.86	.74	.1
Total	17.33	16.95	17.34	18.53	19.49	20.27	.7
Discrepancy [13]	.01	.00	.00	.00	.00	.00	-
Net Disposition	17.34	16.96	17.34	18.53	19.49	20.27	.7

[1] Average refiner acquisition cost for imported crude oil.
[2] Includes lease condensate.
[3] Includes other hydrocarbons, ethanol, and synthetic crude oil.
[4] Represents volumetric gain in refinery distillation and cracking processes.
[5] SPR is the Strategic Petroleum Reserve.
[6] Computed as the end-of-year stock levels in the current period subtracted from the end-of-year stock levels in the preceding period. A negative (-) represents an increase to inventories.
[7] Total production plus net imports plus net stock withdrawals minus SPR additions.
[8] Includes ethanol blended into gasoline.
[9] Includes naphtha and kerosene type.
[10] Includes aviation gasoline, kerosene, liquefied petroleum gas, petrochemical feedstocks, miscellaneous petroleum products, lubricants, waxes, asphalt, road oil, still gas, special naphthas, petroleum coke, crude oil product supplied, natural gas liquids, liquefied refinery gas, and other liquids.
[11] Includes consumption by cogenerators.
[12] Includes consumption by independent power producers.
[13] Balancing item.

Note: Totals may not equal sum of components due to independent rounding.

Sources: 1989: Energy Information Administration, *Petroleum Supply Annual 1989*, DOE/EIA-0340(89) (Washington, DC, May 1990). 1990: preliminary estimates. Projections: Energy Information Administration, AEO 1991 Forecasting System run IGMDCA.D0116914.

Table A9. Natural Gas Supply, Disposition, and Prices (Trillion Cubic Feet per Year, Unless Otherwise Noted)

Supply, Disposition, and Prices	Reference Case						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Production							
Dry Gas Production [1]	17.26	17.40	18.22	19.62	19.82	19.08	0.5
Synthetic Natural Gas [2]	.11	.17	.11	.12	.19	.23	3.6
Net Imports	1.28	1.36	2.30	2.56	2.95	3.09	4.3
Net Storage Withdrawals [3]	.32	-.28	.00	.00	.00	.00	-
Total Supply	18.97	18.65	20.62	22.30	22.96	22.40	.8
Consumption by Sector							
Residential	4.77	4.38	4.71	4.72	4.67	4.55	-.2
Commercial	2.71	2.57	2.76	2.84	2.88	2.89	.3
Industrial [4]	6.83	6.97	7.17	7.49	7.06	6.79	.0
Electric Utilities [5]	2.78	2.84	3.59	4.67	5.69	5.54	3.3
Lease and Plant Fuel [6]	1.07	1.17	1.10	1.18	1.19	1.15	.3
Pipeline Fuel	.63	.61	.67	.73	.75	.75	.9
Transportation [7]	.00	.00	.00	.01	.03	.06	-
Total	18.79	18.53	20.01	21.64	22.27	21.73	.7
Unaccounted for [8]	.18	.12	.61	.66	.69	.67	6.4
Average Wellhead Price (1990 dollars per thousand cubic feet)	1.76	1.77	2.12	2.61	4.09	5.04	5.1
Delivered Prices (1990 dollars per thousand cubic feet)							
Residential	5.89	5.86	6.25	6.75	8.23	9.17	2.1
Commercial	4.95	4.92	5.36	5.86	7.34	8.29	2.5
Industrial	3.08	3.01	3.42	3.91	5.40	6.35	3.5
Electric Utilities	2.53	2.30	2.81	3.27	4.74	5.65	3.9
Transportation	.00	.00	6.34	6.79	8.28	9.23	-
Average [9]	4.07	3.93	4.32	4.72	6.14	7.09	2.7

[1] Dry marketed production minus nonhydrocarbon gases removed.
[2] Includes synthetic natural gas (from the manufacture, conversion, or reforming of petroleum hydrocarbons) and propane/air mixtures.
[3] Computed as the end-of-year stock levels in the current period subtracted from the end-of-year stock levels in the preceding period. A negative (-) represents an increase to inventories.
[4] Includes consumption by cogenerators.
[5] Includes consumption by independent power producers.
[6] Represents natural gas used in the field gathering and processing plant machinery.
[7] Compressed natural gas used as vehicle fuel.
[8] Balancing item. Reflects natural gas lost, the net result of converting flow data measured at varying temperatures and pressures to a standard temperature and pressure, and the merger of different data reporting systems which vary in scope, format, definition, and respondent type.
[9] Weighted average price. Weights used are the sectoral consumption values excluding lease, plant and pipeline fuel.

Note: Totals may not equal sum of components due to independent rounding.

Sources: 1989: Energy Information Administration, *Natural Gas Annual 1989*, DOE/EIA-0131(89) (Washington, DC, September 1990). 1990: preliminary estimates. Projections: Energy Information Administration, AEO 1991 Forecasting System run IGMDCA.D0116914.

Table A10. Coal Supply, Disposition, and Prices (Million Short Tons per Year, Unless Otherwise Noted)

Supply, Disposition, and Prices	Reference Case						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Production [1]							
East of the Mississippi	599	638	627	654	748	869	1.8
West of the Mississippi	382	397	427	479	524	623	2.4
Total	981	1,035	1,054	1,133	1,272	1,492	2.0
Net Imports							
Imports	3	2	5	6	9	11	6.6
Exports	101	107	109	136	199	252	4.4
Total	-98	-105	-104	-130	-189	-240	4.4
Net Stock Withdrawals [2]	14	-29	-2	-1	-5	-8	-
Total Supply [3]	897	901	948	1,002	1,077	1,243	1.6
Consumption by Sector							
Residential and Commercial	6	6	6	5	5	5	-1.3
Industrial [4]	76	77	76	75	76	83	.4
Coking Plants	41	37	40	38	35	32	-1.2
Electric Utilities [5]	766	772	826	884	963	1,124	1.8
Total	889	893	948	1,003	1,078	1,244	1.6
Discrepancy [6]	7	8	0	-1	-1	-1	-
Average Minemouth Price [7] **(1990 dollars per short ton)**	22.70	22.18	24.69	27.12	29.99	31.64	1.6
Delivered Prices (1990 dollars per short ton)							
Residential and Commercial	49.48	48.39	55.28	58.29	64.44	67.83	1.5
Industrial	34.36	33.60	39.33	41.85	46.11	49.43	1.7
Coking Plants	49.42	47.70	55.47	59.87	65.83	69.46	1.6
Electric Utilities	31.35	30.64	34.33	36.37	39.44	42.10	1.4
Average [8]	32.56	31.75	35.76	37.78	40.86	43.38	1.4

[1] Includes anthracite, bituminous coal, and lignite.
[2] From all stocks held by industrial plants, coke plants, electric utilities, and producers/distributors. Computed as the end-of-year stock levels in the current period subtracted from the end-of-year stock levels in the preceding period. A negative (-) represents an increase to inventories.
[3] Production plus net imports plus net storage withdrawals.
[4] Includes consumption by cogenerators.
[5] Includes consumption by independent power producers.
[6] Balancing item: the sum of production, net imports, and net stock withdrawals minus total consumption.
[7] Free-on-board price.
[8] Weighted average prices. Weights used are consumption values by sector.

Note: Totals may not equal sum of components due to independent rounding.
Sources: 1989: Energy Information Administration, *Monthly Energy Review*, DOE/EIA-0035(90/08) (Washington, DC, November 1990); *Quarterly Coal Report*, DOE/EIA-0121(90/3Q) (Washington, DC, January 1991); and *Coal Production 1989*, DOE/EIA-0118(89) (Washington, DC, November 1990). 1990: preliminary estimates. Projections: Energy Information Administration, AEO 1991 Forecasting System run IGMDCA.D0116914.

Table A11. Residential Sector Key Indicators and End-Use Consumption (Quadrillion Btu per Year, Unless Otherwise Noted)

Key Indicators and Consumption	Reference Case						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Key Indicators							
Total Housing (millions)	92.6	93.4	98.2	103.2	107.8	111.8	0.9
Energy Consumption per Household (MMBtu)	114.1	109.5	110.0	106.5	104.9	104.3	-.4
End-Use Consumption							
Distillate							
Space Heating	.90	.89	.80	.69	.60	.54	-2.4
Other Uses [1]	.16	.16	.13	.10	.08	.06	-4.3
Total	1.06	1.05	.93	.79	.69	.60	-2.7
Natural Gas							
Space Heating	3.43	3.14	3.35	3.33	3.28	3.21	-.3
Water Heating	1.13	1.05	1.18	1.22	1.23	1.19	.2
Other Uses [1]	.35	.32	.33	.31	.30	.29	-.9
Total	4.91	4.51	4.86	4.86	4.81	4.69	-.2
Other Fuels [2]	.62	.60	.54	.49	.44	.40	-2.1
Renewables [3]	.89	.92	1.03	1.21	1.54	1.95	3.8
Electricity							
Space Heating	.32	.33	.37	.39	.41	.44	1.5
Cooling	.50	.51	.56	.58	.59	.60	.9
Water Heating	.36	.38	.44	.50	.57	.65	2.8
Other Uses [1]	1.91	1.94	2.08	2.17	2.26	2.34	1.0
Total	3.09	3.17	3.45	3.64	3.83	4.02	1.3
Total Consumption	10.58	10.24	10.81	10.99	11.30	11.66	.5

[1] Includes cooking, cooling (natural gas), water heating (distillate), refrigeration and lighting (electricity), and other household appliances.
[2] Includes liquefied petroleum gas, kerosene and coal.
[3] Includes solar, geothermal, and wood energy.
MMBtu = million Btu.
Note: Totals may not equal sum of components due to independent rounding.
Sources: 1989 and 1990 estimates: Energy Information Administration (EIA), *State Energy Data Report*, DOE/EIA-0214(88) (Washington, DC, May 1990) and *Monthly Energy Review*, DOE/EIA-0035(90/08) (Washington, DC, November 1990). Projections: EIA, AEO 1991 Forecasting System Run IGMDCA.D0116914.

Table A12. Commercial Sector Key Indicators and End-Use Consumption (Quadrillion Btu per Year, Unless Otherwise Noted)

Key Indicators and Consumption	Reference Case						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Key Indicators							
Total Employment (millions)	108.4	110.4	116.8	124.9	131.5	136.4	1.1
Total Floor Space (billion sq. ft.)	63.0	64.3	70.4	77.0	83.9	91.0	1.8
Energy Consumption per Square Foot (MBtu)	107.3	104.3	102.5	99.5	97.6	96.8	-.5
End-Use Consumption							
Distillate							
Space Heating	.52	.52	.49	.46	.43	.40	-1.3
Other Uses [1]	.05	.05	.04	.03	.02	.02	-4.4
Total	.57	.56	.53	.49	.45	.42	-1.5
Natural Gas							
Space Heating	1.84	1.74	1.87	1.92	1.94	1.90	.2
Cooling	.21	.19	.17	.13	.11	.08	-4.2
Other Uses [1]	.75	.72	.81	.87	.93	.99	1.3
Total	2.80	2.65	2.85	2.93	2.97	2.98	.3
Other Fuels[2]	.58	.56	.51	.46	.42	.39	-1.8
Renewables [3]	.05	.08	.13	.21	.36	.56	12.1
Electricity							
Space Heating	.51	.52	.60	.68	.81	.97	3.1
Cooling	.71	.74	.84	.94	1.05	1.16	2.3
Lighting	1.09	1.12	1.23	1.34	1.46	1.58	1.8
Other Uses [1]	.45	.47	.53	.60	.66	.74	2.4
Total	2.77	2.85	3.20	3.56	3.98	4.46	2.3
Total Consumption	6.76	6.70	7.22	7.66	8.19	8.80	1.3

[1] Includes water heating, cooking, and other miscellaneous commercial uses.
[2] Includes residual fuel oil, liquefied petroleum gas, coal, motor gasoline, and kerosene.
[3] Includes solar, geothermal, wood, and municipal solid waste energy.
MBtu = thousand Btu.
Note: Totals may not equal sum of components due to independent rounding.
Sources: 1989 and 1990 estimates: Energy Information Administration (EIA), *State Energy Data Report*, DOE/EIA-0214(88) (Washington, DC, May 1990) and *Monthly Energy Review*, DOE/EIA-0035(90/08) (Washington, DC, November 1990). Projections: EIA, AEO 1991 Forecasting System Run IGMDCA.D0116914.

Table A13. Industrial Sector Key Indicators and Consumption

Key Indicators and Consumption	Reference Case						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Key Indicators							
Value of Gross Output (billion 1982 dollars)							
Manufacturing	2,402	2,399	2,696	3,172	3,626	4,057	2.5
Nonmanufacturing	832	820	905	985	1,062	1,135	1.5
Total	3,234	3,220	3,601	4,157	4,688	5,191	2.3
Consumption per Unit Output (thousand Btu per 1982 dollars)							
Distillate	.375	.317	.366	.365	.354	.345	-.4
Liquefied Petroleum Gas	.519	.490	.490	.478	.470	.460	-.6
Petrochemical Feedstocks	.289	.301	.297	.299	.296	.295	.1
Residual Fuel	.198	.190	.183	.171	.160	.152	-1.3
Other Petroleum [1]	1.133	1.195	.979	.861	.766	.700	-2.3
Natural Gas [2]	2.518	2.605	2.368	2.150	1.814	1.576	-2.2
Metallurgical Coal and Coke [3]	.352	.319	.293	.250	.216	.190	-2.9
Steam Coal [4]	.527	.521	.466	.401	.360	.353	-1.9
Renewables [5]	.592	.635	.652	.645	.649	.661	.5
Electricity	.978	.988	.954	.956	.970	.979	.0
Total	7.540	7.622	7.107	6.632	6.107	5.762	-1.3
Consumption (quadrillion Btu per year)							
Distillate	1.21	1.02	1.32	1.52	1.66	1.79	1.9
Liquefied Petroleum Gas	1.68	1.58	1.77	1.99	2.20	2.39	1.7
Motor Gasoline [6]	.19	.19	.21	.23	.25	.26	1.5
Petrochemical Feedstocks	.93	.97	1.07	1.24	1.39	1.53	2.4
Residual Fuel	.64	.61	.66	.71	.75	.79	1.0
Other Petroleum [1]	3.66	3.85	3.53	3.58	3.59	3.63	.0
Natural Gas [2]	8.14	8.39	8.53	8.94	8.50	8.18	.0
Metallurgical Coal and Coke [3]	1.14	1.03	1.05	1.04	1.01	.99	-.7
Steam Coal [4]	1.70	1.68	1.68	1.67	1.69	1.83	.4
Renewables [5]	1.91	2.04	2.35	2.68	3.04	3.43	2.8
Electricity	3.16	3.18	3.43	3.97	4.55	5.08	2.3
Total	24.37	24.54	25.59	27.58	28.63	29.90	1.0

[1] Includes petroleum coke, asphalt, road oil, lubricants, and miscellaneous petroleum products.
[2] Includes lease and plant fuel.
[3] Includes net imports of coal coke.
[4] Includes consumption by cogenerators.
[5] Does not include renewables consumed for nonutility electricity generation in the industrial sector for sales to the grid.
[6] Includes ethanol blended into gasoline.

Note: Totals may not equal sum of components due to independent rounding.

Sources: 1989 and 1990 estimates: Energy Information Administration (EIA), *State Energy Data Report*, DOE/EIA-0214(88) (Washington, DC, May 1990) and *Monthly Energy Review*, DOE/EIA-0035(90/08) (Washington, DC, November 1990). Projections: EIA, AEO 1991 Forecasting System Run IGMDCA.D0116914.

Table A14. Transportation Sector Key Indicators and Consumption

Key Indicators and Consumption	Reference Case						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Key Indicators							
Level of Travel Index (1989= 1.0)							
Light Duty Vehicles	1.000	0.999	1.075	1.183	1.293	1.404	1.6
Freight Trucks	1.000	.995	1.092	1.224	1.350	1.473	1.9
Air	1.000	.985	1.203	1.514	1.820	2.142	3.7
Rail	1.000	.982	1.051	1.134	1.215	1.293	1.2
Marine	1.000	.974	1.035	1.097	1.165	1.236	1.0
Energy Efficiency Indicators							
New Car MPG [1]	28.3	28.2	30.8	32.6	34.8	37.3	1.3
New Light Truck MPG [1]	20.9	20.9	23.6	24.0	25.3	27.0	1.2
Light Duty Fleet MPG [2]	18.5	18.7	19.9	21.0	21.8	22.8	1.0
Aircraft Efficiency Index [3]	1.000	1.012	1.076	1.148	1.224	1.276	1.2
Freight Truck Efficiency Index [4]	1.000	1.004	1.051	1.094	1.112	1.130	.6
Rail Efficiency Index [5]	1.000	1.003	1.020	1.037	1.055	1.073	.3
Domestic Shipping Efficiency Index	1.000	1.000	1.000	1.000	1.000	1.000	.0
Energy Use By Mode (quadrillion Btu)							
Light Duty Vehicles	11.66	11.58	11.53	12.04	12.61	13.08	.5
Freight Trucks	4.97	4.93	5.17	5.55	6.01	6.45	1.3
Air	3.15	3.21	3.41	3.86	4.26	4.72	1.9
Rail	.48	.47	.49	.52	.55	.57	.9
Marine	1.13	1.10	1.07	1.18	1.29	1.40	1.0
Pipeline Fuel	.65	.63	.69	.75	.77	.78	.9
Other	.16	.17	.17	.19	.20	.21	1.3
Total	22.19	21.99	22.50	24.06	25.67	27.18	1.0

[1] Unadjusted Corporate Average Fuel Economy estimates.
[2] Average *on-the-road* efficiency estimate including cars and light trucks.
[3] Based on estimates of passenger seat miles per gallon (1989=1.0).
[4] Based on Btu per vehicle miles traveled (1989=1.0).
[5] Based on Btu per ton-miles traveled (1989=1.0).
Note: Totals may not equal sum of components due to independent rounding.
Sources: 1989 and 1990 estimates: Energy Information Administration (EIA), *State Energy Data Report*, DOE/EIA-0214(88) (Washington, DC, May 1990) and *Monthly Energy Review*, DOE/EIA-0035(90/08) (Washington, DC, November 1990). Energy use by mode based on model estimates.
Projections: EIA, AEO 1991 Forecasting System Run IGMDCA.D0116914.

Appendix B

Low Oil Price Case Projections

Table B1. Total Energy Supply, Disposition, and Prices (Quadrillion Btu per Year, Unless Otherwise Noted)

Supply, Disposition, and Prices	Low Oil Price						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Production							
Crude Oil and Lease Condensate [1]	16.24	15.46	13.16	10.32	8.43	7.72	-3.5
Natural Gas Plant Liquids	2.15	2.14	2.14	2.30	2.28	2.10	-.1
Dry Natural Gas [2]	17.91	18.11	18.77	20.21	20.22	18.80	.2
Coal	21.36	22.54	22.70	24.09	27.06	30.98	1.8
Nuclear Power	5.69	6.14	6.21	6.48	6.70	7.14	1.1
Renewable Energy [3]	6.43	6.81	7.76	8.90	10.33	11.64	2.9
Total	69.78	71.20	70.73	72.31	75.02	78.37	.6
Imports							
Crude Oil [4]	12.58	12.94	16.05	20.00	21.65	22.36	2.8
Petroleum Products	4.48	4.21	5.46	6.66	9.92	12.65	5.1
Natural Gas [5]	1.32	1.40	2.37	2.64	3.04	3.19	4.3
Other Imports [6]	.22	.11	.53	.77	1.04	1.19	8.5
Total	18.60	18.66	24.40	30.07	35.65	39.38	3.6
Exports							
Coal	2.61	2.64	2.80	3.44	4.99	6.29	4.3
Petroleum	1.81	1.71	1.62	1.68	1.79	1.78	-.1
Total	4.42	4.35	4.42	5.13	6.79	8.07	2.9
Net Stock Withdrawals	.44	-.67	-.20	-.19	-.19	-.17	-
Discrepancy [7]	.29	-.45	-.35	-.41	-.51	-.67	-
Consumption							
Petroleum Products [8]	34.21	33.49	35.40	37.83	40.73	43.17	1.1
Natural Gas	19.37	19.11	20.51	22.17	22.57	21.33	.5
Coal	18.91	18.90	19.97	20.78	22.19	24.82	1.3
Nuclear Power	5.69	6.14	6.21	6.48	6.70	7.14	1.1
Renewable Energy/Other [9]	6.50	6.76	8.06	9.40	10.98	12.40	3.1
Total	84.69	84.39	90.15	96.65	103.20	108.80	1.2
Net Imports - Petroleum	15.25	15.44	19.89	24.97	29.78	33.23	3.8
Prices (1990 dollars per unit)							
World Oil Price ($ per barrel) [10]	18.81	22.00	19.00	20.10	21.70	23.40	1.0
Natural Gas Wellhead Price ($ per Mcf)	1.76	1.77	2.06	2.62	3.79	4.68	4.8
Coal Minemouth Price ($ per ton)	22.70	22.18	24.70	27.13	29.84	31.22	1.5

[1] Includes other hydrocarbons, ethanol, and synthetic crude oil.
[2] Includes synthetic gas.
[3] Includes utility and nonutility electricity from hydroelectric, geothermal, wood and wood waste, municipal solid waste, other biomass, wind, photovoltaic and solar thermal sources; non-electric energy from renewable sources such as active and passive solar systems, groundwater heat pumps, and wood; alcohol fuels from renewable sources; and in addition to renewables, electricity from waste heat.
[4] Includes imports of crude oil for the Strategic Petroleum Reserve.
[5] Represents net imports.
[6] Includes coal, coal coke (net), electricity (net), and methanol.
[7] Balancing item. Includes unaccounted for supply, losses, and gains.
[8] Includes natural gas plant liquids, crude oil consumed as a fuel, and nonpetroleum based liquids, such as ethanol.
[9] Includes utility and nonutility electricity from hydroelectric, geothermal, wood and wood waste, municipal solid waste, other biomass, wind, photovoltaic and solar thermal sources; non-electric energy from renewable sources such as active and passive solar systems, groundwater heat pumps, and wood; alcohol fuels from renewable sources; and in addition to renewables, electricity from waste heat, plus net coal coke imports, and net electricity imports.
[10] Average refiner acquisition cost for imported crude oil.
Note: Totals may not equal sum of components due to independent rounding.
Sources: 1989: Calculated from values in Tables B4 through B10 using the conversion factors in Appendix G. 1990: preliminary estimates. Projections: Energy Information Administration, AEO 1991 Forecasting System run IGLMCA.D0115912.

