

CRS Report for Congress

Energy: Selected Facts and Numbers

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Carol Glover
Information Resources Specialist
Knowledge Services Group

Carl E. Behrens
Specialist in Energy Policy
Resources, Science, and Industry Division



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Committees of Congress

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Summary

Energy supplies and prices are major economic factors in the United States, and energy markets are volatile and unpredictable. Thus, energy policy has been a recurring issue for Congress since the first major crisis in the 1970s. As an aid in policy making, this report presents a current and historical view of the supply and consumption of various forms of energy.

The historical trends show petroleum as the major source of energy, rising from about 38% in 1950 to 45% in 1975, then declining to about 40% in response to the energy crisis of the 1970s. Significantly, the transportation sector has been and continues to be almost completely dependent on petroleum, mostly gasoline.

Natural gas followed a similar pattern at a lower level, increasing its share of total energy from about 17% in 1950 to more than 30% in 1970, then declining to about 20%. Consumption of coal in 1950 was 35% of the total, almost equal to oil, but it declined to about 20% a decade later and has remained at about that proportion since then. Coal currently is used almost exclusively for electric power generation.

Nuclear power started coming online in significant amounts in the late 1960s, and by 1975, in the midst of the oil crisis, was supplying 9% of total electricity generation. However, increases in capital costs, construction delays, and public opposition to nuclear power following the Three Mile Island accident in 1979 curtailed expansion of the technology, and many construction projects were cancelled. Continuation of some construction increased the nuclear share of generation to 20% in 1990, where it remains currently. Plans recently have been announced for the first reactor license applications in nearly 30 years, but no new plants are currently under construction or on order.

Construction of major hydroelectric projects has also essentially ceased, and hydropower's share of electricity generation has gradually declined, from 30% in 1950 to 15% in 1975 and less than 10% in 2000. However, hydropower remains highly important on a regional basis.

Renewable energy sources (except hydropower) continue to offer more potential than actual energy production, although fuel ethanol has become a significant factor in transportation fuel, and wind power has recently grown rapidly. Conservation and energy efficiency have shown significant gains over the past three decades and offer encouraging potential to relieve some of the dependence on imports that has caused economic difficulties in the past, as well as the present.

After an introductory overview of aggregate energy consumption, this report presents detailed analysis of trends and statistics regarding specific energy sources: oil, electricity, natural gas, coal and renewable energy. A section on trends in energy efficiency is also presented.

Contacts

| Area of Expertise | Name | Telephone |
|---------------------------------------|-------------------|------------------|
| Introduction and General | Carl Behrens | 7-8303 |
| Oil | Robert Pirog | 7-6847 |
| Energy Taxes | Salvatore Lazzari | 7-7825 |
| Electricity | Amy Abel | 7-7239 |
| Other Conventional Energy Sources | | |
| Natural Gas | Robert Pirog | 7-6847 |
| Coal | Stan Kaplan | 7-9529 |
| Nuclear Energy | Mark Holt | 7-1704 |
| Conservation and Energy Efficiency | | |
| Renewable Energy | Fred Sissine | 7-7039 |
| | Larry Parker | 7-7238 |
| | Brent Yacobucci | 7-9662 |
| CAFE Standards (vehicle fuel economy) | Brent Yacobucci | 7-9662 |
| Statistics, Tables, and Figures | Carol Glover | 7-7353 |

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Energy: Selected Facts and Numbers

Introduction

Tracking changes in energy activity is complicated by variations in different energy markets. These markets, for the most part, operate independently, although events in one may influence trends in another. For instance, oil price movement can affect the price of natural gas, which then plays a significant role in the price of electricity. Since aggregate indicators of total energy production and consumption do not adequately reflect these complexities, this compendium focuses on the details of individual energy sectors. Primary among these are oil, particularly gasoline for transportation, and electricity generation and consumption. Natural gas is also an important energy source, for home heating as well as in industry and electricity generation. Coal is used almost entirely for electricity generation, nuclear and hydropower completely so.