Table B2. Energy Consumption by End-Use Sector and Source (Quadrillion Btu per Year)

Sector and Source	Low Oil Price						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Residential							
Distillate Fuel	1.06	1.05	0.94	0.81	0.71	0.63	-2.4
Kerosene	.10	.11	.09	.07	.06	.05	-3.1
Liquefied Petroleum Gas	.46	.43	.40	.36	.32	.29	-2.2
Natural Gas	4.91	4.51	4.85	4.85	4.79	4.67	-.2
Coal	.06	.06	.06	.06	.06	.06	-.1
Renewable Energy [1]	.89	.92	1.03	1.21	1.54	1.95	3.8
Electricity	3.09	3.17	3.45	3.64	3.84	4.02	1.3
Total	10.58	10.24	10.81	10.99	11.31	11.67	.5
Commercial							
Distillate Fuel	.57	.56	.54	.50	.47	.44	-1.3
Kerosene	.04	.04	.03	.03	.02	.02	-3.1
Motor Gasoline [2]	.11	.11	.13	.13	.14	.15	1.4
Residual Fuel	.26	.25	.21	.18	.15	.13	-3.1
Natural Gas	2.80	2.65	2.84	2.92	2.96	2.97	.3
Other [3]	.17	.17	.14	.12	.11	.09	-2.9
Renewable Energy [1]	.05	.08	.13	.21	.36	.56	12.1
Electricity	2.77	2.85	3.20	3.56	3.98	4.44	2.3
Total	6.76	6.70	7.22	7.66	8.19	8.80	1.3
Industrial [4]							
Distillate Fuel	1.21	1.02	1.40	1.60	1.79	1.93	2.2
Liquefied Petroleum Gas	1.68	1.58	1.89	2.08	2.34	2.51	1.9
Motor Gasoline [2]	.19	.19	.22	.24	.25	.27	1.6
Petrochemical Feedstocks	.93	.97	1.13	1.30	1.49	1.65	2.7
Residual Fuel	.64	.61	.79	.87	.97	1.01	2.2
Other Petroleum [5]	3.66	3.85	3.61	3.65	3.69	3.73	.1
Natural Gas [6]	8.14	8.39	8.46	8.78	8.38	8.11	.0
Metallurgical Coal	1.10	1.01	1.08	1.00	.92	.85	-1.2
Steam Coal	1.70	1.68	1.67	1.66	1.68	1.83	.3
Net Coal Coke Imports	.03	.01	-.02	.04	.10	.15	7.8
Renewable Energy [1]	1.91	2.04	2.35	2.68	3.04	3.43	2.8
Purchased Electricity	3.16	3.18	3.50	4.01	4.64	5.19	2.4
Total	24.37	24.54	26.07	27.92	29.30	30.66	1.1
Transportation							
Distillate Fuel	3.72	3.71	4.10	4.49	4.99	5.43	1.8
Jet Fuel	3.06	3.09	3.41	3.82	4.31	4.73	2.1
Motor Gasoline [2]	13.75	13.56	13.85	14.46	15.29	15.89	.7
Residual Fuel	.77	.74	.68	.76	.84	.92	.8
Other Petroleum [7]	.23	.24	.25	.27	.30	.33	1.6
Pipeline Fuel Natural Gas	.65	.63	.69	.75	.76	.72	.5
Compressed Natural Gas	.00	.00	.00	.00	.01	.02	-
Alcohol Fuels	.00	.00	.00	.00	.03	.05	-
Electricity	.02	.02	.02	.02	.02	.03	2.9
Total	22.19	21.99	23.01	24.58	26.55	28.11	1.1
Electric Utilities [8]							
Distillate Fuel	.10	.08	.07	.17	.18	.13	1.2
Residual Fuel	1.58	1.22	1.60	1.97	2.35	2.89	2.9
Natural Gas	2.87	2.93	3.66	4.88	5.68	4.84	2.5
Steam Coal [9]	15.96	16.06	17.08	17.99	19.48	22.03	1.5
Nuclear Power	5.69	6.14	6.21	6.48	6.70	7.14	1.1
Renewable Energy/Other [10]	3.62	3.71	4.58	5.25	5.92	6.26	2.6
Total	29.82	30.14	33.20	36.74	40.31	43.28	1.8
Primary Energy Consumption							
Distillate Fuel	6.67	6.42	7.04	7.58	8.14	8.56	1.2
Kerosene	.14	.15	.12	.10	.09	.07	-3.1
Jet Fuel	3.06	3.09	3.41	3.82	4.31	4.73	2.1
Liquefied Petroleum Gas	2.24	2.11	2.37	2.52	2.74	2.87	1.2
Motor Gasoline	14.05	13.86	14.20	14.83	15.68	16.30	.7
Petrochemical Feedstocks	.93	.97	1.13	1.30	1.49	1.65	2.7
Residual Fuel	3.24	2.82	3.29	3.77	4.32	4.95	2.0
Other Petroleum [11]	3.87	4.07	3.83	3.90	3.97	4.03	.2
Natural Gas	19.37	19.11	20.51	22.17	22.57	21.33	.5
Metallurgical Coal	1.10	1.01	1.08	1.00	.92	.85	-1.2
Steam Coal	17.81	17.89	18.89	19.78	21.27	23.97	1.4
Net Coal Coke Imports	.03	.01	-.02	.04	.10	.15	7.8
Nuclear Power	5.69	6.14	6.21	6.48	6.70	7.14	1.1
Renewable Energy/Other [12]	6.47	6.75	8.09	9.35	10.86	12.20	3.1

- See footnotes at end of table.

Table B2. Energy Consumption by End-Use Sector and Source (Continued) (Quadrillion Btu per Year)

Sector and Source	Low Oil Price						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Primary Energy Consumption							
Alcohols	0.00	0.00	0.00	0.00	0.03	0.05	-
Total	84.69	84.39	90.15	96.65	103.20	108.80	1.2
Electricity Consumption (all Sectors)	9.03	9.21	10.16	11.24	12.48	13.68	2.0
Industrial Electricity							
Gross Consumption	3.48	3.51	3.82	4.40	5.06	5.65	2.3
Self-generation - Own Use	.32	.33	.33	.38	.42	.46	1.7
Purchased Electricity	3.16	3.18	3.50	4.01	4.64	5.19	2.4

[1] Includes electricity generated by the sector for self-use from hydroelectric, geothermal, wood and wood waste, municipal solid waste, other biomass, wind, photovoltaic and solar thermal sources, and non-electric energy from renewable sources such as active and passive solar systems, groundwater heat pumps, and wood.
[2] Includes ethanol blended into gasoline.
[3] Includes liquefied petroleum gas and coal.
[4] Includes consumption by cogenerators.
[5] Includes petroleum coke, asphalt, road oil, lubricants, and miscellaneous petroleum products.
[6] Includes lease and plant fuel.
[7] Includes aviation gas, liquefied petroleum gas, lubricants, and miscellaneous petroleum products.
[8] Includes consumption of energy by electric utilities, independent power producers, and small power producers that sell power to the grid.
[9] Includes consumption by independent power producers.
[10] Includes electricity generated to serve the grid from hydroelectric, geothermal, wood and wood waste, municipal solid waste, other biomass, wind, photovoltaic and solar thermal sources, plus waste heat, and net electricity imports.
[11] Includes unfinished oils, natural gasoline, motor gasoline blending components, aviation gasoline, lubricants, asphalt, road oil, and miscellaneous petroleum products.
[12] Includes electricity generated to serve the grid and for self use from renewable sources, non-electric energy from renewable sources, excluding alcohol fuels, electricity generated from waste heat, and net electricity imports.

Note: Totals may not equal sum of components due to independent rounding.

Sources: 1989: Energy Information Administration, *Monthly Energy Review*, DOE/EIA-0035(90/08) (Washington, DC, November 1990). Calculated from values in Tables B4 through B10 using the conversion factors in Appendix G. 1990: preliminary estimates. Projections: Energy Information Administration, AEO 1991 Forecasting System run IGLMCA.D0115912.

Table B3. Energy Prices by End-Use Sector and Source (1990 Dollars per Million Btu)

Sector and Source	Low Oil Price						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Residential	11.92	12.22	12.61	13.07	14.32	15.45	1.2
Primary Energy	6.21	6.30	6.30	6.80	7.81	8.62	1.6
Petroleum Products	7.86	8.21	7.46	7.98	8.64	9.35	.8
Distillate Fuel	6.73	7.64	6.66	7.15	7.77	8.42	1.1
Kerosene	7.34	8.30	8.04	8.28	8.61	8.96	1.0
Liquefied Petroleum Gas	10.60	9.56	9.20	9.80	10.60	11.47	.4
Natural Gas	5.72	5.69	6.00	6.55	7.68	8.54	1.9
Steam Coal	2.17	2.15	2.35	2.50	2.72	2.88	1.4
Electricity	24.10	23.72	24.20	23.63	24.39	25.14	.2
Commercial	12.24	12.49	12.91	13.19	14.26	15.36	1.1
Primary Energy	4.76	4.96	5.10	5.65	6.69	7.53	2.2
Petroleum Products	4.88	5.70	5.21	5.77	6.49	7.23	1.9
Distillate Fuel	4.75	5.65	4.68	5.18	5.81	6.47	1.5
Residual Fuel	2.81	3.15	3.31	3.56	3.90	4.29	2.0
Kerosene	4.98	5.96	5.46	5.72	6.06	6.43	1.2
Other Petroleum [1]	8.02	9.17	8.77	9.46	10.34	11.19	1.6
Natural Gas	4.80	4.77	5.14	5.69	6.83	7.68	2.3
Steam Coal	2.15	2.13	2.33	2.48	2.70	2.86	1.4
Electricity	22.91	22.46	22.40	21.40	21.59	22.06	-.2
Industrial	5.26	5.54	5.71	6.23	7.17	7.91	2.0
Primary Energy	3.52	3.87	3.96	4.42	5.18	5.81	2.4
Petroleum Products	4.56	5.41	5.17	5.55	6.07	6.65	1.8
Distillate Fuel	4.74	5.60	4.62	5.10	5.72	6.37	1.4
Liquefied Petroleum Gas	4.37	5.76	5.60	6.19	6.97	7.82	2.8
Motor Gasoline [2]	8.57	9.51	8.97	9.66	10.53	11.35	1.3
Residual Fuel	2.60	2.97	3.13	3.38	3.73	4.11	2.2
Other Petroleum [3]	4.69	5.40	5.33	5.61	6.01	6.45	1.5
Natural Gas [4]	2.99	2.92	3.26	3.81	4.95	5.81	3.2
Metallurgical Coal	1.96	1.92	2.08	2.26	2.47	2.58	1.3
Steam Coal	1.64	1.63	1.78	1.89	2.06	2.22	1.5
Electricity	15.28	15.00	15.25	15.22	15.88	16.31	.3
Transportation	7.63	8.58	8.09	8.65	9.37	10.07	1.3
Primary Energy	7.62	8.57	8.08	8.64	9.36	10.06	1.3
Petroleum Products	7.62	8.57	8.08	8.64	9.36	10.06	1.3
Distillate Fuel [5]	7.59	8.36	8.37	8.85	9.46	10.11	1.4
Jet Fuel [6]	4.57	5.84	4.83	5.33	5.96	6.63	1.8
Motor Gasoline [2]	8.55	9.51	8.97	9.66	10.53	11.35	1.4
Residual Fuel	2.50	3.05	3.08	3.35	3.70	4.03	2.3
Other Petroleum [7]	9.84	11.05	12.30	12.57	12.95	13.36	1.5
Natural Gas	.00	.00	.00	6.60	7.73	8.60	-
Electricity	24.14	23.42	23.33	22.97	23.33	23.62	-.1
Total End-Use Energy	8.00	8.50	8.49	8.94	9.84	10.63	1.4
Primary Energy	5.73	6.29	6.11	6.65	7.49	8.22	1.7
Electricity	20.67	20.32	20.55	19.92	20.33	20.79	.0
Electric Utilities	1.77	1.74	1.98	2.25	2.64	2.84	2.3
Fossil Fuel Average	3.04	3.43	3.63	3.89	4.25	4.73	2.1
Petroleum Products	4.41	5.37	4.30	4.83	5.46	6.10	1.6
Distillate Fuel	2.95	3.30	3.60	3.81	4.15	4.67	2.2
Residual Fuel	2.45	2.23	2.66	3.19	4.31	5.16	3.6
Natural Gas	1.52	1.51	1.67	1.80	1.94	2.08	1.5
Steam Coal							
Average Price to All Users [8]	6.58	7.49	7.02	7.49	8.11	8.74	1.4
Petroleum Products	6.64	7.53	7.08	7.54	8.19	8.89	1.4
Distillate Fuel [5]	4.57	5.84	4.83	5.33	5.96	6.63	1.8
Jet Fuel [6]	6.67	7.63	7.35	7.58	7.89	8.24	1.0
Kerosene	5.78	6.67	6.31	6.79	7.47	8.26	1.7
Liquefied Petroleum Gas	8.55	9.51	8.97	9.66	10.53	11.35	1.4
Motor Gasoline [2]	2.76	3.15	3.36	3.61	3.96	4.43	2.3
Residual Fuel							

- See footnotes at end of table.

Table B3. Energy Prices by End-Use Sector and Source (Continued)
(1990 Dollars per Million Btu)

Sector and Source	Low Oil Price						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Average Price to All Users [8]							
Other Petroleum Products [9]	4.93	5.65	5.67	5.96	6.37	6.83	1.6
Natural Gas	3.95	3.81	4.14	4.59	5.68	6.59	2.5
Coal	1.56	1.55	1.70	1.83	1.98	2.11	1.4
Electricity	20.67	20.32	20.55	19.92	20.33	20.79	.0

[1] Average price for liquefied petroleum gas, motor gasoline, and miscellaneous petroleum products.
[2] Average price for all grades. Includes Federal and State taxes and excludes county and local taxes.
[3] Average price for petrochemical feedstocks and miscellaneous petroleum products.
[4] Excludes uses for lease and plant fuel.
[5] Includes Federal and State taxes on diesel fuel and excludes county and local taxes.
[6] Kerosene-type jet fuel.
[7] Average price for liquefied petroleum gas and miscellaneous petroleum products.
[8] Weighted averages of end-use fuel prices are derived from the prices shown in each sector and the corresponding sectoral consumption. For each sector, electricity and natural gas prices are derived by dividing total revenues by sales.
[9] Average price for petrochemical feedstocks and miscellaneous petroleum products.

Sources: 1989 prices for gasoline, distillate, jet fuel, residual fuel, liquefied petroleum gas, and kerosene are based on prices in the Energy Information Administration, *Petroleum Marketing Annual 1989*, DOE/EIA-0487(89) (Washington, DC, December 1990). 1990 prices for these products are preliminary estimates based on data from the Energy Information Administration, *Petroleum Marketing Monthly*, DOE/EIA-0380 (Washington, DC, January 1990 through October 1990). 1989 and 1990 prices for all other petroleum products are derived from the Energy Information Administration, *State Energy Price and Expenditures Report: 1988*, DOE/EIA-0376(88) (Washington, DC, September 1990), applying the growth rate of the world oil price. Projections: Energy Information Administration, AEO 1991 Forecasting System run IGLMCA.D0115912.

Table B4. Electricity Supply, Disposition, and Prices (Billion Kilowatthours, Unless Otherwise Noted)

Supply, Disposition, and Prices	Low Oil Price						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Electric Utilities							
Generation by Fuel Type							
Coal	1,554	1,558	1,647	1,736	1,835	2,130	1.5
Petroleum	158	122	156	201	239	280	2.8
Natural Gas	267	270	339	441	562	514	3.2
Nuclear Power	529	575	570	594	614	654	1.0
Pumped Storage Hydroelectric	-9	-9	-10	-10	-10	-11	1.1
Renewable Sources/Other [1]	285	298	320	332	341	344	.9
Total	2,785	2,813	3,022	3,293	3,581	3,911	1.6
Net Imports	11	2	41	55	65	68	9.1
Nonutilities [2]							
Generation by Fuel Type							
Coal	33	34	42	44	95	116	6.2
Petroleum	3	3	4	4	5	6	3.0
Natural Gas	78	93	103	127	129	133	2.6
Renewable Sources/Other [1]	72	72	113	153	198	228	5.6
Total	185	201	262	328	428	482	4.7
Sales to Utilities	90	105	166	215	304	347	6.6
Generation for Own Use	95	96	96	113	123	135	1.7
Electricity Sales by Sector							
Residential	906	928	1,011	1,068	1,124	1,178	1.3
Commercial/Other [3]	815	839	943	1,049	1,174	1,311	2.3
Industrial	926	933	1,025	1,176	1,360	1,521	2.4
Total	2,647	2,700	2,978	3,294	3,658	4,009	2.0
End-Use Prices [4]							
(1990 cents per kilowatthour)							
Residential	8.22	8.09	8.26	8.06	8.32	8.58	.2
Commercial/Other [3]	7.82	7.67	7.64	7.30	7.37	7.53	-.2
Industrial [5]	5.22	5.12	5.20	5.19	5.42	5.56	.3
Average	7.05	6.93	7.01	6.80	6.94	7.09	.0
Price Components [4]							
(1990 cents per kilowatthour)							
Capital Component	3.09	3.06	2.94	2.45	2.23	2.25	-1.5
Fuel Component	1.83	1.75	1.98	2.27	2.64	2.78	2.0
O&M Component	2.13	2.12	2.09	2.08	2.06	2.06	-.2
Total	7.05	6.93	7.01	6.80	6.94	7.09	.0

[1] Includes conventional hydroelectric, geothermal, wood, wood waste, municipal solid waste, other biomass, solar and wind power, plus a small quantity of petroleum coke. For nonutilities, also includes waste heat, blast furnace gas, and coke oven gas.

[2] Includes cogenerators, small power producers, independent power producers, and all other sources, except electric utilities, which produce electricity for self use or for delivery to the grid.

[3] Other includes sales of electricity to Government, railways, and street lighting authorities.

[4] Prices represent average revenue per kilowatthour of sales over all customer classes.

[5] Weighted average, including transportation. Weights used are consumption levels by sector.

O&M = Operating and Maintenance

Note: Totals may not equal sum of components due to independent rounding.

Sources: 1989, except for nonutilities and prices: Energy Information Administration, *Electric Power Annual 1989*, DOE/EIA-0348(89) (Washington, DC, January 1991). 1990 generation: Energy Information Administration, *Short-Term Energy Outlook*, DOE/EIA-0202(91/1Q) (Washington, DC, January 1991). 1989 and 1990 nonutilities, prices, and all projections: Energy Information Administration, AEO 1991 Forecasting System run IGLMCA.D0115912.

Table B5. Electricity Generating Capability (Thousand Megawatts)

Summer Capability [1]	Low Oil Price						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Electric Utilities							
Capability							
Coal Steam	296.2	297.5	300.2	303.7	314.5	362.3	1.0
Other Fossil Steam [2]	144.6	145.3	139.9	132.7	125.8	122.1	-.8
Combined Cycle	5.1	5.2	6.4	11.7	47.0	60.9	12.5
Combustion Turbine/Diesel	46.0	46.6	53.7	66.2	74.4	79.1	2.6
Nuclear Power	98.2	99.6	103.1	105.4	106.5	110.2	.5
Pumped Storage Hydroelectric	17.2	17.2	19.8	19.8	19.8	19.8	.7
Renewable Sources/Other [3]	77.3	77.5	80.1	81.8	82.9	83.4	.4
Total	684.6	688.9	703.2	721.3	770.8	837.8	1.0
Cumulative Planned Additions [4]							
Coal Steam	.0	1.7	8.6	17.3	19.0	19.2	-
Other Fossil Steam	.0	.0	.5	.5	.5	.5	-
Combined Cycle	.0	.1	1.3	4.4	4.4	4.4	-
Combustion Turbine/Diesel	.0	.6	5.3	10.8	10.9	10.9	-
Nuclear Power	.0	2.3	5.8	8.3	9.5	9.5	-
Pumped Storage Hydroelectric	.0	.0	2.6	2.7	2.7	2.7	-
Renewable Sources/Other [3]	.0	.1	2.3	2.7	2.8	2.8	-
Total	.0	4.8	26.4	46.6	49.7	49.9	-
Cumulative Unplanned Additions [4]							
Coal Steam	.0	.0	.0	.6	12.8	63.2	-
Other Fossil Steam	.0	.0	.0	.0	.0	.0	-
Combined Cycle	.0	.0	.0	2.2	37.5	51.4	-
Combustion Turbine/Diesel	.0	.0	2.8	10.1	19.5	24.3	-
Nuclear Power	.0	.0	.0	.0	.0	6.0	-
Pumped Storage Hydroelectric	.0	.0	.0	.0	.0	.0	-
Renewable Sources/Other [3]	.0	.1	.6	1.8	2.8	3.3	-
Total	.0	.1	3.4	14.7	72.6	148.2	-
Cumulative Total Additions	.0	4.9	29.7	61.4	122.2	198.1	-
Cumulative Retirements	.0	1.4	11.9	25.4	36.7	45.6	-
Nonutilities [5]							
Capability							
Coal	5.8	5.9	7.8	8.0	17.1	21.4	6.4
Petroleum	.9	1.0	1.3	1.5	1.8	2.1	3.7
Natural Gas	13.8	16.7	18.6	22.8	23.3	23.9	2.6
Renewable Sources/Other [3]	16.1	16.8	21.3	27.5	34.7	40.1	4.4
Total	36.7	40.5	48.9	59.8	76.8	87.5	4.2
Cumulative Additions	.0	3.8	12.2	23.1	40.1	50.8	-

[1] Net summer capability is the steady hourly output that generating equipment is expected to supply to system load (exclusive of auxiliary power), as demonstrated by tests during summer peak demand.

[2] Includes oil-, gas-, and dual-fired capability.

[3] Includes conventional hydroelectric, geothermal, wood, wood waste, municipal solid waste, other biomass, solar, and wind power, plus a small quantity of petroleum coke. For nonutilities, also includes waste heat, blast furnace gas, and coke oven gas.

[4] Cumulative additions after December 31, 1989.

[5] Includes cogenerators, small power producers, independent power producers, and all other sources, except electric utilities, which produce electricity for self use or for sales to the grid.

Note: Totals may not equal sum of components due to independent rounding.

Sources: 1989 utility capability: Energy Information Administration, *Electric Power Annual 1989*, DOE/EIA-0348(89) (Washington, DC, January 1991). 1990 utility capability: Energy Information Administration, Form EIA-860, *Annual Electric Generator Report*. 1989 and 1990 nonutility capability and all projections: Energy Information Administration, AEO 1991 Forecasting System run IGLMCA.D0115912.

Table B6. Renewable Energy (Quadrillion Btu per Year, Unless Otherwise Noted)

Electricity and Non-Electric	Low Oil Price						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Electricity							
Capability (gigawatts)							
Conventional Hydropower	75.48	75.67	77.94	78.36	78.36	78.46	0.2
Geothermal	2.47	2.59	3.25	6.25	9.65	10.65	7.2
Municipal Solid Waste	1.98	2.10	3.75	6.16	8.79	10.81	8.4
Biomass/Other Waste	5.31	5.46	6.21	7.02	7.90	8.88	2.5
Solar Thermal	.33	.43	.43	.43	.81	1.78	8.4
Solar Photovoltaic	.00	.00	.01	.01	.01	.01	2.1
Wind	1.93	1.95	2.46	3.50	4.40	5.30	4.9
Total	87.51	88.20	94.05	101.70	109.90	115.90	1.3
Generation (billion kilowatthours)							
Conventional Hydropower	276.90	302.20	312.40	314.60	314.60	314.80	.6
Geothermal	15.05	15.98	20.67	43.37	70.63	78.52	8.2
Municipal Solid Waste	13.31	13.48	24.66	41.54	60.06	74.22	8.5
Biomass/Other Waste	29.54	30.36	34.57	39.11	44.01	49.55	2.5
Solar Thermal	.69	.90	.90	1.16	2.30	5.06	10.0
Solar Photovoltaic	.00	.00	.00	.00	.00	.00	2.2
Wind	3.38	3.42	4.32	8.22	10.68	12.97	6.6
Total	338.90	366.30	397.50	448.00	502.30	535.10	2.2
Consumption/Displacement							
Conventional Hydropower	2.88	3.14	3.25	3.27	3.27	3.27	.6
Geothermal	.16	.17	.21	.45	.73	.82	8.2
Municipal Solid Waste	.20	.22	.50	.76	1.05	1.27	9.2
Biomass/Other Waste	.20	.20	.23	.26	.29	.33	2.5
Solar Thermal	.01	.01	.01	.01	.02	.05	10.0
Solar Photovoltaic	.00	.00	.00	.00	.00	.00	2.3
Wind	.04	.04	.04	.09	.11	.13	6.6
Total	3.48	3.78	4.25	4.85	5.48	5.88	2.5
Non-Electric Renewable Energy							
Residential, Commercial, and Industrial							
Hydropower	.00	.00	.00	.00	.00	.00	-
Geothermal	.00	.00	.02	.07	.18	.39	-
Biofuels	2.63	2.77	3.14	3.58	4.05	4.54	2.6
Solar Thermal	.05	.07	.09	.13	.30	.54	11.6
Solar Photovoltaic	.00	.00	.00	.00	.00	.00	-
Wind	.00	.00	.00	.00	.00	.00	-
Transportation							
Ethanol	.07	.08	.10	.12	.14	.14	3.5
Total	2.75	2.92	3.35	3.90	4.68	5.62	3.5
Total Renewable Energy	6.23	6.70	7.61	8.74	10.17	11.50	3.0

Note: Totals may not equal sum of components due to independent rounding.
Sources: 1989 and 1990: Energy Information Administration, Office of Coal, Nuclear, Electric and Alternate Fuels. Projections: Energy Information Administration, AEO 1991 Forecasting System run IGLMCA.D0115912.

Table B7. Macroeconomic Indicators (Billion 1982 Dollars, Unless Otherwise Noted)

Indicator	Low Oil Price						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
GNP Implicit Price Deflator (index, 1982=1.000)	1.263	1.314	1.554	1.897	2.346	2.928	4.1
Real Gross National Product	4,118	4,153	4,665	5,252	5,937	6,528	2.2
Real Disposable Personal Income	2,869	2,891	3,156	3,460	3,825	4,169	1.8
Index of Manufacturing Gross Output (index, 1982=1.000)	1.219	1.217	1.393	1.623	1.886	2.094	2.6
AA Utility Bond Rate (percent)	9.55	9.65	9.60	9.13	8.82	8.83	-
90-Day U.S. Government Treasury Bill Rate (percent)	8.11	7.51	6.11	5.77	5.51	5.48	-
Energy Intensity (thousand Btu per 1982 $ of GNP)	20.57	20.32	19.32	18.40	17.38	16.67	-1.0

Note: Totals may not equal sum of components due to independent rounding.
Sources: 1989: Data Resources Incorporated (DRI), USCEN Databank. 1990: DRI Control0191. Projections: Energy Information Administration, AEO 1991 Forecasting System run IGLMCA.D0115912.

Table B8. Petroleum Supply and Disposition Balance (Million Barrels per Day, Unless Otherwise Noted)

Supply and Disposition	Low Oil Price						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
World Oil Price (1990 dollars per barrel) [1]	18.81	22.00	19.00	20.10	21.70	23.40	1.0
Production							
Crude Oil [2]	7.61	7.23	6.11	4.69	3.75	3.36	-3.8
Alaska	1.87	1.75	1.21	.79	.53	.42	-6.8
Lower 48	5.74	5.48	4.89	3.90	3.22	2.94	-3.1
Natural Gas Plant Liquids	1.55	1.54	1.54	1.66	1.64	1.51	-.1
Other Domestic [3]	.06	.07	.19	.27	.36	.41	9.6
Processing Gain [4]	.66	.67	.64	.65	.66	.64	-.2
Total	9.88	9.51	8.48	7.27	6.41	5.92	-2.4
Imports (including SPR) [5]							
Crude Oil	5.84	6.01	7.45	9.26	10.05	10.38	2.8
Refined Products	2.22	2.08	2.70	3.28	4.91	6.25	5.1
Total	8.06	8.09	10.15	12.54	14.96	16.64	3.5
Exports							
Crude Oil	.14	.11	.09	.06	.05	.04	-5.4
Refined Products	.72	.70	.68	.73	.80	.80	.5
Total	.86	.81	.77	.79	.85	.84	-.1
Net Imports (including SPR)	7.20	7.28	9.38	11.75	14.11	15.79	3.8
Primary Stock Changes							
Net Withdrawals [6]	.12	-.16	-.02	-.02	-.04	-.02	-
SPR Fill Rate Additions (-) [5]	-.06	-.02	-.05	-.05	.00	.00	-
Total Primary Supply [7]	17.14	16.62	17.79	18.94	20.48	21.69	1.1
Unaccounted for Crude	.20	.34	.15	.15	.15	.15	-1.4
Refined Petroleum Products Supplied							
Motor Gasoline [8]	7.33	7.23	7.40	7.71	8.18	8.50	.7
Jet Fuel [9]	1.49	1.51	1.66	1.85	2.10	2.30	2.1
Distillate Fuel	3.14	3.02	3.31	3.56	3.83	4.02	1.2
Residual Fuel	1.41	1.23	1.43	1.64	1.90	2.18	2.1
Other [10]	3.96	3.97	4.13	4.33	4.63	4.85	1.0
Total	17.33	16.95	17.94	19.09	20.63	21.84	1.1
Refined Petroleum Products Supplied							
Residential and Commercial	1.41	1.38	1.26	1.12	1.01	.92	-2.0
Industrial [11]	4.32	4.25	4.71	5.09	5.57	5.91	1.5
Transportation	10.86	10.76	11.24	11.94	12.93	13.69	1.1
Electric Utilities [12]	.74	.57	.73	.93	1.12	1.32	2.8
Total	17.33	16.95	17.94	19.09	20.63	21.84	1.1
Discrepancy [13]	.01	.00	.00	.00	.00	.00	-
Net Disposition	17.34	16.96	17.94	19.09	20.63	21.84	1.1

[1] Average refiner acquisition cost for imported crude oil.
[2] Includes lease condensate.
[3] Includes other hydrocarbons, ethanol, and synthetic crude oil.
[4] Represents volumetric gain in refinery distillation and cracking processes.
[5] SPR is the Strategic Petroleum Reserve.
[6] Computed as the end-of-year stock levels in the current period subtracted from the end-of-year stock levels in the preceding period. A negative (-) represents an increase to inventories.
[7] Total production plus net imports plus net stock withdrawals minus SPR additions.
[8] Includes ethanol blended into gasoline.
[9] Includes naphtha and kerosene type.
[10] Includes aviation gasoline, kerosene, liquefied petroleum gas, petrochemical feedstocks, miscellaneous petroleum products, lubricants, waxes, asphalt, road oil, still gas, special naphthas, petroleum coke, crude oil product supplied, natural gas liquids, liquefied refinery gas, and other liquids.
[11] Includes consumption by cogenerators.
[12] Includes consumption by independent power producers.
[13] Balancing item.

Note: Totals may not equal sum of components due to independent rounding.

Sources: 1989: Energy Information Administration, *Petroleum Supply Annual 1989*, DOE/EIA-0340(89) (Washington, DC, May 1990). 1990: preliminary estimates. Projections: Energy Information Administration, AEO 1991 Forecasting System run IGLMCA.D0115912.

Table B9. Natural Gas Supply, Disposition, and Prices (Trillion Cubic Feet per Year, Unless Otherwise Noted)

Supply, Disposition, and Prices	Low Oil Price						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Production							
Dry Gas Production [1]	17.26	17.40	18.08	19.47	19.36	17.88	0.2
Synthetic Natural Gas [2]	.11	.17	.12	.14	.25	.35	5.7
Net Imports	1.28	1.36	2.30	2.56	2.95	3.09	4.3
Net Storage Withdrawals [3]	.32	-.28	.00	.00	.00	.00	-
Total Supply	18.97	18.65	20.50	22.16	22.56	21.33	.6
Consumption by Sector							
Residential	4.77	4.38	4.70	4.70	4.64	4.53	-.2
Commercial	2.71	2.57	2.76	2.83	2.87	2.88	.3
Industrial [4]	6.83	6.97	7.11	7.34	6.96	6.78	.0
Electric Utilities [5]	2.78	2.84	3.55	4.73	5.50	4.69	2.5
Lease and Plant Fuel [6]	1.07	1.17	1.10	1.17	1.17	1.09	.1
Pipeline Fuel	.63	.61	.67	.73	.73	.70	.5
Transportation [7]	.00	.00	.00	.00	.01	.02	-
Total	18.79	18.53	19.89	21.50	21.89	20.68	.5
Unaccounted for [8]	.18	.12	.61	.66	.67	.64	6.2
Average Wellhead Price (1990 dollars per thousand cubic feet)	1.76	1.77	2.06	2.62	3.79	4.68	4.8
Delivered Prices (1990 dollars per thousand cubic feet)							
Residential	5.89	5.86	6.19	6.76	7.92	8.80	1.9
Commercial	4.95	4.92	5.30	5.87	7.04	7.92	2.3
Industrial	3.08	3.01	3.36	3.93	5.10	5.99	3.2
Electric Utilities	2.53	2.30	2.75	3.29	4.45	5.32	3.6
Transportation	.00	.00	.00	6.80	7.97	8.86	-
Average [9]	4.07	3.93	4.27	4.73	5.86	6.79	2.5

[1] Dry marketed production minus nonhydrocarbon gases removed.
[2] Includes synthetic natural gas (from the manufacture, conversion, or reforming of petroleum hydrocarbons) and propane/air mixtures.
[3] Computed as the end-of-year stock levels in the current period subtracted from the end-of-year stock levels in the preceding period. A negative (-) represents an increase to inventories.
[4] Includes consumption by cogenerators.
[5] Includes consumption by independent power producers.
[6] Represents natural gas used in the field gathering and processing plant machinery.
[7] Compressed natural gas used as vehicle fuel.
[8] Balancing item. Reflects natural gas lost, the net result of converting flow data measured at varying temperatures and pressures to a standard temperature and pressure, and the merger of different data reporting systems which vary in scope, format, definition, and respondent type.
[9] Weighted average price. Weights used are the sectoral consumption values excluding lease, plant and pipeline fuel.

Note: Totals may not equal sum of components due to independent rounding.

Sources: 1989: Energy Information Administration, *Natural Gas Annual 1989*, DOE/EIA-0131(89) (Washington, DC, September 1990). 1990: preliminary estimates. Projections: Energy Information Administration, AEO 1991 Forecasting System run IGLMCA.D0115912.

Table B10. Coal Supply, Disposition, and Prices (Million Short Tons per Year, Unless Otherwise Noted)

Supply, Disposition, and Prices	Low Oil Price						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Production [1]							
East of the Mississippi	599	638	628	655	741	848	1.7
West of the Mississippi	382	397	428	480	527	618	2.3
Total	981	1,035	1,056	1,135	1,268	1,466	1.9
Net Imports							
Imports	3	2	5	6	9	11	6.6
Exports	101	107	109	136	199	251	4.4
Total	-98	-105	-104	-130	-189	-240	4.4
Net Stock Withdrawals [2]	14	-29	-2	-1	-5	-6	-
Total Supply [3]	897	901	949	1,004	1,074	1,219	1.5
Consumption by Sector							
Residential and Commercial	6	6	6	5	5	5	-1.3
Industrial [4]	76	77	76	75	75	83	.4
Coking Plants	41	37	41	38	35	32	-1.2
Electric Utilities [5]	766	772	828	887	960	1,100	1.7
Total	889	893	950	1,005	1,075	1,220	1.5
Discrepancy [6]	7	8	-1	-1	-1	-1	-
Average Minemouth Price [7] **(1990 dollars per short ton)**	22.70	22.18	24.70	27.13	29.84	31.22	1.5
Delivered Prices (1990 dollars per short ton)							
Residential and Commercial	49.48	48.39	55.36	58.48	64.36	66.67	1.4
Industrial	34.36	33.60	39.34	41.86	46.07	48.90	1.7
Coking Plants	49.42	47.70	55.23	59.95	65.63	68.44	1.6
Electric Utilities	31.35	30.64	34.35	36.42	39.37	41.57	1.4
Average [8]	32.56	31.75	35.77	37.82	40.80	42.87	1.3

[1] Includes anthracite, bituminous coal, and lignite.
[2] From all stocks held by industrial plants, coke plants, electric utilities, and producers/distributors. Computed as the end-of-year stock levels in the current period subtracted from the end-of-year stock levels in the preceding period. A negative (-) represents an increase to inventories.
[3] Production plus net imports plus net storage withdrawals.
[4] Includes consumption by cogenerators.
[5] Includes consumption by independent power producers.
[6] Balancing item: the sum of production, net imports, and net stock withdrawals minus total consumption.
[7] Free-on-board price.
[8] Weighted average prices. Weights used are consumption values by sector.

Note: Totals may not equal sum of components due to independent rounding.
Sources: 1989: Energy Information Administration, *Monthly Energy Review*, DOE/EIA-0035(90/08) (Washington, DC, November 1990); *Quarterly Coal Report*, DOE/EIA-0121(90/3Q) (Washington, DC, January 1991); and *Coal Production 1989*, DOE/EIA-0118(89) (Washington, DC, November 1990). 1990: preliminary estimates. Projections: Energy Information Administration, AEO 1991 Forecasting System run IGLMCA.D0115912.

Table B11. Residential Sector Key Indicators and End-Use Consumption (Quadrillion Btu per Year, Unless Otherwise Noted)

Key Indicators and Consumption	Low Oil Price						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Key Indicators							
Total Housing (millions)	92.6	93.4	98.2	103.2	107.8	111.8	0.9
Energy Consumption per Household (MMBtu)	114.1	109.5	110.0	106.5	104.9	104.4	-.4
End-Use Consumption							
Distillate							
Space Heating	.90	.89	.81	.71	.63	.57	-2.2
Other Uses [1]	.16	.16	.13	.10	.08	.06	-4.3
Total	1.06	1.05	.94	.81	.71	.63	-2.4
Natural Gas							
Space Heating	3.43	3.14	3.34	3.31	3.26	3.18	-.3
Water Heating	1.13	1.05	1.18	1.22	1.22	1.19	.2
Other Uses [1]	.35	.32	.33	.31	.30	.29	-.9
Total	4.91	4.51	4.85	4.85	4.79	4.67	-.2
Other Fuels [2]	.62	.60	.54	.49	.44	.40	-2.1
Renewables [3]	.89	.92	1.03	1.21	1.54	1.95	3.8
Electricity							
Space Heating	.32	.33	.37	.39	.41	.43	1.4
Cooling	.50	.51	.56	.58	.59	.60	.9
Water Heating	.36	.38	.44	.50	.57	.65	2.8
Other Uses [1]	1.91	1.94	2.08	2.17	2.26	2.34	1.0
Total	3.09	3.17	3.45	3.64	3.84	4.02	1.3
Total Consumption	10.58	10.24	10.81	10.99	11.31	11.67	.5

[1] Includes cooking, cooling (natural gas), water heating (distillate), refrigeration and lighting (electricity), and other household appliances.
[2] Includes liquefied petroleum gas, kerosene and coal.
[3] Includes solar, geothermal, and wood energy.
MMBtu = million Btu.
Note: Totals may not equal sum of components due to independent rounding.
Sources: 1989 and 1990 estimates: Energy Information Administration (EIA), *State Energy Data Report*, DOE/EIA-0214(88) (Washington, DC, May 1990) and *Monthly Energy Review*, DOE/EIA-0035(90/08) (Washington, DC, November 1990). Projections: EIA, AEO 1991 Forecasting System Run IGLMCA.D0115912.

Table B12. Commercial Sector Key Indicators and End-Use Consumption (Quadrillion Btu per Year, Unless Otherwise Noted)

Key Indicators and Consumption	Low Oil Price						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Key Indicators							
Total Employment (millions)	108.4	110.4	116.8	124.9	131.5	136.4	1.1
Total Floor Space (billion sq. ft.)	63.0	64.3	70.4	77.0	83.9	91.0	1.8
Energy Consumption per Square Foot (MBtu)	107.3	104.3	102.6	99.5	97.7	96.8	-.5
End-Use Consumption							
Distillate							
Space Heating	.52	.52	.50	.47	.45	.42	-1.1
Other Uses [1]	.05	.05	.04	.03	.02	.02	-4.4
Total	.57	.56	.54	.50	.47	.44	-1.3
Natural Gas							
Space Heating	1.84	1.74	1.87	1.91	1.93	1.89	.1
Cooling	.21	.19	.16	.13	.11	.09	-4.1
Other Uses [1]	.75	.72	.81	.87	.93	.99	1.3
Total	2.80	2.65	2.84	2.92	2.96	2.97	.3
Other Fuels[2]	.58	.56	.51	.46	.42	.39	-1.8
Renewables [3]	.05	.08	.13	.21	.36	.56	12.1
Electricity							
Space Heating	.51	.52	.60	.68	.80	.96	3.0
Cooling	.71	.74	.84	.94	1.05	1.16	2.3
Lighting	1.09	1.12	1.23	1.34	1.46	1.58	1.8
Other Uses [1]	.45	.47	.53	.60	.67	.75	2.4
Total	2.77	2.85	3.20	3.56	3.98	4.44	2.3
Total Consumption	6.76	6.70	7.22	7.66	8.19	8.80	1.3

[1] Includes water heating, cooking, and other miscellaneous commercial uses.
[2] Includes residual fuel oil, liquefied petroleum gas, coal, motor gasoline, and kerosene.
[3] Includes solar, geothermal, wood, and municipal solid waste energy.
MBtu = thousand Btu.
Note: Totals may not equal sum of components due to independent rounding.
Sources: 1989 and 1990 estimates: Energy Information Administration (EIA), *State Energy Data Report*, DOE/EIA-0214(88) (Washington, DC, May 1990) and *Monthly Energy Review*, DOE/EIA-0035(90/08) (Washington, DC, November 1990). Projections: EIA, AEO 1991 Forecasting System Run IGLMCA.D0115912.

Table B13. Industrial Sector Key Indicators and Consumption

Key Indicators and Consumption	Low Oil Price						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Key Indicators							
Value of Gross Output (billion 1982 dollars)							
Manufacturing	2,402	2,399	2,745	3,198	3,717	4,127	2.6
Nonmanufacturing	832	820	915	991	1,073	1,147	1.5
Total	3,234	3,220	3,660	4,189	4,790	5,274	2.4
Consumption per Unit Output (thousand Btu per 1982 dollars)							
Distillate	.375	.317	.381	.383	.374	.366	-.1
Liquefied Petroleum Gas	.519	.490	.515	.498	.489	.476	-.4
Petrochemical Feedstocks	.289	.301	.309	.311	.310	.312	.4
Residual Fuel	.198	.190	.217	.207	.202	.193	-.1
Other Petroleum [1]	1.133	1.195	.985	.871	.771	.708	-2.2
Natural Gas [2]	2.518	2.605	2.312	2.095	1.749	1.538	-2.3
Metallurgical Coal and Coke [3]	.352	.319	.289	.249	.213	.189	-2.9
Steam Coal [4]	.527	.521	.458	.397	.351	.347	-2.0
Renewables [5]	.592	.635	.642	.641	.635	.650	.4
Electricity	.978	.988	.956	.958	.969	.984	.0
Total	7.540	7.622	7.124	6.665	6.117	5.814	-1.2
Consumption (quadrillion Btu per year)							
Distillate	1.21	1.02	1.40	1.60	1.79	1.93	2.2
Liquefied Petroleum Gas	1.68	1.58	1.89	2.08	2.34	2.51	1.9
Motor Gasoline [6]	.19	.19	.22	.24	.25	.27	1.6
Petrochemical Feedstocks	.93	.97	1.13	1.30	1.49	1.65	2.7
Residual Fuel	.64	.61	.79	.87	.97	1.01	2.2
Other Petroleum [1]	3.66	3.85	3.61	3.65	3.69	3.73	.1
Natural Gas [2]	8.14	8.39	8.46	8.78	8.38	8.11	.0
Metallurgical Coal and Coke [3]	1.14	1.03	1.06	1.04	1.02	1.00	-.6
Steam Coal [4]	1.70	1.68	1.67	1.66	1.68	1.83	.3
Renewables [5]	1.91	2.04	2.35	2.68	3.04	3.43	2.8
Electricity	3.16	3.18	3.50	4.01	4.64	5.19	2.4
Total	24.37	24.54	26.07	27.92	29.30	30.66	1.1

[1] Includes petroleum coke, asphalt, road oil, lubricants, and miscellaneous petroleum products.
[2] Includes lease and plant fuel.
[3] Includes net imports of coal coke.
[4] Includes consumption by cogenerators.
[5] Does not include renewables consumed for nonutility electricity generation in the industrial sector for sales to the grid.
[6] Includes ethanol blended into gasoline.

Note: Totals may not equal sum of components due to independent rounding.

Sources: 1989 and 1990 estimates: Energy Information Administration (EIA), *State Energy Data Report*, DOE/EIA-0214(88) (Washington, DC, May 1990) and *Monthly Energy Review*, DOE/EIA-0035(90/08) (Washington, DC, November 1990). Projections: EIA, AEO 1991 Forecasting System Run IGLMCA.D0115912.

Table B14. Transportation Sector Key Indicators and Consumption

Key Indicators and Consumption	Low Oil Price						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Key Indicators							
Level of Travel Index (1989= 1.0)							
Light Duty Vehicles	1.000	0.999	1.089	1.189	1.308	1.417	1.7
Freight Trucks	1.000	.995	1.106	1.231	1.369	1.490	1.9
Air	1.000	.985	1.248	1.549	1.910	2.228	3.9
Rail	1.000	.982	1.066	1.144	1.234	1.314	1.3
Marine	1.000	.974	1.051	1.109	1.184	1.262	1.1
Energy Efficiency Indicators							
New Car MPG [1]	28.3	28.2	29.5	31.4	33.2	35.3	1.1
New Light Truck MPG [1]	20.9	20.9	22.6	23.1	24.1	25.6	1.0
Light Duty Fleet MPG [2]	18.5	18.7	19.6	20.4	21.1	21.9	.8
Aircraft Efficiency Index [3]	1.000	1.012	1.076	1.148	1.224	1.276	1.2
Freight Truck Efficiency Index [4]	1.000	1.006	1.051	1.094	1.112	1.129	.6
Rail Efficiency Index [5]	1.000	1.003	1.020	1.037	1.055	1.073	.3
Domestic Shipping Efficiency Index	1.000	1.000	1.000	1.000	1.000	1.000	.0
Energy Use By Mode (quadrillion Btu)							
Light Duty Vehicles	11.66	11.54	11.85	12.44	13.21	13.80	.8
Freight Trucks	4.97	4.92	5.23	5.58	6.10	6.53	1.3
Air	3.15	3.18	3.52	3.94	4.45	4.89	2.1
Rail	.48	.47	.50	.52	.56	.58	.9
Marine	1.13	1.10	1.07	1.19	1.31	1.41	1.1
Pipeline Fuel	.65	.63	.69	.75	.76	.72	.5
Other	.16	.17	.17	.19	.20	.22	1.3
Total	22.19	21.99	23.01	24.58	26.55	28.11	1.1

[1] Unadjusted Corporate Average Fuel Economy estimates.
[2] Average *on-the-road* efficiency estimate including cars and light trucks.
[3] Based on estimates of passenger seat miles per gallon (1989=1.0).
[4] Based on Btu per vehicle miles traveled (1989=1.0).
[5] Based on Btu per ton-miles traveled (1989=1.0).

Note: Totals may not equal sum of components due to independent rounding.