Renewable sources (except hydropower) continue to offer more potential than actual energy production, although fuel ethanol has become a significant factor in transportation fuel, and wind power has recently grown rapidly. Conservation and energy efficiency have shown significant gains over the past three decades, and offer encouraging potential to relieve some of the dependence on imports that has caused economic difficulties in the past as well as the present.

To give a general view of energy consumption trends, **Table 1** shows consumption by economic sector — residential, commercial, transportation, and industry — from 1950 to the present. To supplement this overview, some of the trends are highlighted by graphs in **Figures 1 and 2**.

In viewing these figures, a note on units of energy may be helpful. Each source has its own unit of energy. Oil consumption, for instance, is measured in million barrels per day (mbd)¹, coal in million tons per year, natural gas in trillion cubic feet (tcf) per year. To aggregate various types of energy in a single table, a common measure, British Thermal Unit (Btu), is often used. In **Table 1**, energy consumption by sector is given in units of quadrillion Btus per year, or “quads,” while per capita consumption is given in million Btus (MMBtu) per year. One quad corresponds to one tcf of natural gas, or approximately 50 million tons of coal. One million barrels per day of oil is approximately 2 quads per year. One million Btus is equivalent to approximately 293 kilowatt-hours (kwh) of electricity.

¹ Further complications can result from the fact that not all sources use the same abbreviations for the various units. The Energy Information Administration (EIA), for example, abbreviates “million barrels per day” as “MMbbl/d” rather than “mbd.” For a list of EIA’s abbreviation forms for energy terms, see [http://www.eia.doe.gov/neic/a-z/a-z_abbrev/a-z_abbrev.html].

Table 1 shows that total U.S. energy consumption almost tripled since 1950, with the industrial sector, the heaviest energy user, growing at the slowest rate. The growth in energy consumption per capita (i.e., per person) over the same period was about 50%. As **Figure 1** illustrates, much of the growth in per capita energy consumption took place before 1970.

Table 1 does not list the consumption of energy by the electricity sector separately because it is both a producer and a consumer of energy. For the residential, commercial, industrial, and transportation sectors, the consumption figures given are the sum of the resources (such as oil and gas) that are directly consumed plus the total energy used to produce the electricity each sector consumed — that is, both the energy value of the kilowatt-hours consumed and the energy lost in generating that electricity. As **Figure 2** demonstrates, a major trend during the period was the electrification of the residential and commercial sectors and, to a lesser extent, industry. By 2005, electricity (including the energy lost in generating it) represented 65% of residential energy consumption, 75% of commercial energy consumption, and about a third of industrial energy consumption.²

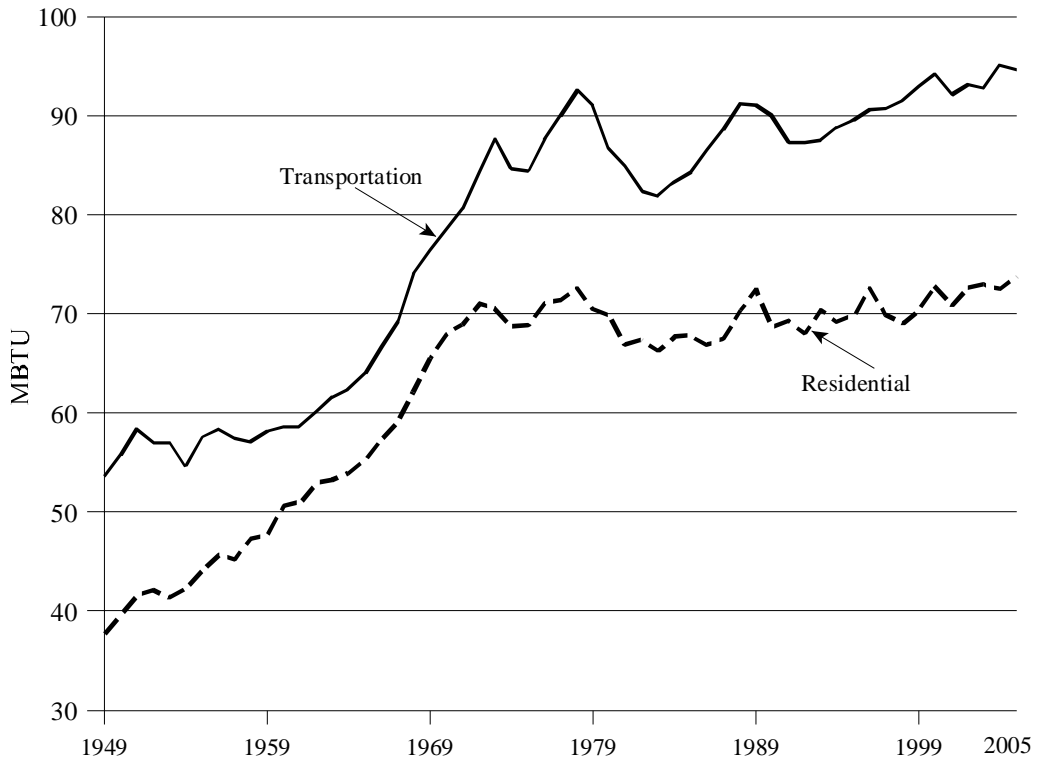
Table 1. U.S. Energy Consumption, 1950-2005