Sources: 1989 and 1990 estimates: Energy Information Administration (EIA), *State Energy Data Report*, DOE/EIA-0214(88) (Washington, DC, May 1990) and *Monthly Energy Review*, DOE/EIA-0035(90/08) (Washington, DC, November 1990). Energy use by mode based on model estimates.
Projections: EIA, AEO 1991 Forecasting System Run IGLMCA.D0115912.

Appendix C

High Economic Growth Case Projections

Table C1. Total Energy Supply, Disposition, and Prices (Quadrillion Btu per Year, Unless Otherwise Noted)

Supply, Disposition, and Prices	High Economic Growth						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Production							
Crude Oil and Lease Condensate [1]	16.24	15.46	13.12	10.20	8.52	7.80	-3.4
Natural Gas Plant Liquids	2.15	2.14	2.19	2.39	2.32	2.27	.3
Dry Natural Gas [2]	17.91	18.11	19.26	21.09	20.73	20.23	.6
Coal	21.36	22.54	23.20	24.99	29.16	34.05	2.2
Nuclear Power	5.69	6.14	6.22	6.48	6.70	7.14	1.1
Renewable Energy [3]	6.43	6.81	7.76	8.90	10.32	11.64	2.9
Total	69.78	71.20	71.74	74.07	77.75	83.13	.8
Imports							
Crude Oil [4]	12.58	12.94	17.06	20.12	21.56	22.28	2.8
Petroleum Products	4.48	4.21	5.77	9.19	13.62	16.52	6.4
Natural Gas [5]	1.32	1.40	2.40	2.74	3.11	3.19	4.3
Other Imports [6]	.22	.11	.54	.79	1.06	1.22	8.6
Total	18.60	18.66	25.77	32.85	39.35	43.20	4.1
Exports							
Coal	2.61	2.64	3.18	4.20	6.14	7.02	4.8
Petroleum	1.81	1.71	1.68	1.80	1.79	1.78	-.1
Total	4.42	4.35	4.86	6.00	7.94	8.80	3.3
Net Stock Withdrawals	.44	-.67	-.25	-.24	-.25	-.26	-
Discrepancy [7]	.29	-.45	-.37	-.33	-.57	-.49	-
Consumption							
Petroleum Products [8]	34.21	33.49	36.64	40.38	44.45	47.42	1.6
Natural Gas	19.37	19.11	21.03	23.14	23.11	22.71	.8
Coal	18.91	18.90	20.08	20.92	23.10	27.09	1.7
Nuclear Power	5.69	6.14	6.22	6.48	6.70	7.14	1.1
Renewable Energy/Other [9]	6.50	6.76	8.08	9.42	11.00	12.42	3.1
Total	84.69	84.39	92.03	100.30	108.40	116.80	1.5
Net Imports - Petroleum	15.25	15.44	21.15	27.51	33.39	37.02	4.3
Prices (1990 dollars per unit)							
World Oil Price ($ per barrel) [10]	18.81	22.00	19.00	20.10	21.70	23.40	1.0
Natural Gas Wellhead Price ($ per Mcf)	1.76	1.77	2.28	3.15	4.24	5.21	5.3
Coal Minemouth Price ($ per ton)	22.70	22.18	25.34	28.18	32.27	33.52	1.9

[1] Includes other hydrocarbons, ethanol, and synthetic crude oil.
[2] Includes synthetic gas.
[3] Includes utility and nonutility electricity from hydroelectric, geothermal, wood and wood waste, municipal solid waste, other biomass, wind, photovoltaic and solar thermal sources; non-electric energy from renewable sources such as active and passive solar systems, groundwater heat pumps, and wood; alcohol fuels from renewable sources; and in addition to renewables, electricity from waste heat.
[4] Includes imports of crude oil for the Strategic Petroleum Reserve.
[5] Represents net imports.
[6] Includes coal, coal coke (net), electricity (net), and methanol.
[7] Balancing item. Includes unaccounted for supply, losses, and gains.
[8] Includes natural gas plant liquids, crude oil consumed as a fuel, and nonpetroleum based liquids, such as ethanol.
[9] Includes utility and nonutility electricity from hydroelectric, geothermal, wood and wood waste, municipal solid waste, other biomass, wind, photovoltaic and solar thermal sources; non-electric energy from renewable sources such as active and passive solar systems, groundwater heat pumps, and wood; alcohol fuels from renewable sources; and in addition to renewables, electricity from waste heat, plus net coal coke imports, and net electricity imports.
[10] Average refiner acquisition cost for imported crude oil.

Note: Totals may not equal sum of components due to independent rounding.

Sources: 1989: Calculated from values in Tables C4 through C10 using the conversion factors in Appendix G. 1990: preliminary estimates. Projections: Energy Information Administration, AEO 1991 Forecasting System run IGLOCA.D0115911.

Table C2. Energy Consumption by End-Use Sector and Source (Quadrillion Btu per Year)

Sector and Source	High Economic Growth						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Residential							
Distillate Fuel	1.06	1.05	0.94	0.82	0.73	0.66	-2.2
Kerosene	.10	.11	.09	.07	.06	.05	-3.1
Liquefied Petroleum Gas	.46	.43	.40	.36	.32	.29	-2.1
Natural Gas	4.91	4.51	4.88	4.89	4.84	4.74	-.2
Coal	.06	.06	.06	.06	.06	.06	-.1
Renewable Energy [1]	.89	.92	1.03	1.21	1.54	1.95	3.8
Electricity	3.09	3.17	3.49	3.73	3.97	4.21	1.5
Total	10.58	10.24	10.89	11.14	11.52	11.97	.6
Commercial							
Distillate Fuel	.57	.56	.54	.50	.47	.45	-1.2
Kerosene	.04	.04	.03	.03	.02	.02	-3.1
Motor Gasoline [2]	.11	.11	.13	.14	.15	.15	1.6
Residual Fuel	.26	.25	.21	.18	.15	.13	-3.1
Natural Gas	2.80	2.65	2.84	2.91	2.94	2.94	.2
Other [3]	.17	.17	.14	.12	.11	.09	-2.9
Renewable Energy [1]	.05	.08	.13	.21	.36	.56	12.1
Electricity	2.77	2.85	3.21	3.59	4.03	4.53	2.4
Total	6.76	6.70	7.24	7.68	8.23	8.87	1.3
Industrial [4]							
Distillate Fuel	1.21	1.02	1.45	1.72	1.97	2.18	2.8
Liquefied Petroleum Gas	1.68	1.58	1.97	2.26	2.56	2.81	2.5
Motor Gasoline [2]	.19	.19	.23	.26	.28	.30	2.2
Petrochemical Feedstocks	.93	.97	1.18	1.40	1.64	1.88	3.4
Residual Fuel	.64	.61	.84	.96	1.08	1.19	3.0
Other Petroleum [5]	3.66	3.85	3.66	3.73	3.79	3.85	.2
Natural Gas [6]	8.14	8.39	8.55	9.05	8.90	8.85	.4
Metallurgical Coal	1.10	1.01	1.08	1.00	.92	.85	-1.2
Steam Coal	1.70	1.68	1.69	1.68	1.70	1.85	.4
Net Coal Coke Imports	.03	.01	-.01	.06	.12	.17	8.5
Renewable Energy [1]	1.91	2.04	2.35	2.68	3.04	3.43	2.8
Purchased Electricity	3.16	3.18	3.66	4.35	5.14	5.97	3.1
Total	24.37	24.54	26.63	29.15	31.12	33.35	1.5
Transportation							
Distillate Fuel	3.72	3.71	4.29	4.83	5.46	6.10	2.4
Jet Fuel	3.06	3.09	3.63	4.27	5.00	5.80	3.1
Motor Gasoline [2]	13.75	13.56	14.09	15.09	16.33	17.34	1.1
Residual Fuel	.77	.74	.70	.79	.89	.98	1.1
Other Petroleum [7]	.23	.24	.26	.29	.32	.36	2.1
Pipeline Fuel Natural Gas	.65	.63	.71	.78	.78	.80	1.0
Compressed Natural Gas	.00	.00	.00	.00	.01	.02	-
Alcohol Fuels	.00	.00	.00	.00	.03	.05	-
Electricity	.02	.02	.02	.02	.03	.03	3.3
Total	22.19	21.99	23.69	26.08	28.84	31.48	1.7
Electric Utilities [8]							
Distillate Fuel	.10	.08	.11	.31	.16	.11	.1
Residual Fuel	1.58	1.22	1.83	2.32	3.03	2.72	2.6
Natural Gas	2.87	2.93	4.05	5.50	5.64	5.36	3.0
Steam Coal [9]	15.96	16.06	17.18	18.12	20.37	24.29	2.0
Nuclear Power	5.69	6.14	6.22	6.48	6.70	7.14	1.1
Renewable Energy/Other [10]	3.62	3.71	4.58	5.25	5.91	6.25	2.6
Total	29.82	30.14	33.96	37.98	41.81	45.86	2.1
Primary Energy Consumption							
Distillate Fuel	6.67	6.42	7.33	8.18	8.79	9.50	1.7
Kerosene	.14	.15	.12	.10	.09	.07	-3.1
Jet Fuel	3.06	3.09	3.63	4.27	5.00	5.80	3.1
Liquefied Petroleum Gas	2.24	2.11	2.46	2.70	2.96	3.18	1.7
Motor Gasoline	14.05	13.86	14.45	15.48	16.75	17.79	1.1
Petrochemical Feedstocks	.93	.97	1.18	1.40	1.64	1.88	3.4
Residual Fuel	3.24	2.82	3.57	4.25	5.15	5.01	2.1
Other Petroleum [11]	3.87	4.07	3.89	3.99	4.08	4.17	.4
Natural Gas	19.37	19.11	21.03	23.14	23.11	22.71	.8
Metallurgical Coal	1.10	1.01	1.08	1.00	.92	.85	-1.2
Steam Coal	17.81	17.89	19.00	19.92	22.18	26.25	1.9
Net Coal Coke Imports	.03	.01	-.01	.06	.12	.17	8.5
Nuclear Power	5.69	6.14	6.22	6.48	6.70	7.14	1.1
Renewable Energy/Other [12]	6.47	6.75	8.09	9.35	10.85	12.20	3.1

- See footnotes at end of table.

Table C2. Energy Consumption by End-Use Sector and Source (Continued) (Quadrillion Btu per Year)

Sector and Source	High Economic Growth						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Primary Energy Consumption							
Alcohols	0.00	0.00	0.00	0.00	0.03	0.05	-
Total	84.69	84.39	92.03	100.30	108.40	116.80	1.5
Electricity Consumption (all Sectors)	9.03	9.21	10.37	11.69	13.18	14.74	2.4
Industrial Electricity							
Gross Consumption	3.48	3.51	3.99	4.77	5.60	6.48	3.0
Self-generation - Own Use	.32	.33	.33	.42	.46	.51	2.2
Purchased Electricity	3.16	3.18	3.66	4.35	5.14	5.97	3.1

[1] Includes electricity generated by the sector for self-use from hydroelectric, geothermal, wood and wood waste, municipal solid waste, other biomass, wind, photovoltaic and solar thermal sources, and non-electric energy from renewable sources such as active and passive solar systems, groundwater heat pumps, and wood.
[2] Includes ethanol blended into gasoline.
[3] Includes liquefied petroleum gas and coal.
[4] Includes consumption by cogenerators.
[5] Includes petroleum coke, asphalt, road oil, lubricants, and miscellaneous petroleum products.
[6] Includes lease and plant fuel.
[7] Includes aviation gas, liquefied petroleum gas, lubricants, and miscellaneous petroleum products.
[8] Includes consumption of energy by electric utilities, independent power producers, and small power producers that sell power to the grid.
[9] Includes consumption by independent power producers.
[10] Includes electricity generated to serve the grid from hydroelectric, geothermal, wood and wood waste, municipal solid waste, other biomass, wind, photovoltaic and solar thermal sources, plus waste heat, and net electricity imports.
[11] Includes unfinished oils, natural gasoline, motor gasoline blending components, aviation gasoline, lubricants, asphalt, road oil, and miscellaneous petroleum products.
[12] Includes electricity generated to serve the grid and for self use from renewable sources, non-electric energy from renewable sources, excluding alcohol fuels, electricity generated from waste heat, and net electricity imports.

Note: Totals may not equal sum of components due to independent rounding.

Sources: 1989: Energy Information Administration, *Monthly Energy Review*, DOE/EIA-0035(90/08) (Washington, DC, November 1990). Calculated from values in Tables C4 through C10 using the conversion factors in Appendix G. 1990: preliminary estimates. Projections: Energy Information Administration, AEO 1991 Forecasting System run IGLOCA.D0115911.

Table C3. Energy Prices by End-Use Sector and Source (1990 Dollars per Million Btu)

Sector and Source	High Economic Growth						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Residential	11.92	12.22	12.71	13.42	14.69	15.89	1.4
Primary Energy	6.21	6.30	6.46	7.20	8.16	9.04	1.8
Petroleum Products	7.86	8.21	7.47	7.99	8.64	9.33	.8
Distillate Fuel	6.73	7.64	6.67	7.16	7.78	8.43	1.1
Kerosene	7.34	8.30	8.04	8.28	8.61	8.96	1.0
Liquefied Petroleum Gas	10.60	9.56	9.21	9.82	10.61	11.44	.4
Natural Gas	5.72	5.69	6.22	7.06	8.11	9.05	2.2
Steam Coal	2.17	2.18	2.39	2.57	2.85	3.05	1.6
Electricity	24.10	23.73	24.11	23.76	24.56	25.34	.2
Commercial	12.24	12.49	12.97	13.52	14.68	15.94	1.3
Primary Energy	4.76	4.96	5.26	6.04	7.02	7.93	2.5
Petroleum Products	4.88	5.70	5.23	5.79	6.51	7.26	1.9
Distillate Fuel	4.75	5.65	4.69	5.19	5.82	6.49	1.5
Residual Fuel	2.81	3.15	3.33	3.59	3.94	4.26	2.0
Kerosene	4.98	5.96	5.46	5.72	6.06	6.43	1.2
Other Petroleum [1]	8.02	9.17	8.78	9.46	10.34	11.19	1.6
Natural Gas	4.80	4.77	5.35	6.20	7.25	8.20	2.6
Steam Coal	2.15	2.16	2.37	2.56	2.83	3.03	1.7
Electricity	22.91	22.47	22.32	21.61	21.97	22.61	-.1
Industrial	5.26	5.54	5.84	6.52	7.46	8.27	2.2
Primary Energy	3.52	3.88	4.07	4.64	5.37	6.03	2.6
Petroleum Products	4.56	5.41	5.17	5.55	6.07	6.63	1.8
Distillate Fuel	4.74	5.60	4.63	5.11	5.73	6.38	1.4
Liquefied Petroleum Gas	4.37	5.76	5.60	6.19	6.97	7.78	2.8
Motor Gasoline [2]	8.57	9.51	8.97	9.65	10.53	11.35	1.3
Residual Fuel	2.60	2.97	3.15	3.41	3.76	4.08	2.2
Other Petroleum [3]	4.69	5.40	5.33	5.60	6.00	6.45	1.5
Natural Gas [4]	2.99	2.92	3.48	4.32	5.38	6.33	3.6
Metallurgical Coal	1.96	1.94	2.13	2.33	2.62	2.76	1.6
Steam Coal	1.64	1.64	1.79	1.92	2.15	2.33	1.7
Electricity	15.28	15.01	15.29	15.52	16.22	16.71	.4
Transportation	7.63	8.58	8.07	8.62	9.33	10.01	1.3
Primary Energy	7.62	8.57	8.06	8.61	9.32	10.00	1.3
Petroleum Products	7.62	8.57	8.06	8.61	9.32	10.00	1.3
Distillate Fuel [5]	7.59	8.36	8.38	8.86	9.47	10.12	1.4
Jet Fuel [6]	4.57	5.84	4.84	5.34	5.97	6.64	1.8
Motor Gasoline [2]	8.55	9.51	8.97	9.65	10.52	11.34	1.4
Residual Fuel	2.50	3.05	3.09	3.34	3.70	4.03	2.3
Other Petroleum [7]	9.84	11.05	12.29	12.56	12.94	13.35	1.5
Natural Gas	.00	.00	.00	7.09	8.17	9.11	-
Electricity	24.14	23.43	23.29	23.14	23.55	23.76	-.1
Total End-Use Energy	8.00	8.50	8.53	9.08	9.96	10.76	1.4
Primary Energy	5.73	6.29	6.19	6.81	7.62	8.36	1.8
Electricity	20.67	20.33	20.44	20.03	20.51	21.00	.1
Electric Utilities							
Fossil Fuel Average	1.77	1.74	2.04	2.42	2.77	2.96	2.5
Petroleum Products	3.04	3.43	3.66	3.97	4.29	4.70	2.1
Distillate Fuel	4.41	5.37	4.35	4.85	5.47	6.07	1.5
Residual Fuel	2.95	3.30	3.62	3.85	4.23	4.64	2.2
Natural Gas	2.45	2.23	2.87	3.68	4.72	5.64	4.1
Steam Coal	1.52	1.52	1.67	1.81	1.99	2.17	1.7
Average Price to All Users [8]							
Petroleum Products	6.58	7.49	7.00	7.44	8.06	8.75	1.4
Distillate Fuel [5]	6.64	7.53	7.08	7.52	8.22	8.93	1.4
Jet Fuel [6]	4.57	5.84	4.84	5.34	5.97	6.64	1.8
Kerosene	6.67	7.63	7.36	7.58	7.90	8.24	1.0
Liquefied Petroleum Gas	5.78	6.67	6.29	6.76	7.44	8.18	1.7
Motor Gasoline [2]	8.55	9.51	8.97	9.65	10.52	11.34	1.4
Residual Fuel	2.76	3.15	3.39	3.65	4.03	4.38	2.2

- See footnotes at end of table.

Table C3. Energy Prices by End-Use Sector and Source (Continued) (1990 Dollars per Million Btu)

Sector and Source	High Economic Growth						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Average Price to All Users [8]							
Other Petroleum Products [9]	4.93	5.65	5.66	5.96	6.37	6.83	1.6
Natural Gas	3.95	3.81	4.32	5.05	6.09	7.04	2.8
Coal	1.56	1.55	1.71	1.85	2.03	2.21	1.7
Electricity	20.67	20.33	20.44	20.03	20.51	21.00	.1

[1] Average price for liquefied petroleum gas, motor gasoline, and miscellaneous petroleum products.
[2] Average price for all grades. Includes Federal and State taxes and excludes county and local taxes.
[3] Average price for petrochemical feedstocks and miscellaneous petroleum products.
[4] Excludes uses for lease and plant fuel.
[5] Includes Federal and State taxes on diesel fuel and excludes county and local taxes.
[6] Kerosene-type jet fuel.
[7] Average price for liquefied petroleum gas and miscellaneous petroleum products.
[8] Weighted averages of end-use fuel prices are derived from the prices shown in each sector and the corresponding sectoral consumption. For each sector, electricity and natural gas prices are derived by dividing total revenues by sales.
[9] Average price for petrochemical feedstocks and miscellaneous petroleum products.

Sources: 1989 prices for gasoline, distillate, jet fuel, residual fuel, liquefied petroleum gas, and kerosene are based on prices in the Energy Information Administration, *Petroleum Marketing Annual 1989*, DOE/EIA-0487(89) (Washington, DC, December 1990). 1990 prices for these products are preliminary estimates based on data from the Energy Information Administration, *Petroleum Marketing Monthly*, DOE/EIA-0380 (Washington, DC, January 1990 through October 1990). 1989 and 1990 prices for all other petroleum products are derived from the Energy Information Administration, *State Energy Price and Expenditures Report: 1988*, DOE/EIA-0376(88) (Washington, DC, September 1990), applying the growth rate of the world oil price. Projections: Energy Information Administration, AEO 1991 Forecasting System run IGLOCA.D0115911.

Table C4. Electricity Supply, Disposition, and Prices (Billion Kilowatthours, Unless Otherwise Noted)

Supply, Disposition, and Prices	High Economic Growth						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Electric Utilities							
Generation by Fuel Type							
Coal	1,554	1,558	1,656	1,745	1,889	2,355	2.0
Petroleum	158	122	180	245	297	262	2.4
Natural Gas	267	270	370	500	603	580	3.8
Nuclear Power	529	575	570	594	614	654	1.0
Pumped Storage Hydroelectric	-9	-9	-10	-10	-10	-11	1.2
Renewable Sources/Other [1]	285	298	320	332	341	343	.9
Total	2,785	2,813	3,087	3,406	3,734	4,183	2.0
Net Imports	11	2	41	55	65	68	9.1
Nonutilities [2]							
Generation by Fuel Type							
Coal	33	34	43	47	130	149	7.4
Petroleum	3	3	4	4	5	6	3.2
Natural Gas	78	93	103	161	169	174	3.9
Renewable Sources/Other [1]	72	72	113	153	198	228	5.6
Total	185	201	263	365	503	556	5.4
Sales to Utilities	90	105	166	243	367	408	7.5
Generation for Own Use	95	96	96	122	136	149	2.2
Electricity Sales by Sector							
Residential	906	928	1,022	1,093	1,165	1,233	1.5
Commercial/Other [3]	815	839	946	1,058	1,190	1,337	2.4
Industrial	926	933	1,072	1,275	1,507	1,751	3.1
Total	2,647	2,700	3,041	3,426	3,862	4,321	2.4
End-Use Prices [4]							
(1990 cents per kilowatthour)							
Residential	8.22	8.10	8.23	8.11	8.38	8.65	.2
Commercial/Other [3]	7.82	7.67	7.62	7.38	7.50	7.72	-.1
Industrial [5]	5.22	5.12	5.22	5.29	5.53	5.70	.4
Average	7.05	6.94	6.97	6.83	7.00	7.17	.1
Price Components [4]							
(1990 cents per kilowatthour)							
Capital Component	3.09	3.06	2.86	2.36	2.21	2.27	-1.5
Fuel Component	1.83	1.75	2.04	2.43	2.78	2.88	2.2
O&M Component	2.13	2.12	2.07	2.04	2.01	2.01	-.3
Total	7.05	6.94	6.97	6.83	7.00	7.17	.1

[1] Includes conventional hydroelectric, geothermal, wood, wood waste, municipal solid waste, other biomass, solar and wind power, plus a small quantity of petroleum coke. For nonutilities, also includes waste heat, blast furnace gas, and coke oven gas.

[2] Includes cogenerators, small power producers, independent power producers, and all other sources, except electric utilities, which produce electricity for self use or for delivery to the grid.

[3] Other includes sales of electricity to Government, railways, and street lighting authorities.

[4] Prices represent average revenue per kilowatthour of sales over all customer classes.

[5] Weighted average, including transportation. Weights used are consumption levels by sector.

O&M = Operating and Maintenance

Note: Totals may not equal sum of components due to independent rounding.

Sources: 1989, except for nonutilities and prices: Energy Information Administration, *Electric Power Annual 1989*, DOE/EIA-0348(89) (Washington, DC, January 1991). 1990 generation: Energy Information Administration, *Short-Term Energy Outlook*, DOE/EIA-0202(91/1Q) (Washington, DC, January 1991). 1989 and 1990 nonutilities, prices, and all projections: Energy Information Administration, AEO 1991 Forecasting System run IGLOCA.D0115911.

Table C5. Electricity Generating Capability (Thousand Megawatts)

Summer Capability [1]	High Economic Growth						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Electric Utilities							
Capability							
Coal Steam	296.2	297.5	300.2	303.2	322.8	400.0	1.4
Other Fossil Steam [2]	144.6	145.3	139.9	132.7	125.8	122.1	-.8
Combined Cycle	5.1	5.2	6.4	22.8	73.6	80.8	14.1
Combustion Turbine/Diesel	46.0	46.6	54.4	68.5	75.1	82.0	2.8
Nuclear Power	98.2	99.6	103.1	105.4	106.5	110.2	.5
Pumped Storage Hydroelectric	17.2	17.2	19.8	19.8	19.8	19.8	.7
Renewable Sources/Other [3]	77.3	77.5	80.1	81.8	82.9	83.4	.4
Total	684.6	688.9	704.0	734.2	806.5	898.4	1.3
Cumulative Planned Additions [4]							
Coal Steam	.0	1.7	8.6	17.3	19.0	19.2	-
Other Fossil Steam	.0	.0	.5	.5	.5	.5	-
Combined Cycle	.0	.1	1.3	4.4	4.4	4.4	-
Combustion Turbine/Diesel	.0	.6	5.3	10.8	10.9	10.9	-
Nuclear Power	.0	2.3	5.8	8.3	9.5	9.5	-
Pumped Storage Hydroelectric	.0	.0	2.6	2.7	2.7	2.7	-
Renewable Sources/Other [3]	.0	.1	2.3	2.7	2.8	2.8	-
Total	.0	4.8	26.4	46.6	49.7	49.9	-
Cumulative Unplanned Additions [4]							
Coal Steam	.0	.0	.0	.0	21.1	100.9	-
Other Fossil Steam	.0	.0	.0	.0	.0	.0	-
Combined Cycle	.0	.0	.0	13.3	64.1	71.3	-
Combustion Turbine/Diesel	.0	.0	3.6	12.4	20.2	27.2	-
Nuclear Power	.0	.0	.0	.0	.0	6.0	-
Pumped Storage Hydroelectric	.0	.0	.0	.0	.0	.0	-
Renewable Sources/Other [3]	.0	.1	.6	1.8	2.8	3.3	-
Total	.0	.1	4.1	27.6	108.2	208.8	-
Cumulative Total Additions	.0	4.9	30.5	74.3	157.9	258.7	-
Cumulative Retirements	.0	1.4	11.9	25.4	36.7	45.6	-
Nonutilities [5]							
Capability							
Coal	5.8	5.9	7.8	8.6	23.2	26.9	7.6
Petroleum	.9	1.0	1.3	1.5	1.8	2.2	4.0
Natural Gas	13.8	16.7	18.7	28.5	30.2	31.0	3.9
Renewable Sources/Other [3]	16.1	16.8	21.3	27.5	34.7	40.1	4.4
Total	36.7	40.5	49.0	66.1	89.9	100.2	4.9
Cumulative Additions	.0	3.8	12.3	29.4	53.2	63.5	-

[1] Net summer capability is the steady hourly output that generating equipment is expected to supply to system load (exclusive of auxiliary power), as demonstrated by tests during summer peak demand.

[2] Includes oil-, gas-, and dual-fired capability.

[3] Includes conventional hydroelectric, geothermal, wood, wood waste, municipal solid waste, other biomass, solar, and wind power, plus a small quantity of petroleum coke. For nonutilities, also includes waste heat, blast furnace gas, and coke oven gas.

[4] Cumulative additions after December 31, 1989.

[5] Includes cogenerators, small power producers, independent power producers, and all other sources, except electric utilities, which produce electricity for self use or for sales to the grid.

Note: Totals may not equal sum of components due to independent rounding.

Sources: 1989 utility capability: Energy Information Administration, *Electric Power Annual 1989*, DOE/EIA-0348(89) (Washington, DC, January 1991). 1990 utility capability: Energy Information Administration, Form EIA-860, *Annual Electric Generator Report*. 1989 and 1990 nonutility capability and all projections: Energy Information Administration, AEO 1991 Forecasting System run IGLOCA.D0115911.

Table C6. Renewable Energy (Quadrillion Btu per Year, Unless Otherwise Noted)

Electricity and Non-Electric	High Economic Growth						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Electricity							
Capability (gigawatts)							
Conventional Hydropower	75.48	75.67	77.94	78.36	78.36	78.46	0.2
Geothermal	2.47	2.59	3.25	6.25	9.65	10.65	7.2
Municipal Solid Waste	1.98	2.10	3.75	6.16	8.79	10.81	8.4
Biomass/Other Waste	5.31	5.46	6.21	7.02	7.90	8.88	2.5
Solar Thermal	.33	.43	.43	.43	.81	1.78	8.4
Solar Photovoltaic	.00	.00	.01	.01	.01	.01	2.1
Wind	1.93	1.95	2.46	3.50	4.40	5.30	4.9
Total	87.51	88.20	94.05	101.70	109.90	115.90	1.3
Generation (billion kilowatthours)							
Conventional Hydropower	276.90	302.20	312.40	314.60	314.60	314.80	.6
Geothermal	15.05	15.98	20.67	43.37	70.63	78.52	8.2
Municipal Solid Waste	13.31	13.48	24.66	41.54	60.06	74.22	8.5
Biomass/Other Waste	29.54	30.36	34.57	39.11	44.01	49.55	2.5
Solar Thermal	.69	.90	.90	1.16	2.30	5.06	10.0
Solar Photovoltaic	.00	.00	.00	.00	.00	.00	2.2
Wind	3.38	3.42	4.32	8.22	10.68	12.97	6.6
Total	338.90	366.30	397.50	448.00	502.30	535.10	2.2
Consumption/Displacement							
Conventional Hydropower	2.88	3.14	3.25	3.27	3.27	3.27	.6
Geothermal	.16	.17	.21	.45	.73	.82	8.2
Municipal Solid Waste	.20	.22	.50	.76	1.05	1.27	9.2
Biomass/Other Waste	.20	.20	.23	.26	.29	.33	2.5
Solar Thermal	.01	.01	.01	.01	.02	.05	10.0
Solar Photovoltaic	.00	.00	.00	.00	.00	.00	2.3
Wind	.04	.04	.04	.09	.11	.13	6.6
Total	3.48	3.78	4.25	4.85	5.48	5.88	2.5
Non-Electric Renewable Energy							
Residential, Commercial, and Industrial							
Hydropower	.00	.00	.00	.00	.00	.00	-
Geothermal	.00	.00	.02	.07	.18	.39	-
Biofuels	2.63	2.77	3.14	3.58	4.05	4.54	2.6
Solar Thermal	.05	.07	.09	.13	.30	.54	11.6
Solar Photovoltaic	.00	.00	.00	.00	.00	.00	-
Wind	.00	.00	.00	.00	.00	.00	-
Transportation							
Ethanol	.07	.08	.10	.12	.14	.14	3.5
Total	2.75	2.92	3.35	3.90	4.68	5.62	3.5
Total Renewable Energy	6.23	6.70	7.61	8.74	10.17	11.50	3.0

Note: Totals may not equal sum of components due to independent rounding.
Sources: 1989 and 1990: Energy Information Administration, Office of Coal, Nuclear, Electric and Alternate Fuels. Projections: Energy Information Administration, AEO 1991 Forecasting System run IGLOCA.D0115911.

Table C7. Macroeconomic Indicators (Billion 1982 Dollars, Unless Otherwise Noted)

Indicator	High Economic Growth						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
GNP Implicit Price Deflator (index, 1982=1.000)	1.263	1.314	1.609	1.944	2.346	2.874	4.0
Real Gross National Product	4,118	4,153	4,845	5,618	6,482	7,355	2.8
Real Disposable Personal Income	2,869	2,891	3,199	3,629	4,143	4,639	2.3
Index of Manufacturing Gross Output (index, 1982=1.000)	1.219	1.217	1.475	1.771	2.094	2.416	3.3
AA Utility Bond Rate (percent)	9.55	9.65	8.61	8.22	8.07	7.92	-
90-Day U.S. Government Treasury Bill Rate (percent)	8.11	7.51	5.52	5.10	4.95	4.84	-
Energy Intensity (thousand Btu per 1982 $ of GNP)	20.57	20.32	19.00	17.86	16.72	15.88	-1.2

Note: Totals may not equal sum of components due to independent rounding.
Sources: 1989: Data Resources Incorporated (DRI), USCEN Databank. 1990: DRI Control0191. Projections: Energy Information Administration, AEO 1991 Forecasting System run IGLOCA.D0115911.

Table C8. Petroleum Supply and Disposition Balance (Million Barrels per Day, Unless Otherwise Noted)

Supply and Disposition	High Economic Growth						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
World Oil Price (1990 dollars per barrel) [1]	18.81	22.00	19.00	20.10	21.70	23.40	1.0
Production							
Crude Oil [2]	7.61	7.23	6.09	4.63	3.78	3.37	-3.8
Alaska	1.87	1.75	1.21	.79	.53	.42	-6.8
Lower 48	5.74	5.48	4.87	3.83	3.25	2.95	-3.1
Natural Gas Plant Liquids	1.55	1.54	1.58	1.72	1.67	1.64	.3
Other Domestic [3]	.06	.07	.19	.28	.37	.43	9.9
Processing Gain [4]	.66	.67	.66	.70	.67	.74	.6
Total	9.88	9.51	8.52	7.33	6.50	6.19	-2.2
Imports (including SPR) [5]							
Crude Oil	5.84	6.01	7.92	9.32	10.01	10.34	2.8
Refined Products	2.22	2.08	2.85	4.53	6.74	8.17	6.4
Total	8.06	8.09	10.77	13.85	16.75	18.52	4.0
Exports							
Crude Oil	.14	.11	.09	.06	.05	.04	-5.4
Refined Products	.72	.70	.71	.79	.80	.80	.5
Total	.86	.81	.80	.85	.85	.84	-.1
Net Imports (including SPR)	7.20	7.28	9.98	13.00	15.90	17.67	4.4
Primary Stock Changes							
Net Withdrawals [6]	.12	-.16	-.04	-.05	-.05	-.03	-
SPR Fill Rate Additions (-) [5]	-.06	-.02	-.05	-.05	.00	.00	-
Total Primary Supply [7]	17.14	16.62	18.40	20.23	22.34	23.83	1.6
Unaccounted for Crude	.20	.34	.15	.15	.15	.15	-1.4
Refined Petroleum Products Supplied							
Motor Gasoline [8]	7.33	7.23	7.54	8.05	8.73	9.28	1.1
Jet Fuel [9]	1.49	1.51	1.77	2.07	2.43	2.82	3.1
Distillate Fuel	3.14	3.02	3.45	3.84	4.13	4.46	1.7
Residual Fuel	1.41	1.23	1.56	1.86	2.27	2.18	2.1
Other [10]	3.96	3.97	4.24	4.56	4.93	5.23	1.3
Total	17.33	16.95	18.55	20.38	22.49	23.98	1.6
Refined Petroleum Products Supplied							
Residential and Commercial	1.41	1.38	1.26	1.13	1.03	.94	-1.9
Industrial [11]	4.32	4.25	4.88	5.43	6.01	6.47	1.9
Transportation	10.86	10.76	11.56	12.66	14.04	15.34	1.7
Electric Utilities [12]	.74	.57	.85	1.16	1.41	1.23	2.5
Total	17.33	16.95	18.55	20.38	22.49	23.98	1.6
Discrepancy [13]	.01	.00	.00	.00	.00	.00	-
Net Disposition	17.34	16.96	18.55	20.38	22.49	23.98	1.6

[1] Average refiner acquisition cost for imported crude oil.
[2] Includes lease condensate.
[3] Includes other hydrocarbons, ethanol, and synthetic crude oil.
[4] Represents volumetric gain in refinery distillation and cracking processes.
[5] SPR is the Strategic Petroleum Reserve.
[6] Computed as the end-of-year stock levels in the current period subtracted from the end-of-year stock levels in the preceding period. A negative (-) represents an increase to inventories.
[7] Total production plus net imports plus net stock withdrawals minus SPR additions.
[8] Includes ethanol blended into gasoline.
[9] Includes naphtha and kerosene type.
[10] Includes aviation gasoline, kerosene, liquefied petroleum gas, petrochemical feedstocks, miscellaneous petroleum products, lubricants, waxes, asphalt, road oil, still gas, special naphthas, petroleum coke, crude oil product supplied, natural gas liquids, liquefied refinery gas, and other liquids.
[11] Includes consumption by cogenerators.
[12] Includes consumption by independent power producers.
[13] Balancing item.

Note: Totals may not equal sum of components due to independent rounding.

Sources: 1989: Energy Information Administration, *Petroleum Supply Annual 1989*, DOE/EIA-0340(89) (Washington, DC, May 1990). 1990: preliminary estimates. Projections: Energy Information Administration, AEO 1991 Forecasting System run IGLOCA.D0115911.

Table C9. Natural Gas Supply, Disposition, and Prices (Trillion Cubic Feet per Year, Unless Otherwise Noted)

Supply, Disposition, and Prices	High Economic Growth						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Production							
Dry Gas Production [1]	17.26	17.40	18.55	20.27	19.76	19.23	0.5
Synthetic Natural Gas [2]	.11	.17	.14	.19	.35	.40	6.3
Net Imports	1.28	1.36	2.33	2.66	3.02	3.09	4.3
Net Storage Withdrawals [3]	.32	-.28	.00	.00	.00	.00	-
Total Supply	18.97	18.65	21.02	23.12	23.13	22.72	.9
Consumption by Sector							
Residential	4.77	4.38	4.73	4.74	4.70	4.60	-.2
Commercial	2.71	2.57	2.76	2.82	2.85	2.85	.2
Industrial [4]	6.83	6.97	7.17	7.56	7.44	7.42	.4
Electric Utilities [5]	2.78	2.84	3.92	5.33	5.46	5.19	3.0
Lease and Plant Fuel [6]	1.07	1.17	1.12	1.22	1.19	1.16	.4
Pipeline Fuel	.63	.61	.69	.76	.75	.77	1.0
Transportation [7]	.00	.00	.00	.00	.01	.02	-
Total	18.79	18.53	20.39	22.43	22.41	22.02	.8
Unaccounted for [8]	.18	.12	.62	.68	.72	.70	6.6
Average Wellhead Price (1990 dollars per thousand cubic feet)	1.76	1.77	2.28	3.15	4.24	5.21	5.3
Delivered Prices (1990 dollars per thousand cubic feet)							
Residential	5.89	5.86	6.41	7.28	8.36	9.33	2.2
Commercial	4.95	4.92	5.52	6.39	7.48	8.45	2.6
Industrial	3.08	3.01	3.58	4.46	5.55	6.52	3.6
Electric Utilities	2.53	2.30	2.96	3.79	4.87	5.82	4.1
Transportation	.00	.00	.00	7.31	8.42	9.40	-
Average [9]	4.07	3.93	4.46	5.20	6.28	7.26	2.8

[1] Dry marketed production minus nonhydrocarbon gases removed.
[2] Includes synthetic natural gas (from the manufacture, conversion, or reforming of petroleum hydrocarbons) and propane/air mixtures.
[3] Computed as the end-of-year stock levels in the current period subtracted from the end-of-year stock levels in the preceding period. A negative (-) represents an increase to inventories.
[4] Includes consumption by cogenerators.
[5] Includes consumption by independent power producers.
[6] Represents natural gas used in the field gathering and processing plant machinery.
[7] Compressed natural gas used as vehicle fuel.
[8] Balancing item. Reflects natural gas lost, the net result of converting flow data measured at varying temperatures and pressures to a standard temperature and pressure, and the merger of different data reporting systems which vary in scope, format, definition, and respondent type.
[9] Weighted average price. Weights used are the sectoral consumption values excluding lease, plant and pipeline fuel.

Note: Totals may not equal sum of components due to independent rounding.

Sources: 1989: Energy Information Administration, *Natural Gas Annual 1989*, DOE/EIA-0131(89) (Washington, DC, September 1990). 1990: preliminary estimates. Projections: Energy Information Administration, AEO 1991 Forecasting System run IGLOCA.D0115911.

Table C10. Coal Supply, Disposition, and Prices (Million Short Tons per Year, Unless Otherwise Noted)

Supply, Disposition, and Prices	High Economic Growth						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Production [1]							
East of the Mississippi	599	638	648	689	803	929	2.1
West of the Mississippi	382	397	424	478	549	675	2.7
Total	981	1,035	1,072	1,168	1,352	1,604	2.4
Net Imports							
Imports	3	2	5	6	9	11	6.6
Exports	101	107	124	166	244	282	5.0
Total	-98	-105	-119	-159	-234	-270	4.9
Net Stock Withdrawals [2]	14	-29	-2	-1	-6	-10	-
Total Supply [3]	897	901	950	1,007	1,111	1,324	1.9
Consumption by Sector							
Residential and Commercial	6	6	6	5	5	5	-1.3
Industrial [4]	76	77	76	76	76	84	.5
Coking Plants	41	37	40	38	35	32	-1.2
Electric Utilities [5]	766	772	828	889	996	1,205	2.2
Total	889	893	950	1,008	1,112	1,325	1.9
Discrepancy [6]	7	8	0	-1	0	-1	-
Average Minemouth Price [7] **(1990 dollars per short ton)**	22.70	22.18	25.34	28.18	32.27	33.52	1.9
Delivered Prices (1990 dollars per short ton)							
Residential and Commercial	49.48	48.39	56.70	60.38	66.51	71.56	1.8
Industrial	34.36	33.60	39.67	42.55	47.79	51.53	1.9
Coking Plants	49.42	47.70	56.62	61.86	69.59	73.11	1.9
Electric Utilities	31.35	30.64	34.61	36.86	40.73	43.82	1.6
Average [8]	32.56	31.75	36.08	38.35	42.23	45.11	1.6

[1] Includes anthracite, bituminous coal, and lignite.
[2] From all stocks held by industrial plants, coke plants, electric utilities, and producers/distributors. Computed as the end-of-year stock levels in the current period subtracted from the end-of-year stock levels in the preceding period. A negative (-) represents an increase to inventories.
[3] Production plus net imports plus net storage withdrawals.
[4] Includes consumption by cogenerators.
[5] Includes consumption by independent power producers.
[6] Balancing item: the sum of production, net imports, and net stock withdrawals minus total consumption.
[7] Free-on-board price.
[8] Weighted average prices. Weights used are consumption values by sector.

Note: Totals may not equal sum of components due to independent rounding.

Sources: 1989: Energy Information Administration, *Monthly Energy Review*, DOE/EIA-0035(90/08) (Washington, DC, November 1990); *Quarterly Coal Report*, DOE/EIA-0121(90/3Q) (Washington, DC, January 1991); and *Coal Production 1989*, DOE/EIA-0118(89) (Washington, DC, November 1990). 1990: preliminary estimates. Projections: Energy Information Administration, AEO 1991 Forecasting System run IGLOCA.D0115911.

Table C11. Residential Sector Key Indicators and End-Use Consumption (Quadrillion Btu per Year, Unless Otherwise Noted)

Key Indicators and Consumption	High Economic Growth						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Key Indicators							
Total Housing (millions)	92.6	93.4	99.3	105.4	111.1	116.3	1.1
Energy Consumption per Household (MMBtu)	114.1	109.5	109.6	105.7	103.7	102.9	-.5
End-Use Consumption							
Distillate							
Space Heating	.90	.89	.81	.72	.65	.60	-1.9
Other Uses [1]	.16	.16	.13	.11	.08	.06	-4.2
Total	1.06	1.05	.94	.82	.73	.66	-2.2
Natural Gas							
Space Heating	3.43	3.14	3.36	3.34	3.30	3.24	-.3
Water Heating	1.13	1.05	1.19	1.23	1.23	1.20	.3
Other Uses [1]	.35	.32	.33	.32	.31	.30	-.8
Total	4.91	4.51	4.88	4.89	4.84	4.74	-.2
Other Fuels [2]	.62	.60	.55	.49	.44	.40	-2.0
Renewables [3]	.89	.92	1.03	1.21	1.54	1.95	3.8
Electricity							
Space Heating	.32	.33	.37	.40	.43	.46	1.7
Cooling	.50	.51	.57	.59	.61	.62	1.1
Water Heating	.36	.38	.45	.52	.61	.70	3.2
Other Uses [1]	1.91	1.94	2.10	2.21	2.33	2.43	1.2
Total	3.09	3.17	3.49	3.73	3.97	4.21	1.5
Total Consumption	10.58	10.24	10.89	11.14	11.52	11.97	.6

[1] Includes cooking, cooling (natural gas), water heating (distillate), refrigeration and lighting (electricity), and other household appliances.
[2] Includes liquefied petroleum gas, kerosene and coal.
[3] Includes solar, geothermal, and wood energy.
MMBtu = million Btu.
Note: Totals may not equal sum of components due to independent rounding.
Sources: 1989 and 1990 estimates: Energy Information Administration (EIA), *State Energy Data Report*, DOE/EIA-0214(88) (Washington, DC, May 1990) and *Monthly Energy Review*, DOE/EIA-0035(90/08) (Washington, DC, November 1990). Projections: EIA, AEO 1991 Forecasting System Run IGLOCA.D0115911.

Table C12. Commercial Sector Key Indicators and End-Use Consumption (Quadrillion Btu per Year, Unless Otherwise Noted)

Key Indicators and Consumption	High Economic Growth						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Key Indicators							
Total Employment (millions)	108.4	110.4	119.4	127.0	135.1	142.0	1.3
Total Floor Space (billion sq. ft.)	63.0	64.3	70.6	77.3	84.3	91.8	1.8
Energy Consumption per Square Foot (MBtu)	107.3	104.3	102.5	99.4	97.6	96.6	-.5
End-Use Consumption							
Distillate							
Space Heating	.52	.52	.50	.47	.45	.43	-1.0
Other Uses [1]	.05	.05	.04	.03	.02	.02	-4.6
Total	.57	.56	.54	.50	.47	.45	-1.2
Natural Gas							
Space Heating	1.84	1.74	1.87	1.90	1.90	1.86	.0
Cooling	.21	.19	.16	.13	.11	.09	-4.1
Other Uses [1]	.75	.72	.81	.87	.93	.99	1.3
Total	2.80	2.65	2.84	2.91	2.94	2.94	.2
Other Fuels[2]	.58	.56	.51	.47	.43	.40	-1.8
Renewables [3]	.05	.08	.13	.21	.36	.56	12.1
Electricity							
Space Heating	.51	.52	.60	.70	.84	1.01	3.3
Cooling	.71	.74	.84	.95	1.05	1.17	2.4
Lighting	1.09	1.12	1.23	1.35	1.47	1.60	1.8
Other Uses [1]	.45	.47	.53	.60	.68	.76	2.5
Total	2.77	2.85	3.21	3.59	4.03	4.53	2.4
Total Consumption	6.76	6.70	7.24	7.68	8.23	8.87	1.3

[1] Includes water heating, cooking, and other miscellaneous commercial uses.
[2] Includes residual fuel oil, liquefied petroleum gas, coal, motor gasoline, and kerosene.
[3] Includes solar, geothermal, wood, and municipal solid waste energy.
MBtu = thousand Btu.
Note: Totals may not equal sum of components due to independent rounding.
Sources: 1989 and 1990 estimates: Energy Information Administration (EIA), *State Energy Data Report*, DOE/EIA-0214(88) (Washington, DC, May 1990) and *Monthly Energy Review*, DOE/EIA-0035(90/08) (Washington, DC, November 1990). Projections: EIA, AEO 1991 Forecasting System Run IGLOCA.D0115911.