| | Energy Consumption by Sector (Quads) | | | | | Population (million) | Consumption Per Capita (MMBtu) | | |
|------|---|-------|--------|--------|-------|-------------------------|-----------------------------------|--------|-------|
| | Resid. | Comm. | Indus. | Trans. | Total | | Resid. | Trans. | Total |
| 1950 | 6.0 | 3.9 | 16.2 | 8.5 | 34.6 | 151.3 | 39.4 | 55.8 | 227.3 |
| 1955 | 7.3 | 3.9 | 19.5 | 9.6 | 40.2 | 165.1 | 44.0 | 57.6 | 242.3 |
| 1960 | 9.1 | 4.6 | 20.8 | 10.6 | 45.1 | 179.3 | 50.2 | 58.7 | 249.6 |
| 1965 | 10.7 | 5.8 | 25.1 | 12.4 | 54.0 | 193.5 | 55.0 | 64.0 | 278.0 |
| 1970 | 13.8 | 8.3 | 29.6 | 16.1 | 67.8 | 203.3 | 67.3 | 78.5 | 330.9 |
| 1975 | 14.8 | 9.5 | 29.4 | 18.2 | 72.0 | 215.5 | 68.7 | 84.5 | 333.4 |
| 1980 | 15.8 | 10.6 | 32.2 | 19.7 | 78.3 | 226.5 | 69.7 | 86.7 | 344.5 |
| 1985 | 16.1 | 11.5 | 28.9 | 20.1 | 76.6 | 237.9 | 67.3 | 84.4 | 321.4 |
| 1990 | 17.1 | 13.4 | 31.9 | 22.4 | 84.7 | 248.8 | 68.6 | 90.1 | 340.6 |
| 1995 | 18.6 | 14.7 | 34.0 | 23.8 | 91.2 | 266.3 | 69.9 | 89.6 | 342.5 |
| 2000 | 20.5 | 17.2 | 34.7 | 26.6 | 99.0 | 281.4 | 72.9 | 94.3 | 351.7 |
| 2001 | 20.2 | 17.3 | 32.7 | 26.3 | 96.5 | 285.1 | 70.9 | 92.2 | 338.5 |
| 2002 | 20.9 | 17.5 | 32.7 | 26.8 | 98.0 | 288.0 | 72.7 | 93.2 | 340.2 |
| 2003 | 21.2 | 17.4 | 32.6 | 27.0 | 98.3 | 290.9 | 73.0 | 92.9 | 337.9 |
| 2004 | 21.3 | 17.7 | 33.4 | 28.0 | 100.4 | 293.7 | 72.5 | 95.2 | 341.9 |
| 2005 | 21.9 | 18.0 | 32.0 | 28.1 | 99.9 | 296.4 | 73.8 | 94.7 | 337.0 |

Source: Energy Information Administration (EIA), *Annual Energy Review 2005*, Tables 2.1a and D1. Per capita data calculated by CRS.

² In calculating these percentages, “electric energy consumption” includes both the energy value of the kilowatt-hours consumed and the energy lost in generating that electricity.

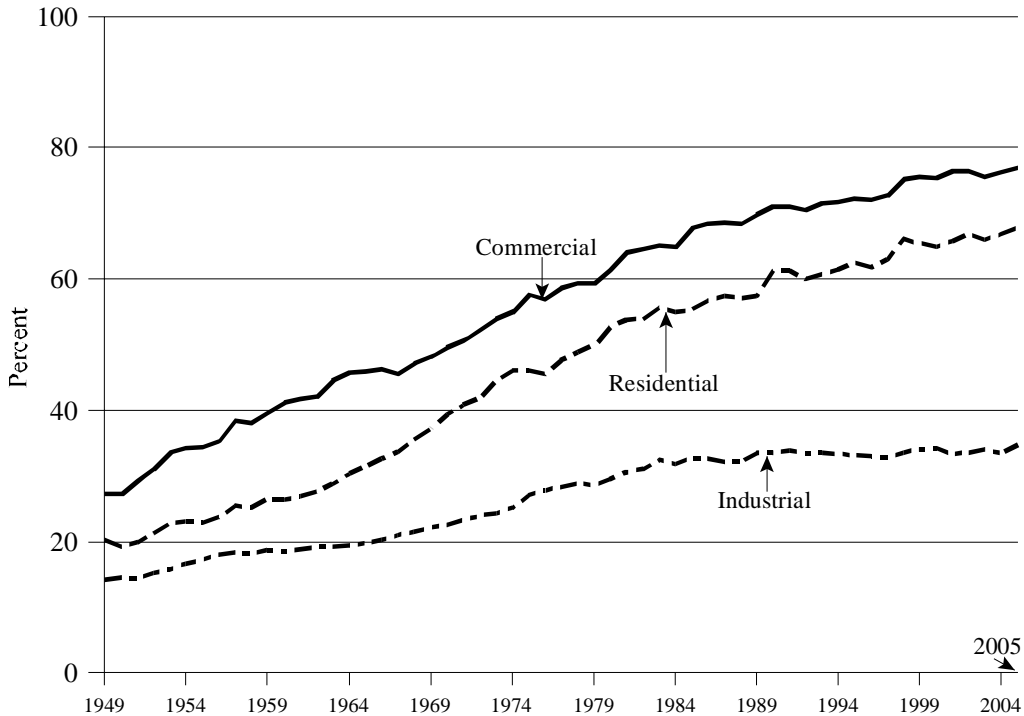
Figure 1. Per Capita Energy Consumption in Transportation and Residential Sectors, 1949-2005



Source: EIA, *Annual Energy Review 2005*, Tables 2.1a and D1. Per capita data calculated by CRS.

Figure 2. Electricity Use: Commercial, Residential, and Industrial Sectors, 1949-2005

(As Percent of Total Sector Energy Use)