Table C13. Industrial Sector Key Indicators and Consumption

Key Indicators and Consumption	High Economic Growth						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Key Indicators							
Value of Gross Output (billion 1982 dollars)							
Manufacturing	2,402	2,399	2,906	3,490	4,127	4,761	3.3
Nonmanufacturing	832	820	982	1,093	1,192	1,299	2.1
Total	3,234	3,220	3,888	4,583	5,319	6,060	3.0
Consumption per Unit Output (thousand Btu per 1982 dollars)							
Distillate	.375	.317	.373	.375	.370	.360	-.2
Liquefied Petroleum Gas	.519	.490	.508	.493	.481	.464	-.5
Petrochemical Feedstocks	.289	.301	.303	.305	.308	.311	.3
Residual Fuel	.198	.190	.215	.209	.203	.196	.0
Other Petroleum [1]	1.133	1.195	.941	.814	.712	.636	-2.7
Natural Gas [2]	2.518	2.605	2.200	1.975	1.673	1.461	-2.6
Metallurgical Coal and Coke [3]	.352	.319	.275	.231	.195	.168	-3.5
Steam Coal [4]	.527	.521	.434	.367	.319	.306	-2.6
Renewables [5]	.592	.635	.604	.585	.572	.566	-.2
Electricity	.978	.988	.941	.950	.967	.986	.0
Total	7.540	7.622	6.853	6.362	5.852	5.504	-1.5
Consumption (quadrillion Btu per year)							
Distillate	1.21	1.02	1.45	1.72	1.97	2.18	2.8
Liquefied Petroleum Gas	1.68	1.58	1.97	2.26	2.56	2.81	2.5
Motor Gasoline [6]	.19	.19	.23	.26	.28	.30	2.2
Petrochemical Feedstocks	.93	.97	1.18	1.40	1.64	1.88	3.4
Residual Fuel	.64	.61	.84	.96	1.08	1.19	3.0
Other Petroleum [1]	3.66	3.85	3.66	3.73	3.79	3.85	.2
Natural Gas [2]	8.14	8.39	8.55	9.05	8.90	8.85	.4
Metallurgical Coal and Coke [3]	1.14	1.03	1.07	1.06	1.04	1.02	-.5
Steam Coal [4]	1.70	1.68	1.69	1.68	1.70	1.85	.4
Renewables [5]	1.91	2.04	2.35	2.68	3.04	3.43	2.8
Electricity	3.16	3.18	3.66	4.35	5.14	5.97	3.1
Total	24.37	24.54	26.63	29.15	31.12	33.35	1.5

[1] Includes petroleum coke, asphalt, road oil, lubricants, and miscellaneous petroleum products.
[2] Includes lease and plant fuel.
[3] Includes net imports of coal coke.
[4] Includes consumption by cogenerators.
[5] Does not include renewables consumed for nonutility electricity generation in the industrial sector for sales to the grid.
[6] Includes ethanol blended into gasoline.

Note: Totals may not equal sum of components due to independent rounding.

Sources: 1989 and 1990 estimates: Energy Information Administration (EIA), *State Energy Data Report*, DOE/EIA-0214(88) (Washington, DC, May 1990) and *Monthly Energy Review*, DOE/EIA-0035(90/08) (Washington, DC, November 1990). Projections: EIA, AEO 1991 Forecasting System Run IGLOCA.D0115911.

Table C14. Transportation Sector Key Indicators and Consumption

Key Indicators and Consumption	High Economic Growth						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Key Indicators							
Level of Travel Index (1989= 1.0)							
Light Duty Vehicles	1.000	0.999	1.100	1.234	1.390	1.538	2.1
Freight Trucks	1.000	.995	1.169	1.341	1.519	1.700	2.6
Air	1.000	.985	1.340	1.757	2.251	2.782	5.0
Rail	1.000	.982	1.098	1.204	1.325	1.444	1.8
Marine	1.000	.974	1.054	1.131	1.221	1.318	1.3
Energy Efficiency Indicators							
New Car MPG [1]	28.3	28.2	29.5	31.4	33.2	35.3	1.1
New Light Truck MPG [1]	20.9	20.9	22.6	23.1	24.1	25.6	1.0
Light Duty Fleet MPG [2]	18.5	18.7	19.6	20.4	21.2	21.9	.8
Aircraft Efficiency Index [3]	1.000	1.012	1.076	1.148	1.224	1.276	1.2
Freight Truck Efficiency Index [4]	1.000	1.006	1.051	1.094	1.112	1.129	.6
Rail Efficiency Index [5]	1.000	1.003	1.020	1.037	1.055	1.073	.3
Domestic Shipping Efficiency Index	1.000	1.000	1.000	1.000	1.000	1.000	.0
Energy Use By Mode (quadrillion Btu)							
Light Duty Vehicles	11.66	11.54	11.97	12.88	14.02	14.95	1.2
Freight Trucks	4.97	4.92	5.52	6.07	6.75	7.43	1.9
Air	3.15	3.18	3.74	4.40	5.15	5.97	3.1
Rail	.48	.47	.51	.55	.60	.64	1.4
Marine	1.13	1.10	1.10	1.23	1.37	1.50	1.3
Pipeline Fuel	.65	.63	.71	.78	.78	.80	1.0
Other	.16	.17	.18	.19	.21	.23	1.7
Total	22.19	21.99	23.69	26.08	28.84	31.48	1.7

[1] Unadjusted Corporate Average Fuel Economy estimates.
[2] Average *on-the-road* efficiency estimate including cars and light trucks.
[3] Based on estimates of passenger seat miles per gallon (1989=1.0).
[4] Based on Btu per vehicle miles traveled (1989=1.0).
[5] Based on Btu per ton-miles traveled (1989=1.0).

Note: Totals may not equal sum of components due to independent rounding.

Sources: 1989 and 1990 estimates: Energy Information Administration (EIA), *State Energy Data Report*, DOE/EIA-0214(88) (Washington, DC, May 1990) and *Monthly Energy Review*, DOE/EIA-0035(90/08) (Washington, DC, November 1990). Energy use by mode based on model estimates.
Projections: EIA, AEO 1991 Forecasting System Run IGLOCA.D0115911.

Appendix D

High Oil Price Case Projections

Table D1. Total Energy Supply, Disposition, and Prices (Quadrillion Btu per Year, Unless Otherwise Noted)

Supply, Disposition, and Prices	High Oil Price						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Production							
Crude Oil and Lease Condensate [1]	16.24	15.46	15.97	13.27	11.97	11.68	-1.6
Natural Gas Plant Liquids	2.15	2.14	2.11	2.24	2.30	2.20	.1
Dry Natural Gas [2]	17.91	18.11	18.52	19.57	20.26	19.40	.4
Coal	21.36	22.54	22.65	23.99	26.19	29.27	1.5
Nuclear Power	5.69	6.14	6.21	6.45	6.67	6.79	.8
Renewable Energy [3]	6.43	6.81	7.74	8.90	10.33	11.65	2.9
Total	69.78	71.20	73.19	74.43	77.72	81.00	.7
Imports							
Crude Oil [4]	12.58	12.94	10.95	15.47	18.16	18.51	1.9
Petroleum Products	4.48	4.21	4.76	5.00	5.17	6.25	1.6
Natural Gas [5]	1.32	1.40	2.30	2.56	2.93	2.76	3.6
Other Imports [6]	.22	.11	.52	.80	1.12	1.36	9.2
Total	18.60	18.66	18.53	23.83	27.38	28.88	2.1
Exports							
Coal	2.61	2.64	2.90	3.47	5.00	6.25	4.2
Petroleum	1.81	1.71	1.54	1.59	1.70	1.79	-.1
Total	4.42	4.35	4.44	5.07	6.70	8.04	2.9
Net Stock Withdrawals	.44	-.67	-.21	-.18	-.12	-.11	-
Discrepancy [7]	.29	-.45	-.11	-.24	-.32	-.42	-
Consumption							
Petroleum Products [8]	34.21	33.49	32.70	34.77	36.36	37.27	.4
Natural Gas	19.37	19.11	20.20	21.48	22.50	21.50	.5
Coal	18.91	18.90	19.81	20.65	21.37	23.18	1.0
Nuclear Power	5.69	6.14	6.21	6.45	6.67	6.79	.8
Renewable Energy/Other [9]	6.50	6.76	8.04	9.42	11.06	12.57	3.2
Total	84.69	84.39	86.96	92.78	97.97	101.30	.9
Net Imports - Petroleum	15.25	15.44	14.17	18.87	21.64	22.97	2.0
Prices (1990 dollars per unit)							
World Oil Price ($ per barrel) [10]	18.81	22.00	29.00	31.10	38.20	45.40	4.3
Natural Gas Wellhead Price ($ per Mcf)	1.76	1.77	1.96	2.34	3.41	4.73	4.8
Coal Minemouth Price ($ per ton)	22.70	22.18	24.83	26.99	29.72	31.34	1.5

[1] Includes other hydrocarbons, ethanol, and synthetic crude oil.
[2] Includes synthetic gas.
[3] Includes utility and nonutility electricity from hydroelectric, geothermal, wood and wood waste, municipal solid waste, other biomass, wind, photovoltaic and solar thermal sources; non-electric energy from renewable sources such as active and passive solar systems, groundwater heat pumps, and wood; alcohol fuels from renewable sources; and in addition to renewables, electricity from waste heat.
[4] Includes imports of crude oil for the Strategic Petroleum Reserve.
[5] Represents net imports.
[6] Includes coal, coal coke (net), electricity (net), and methanol.
[7] Balancing item. Includes unaccounted for supply, losses, and gains.
[8] Includes natural gas plant liquids, crude oil consumed as a fuel, and nonpetroleum based liquids, such as ethanol.
[9] Includes utility and nonutility electricity from hydroelectric, geothermal, wood and wood waste, municipal solid waste, other biomass, wind, photovoltaic and solar thermal sources; non-electric energy from renewable sources such as active and passive solar systems, groundwater heat pumps, and wood; alcohol fuels from renewable sources; and in addition to renewables, electricity from waste heat, plus net coal coke imports, and net electricity imports.
[10] Average refiner acquisition cost for imported crude oil.
Note: Totals may not equal sum of components due to independent rounding.
Sources: 1989: Calculated from values in Tables D4 through D10 using the conversion factors in Appendix G. 1990: preliminary estimates. Projections: Energy Information Administration, AEO 1991 Forecasting System run IGHICA.D0116912.

Table D2. Energy Consumption by End-Use Sector and Source (Quadrillion Btu per Year)

Sector and Source	High Oil Price						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Residential							
Distillate Fuel	1.06	1.05	0.79	0.64	0.52	0.43	-4.2
Kerosene	.10	.11	.07	.06	.05	.04	-4.4
Liquefied Petroleum Gas	.46	.43	.35	.30	.27	.24	-3.0
Natural Gas	4.91	4.51	4.74	4.55	4.32	4.03	-.9
Coal	.06	.06	.06	.06	.06	.06	-.1
Renewable Energy [1]	.89	.92	1.03	1.21	1.54	1.95	3.8
Electricity	3.09	3.17	3.34	3.45	3.55	3.62	.8
Total	10.58	10.24	10.38	10.26	10.29	10.37	-.1
Commercial							
Distillate Fuel	.57	.56	.53	.47	.42	.37	-2.1
Kerosene	.04	.04	.03	.03	.02	.02	-3.1
Motor Gasoline [2]	.11	.11	.12	.13	.14	.15	1.4
Residual Fuel	.26	.25	.21	.18	.15	.13	-3.1
Natural Gas	2.80	2.65	2.82	2.84	2.85	2.83	.1
Other [3]	.17	.17	.14	.12	.11	.09	-2.9
Renewable Energy [1]	.05	.08	.13	.21	.36	.56	12.1
Electricity	2.77	2.85	3.11	3.39	3.68	3.98	1.8
Total	6.76	6.70	7.09	7.38	7.73	8.14	.9
Industrial [4]							
Distillate Fuel	1.21	1.02	1.21	1.37	1.49	1.56	1.2
Liquefied Petroleum Gas	1.68	1.58	1.62	1.81	1.97	2.11	1.1
Motor Gasoline [2]	.19	.19	.21	.23	.24	.25	1.3
Petrochemical Feedstocks	.93	.97	1.02	1.19	1.32	1.43	2.0
Residual Fuel	.64	.61	.57	.60	.60	.61	-.3
Other Petroleum [5]	3.66	3.85	3.46	3.51	3.52	3.53	-.2
Natural Gas [6]	8.14	8.39	8.69	9.16	9.02	8.46	.2
Metallurgical Coal	1.10	1.01	1.08	.99	.92	.85	-1.2
Steam Coal	1.70	1.68	1.68	1.67	1.69	1.84	.4
Net Coal Coke Imports	.03	.01	-.03	.04	.10	.14	7.5
Renewable Energy [1]	1.91	2.04	2.35	2.68	3.04	3.43	2.8
Purchased Electricity	3.16	3.18	3.37	3.93	4.50	4.99	2.2
Total	24.37	24.54	25.21	27.19	28.41	29.19	.9
Transportation							
Distillate Fuel	3.72	3.71	4.00	4.40	4.80	5.12	1.5
Jet Fuel	3.06	3.09	3.19	3.64	4.00	4.30	1.6
Motor Gasoline [2]	13.75	13.56	13.17	13.52	13.86	13.94	.1
Residual Fuel	.77	.74	.67	.76	.83	.90	.7
Other Petroleum [7]	.23	.24	.25	.27	.30	.32	1.5
Pipeline Fuel Natural Gas	.65	.63	.68	.72	.75	.74	.6
Compressed Natural Gas	.00	.00	.00	.01	.05	.10	-
Alcohol Fuels	.00	.00	.00	.03	.12	.23	-
Electricity	.02	.02	.02	.02	.03	.04	4.8
Total	22.19	21.99	21.98	23.36	24.75	25.70	.7
Electric Utilities [8]							
Distillate Fuel	.10	.08	.06	.14	.25	.17	2.3
Residual Fuel	1.58	1.22	1.13	1.48	1.56	1.61	.1
Natural Gas	2.87	2.93	3.27	4.19	5.51	5.33	3.0
Steam Coal [9]	15.96	16.06	16.91	17.86	18.65	20.39	1.2
Nuclear Power	5.69	6.14	6.21	6.45	6.67	6.79	.8
Renewable Energy/Other [10]	3.62	3.71	4.56	5.25	5.91	6.26	2.6
Total	29.82	30.14	32.14	35.38	38.55	40.55	1.5
Primary Energy Consumption							
Distillate Fuel	6.67	6.42	6.58	7.02	7.47	7.65	.7
Kerosene	.14	.15	.11	.09	.07	.06	-4.0
Jet Fuel	3.06	3.09	3.19	3.64	4.00	4.30	1.6
Liquefied Petroleum Gas	2.24	2.11	2.05	2.19	2.31	2.43	.4
Motor Gasoline	14.05	13.86	13.50	13.88	14.25	14.34	.1
Petrochemical Feedstocks	.93	.97	1.02	1.19	1.32	1.43	2.0
Residual Fuel	3.24	2.82	2.57	3.02	3.15	3.25	.0
Other Petroleum [11]	3.87	4.07	3.68	3.76	3.79	3.81	-.1
Natural Gas	19.37	19.11	20.20	21.48	22.50	21.50	.5
Metallurgical Coal	1.10	1.01	1.08	.99	.92	.85	-1.2
Steam Coal	17.81	17.89	18.73	19.66	20.46	22.34	1.1
Net Coal Coke Imports	.03	.01	-.03	.04	.10	.14	7.5
Nuclear Power	5.69	6.14	6.21	6.45	6.67	6.79	.8
Renewable Energy/Other [12]	6.47	6.75	8.07	9.35	10.85	12.21	3.1

- See footnotes at end of table.

Table D2. Energy Consumption by End-Use Sector and Source (Continued) (Quadrillion Btu per Year)

Sector and Source	High Oil Price						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Primary Energy Consumption							
Alcohols	0.00	0.00	0.00	0.03	0.12	0.23	-
Total	84.69	84.39	86.96	92.78	97.97	101.30	0.9
Electricity Consumption (all Sectors)	9.03	9.21	9.84	10.79	11.76	12.63	1.6
Industrial Electricity							
Gross Consumption	3.48	3.51	3.69	4.29	4.90	5.42	2.1
Self-generation - Own Use	.32	.33	.32	.36	.40	.43	1.4
Purchased Electricity	3.16	3.18	3.37	3.93	4.50	4.99	2.2

[1] Includes electricity generated by the sector for self-use from hydroelectric, geothermal, wood and wood waste, municipal solid waste, other biomass, wind, photovoltaic and solar thermal sources, and non-electric energy from renewable sources such as active and passive solar systems, groundwater heat pumps, and wood.

[2] Includes ethanol blended into gasoline.

[3] Includes liquefied petroleum gas and coal.

[4] Includes consumption by cogenerators.

[5] Includes petroleum coke, asphalt, road oil, lubricants, and miscellaneous petroleum products.

[6] Includes lease and plant fuel.

[7] Includes aviation gas, liquefied petroleum gas, lubricants, and miscellaneous petroleum products.

[8] Includes consumption of energy by electric utilities, independent power producers, and small power producers that sell power to the grid.

[9] Includes consumption by independent power producers.

[10] Includes electricity generated to serve the grid from hydroelectric, geothermal, wood and wood waste, municipal solid waste, other biomass, wind, photovoltaic and solar thermal sources, plus waste heat, and net electricity imports.

[11] Includes unfinished oils, natural gasoline, motor gasoline blending components, aviation gasoline, lubricants, asphalt, road oil, and miscellaneous petroleum products.

[12] Includes electricity generated to serve the grid and for self use from renewable sources, non-electric energy from renewable sources, excluding alcohol fuels, electricity generated from waste heat, and net electricity imports.

Note: Totals may not equal sum of components due to independent rounding.

Sources: 1989: Energy Information Administration, *Monthly Energy Review*, DOE/EIA-0035(90/08) (Washington, DC, November 1990). Calculated from values in Tables D4 through D10 using the conversion factors in Appendix G. 1990: preliminary estimates. Projections: Energy Information Administration, AEO 1991 Forecasting System run IGHICA.D0116912.

Table D3. Energy Prices by End-Use Sector and Source (1990 Dollars per Million Btu)

Sector and Source	High Oil Price						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Residential	11.92	12.23	13.04	13.39	14.72	16.30	1.5
Primary Energy	6.21	6.30	6.53	6.84	7.88	9.13	1.8
Petroleum Products	7.86	8.21	9.14	9.62	11.09	12.59	2.3
Distillate Fuel	6.73	7.64	8.24	8.64	9.95	11.29	2.5
Kerosene	7.34	8.30	9.38	9.65	10.64	11.65	2.2
Liquefied Petroleum Gas	10.60	9.56	11.15	11.68	13.37	15.04	1.7
Natural Gas	5.72	5.69	5.92	6.29	7.33	8.60	2.0
Steam Coal	2.17	2.16	2.37	2.51	2.71	2.87	1.4
Electricity	24.10	23.75	24.74	24.00	24.76	25.83	.3
Commercial	12.24	12.50	13.26	13.32	14.28	15.59	1.2
Primary Energy	4.76	4.96	5.44	5.82	6.91	8.19	2.6
Petroleum Products	4.88	5.70	6.84	7.37	8.84	10.37	3.7
Distillate Fuel	4.75	5.65	6.25	6.67	7.99	9.34	3.3
Residual Fuel	2.81	3.15	4.90	5.22	6.33	7.44	4.7
Kerosene	4.98	5.96	6.83	7.13	8.15	9.19	3.0
Other Petroleum [1]	8.02	9.17	10.62	11.21	12.87	14.61	2.9
Natural Gas	4.80	4.77	5.05	5.42	6.47	7.74	2.3
Steam Coal	2.15	2.14	2.34	2.49	2.69	2.85	1.4
Electricity	22.91	22.49	22.92	21.69	21.68	22.26	-.1
Industrial	5.26	5.54	6.26	6.71	7.91	9.15	2.7
Primary Energy	3.52	3.88	4.57	4.96	6.07	7.27	3.5
Petroleum Products	4.56	5.41	6.80	7.18	8.46	9.78	3.7
Distillate Fuel	4.74	5.60	6.20	6.61	7.93	9.28	3.2
Liquefied Petroleum Gas	4.37	5.76	7.58	8.08	9.75	11.39	4.7
Motor Gasoline [2]	8.57	9.51	10.78	11.37	12.99	14.74	2.6
Residual Fuel	2.60	2.97	4.72	5.04	6.15	7.26	5.0
Other Petroleum [3]	4.69	5.40	6.77	7.07	8.15	9.31	3.3
Natural Gas [4]	2.99	2.92	3.16	3.53	4.57	5.84	3.2
Metallurgical Coal	1.96	1.93	2.10	2.26	2.45	2.58	1.3
Steam Coal	1.64	1.63	1.79	1.89	2.05	2.19	1.4
Electricity	15.28	15.02	15.48	15.30	15.90	16.48	.4
Transportation	7.63	8.58	9.82	10.26	11.70	13.21	2.7
Primary Energy	7.62	8.57	9.81	10.25	11.68	13.19	2.7
Petroleum Products	7.62	8.57	9.81	10.26	11.69	13.21	2.7
Distillate Fuel [5]	7.59	8.36	9.94	10.36	11.67	13.02	2.6
Jet Fuel [6]	4.57	5.84	6.46	6.88	8.23	9.63	3.6
Motor Gasoline [2]	8.55	9.51	10.78	11.36	12.99	14.73	2.6
Residual Fuel	2.50	3.05	4.42	4.73	5.72	6.75	4.8
Other Petroleum [7]	9.84	11.05	13.72	14.03	15.11	16.20	2.4
Natural Gas	.00	.00	5.98	6.34	7.37	8.64	-
Electricity	24.14	23.43	24.34	23.72	24.60	25.49	.3
Total End-Use Energy	8.00	8.50	9.42	9.74	10.99	12.36	2.1
Primary Energy	5.73	6.29	7.13	7.56	8.87	10.28	2.8
Electricity	20.67	20.34	20.99	20.11	20.41	21.01	.1
Electric Utilities							
Fossil Fuel Average	1.77	1.74	2.01	2.25	2.68	3.02	2.6
Petroleum Products	3.04	3.43	5.16	5.49	6.62	7.91	4.7
Distillate Fuel	4.41	5.37	5.88	6.33	7.69	9.02	3.5
Residual Fuel	2.95	3.30	5.12	5.41	6.46	7.80	4.7
Natural Gas	2.45	2.23	2.57	2.92	3.94	5.17	3.6
Steam Coal	1.52	1.52	1.68	1.80	1.93	2.03	1.4
Average Price to All Users [8]							
Petroleum Products	6.58	7.49	8.79	9.17	10.55	12.02	2.9
Distillate Fuel [5]	6.64	7.53	8.72	9.14	10.47	11.89	2.8
Jet Fuel [6]	4.57	5.84	6.46	6.88	8.23	9.63	3.6
Kerosene	6.67	7.63	8.59	8.83	9.80	10.80	2.3
Liquefied Petroleum Gas	5.78	6.67	8.30	8.68	10.26	11.84	3.5
Motor Gasoline [2]	8.55	9.51	10.78	11.36	12.99	14.73	2.6
Residual Fuel	2.76	3.15	4.83	5.16	6.20	7.39	4.8

- See footnotes at end of table.

Table D3. Energy Prices by End-Use Sector and Source (Continued) (1990 Dollars per Million Btu)

Sector and Source	High Oil Price						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Average Price to All Users [8]							
Other Petroleum Products [9]	4.93	5.65	7.11	7.43	8.53	9.70	3.3
Natural Gas	3.95	3.81	4.05	4.32	5.25	6.51	2.4
Coal	1.56	1.55	1.71	1.83	1.96	2.07	1.3
Electricity	20.67	20.34	20.99	20.11	20.41	21.01	.1

[1] Average price for liquefied petroleum gas, motor gasoline, and miscellaneous petroleum products.
[2] Average price for all grades. Includes Federal and State taxes and excludes county and local taxes.
[3] Average price for petrochemical feedstocks and miscellaneous petroleum products.
[4] Excludes uses for lease and plant fuel.
[5] Includes Federal and State taxes on diesel fuel and excludes county and local taxes.
[6] Kerosene-type jet fuel.
[7] Average price for liquefied petroleum gas and miscellaneous petroleum products.
[8] Weighted averages of end-use fuel prices are derived from the prices shown in each sector and the corresponding sectoral consumption. For each sector, electricity and natural gas prices are derived by dividing total revenues by sales.
[9] Average price for petrochemical feedstocks and miscellaneous petroleum products.

Sources: 1989 prices for gasoline, distillate, jet fuel, residual fuel, liquefied petroleum gas, and kerosene are based on prices in the Energy Information Administration, *Petroleum Marketing Annual 1989*, DOE/EIA-0487(89) (Washington, DC, December 1990). 1990 prices for these products are preliminary estimates based on data from the Energy Information Administration, *Petroleum Marketing Monthly*, DOE/EIA-0380 (Washington, DC, January 1990 through October 1990). 1989 and 1990 prices for all other petroleum products are derived from the Energy Information Administration, *State Energy Price and Expenditures Report: 1988*, DOE/EIA-0376(88) (Washington, DC, September 1990), applying the growth rate of the world oil price. Projections: Energy Information Administration, AEO 1991 Forecasting System run IGHICA.D0116912.

Table D4. Electricity Supply, Disposition, and Prices (Billion Kilowatthours, Unless Otherwise Noted)

Supply, Disposition, and Prices	High Oil Price						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Electric Utilities							
Generation by Fuel Type							
Coal	1,554	1,558	1,631	1,724	1,777	1,972	1.1
Petroleum	158	122	112	152	167	167	.3
Natural Gas	267	270	301	377	496	514	3.2
Nuclear Power	529	575	570	592	612	623	.8
Pumped Storage Hydroelectric	-9	-9	-10	-10	-11	-11	1.2
Renewable Sources/Other [1]	285	298	319	332	341	344	.9
Total	2,785	2,813	2,922	3,166	3,383	3,609	1.2
Net Imports	11	2	41	55	65	68	9.1
Nonutilities [2]							
Generation by Fuel Type							
Coal	33	34	42	43	69	90	4.9
Petroleum	3	3	4	4	4	5	2.3
Natural Gas	78	93	102	108	122	123	2.2
Renewable Sources/Other [1]	72	72	113	153	198	228	5.6
Total	185	201	261	309	394	446	4.3
Sales to Utilities	90	105	166	204	275	318	6.2
Generation for Own Use	95	96	95	105	118	127	1.4
Electricity Sales by Sector							
Residential	906	928	979	1,012	1,040	1,060	.8
Commercial/Other [3]	815	839	917	998	1,088	1,180	1.8
Industrial	926	933	987	1,151	1,319	1,462	2.2
Total	2,647	2,700	2,883	3,162	3,447	3,702	1.6
End-Use Prices [4]							
(1990 cents per kilowatthour)							
Residential	8.22	8.10	8.44	8.19	8.45	8.81	.3
Commercial/Other [3]	7.82	7.68	7.82	7.40	7.41	7.61	-.1
Industrial [5]	5.22	5.12	5.28	5.22	5.43	5.62	.4
Average	7.05	6.94	7.16	6.86	6.96	7.17	.1
Price Components [4]							
(1990 cents per kilowatthour)							
Capital Component	3.09	3.07	3.05	2.49	2.15	2.11	-1.8
Fuel Component	1.83	1.75	2.00	2.26	2.70	2.96	2.3
O&M Component	2.13	2.12	2.11	2.11	2.11	2.10	-.1
Total	7.05	6.94	7.16	6.86	6.96	7.17	.1

[1] Includes conventional hydroelectric, geothermal, wood, wood waste, municipal solid waste, other biomass, solar and wind power, plus a small quantity of petroleum coke. For nonutilities, also includes waste heat, blast furnace gas, and coke oven gas.

[2] Includes cogenerators, small power producers, independent power producers, and all other sources, except electric utilities, which produce electricity for self use or for delivery to the grid.

[3] Other includes sales of electricity to Government, railways, and street lighting authorities.

[4] Prices represent average revenue per kilowatthour of sales over all customer classes.

[5] Weighted average, including transportation. Weights used are consumption levels by sector.

O&M = Operating and Maintenance

Note: Totals may not equal sum of components due to independent rounding.

Sources: 1989, except for nonutilities and prices: Energy Information Administration, *Electric Power Annual 1989*, DOE/EIA-0348(89) (Washington, DC, January 1991). 1990 generation: Energy Information Administration, *Short-Term Energy Outlook*, DOE/EIA-0202(91/1Q) (Washington, DC, January 1991). 1989 and 1990 nonutilities, prices, and all projections: Energy Information Administration, AEO 1991 Forecasting System run IGHICA.D0116912.

Table D5. Electricity Generating Capability (Thousand Megawatts)

Summer Capability [1]	High Oil Price						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Electric Utilities							
Capability							
Coal Steam	296.2	297.5	300.2	303.2	305.6	336.2	0.6
Other Fossil Steam [2]	144.6	145.3	139.9	132.7	125.8	122.1	-.8
Combined Cycle	5.1	5.2	6.4	9.5	19.8	33.9	9.4
Combustion Turbine/Diesel	46.0	46.6	52.4	61.0	66.8	72.4	2.2
Nuclear Power	98.2	99.6	103.1	105.4	106.5	104.2	.3
Pumped Storage Hydroelectric	17.2	17.2	19.8	19.8	19.8	19.8	.7
Renewable Sources/Other [3]	77.3	77.5	80.1	81.8	82.9	83.4	.4
Total	684.6	688.9	702.0	713.4	727.2	772.1	.6
Cumulative Planned Additions [4]							
Coal Steam	.0	1.7	8.6	17.3	19.0	19.2	-
Other Fossil Steam	.0	.0	.5	.5	.5	.5	-
Combined Cycle	.0	.1	1.3	4.4	4.4	4.4	-
Combustion Turbine/Diesel	.0	.6	5.3	10.8	10.9	10.9	-
Nuclear Power	.0	2.3	5.8	8.3	9.5	9.5	-
Pumped Storage Hydroelectric	.0	.0	2.6	2.7	2.7	2.7	-
Renewable Sources/Other [3]	.0	.1	2.3	2.7	2.8	2.8	-
Total	.0	4.8	26.4	46.6	49.7	49.9	-
Cumulative Unplanned Additions [4]							
Coal Steam	.0	.0	.0	.0	3.9	37.1	-
Other Fossil Steam	.0	.0	.0	.0	.0	.0	-
Combined Cycle	.0	.0	.0	.0	10.3	24.4	-
Combustion Turbine/Diesel	.0	.0	1.6	4.9	11.9	17.6	-
Nuclear Power	.0	.0	.0	.0	.0	.0	-
Pumped Storage Hydroelectric	.0	.0	.0	.0	.0	.0	-
Renewable Sources/Other [3]	.0	.1	.6	1.8	2.8	3.3	-
Total	.0	.1	2.1	6.8	28.9	82.5	-
Cumulative Total Additions	.0	4.9	28.5	53.4	78.6	132.4	-
Cumulative Retirements	.0	1.4	11.9	25.4	36.7	45.6	-
Nonutilities [5]							
Capability							
Coal	5.8	5.9	7.7	8.0	12.6	16.8	5.2
Petroleum	.9	1.0	1.2	1.4	1.5	1.7	2.9
Natural Gas	13.8	16.7	18.5	19.7	21.9	22.3	2.3
Renewable Sources/Other [3]	16.1	16.8	21.3	27.5	34.7	40.1	4.4
Total	36.7	40.5	48.7	56.5	70.8	81.0	3.8
Cumulative Additions	.0	3.8	12.0	19.8	34.0	44.3	-

[1] Net summer capability is the steady hourly output that generating equipment is expected to supply to system load (exclusive of auxiliary power), as demonstrated by tests during summer peak demand.

[2] Includes oil-, gas-, and dual-fired capability.

[3] Includes conventional hydroelectric, geothermal, wood, wood waste, municipal solid waste, other biomass, solar, and wind power, plus a small quantity of petroleum coke. For nonutilities, also includes waste heat, blast furnace gas, and coke oven gas.

[4] Cumulative additions after December 31, 1989.

[5] Includes cogenerators, small power producers, independent power producers, and all other sources, except electric utilities, which produce electricity for self use or for sales to the grid.

Note: Totals may not equal sum of components due to independent rounding.

Sources: 1989 utility capability: Energy Information Administration, *Electric Power Annual 1989*, DOE/EIA-0348(89) (Washington, DC, January 1991). 1990 utility capability: Energy Information Administration, Form EIA-860, *Annual Electric Generator Report*. 1989 and 1990 nonutility capability and all projections: Energy Information Administration, AEO 1991 Forecasting System run IGHICA.D0116912.

Table D6. Renewable Energy (Quadrillion Btu per Year, Unless Otherwise Noted)

Electricity and Non-Electric	High Oil Price						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Electricity							
Capability (gigawatts)							
Conventional Hydropower	75.48	75.67	77.94	78.36	78.36	78.46	0.2
Geothermal	2.47	2.59	3.25	6.25	9.65	10.65	7.2
Municipal Solid Waste	1.98	2.10	3.75	6.16	8.79	10.81	8.4
Biomass/Other Waste	5.31	5.46	6.21	7.02	7.90	8.88	2.5
Solar Thermal	.33	.43	.43	.43	.81	1.78	8.4
Solar Photovoltaic	.00	.00	.01	.01	.01	.01	2.1
Wind	1.93	1.95	2.46	3.50	4.40	5.30	4.9
Total	87.51	88.20	94.05	101.70	109.90	115.90	1.3
Generation (billion kilowatthours)							
Conventional Hydropower	276.90	302.20	312.40	314.60	314.60	314.80	.6
Geothermal	15.05	15.98	20.67	43.37	70.63	78.52	8.2
Municipal Solid Waste	13.31	13.48	24.66	41.54	60.06	74.22	8.5
Biomass/Other Waste	29.54	30.36	34.57	39.11	44.01	49.55	2.5
Solar Thermal	.69	.90	.90	1.16	2.30	5.06	10.0
Solar Photovoltaic	.00	.00	.00	.00	.00	.00	2.2
Wind	3.38	3.42	4.32	8.22	10.68	12.97	6.6
Total	338.90	366.30	397.50	448.00	502.30	535.10	2.2
Consumption/Displacement							
Conventional Hydropower	2.88	3.14	3.25	3.27	3.27	3.27	.6
Geothermal	.16	.17	.21	.45	.73	.82	8.2
Municipal Solid Waste	.20	.22	.50	.76	1.05	1.27	9.2
Biomass/Other Waste	.20	.20	.23	.26	.29	.33	2.5
Solar Thermal	.01	.01	.01	.01	.02	.05	10.0
Solar Photovoltaic	.00	.00	.00	.00	.00	.00	2.3
Wind	.04	.04	.04	.09	.11	.13	6.6
Total	3.48	3.78	4.25	4.85	5.48	5.88	2.5
Non-Electric Renewable Energy							
Residential, Commercial, and Industrial							
Hydropower	.00	.00	.00	.00	.00	.00	-
Geothermal	.00	.00	.02	.07	.18	.39	-
Biofuels	2.63	2.77	3.14	3.58	4.05	4.54	2.6
Solar Thermal	.05	.07	.09	.13	.30	.54	11.6
Solar Photovoltaic	.00	.00	.00	.00	.00	.00	-
Wind	.00	.00	.00	.00	.00	.00	-
Transportation							
Ethanol	.07	.08	.10	.12	.14	.14	3.5
Total	2.75	2.92	3.35	3.90	4.68	5.62	3.5
Total Renewable Energy	6.23	6.70	7.61	8.74	10.17	11.50	3.0

Note: Totals may not equal sum of components due to independent rounding.
Sources: 1989 and 1990: Energy Information Administration, Office of Coal, Nuclear, Electric and Alternate Fuels. Projections: Energy Information Administration, AEO 1991 Forecasting System run IGHICA.D0116912.

Table D7. Macroeconomic Indicators (Billion 1982 Dollars, Unless Otherwise Noted)

Indicator	High Oil Price						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
GNP Implicit Price Deflator (index, 1982=1.000)	1.263	1.314	1.551	1.875	2.332	2.910	4.1
Real Gross National Product	4,118	4,153	4,545	5,174	5,792	6,323	2.1
Real Disposable Personal Income	2,869	2,891	3,090	3,430	3,771	4,084	1.7
Index of Manufacturing Gross Output (index, 1982=1.000)	1.219	1.217	1.346	1.597	1.824	2.006	2.4
AA Utility Bond Rate (percent)	9.55	9.65	9.43	9.04	8.77	8.73	-
90-Day U.S. Government Treasury Bill Rate (percent)	8.11	7.51	6.11	5.77	5.51	5.48	-
Energy Intensity (thousand Btu per 1982 $ of GNP)	20.57	20.32	19.13	17.93	16.92	16.02	-1.2

Note: Totals may not equal sum of components due to independent rounding.
Sources: 1989: Data Resources Incorporated (DRI), USCEN Databank. 1990: DRI Control0191. Projections: Energy Information Administration, AEO 1991 Forecasting System run IGHICA.D0116912.

Table D8. Petroleum Supply and Disposition Balance (Million Barrels per Day, Unless Otherwise Noted)

Supply and Disposition	High Oil Price						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
World Oil Price (1990 dollars per barrel) [1]	18.81	22.00	29.00	31.10	38.20	45.40	4.3
Production							
Crude Oil [2]	7.61	7.23	7.44	6.09	5.35	5.18	-1.8
Alaska	1.87	1.75	1.35	.97	.95	1.17	-2.2
Lower 48	5.74	5.48	6.09	5.12	4.40	4.00	-1.7
Natural Gas Plant Liquids	1.55	1.54	1.52	1.61	1.66	1.58	.1
Other Domestic [3]	.06	.07	.19	.26	.43	.46	10.2
Processing Gain [4]	.66	.67	.63	.63	.66	.66	.0
Total	9.88	9.51	9.78	8.60	8.10	7.89	-1.1
Imports (including SPR) [5]							
Crude Oil	5.84	6.01	5.09	7.16	8.43	8.59	1.9
Refined Products	2.22	2.08	2.35	2.47	2.56	3.09	1.6
Total	8.06	8.09	7.44	9.63	10.99	11.69	1.8
Exports							
Crude Oil	.14	.11	.11	.09	.10	.13	-.6
Refined Products	.72	.70	.62	.67	.70	.72	.0
Total	.86	.81	.73	.75	.80	.85	-.1
Net Imports (including SPR)	7.20	7.28	6.71	8.87	10.19	10.84	2.0
Primary Stock Changes							
Net Withdrawals [6]	.12	-.16	-.02	-.02	-.04	-.01	-
SPR Fill Rate Additions (-) [5]	-.06	-.02	-.05	-.05	.00	.00	-
Total Primary Supply [7]	17.14	16.62	16.42	17.40	18.25	18.72	.4
Unaccounted for Crude	.20	.34	.15	.15	.15	.15	-1.4
Refined Petroleum Products Supplied							
Motor Gasoline [8]	7.33	7.23	7.04	7.22	7.43	7.48	.1
Jet Fuel [9]	1.49	1.51	1.56	1.77	1.95	2.09	1.6
Distillate Fuel	3.14	3.02	3.09	3.29	3.51	3.60	.7
Residual Fuel	1.41	1.23	1.12	1.31	1.37	1.42	.0
Other [10]	3.96	3.97	3.75	3.96	4.13	4.28	.4
Total	17.33	16.95	16.57	17.55	18.40	18.87	.4
Refined Petroleum Products Supplied							
Residential and Commercial	1.41	1.38	1.13	.97	.85	.75	-2.9
Industrial [11]	4.32	4.25	4.20	4.54	4.81	5.01	.7
Transportation	10.86	10.76	10.72	11.32	11.94	12.32	.6
Electric Utilities [12]	.74	.57	.52	.71	.79	.78	.3
Total	17.33	16.95	16.57	17.55	18.40	18.87	.4
Discrepancy [13]	.01	.00	.00	.00	.00	.00	-
Net Disposition	17.34	16.96	16.57	17.55	18.40	18.87	.4

[1] Average refiner acquisition cost for imported crude oil.
[2] Includes lease condensate.
[3] Includes other hydrocarbons, ethanol, and synthetic crude oil.
[4] Represents volumetric gain in refinery distillation and cracking processes.
[5] SPR is the Strategic Petroleum Reserve.
[6] Computed as the end-of-year stock levels in the current period subtracted from the end-of-year stock levels in the preceding period. A negative (-) represents an increase to inventories.
[7] Total production plus net imports plus net stock withdrawals minus SPR additions.
[8] Includes ethanol blended into gasoline.
[9] Includes naphtha and kerosene type.
[10] Includes aviation gasoline, kerosene, liquefied petroleum gas, petrochemical feedstocks, miscellaneous petroleum products, lubricants, waxes, asphalt, road oil, still gas, special naphthas, petroleum coke, crude oil product supplied, natural gas liquids, liquefied refinery gas, and other liquids.
[11] Includes consumption by cogenerators.
[12] Includes consumption by independent power producers.
[13] Balancing item.

Note: Totals may not equal sum of components due to independent rounding.

Sources: 1989: Energy Information Administration, *Petroleum Supply Annual 1989*, DOE/EIA-0340(89) (Washington, DC, May 1990). 1990: preliminary estimates. Projections: Energy Information Administration, AEO 1991 Forecasting System run IGHICA.D0116912.

Table D9. Natural Gas Supply, Disposition, and Prices (Trillion Cubic Feet per Year, Unless Otherwise Noted)

Supply, Disposition, and Prices	High Oil Price						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Production							
Dry Gas Production [1]	17.26	17.40	17.86	18.88	19.52	18.68	0.4
Synthetic Natural Gas [2]	.11	.17	.10	.10	.13	.15	1.3
Net Imports	1.28	1.36	2.23	2.49	2.84	2.68	3.6
Net Storage Withdrawals [3]	.32	-.28	.00	.00	.00	.00	-
Total Supply	18.97	18.65	20.19	21.47	22.49	21.50	.6
Consumption by Sector							
Residential	4.77	4.38	4.60	4.41	4.19	3.91	-.9
Commercial	2.71	2.57	2.73	2.76	2.77	2.75	.1
Industrial [4]	6.83	6.97	7.35	7.74	7.57	7.08	.2
Electric Utilities [5]	2.78	2.84	3.17	4.06	5.34	5.16	3.0
Lease and Plant Fuel [6]	1.07	1.17	1.08	1.14	1.18	1.13	.2
Pipeline Fuel	.63	.61	.66	.70	.73	.72	.6
Transportation [7]	.00	.00	.00	.01	.05	.10	-
Total	18.79	18.53	19.59	20.83	21.82	20.84	.5
Unaccounted for [8]	.18	.12	.60	.64	.68	.65	6.3
Average Wellhead Price (1990 dollars per thousand cubic feet)	1.76	1.77	1.96	2.34	3.41	4.73	4.8
Delivered Prices (1990 dollars per thousand cubic feet)							
Residential	5.89	5.86	6.10	6.49	7.56	8.86	2.0
Commercial	4.95	4.92	5.21	5.59	6.67	7.98	2.3
Industrial	3.08	3.01	3.25	3.64	4.71	6.02	3.2
Electric Utilities	2.53	2.30	2.65	3.02	4.06	5.33	3.6
Transportation	.00	.00	6.16	6.53	7.60	8.91	-
Average [9]	4.07	3.93	4.18	4.45	5.41	6.71	2.4

[1] Dry marketed production minus nonhydrocarbon gases removed.
[2] Includes synthetic natural gas (from the manufacture, conversion, or reforming of petroleum hydrocarbons) and propane/air mixtures.
[3] Computed as the end-of-year stock levels in the current period subtracted from the end-of-year stock levels in the preceding period. A negative (-) represents an increase to inventories.
[4] Includes consumption by cogenerators.
[5] Includes consumption by independent power producers.
[6] Represents natural gas used in the field gathering and processing plant machinery.
[7] Compressed natural gas used as vehicle fuel.
[8] Balancing item. Reflects natural gas lost, the net result of converting flow data measured at varying temperatures and pressures to a standard temperature and pressure, and the merger of different data reporting systems which vary in scope, format, definition, and respondent type.
[9] Weighted average price. Weights used are the sectoral consumption values excluding lease, plant and pipeline fuel.

Note: Totals may not equal sum of components due to independent rounding.

Sources: 1989: Energy Information Administration, *Natural Gas Annual 1989*, DOE/EIA-0131(89) (Washington, DC, September 1990). 1990: preliminary estimates. Projections: Energy Information Administration, AEO 1991 Forecasting System run IGHICA.D0116912.

Table D10. Coal Supply, Disposition, and Prices (Million Short Tons per Year, Unless Otherwise Noted)

Supply, Disposition, and Prices	High Oil Price						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Production [1]							
East of the Mississippi	599	638	626	652	721	817	1.5
West of the Mississippi	382	397	427	478	504	555	1.8
Total	981	1,035	1,053	1,130	1,225	1,372	1.6
Net Imports							
Imports	3	2	5	6	9	11	6.6
Exports	101	107	113	138	198	250	4.4
Total	-98	-105	-108	-131	-189	-238	4.3
Net Stock Withdrawals [2]	14	-29	-2	-1	-2	-4	-
Total Supply [3]	897	901	943	997	1,034	1,130	1.1
Consumption by Sector							
Residential and Commercial	6	6	6	5	5	5	-1.3
Industrial [4]	76	77	76	76	76	83	.4
Coking Plants	41	37	40	37	35	32	-1.2
Electric Utilities [5]	766	772	821	880	920	1,010	1.3
Total	889	893	943	998	1,035	1,130	1.1
Discrepancy [6]	7	8	-1	-1	-1	0	-28.7
Average Minemouth Price [7] **(1990 dollars per short ton)**	22.70	22.18	24.83	26.99	29.72	31.34	1.5
Delivered Prices (1990 dollars per short ton)							
Residential and Commercial	49.48	48.39	56.46	58.81	63.97	67.01	1.5
Industrial	34.36	33.60	39.49	41.93	45.66	48.55	1.7
Coking Plants	49.42	47.70	55.85	59.98	65.14	68.29	1.6
Electric Utilities	31.35	30.64	34.52	36.53	39.10	40.95	1.3
Average [8]	32.56	31.75	35.97	37.93	40.56	42.39	1.3

[1] Includes anthracite, bituminous coal, and lignite.
[2] From all stocks held by industrial plants, coke plants, electric utilities, and producers/distributors. Computed as the end-of-year stock levels in the current period subtracted from the end-of-year stock levels in the preceding period. A negative (-) represents an increase to inventories.
[3] Production plus net imports plus net storage withdrawals.
[4] Includes consumption by cogenerators.
[5] Includes consumption by independent power producers.
[6] Balancing item: the sum of production, net imports, and net stock withdrawals minus total consumption.
[7] Free-on-board price.
[8] Weighted average prices. Weights used are consumption values by sector.