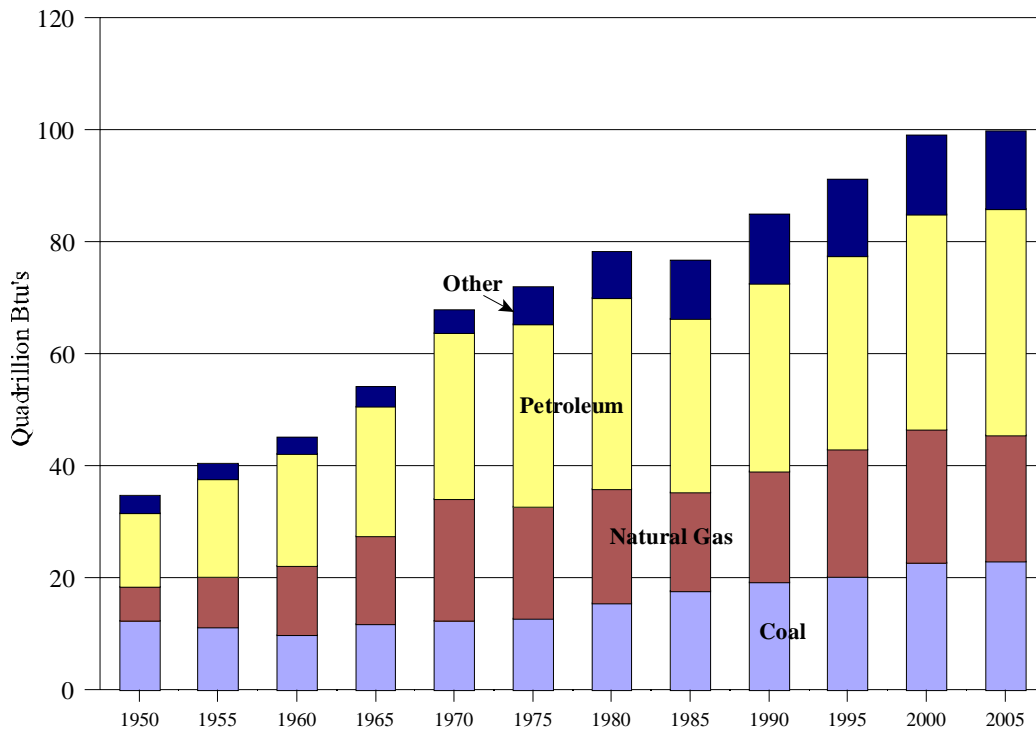
Source: EIA, *Annual Energy Review 2005*, Table 2.1a. Percentages calculated by CRS.

Consumption of major energy resources — petroleum, natural gas, and coal — is presented in **Table 2** and **Figure 3**. The historical trends show that petroleum has been and continues to be the major source of energy, rising from about 38% in 1950 to 45% in 1975, then declining to about 40% in response to the energy crisis of the 1970s. Natural gas followed a similar pattern at a lower level, increasing its share of total energy from about 17% in 1950 to over 30% in 1970, then declining to about 20%. Consumption of coal in 1950 was 35% of the total, almost equal to oil, but it declined to about 20% a decade later and has remained at about that proportion since then.

Table 2. Energy Consumption in Quads and Percentage of Total, 1950-2005

| | Petroleum | | Natural Gas | | Coal | | Other | | Total |
|------|-----------|------|-------------|------|-------|------|-------|------|-------|
| | Quads | % | Quads | % | Quads | % | Quads | % | |
| 1950 | 13.3 | 38.4 | 6.0 | 17.2 | 12.3 | 35.7 | 3.0 | 8.6 | 34.6 |
| 1955 | 17.3 | 43.0 | 9.0 | 22.4 | 11.2 | 27.8 | 2.8 | 7.0 | 40.2 |
| 1960 | 19.9 | 44.1 | 12.4 | 27.5 | 9.8 | 21.8 | 3.0 | 6.5 | 45.1 |
| 1965 | 23.2 | 43.0 | 15.8 | 29.2 | 11.6 | 21.4 | 3.4 | 6.4 | 54.0 |
| 1970 | 29.5 | 43.4 | 21.8 | 32.1 | 12.3 | 18.1 | 4.3 | 6.4 | 67.8 |
| 1975 | 32.7 | 45.4 | 19.9 | 27.7 | 12.7 | 17.6 | 6.6 | 9.2 | 72.0 |
| 1980 | 34.2 | 43.7 | 20.4 | 26.1 | 15.4 | 19.7 | 8.3 | 10.6 | 78.3 |
| 1985 | 30.9 | 40.4 | 17.8 | 23.3 | 17.5 | 22.8 | 10.4 | 13.5 | 76.6 |
| 1990 | 33.6 | 39.7 | 19.7 | 23.3 | 19.2 | 22.6 | 12.3 | 14.5 | 84.7 |
| 1995 | 34.6 | 37.9 | 22.8 | 25.0 | 20.1 | 22.0 | 13.7 | 15.0 | 91.2 |
| 2000 | 38.4 | 38.8 | 23.9 | 24.2 | 22.6 | 22.8 | 14.0 | 14.2 | 99.0 |
| 2005 | 40.4 | 40.5 | 22.6 | 22.7 | 22.8 | 22.9 | 13.9 | 14.0 | 99.9 |

Source: EIA, *Annual Energy Review 2005*, Table 1.3. Percentages calculated by CRS.

Figure 3. U.S. Energy Consumption, 1950-2005

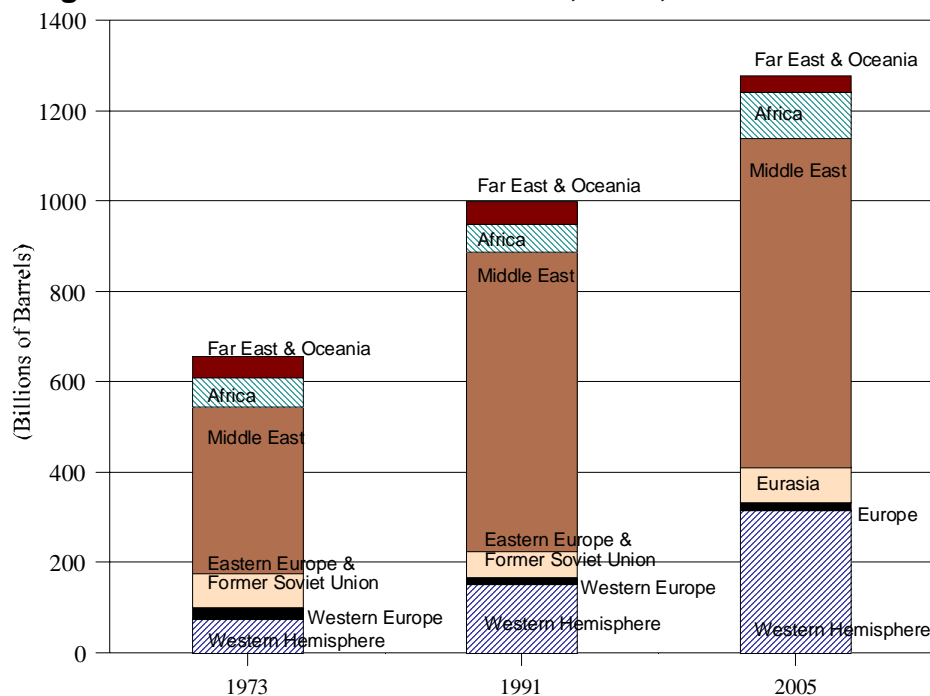
Source: EIA, *Annual Energy Review 2005*, Table 1.3.

Oil

Almost 40% of the energy consumed in the United States is supplied by petroleum, and that proportion has remained approximately the same since 1950, as the data in the previous section show. Also unchanged is the almost total dependence of the transportation sector on petroleum, mostly gasoline.

The perception that the world is on the verge of running out of oil, widespread during the 1970s, has changed, however. The rapid price increases at that time, aided by improved exploration and production technology, stimulated a global search for oil and resulted in the discovery of large amounts of new reserves. Indeed, as concerns about tightening supply and continually increasing prices were at a peak, proven reserves actually increased by about 50% between 1973 and 1990. Some of the increase was in the Western Hemisphere, mostly in Mexico, but most was located in the region that already dominated the world oil market, the Middle East. With prices essentially steady during the 1990s, the search for oil slowed, but additions to reserves during the decade exceeded the amount of oil pumped out of the ground. By 2003, improved technology for retrieving petroleum from oil sands in Canada and, to a lesser extent, from heavy oil in Venezuela led to significant production from these resources, and by 2005, approximately 200 billion barrels of resources from oil sands and heavy oil were added to the total of proven world reserves, 20% of the total 1991 figure. These trends are illustrated in **Figure 4**.

Figure 4. World Crude Oil Reserves, 1973, 1991 and 2005



Source: EIA, *International Energy Annual*, 1990 & 2005, Table 8.1 (data is from *Oil and Gas Journal* and is not certified by EIA, except for the component of Western Hemisphere reserves comprising those of the United States).

Notes: The categories “Eastern Europe & Former Soviet Union” and “Western Europe,” in the data for 1973 and 1991, were changed to “Eurasia” and “Europe” respectively for 2005. Seven countries (Albania, Bulgaria, Czech Republic, Hungary, Poland, Romania, and Slovakia) were moved from the former to the latter.