Note: Totals may not equal sum of components due to independent rounding.
Sources: 1989: Energy Information Administration, *Monthly Energy Review*, DOE/EIA-0035(90/08) (Washington, DC, November 1990); *Quarterly Coal Report*, DOE/EIA-0121(90/3Q) (Washington, DC, January 1991); and *Coal Production 1989*, DOE/EIA-0118(89) (Washington, DC, November 1990). 1990: preliminary estimates. Projections: Energy Information Administration, AEO 1991 Forecasting System run IGHICA.D0116912.

Table D11. Residential Sector Key Indicators and End-Use Consumption (Quadrillion Btu per Year, Unless Otherwise Noted)

Key Indicators and Consumption	High Oil Price						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Key Indicators							
Total Housing (millions)	92.6	93.4	97.9	102.8	107.4	111.3	0.9
Energy Consumption per Household (MMBtu)	114.1	109.5	106.0	99.8	95.9	93.1	-1.0
End-Use Consumption							
Distillate							
Space Heating	.91	.89	.68	.55	.46	.38	-4.0
Other Uses [1]	.15	.15	.11	.08	.06	.05	-5.4
Total	1.06	1.05	.79	.64	.52	.43	-4.2
Natural Gas							
Space Heating	3.41	3.13	3.27	3.14	3.01	2.84	-.9
Water Heating	1.16	1.07	1.17	1.13	1.04	.94	-1.0
Other Uses [1]	.34	.31	.30	.28	.26	.25	-1.4
Total	4.91	4.51	4.74	4.55	4.32	4.03	-.9
Other Fuels [2]	.62	.60	.47	.41	.37	.34	-2.8
Renewables [3]	.89	.92	1.03	1.21	1.54	1.95	3.8
Electricity							
Space Heating	.32	.33	.36	.37	.39	.42	1.3
Cooling	.49	.51	.54	.55	.54	.53	.3
Water Heating	.38	.40	.45	.51	.54	.57	2.0
Other Uses [1]	1.89	1.92	1.99	2.03	2.07	2.10	.5
Total	3.09	3.17	3.34	3.45	3.55	3.62	.8
Total Consumption	10.58	10.24	10.38	10.26	10.29	10.37	-.1

[1] Includes cooking, cooling (natural gas), water heating (distillate), refrigeration and lighting (electricity), and other household appliances.
[2] Includes liquefied petroleum gas, kerosene and coal.
[3] Includes solar, geothermal, and wood energy.
MMBtu = million Btu.
Note: Totals may not equal sum of components due to independent rounding.
Sources: 1989 and 1990 estimates: Energy Information Administration (EIA), *State Energy Data Report*, DOE/EIA-0214(88) (Washington, DC, May 1990) and *Monthly Energy Review*, DOE/EIA-0035(90/08) (Washington, DC, November 1990). Projections: EIA, AEO 1991 Forecasting System Run IGHICA.D0116912.

Table D12. Commercial Sector Key Indicators and End-Use Consumption (Quadrillion Btu per Year, Unless Otherwise Noted)

Key Indicators and Consumption	High Oil Price						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Key Indicators							
Total Employment (millions)	108.4	110.4	115.8	125.3	131.7	136.1	1.1
Total Floor Space (billion sq. ft.)	63.0	64.3	70.3	76.9	83.8	90.9	1.8
Energy Consumption per Square Foot (MBtu)	107.3	104.3	100.8	95.9	92.3	89.5	-.9
End-Use Consumption							
Distillate							
Space Heating	.53	.52	.49	.44	.39	.35	-1.9
Other Uses [1]	.05	.05	.04	.03	.02	.02	-4.4
Total	.57	.56	.53	.47	.42	.37	-2.1
Natural Gas							
Space Heating	1.84	1.74	1.85	1.86	1.85	1.79	-.1
Cooling	.21	.19	.17	.13	.11	.08	-4.1
Other Uses [1]	.75	.72	.80	.85	.90	.95	1.1
Total	2.80	2.65	2.82	2.84	2.85	2.83	.1
Other Fuels[2]	.58	.56	.51	.46	.42	.39	-1.8
Renewables [3]	.05	.08	.13	.21	.36	.56	12.1
Electricity							
Space Heating	.51	.53	.59	.65	.72	.82	2.3
Cooling	.72	.74	.83	.90	.98	1.04	1.8
Lighting	1.08	1.10	1.16	1.24	1.31	1.39	1.2
Other Uses [1]	.46	.47	.54	.60	.67	.73	2.3
Total	2.77	2.85	3.11	3.39	3.68	3.98	1.8
Total Consumption	6.76	6.70	7.09	7.38	7.73	8.14	.9

[1] Includes water heating, cooking, and other miscellaneous commercial uses.
[2] Includes residual fuel oil, liquefied petroleum gas, coal, motor gasoline, and kerosene.
[3] Includes solar, geothermal, wood, and municipal solid waste energy.
MBtu = thousand Btu.
Note: Totals may not equal sum of components due to independent rounding.
Sources: 1989 and 1990 estimates: Energy Information Administration (EIA), *State Energy Data Report*, DOE/EIA-0214(88) (Washington, DC, May 1990) and *Monthly Energy Review*, DOE/EIA-0035(90/08) (Washington, DC, November 1990). Projections: EIA, AEO 1991 Forecasting System Run IGHICA.D0116912.

Table D13. Industrial Sector Key Indicators and Consumption

Key Indicators and Consumption	High Oil Price						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Key Indicators							
Value of Gross Output (billion 1982 dollars)							
Manufacturing	2,402	2,399	2,653	3,148	3,595	3,954	2.4
Nonmanufacturing	832	820	897	980	1,059	1,122	1.4
Total	3,234	3,220	3,550	4,128	4,654	5,076	2.2
Consumption per Unit Output (thousand Btu per 1982 dollars)							
Distillate	.375	.317	.341	.332	.319	.307	-.9
Liquefied Petroleum Gas	.519	.490	.456	.439	.423	.415	-1.1
Petrochemical Feedstocks	.289	.301	.287	.287	.283	.281	-.1
Residual Fuel	.198	.190	.160	.145	.130	.119	-2.4
Other Petroleum [1]	1.133	1.195	.974	.851	.757	.695	-2.3
Natural Gas [2]	2.518	2.605	2.447	2.218	1.939	1.667	-1.9
Metallurgical Coal and Coke [3]	.352	.319	.295	.252	.218	.194	-2.8
Steam Coal [4]	.527	.521	.474	.406	.363	.363	-1.8
Renewables [5]	.592	.635	.661	.650	.654	.676	.6
Electricity	.978	.988	.948	.951	.967	.983	.0
Total	7.540	7.622	7.101	6.587	6.106	5.750	-1.3
Consumption (quadrillion Btu per year)							
Distillate	1.21	1.02	1.21	1.37	1.49	1.56	1.2
Liquefied Petroleum Gas	1.68	1.58	1.62	1.81	1.97	2.11	1.1
Motor Gasoline [6]	.19	.19	.21	.23	.24	.25	1.3
Petrochemical Feedstocks	.93	.97	1.02	1.19	1.32	1.43	2.0
Residual Fuel	.64	.61	.57	.60	.60	.61	-.3
Other Petroleum [1]	3.66	3.85	3.46	3.51	3.52	3.53	-.2
Natural Gas [2]	8.14	8.39	8.69	9.16	9.02	8.46	.2
Metallurgical Coal and Coke [3]	1.14	1.03	1.05	1.04	1.02	.99	-.7
Steam Coal [4]	1.70	1.68	1.68	1.67	1.69	1.84	.4
Renewables [5]	1.91	2.04	2.35	2.68	3.04	3.43	2.8
Electricity	3.16	3.18	3.37	3.93	4.50	4.99	2.2
Total	24.37	24.54	25.21	27.19	28.41	29.19	.9

[1] Includes petroleum coke, asphalt, road oil, lubricants, and miscellaneous petroleum products.
[2] Includes lease and plant fuel.
[3] Includes net imports of coal coke.
[4] Includes consumption by cogenerators.
[5] Does not include renewables consumed for nonutility electricity generation in the industrial sector for sales to the grid.
[6] Includes ethanol blended into gasoline.

Note: Totals may not equal sum of components due to independent rounding.

Sources: 1989 and 1990 estimates: Energy Information Administration (EIA), *State Energy Data Report*, DOE/EIA-0214(88) (Washington, DC, May 1990) and *Monthly Energy Review*, DOE/EIA-0035(90/08) (Washington, DC, November 1990). Projections: EIA, AEO 1991 Forecasting System Run IGHICA.D0116912.

Table D14. Transportation Sector Key Indicators and Consumption

Key Indicators and Consumption	High Oil Price						Annual Growth 1989-2010 (percent)
	1989	1990	1995	2000	2005	2010	
Key Indicators							
Level of Travel Index (1989= 1.0)							
Light Duty Vehicles	1.000	0.999	1.060	1.174	1.283	1.380	1.5
Freight Trucks	1.000	.995	1.081	1.217	1.344	1.452	1.8
Air	1.000	.985	1.156	1.468	1.758	2.004	3.4
Rail	1.000	.982	1.037	1.125	1.208	1.272	1.1
Marine	1.000	.974	1.021	1.087	1.157	1.215	.9
Energy Efficiency Indicators							
New Car MPG [1]	28.3	28.2	32.5	34.7	37.5	40.3	1.7
New Light Truck MPG [1]	20.9	20.9	24.9	25.6	27.2	29.8	1.7
Light Duty Fleet MPG [2]	18.5	18.7	20.2	21.7	23.0	24.4	1.3
Aircraft Efficiency Index [3]	1.000	1.012	1.076	1.148	1.224	1.276	1.2
Freight Truck Efficiency Index [4]	1.000	1.006	1.051	1.094	1.112	1.130	.6
Rail Efficiency Index [5]	1.000	1.003	1.020	1.037	1.055	1.073	.3
Domestic Shipping Efficiency Index	1.000	1.000	1.000	1.000	1.000	1.000	.0
Energy Use By Mode (quadrillion Btu)							
Light Duty Vehicles	11.66	11.54	11.20	11.51	11.87	12.03	.1
Freight Trucks	4.97	4.92	5.11	5.52	5.99	6.36	1.2
Air	3.15	3.18	3.30	3.76	4.14	4.45	1.7
Rail	.48	.47	.48	.51	.54	.56	.8
Marine	1.13	1.10	1.06	1.18	1.29	1.39	1.0
Pipeline Fuel	.65	.63	.68	.72	.75	.74	.6
Other	.16	.17	.17	.19	.20	.21	1.2
Total	22.19	21.99	21.98	23.36	24.75	25.70	.7

[1] Unadjusted Corporate Average Fuel Economy estimates.
[2] Average *on-the-road* efficiency estimate including cars and light trucks.
[3] Based on estimates of passenger seat miles per gallon (1989=1.0).
[4] Based on Btu per vehicle miles traveled (1989=1.0).
[5] Based on Btu per ton-miles traveled (1989=1.0).

Note: Totals may not equal sum of components due to independent rounding.

Sources: 1989 and 1990 estimates: Energy Information Administration (EIA), *State Energy Data Report*, DOE/EIA-0214(88) (Washington, DC, May 1990) and *Monthly Energy Review*, DOE/EIA-0035(90/08) (Washington, DC, November 1990). Energy use by mode based on model estimates. Projections: EIA, AEO 1991 Forecasting System Run IGHICA.D0116912.

Appendix E

Summary of *AEO91* Scenario Assumptions

Appendix E

Summary of *AEO91* Scenario Assumptions

The four scenarios presented in *AEO91* were generated using the Annual Energy Outlook 1991 Forecasting System under varying assumptions. The following matrix summarizes some of the more important assumptions made in order to generate the *AEO91* Reference Case, and it shows what changes, if any, were made in various areas in order to generate the three alternative scenarios: Low Oil Price, High Economic Growth, and High Oil Price. An important feature of the *AEO91* is the incorporation of defined aspects of the Clean Air Act Amendments of 1990, passed in November 1990. Shaded boxes in the matrix indicate that assumptions are unchanged from those in the Reference Case.

Table E1. Summary of *AEO91* Assumptions

Assumptions	Reference Case	Differences from Reference Case		
		Low Oil Price Case	High Economic Growth Case	High Oil Price Case
World Oil Price (1990 dollars per barrel)	Mid-price path, reaching $34.20 in 2010	Low-price path, reaching $23.40 in 2010	Low-price path, reaching $23.40 in 2010	High-price path, reaching $45.40 in 2010
Growth in Real GNP, 1989-2010	2.1 percent	2.2 percent	2.8 percent	2.1 percent
Clean Air Act Amendments of 1990 (CAA)				
Industrial	Macro/IO model reflects estimates of costs for significantly affected industries			
Transportation	Incorporates mid-level estimate of sales of alternatively fueled vehicles as required under Title II of the CAA	Reduced sales of alternatively fueled vehicles	Reduced sales of alternatively fueled vehicles	Higher sales of alternatively fueled vehicles
Oil and Gas	Incorporates production of "clean" gasoline (Title II of the CAA) and limited additions to refining capacity (Titles I and III of the CAA)	Higher refining and distribution costs	Higher refining and distribution costs	
Conservation				
Buildings	Current efficiency trends in shells and appliances	Slower penetration of shell/appliance technologies because of lower energy prices	Slower penetration of shell/appliance technologies because of lower energy prices	Accelerated penetration of shell/appliance technologies
Industrial	Econometric estimate of efficiency improvements based on changes in industrial energy prices and industrial output			
Transportation	Technology-based estimate of efficiency improvements	Less improvement in fuel efficiency of light-duty vehicles, based on lower gasoline prices	Less improvement in fuel efficiency of light-duty vehicles, based on lower gasoline prices	Greater improvement assumed in light-duty vehicle fuel efficiency, based on higher gasoline prices
Oil and Gas				
Natural Gas Imports	Exogenous mid-level estimate		Higher natural gas imports	Lower natural gas imports

Table E1. Summary of *AEO91* Assumptions (Continued)

Assumptions	Reference Case	Differences from Reference Case		
		Low Oil Price Case	High Economic Growth Case	High Oil Price Case
Nuclear				
Life Extensions	None	70 percent life extension	70 percent life extension	50 percent life extension
New Orders	None	New orders included	New orders included	
Coal Exports	Exogenous mid-level estimate		Higher coal exports	Lower coal exports

Appendix F

AEO91 Forecasting System

Appendix F

AEO91 Forecasting System

A modeling system, referred to as IFFS/GAMS/DEMS, was used to produce *AEO91* projections. The system is a collection of models that are used to forecast U.S. energy production, supply, distribution, and consumption. The system uses a combination of models residing on a mainframe computer and on a personal computer (PC), which are linked via a network. The system requires an assumption of the world crude oil price and a baseline macroeconomic forecast. Projections are generated through the year 2010.

The Intermediate Future Forecasting System (IFFS) is the core of the system. It calls supply modules for oil markets, coal, and electricity and links to the Gas Analysis Modeling System (GAMS), a natural gas supply model, and the Demand Evaluation Modeling System (DEMS), a set of energy demand models. The supply models in IFFS/GAMS determine supply and price for each fuel, conditional upon consumption levels, while the demand models in DEMS determine consumption conditional upon end-use price. IFFS solves for the market equilibrium for each fuel by balancing supply and demand to produce an energy balance in each forecast year.

IFFS accounts for the many interactions of the different segments of the energy industries and provides an internally consistent forecast of prices and quantities for which supply equals demand. This equilibrium solution accounts for the main economic factors affecting supply and demand, allows price competition of fuels, and accounts for policies and regulations that cause departures from purely economic behavior.

The Oil Market Module (OMM) represents the domestic refining and pricing of petroleum products. Econometric equations determine refinery gate prices, and end-use prices are computed by adding markups based on historical data. The Coal Supply Transportation Model (CSTM) provides distribution patterns of coal supply and the minemouth and delivered price of coal. The Electricity Market Module (EMM) of IFFS gives a detailed representation of utility and non-utility capacity planning and electricity generation which determines the requirements for oil, coal, natural gas, hydropower and other renewable, and nuclear for electricity generation, as well as determining the prices of electricity.

IFFS is linked to the Gas Analysis Modeling System/ Production of Onshore Lower 48 Oil and Gas Model (GAMS/PROLOG), which represents the domestic supply of crude oil and natural gas and the wellhead and delivered price of natural gas. GAMS/PROLOG includes the domestic production of oil and natural gas, imports of gas, and transmission and distribution of natural gas.

The final major linkage in the system is with the Demand Evaluation Modeling System (DEMS), which provides macroeconomic and energy demand forecasts. DEMS receives energy prices from IFFS and passes them via a network to a macroeconomic model and four end-use demand models that are PC-based. The macroeconomic model provides revised economic forecasts based upon the forecast energy prices. Models for residential, commercial, industrial and transportation demand calculate the demands for each fuel in these sectors as a function of the end-use prices received from IFFS. The resulting macroeconomic values and energy demands are then passed back to IFFS.

The models for the residential and commercial sectors provide explicit representation of different technologies used to provide the various end-use services that consume energy in buildings, such as space heating and cooling, water heating, and lighting. The transportation sector model consists of four distinct segments: personal highway travel, freight travel, aviation travel, and other transportation. Fuel efficiencies, vehicle-miles traveled, and other variables associated with energy consumption for each transportation mode are incorporated in the model. The buildings and transportation models allow evaluation of changes in capital equipment that are designed to conserve energy use. Most of the equations in the industrial model are econometrically based and are organized in sectors consisting of the manufacturing heat and power,

nonmanufacturing heat and power, feedstocks (raw materials), and "other" fuels. In the manufacturing sector, the major energy-consuming industries are explicitly represented.

All models in the IFFS/GAMS/DEMS are calibrated to the most recently available data from EIA's supply and consumption surveys. The EIA report, *Assumptions for the Annual Energy Outlook 1991*, provides more detailed information on the assumptions that underlie the *AEO91* forecasts, the models used to produce the forecasts, and changes made to these models specifically for *AEO91*. This volume also provides references to the model documentation reports, which are available from the National Energy Information Center.

Information on individual models and subject areas can be obtained from the following contact persons:

IFFS	Susan Shaw	586-4838
Oil Markets (OMM)	Bruce Bawks	586-6579
Coal (CSTM)	Scott Sitzer	254-5300
Electricity Markets (EMM)	Jeff Jones	254-5348
GAMS	Barbara Mariner-Volpe	586-5878
PROLOG	Joe Benneche/Ted McCallister	586-4680
DEMS	Michael Lehr	586-1470
Macroeconomic	Ronald Earley/Kay Smith	586-1398
Residential	John Cymbalsky/Henry Clarius	586-5359
Commercial	Eugene Reiser	586-5840
Industry	John Holte/Gerald Peabody	586-1458
Transportation	Barry Cohen	586-5359
Forecast Comparisons	Evelyn Amerchih	586-8760

Appendix G

Conversion Factors

Appendix G. Conversion Factors

Fuel	Units	Approximate Heat Content
Coal		
Production	million Btu/short ton	21.776
Consumption	million Btu/short ton	21.266
Coke Plants	million Btu/short ton	26.800
Industrial	million Btu/short ton	22.411
Residential and Commercial	million Btu/short ton	23.527
Electric Utilities	million Btu/short ton	20.838
Imports	million Btu/short ton	25.000
Exports	million Btu/short ton	26.312
Coal Coke	million Btu/short ton	24.800
Crude Oil		
Production	million Btu/barrel	5.800
Imports	million Btu/barrel	5.903
Petroleum Products		
Consumption	million Btu/barrel	5.406
Motor Gasoline	million Btu/barrel	5.253
Jet Fuel	million Btu/barrel	5.670
Distillate Fuel Oil	million Btu/barrel	5.825
Residual Fuel Oil	million Btu/barrel	6.287
Liquefied Petroleum Gas	million Btu/barrel	3.836
Unfinished Oils	million Btu/barrel	5.825
Imports	million Btu/barrel	5.642
Exports	million Btu/barrel	5.870
Natural Gas Plant Liquids		
Production	million Btu/barrel	3.826
Natural Gas		
Production, Dry	Btu/cubic foot	1,031
Consumption	Btu/cubic foot	1,031
Non-electric Utilities	Btu/cubic foot	1,031
Electric Utilities	Btu/cubic foot	1,032
Imports	Btu/cubic foot	1,031
Exports	Btu/cubic foot	1,031
Electricity Consumption	Btu/kWh	3,412

Type of Generation	Heat Rate (Btu per kilowatthour)
Plant Generation Efficiency	
Fossil Fuel Steam	10,235
Nuclear Energy	10,743
Geothermal	21,096

Sources: Energy Information Administration, *Annual Energy Review 1989*, DOE/EIA-0384(89) (Washington, DC, May 1990). Natural gas conversion factors are those used in model.

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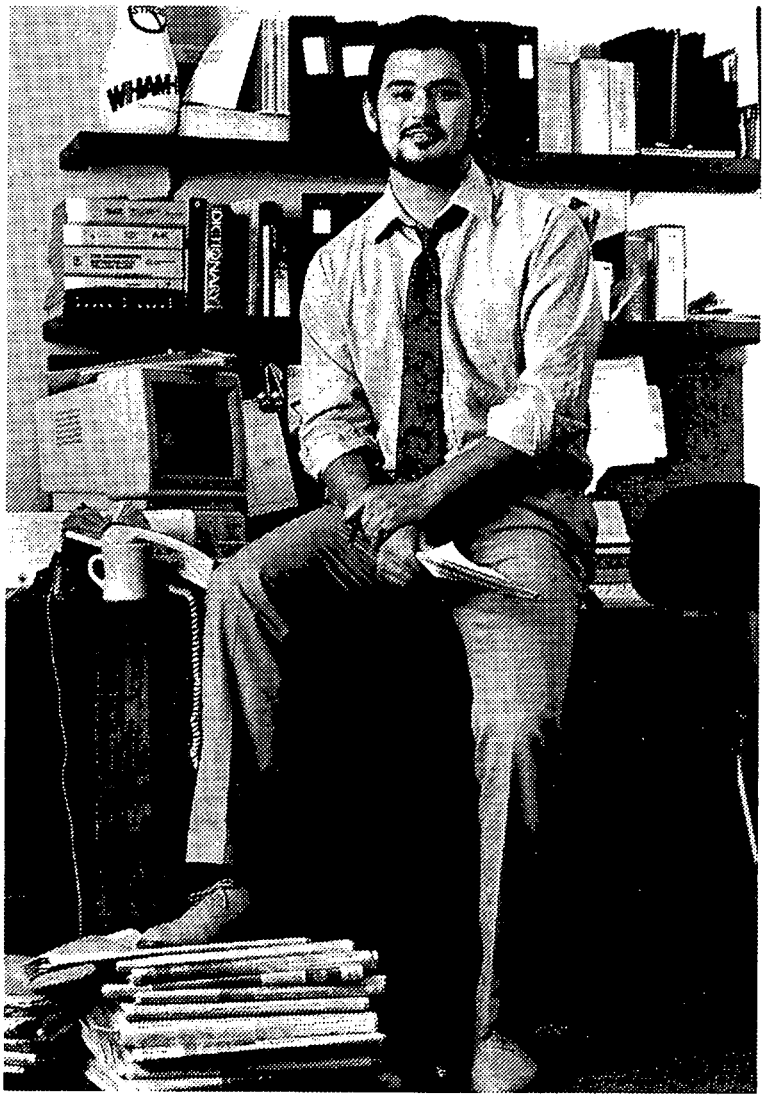

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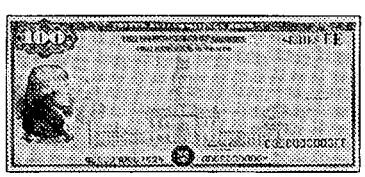

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