Petroleum Consumption, Supply, and Imports

Consumption of petroleum by sector reflects a variety of trends (see **Table 3**). In the residential and commercial sectors, petroleum consumption grew steadily from 1950 to 1970, while accounting for about 15% of total petroleum consumption. After the price surge in the 1970s, consumption in those sectors declined, falling to less than 7% of total petroleum consumption. Usage in the electric power sector followed a similar but more abrupt pattern. Until 1970 only about 3% of petroleum went to power generation. In the late 1960s efforts to improve air quality by reducing emissions led utilities to convert a number of coal-fired powerplants to burn oil, and many new plants were designed to burn oil or natural gas. Utilities found themselves committed to increasing dependence on oil just at the time of shortages and high prices; in 1975 almost 9% of oil consumption went for power production. Consumption then fell sharply as alternate sources became available, declining to about 2%-3% of total consumption.

Table 3. Petroleum Consumption by Sector, 1950-2005
(million barrels per day and percentage of total)

| | Residential-Commercial | | Industrial | | Electric | | Trans. | | Total MBD |
|------|------------------------|------|------------|------|----------|-----|--------|------|-----------|
| | MBD | % | MBD | % | MBD | % | MBD | % | |
| 1950 | 1.1 | 16.5 | 1.8 | 28.0 | 0.2 | 3.2 | 3.4 | 51.6 | 6.5 |
| 1955 | 1.4 | 16.5 | 2.4 | 28.1 | 0.2 | 2.4 | 4.5 | 52.4 | 8.5 |
| 1960 | 1.7 | 17.5 | 2.7 | 27.6 | 0.2 | 2.5 | 5.1 | 52.4 | 9.8 |
| 1965 | 1.9 | 16.6 | 3.2 | 27.2 | 0.3 | 2.7 | 6.0 | 52.5 | 11.5 |
| 1970 | 2.2 | 14.9 | 3.8 | 25.9 | 0.9 | 6.3 | 7.8 | 52.9 | 14.7 |
| 1975 | 1.9 | 11.9 | 4.0 | 24.8 | 1.4 | 8.5 | 9.0 | 54.9 | 16.3 |
| 1980 | 1.5 | 8.9 | 4.8 | 28.3 | 1.2 | 6.7 | 9.5 | 55.8 | 17.1 |
| 1985 | 1.3 | 8.6 | 4.1 | 25.9 | 0.5 | 3.0 | 9.8 | 62.7 | 15.7 |
| 1990 | 1.2 | 7.2 | 4.3 | 25.3 | 0.6 | 3.3 | 10.9 | 64.0 | 17.0 |
| 1995 | 1.1 | 6.4 | 4.6 | 26.0 | 0.3 | 1.9 | 11.7 | 65.9 | 17.7 |
| 2000 | 1.3 | 6.5 | 4.9 | 24.9 | 0.5 | 2.6 | 13.0 | 66.1 | 19.7 |
| 2005 | 1.3 | 6.1 | 5.0 | 24.3 | 0.5 | 2.6 | 13.8 | 66.8 | 20.7 |

Source: EIA, *Annual Energy Review 2005*, Tables 5.13a-d.

Industrial consumption of petroleum, which includes such large consumers as refineries and petrochemical industries, has remained about 25% of total consumption throughout the last half-century. As other sectors' share fell, transportation, which was a little more than half of total consumption prior to 1975, climbed to almost two-thirds by 2000.

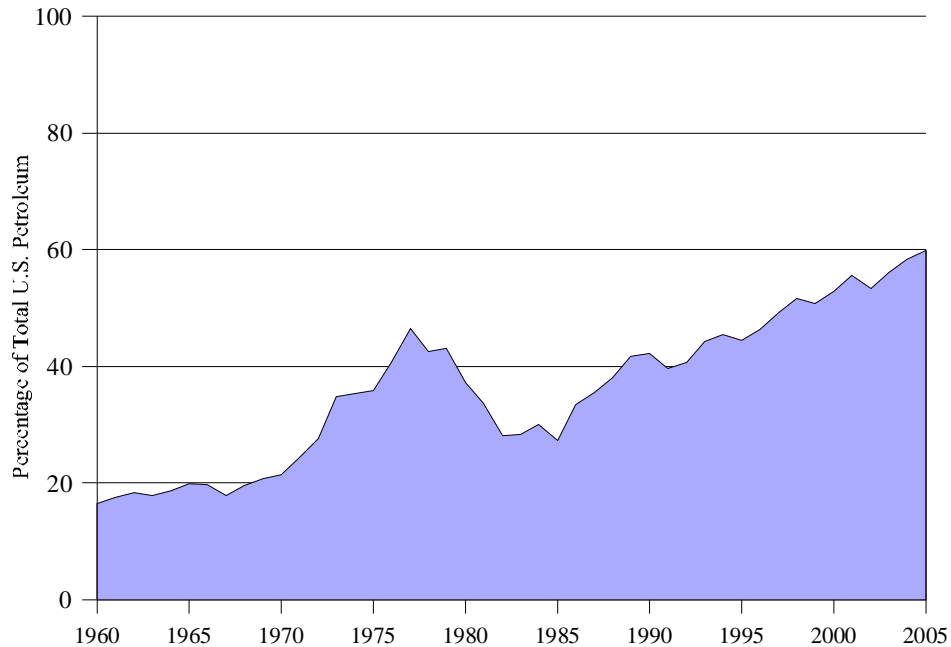
While petroleum consumption increased throughout the last half century (except for a temporary decline following the price surge of the 1970s), U.S. domestic production peaked in 1970 (see **Table 4**). The result, as shown in **Figure 5**, was greater dependence on imported petroleum, which rose from less than 20% in 1960 to about 60% in 2005.

Table 4. U.S. Petroleum Production, 1950-2005
(million barrels per day)

| | Crude Oil | | | Gas Liquids | Other | Total |
|------|-----------|--------|-------|-------------|-------|-------|
| | 48 States | Alaska | Total | | | |
| 1950 | 5.4 | — | 5.4 | 0.5 | — | 5.9 |
| 1955 | 6.8 | — | 6.8 | 0.8 | — | 7.6 |
| 1960 | 7.0 | — | 7.0 | 0.9 | 0.2 | 8.1 |
| 1965 | 7.8 | — | 7.8 | 1.2 | 0.2 | 9.2 |
| 1970 | 9.4 | 0.2 | 9.6 | 1.7 | 0.4 | 11.7 |
| 1975 | 8.2 | 0.2 | 8.4 | 1.6 | 0.5 | 10.5 |
| 1980 | 7.0 | 1.6 | 8.6 | 1.6 | 0.6 | 10.8 |
| 1985 | 7.2 | 1.8 | 9.0 | 1.6 | 0.6 | 11.1 |
| 1990 | 5.6 | 1.8 | 7.4 | 1.6 | 0.7 | 9.6 |
| 1995 | 5.1 | 1.5 | 6.6 | 1.8 | 0.8 | 9.1 |
| 2000 | 4.9 | 1.0 | 5.8 | 1.9 | 1.0 | 8.7 |
| 2005 | 4.3 | 0.9 | 5.1 | 1.7 | 1.0 | 7.8 |

Source: EIA, *Annual Energy Review 2005*, Table 5.1.

Note: “Other” includes processing gain.

Figure 5. U.S. Dependence on Imported Petroleum, 1960-2005

Source: EIA, *Monthly Energy Review*, September 2006, Table 1.7, and *Annual Energy Review 1986*, Table 51.

Petroleum and Transportation

Since the transportation sector is so heavily dependent on petroleum, and uses so much of it, **Table 5** and **Figure 6** present a more detailed breakdown of the various types of petroleum used.

Table 5. Transportation Use of Petroleum, 1950-2005
(million barrels per day)

| Year | Aviation | Diesel Fuel | Motor Gasoline | Other | Total |
|------|----------|-------------|----------------|-------|-------|
| 1950 | 0.1 | 0.2 | 2.4 | 0.6 | 3.4 |
| 1955 | 0.3 | 0.4 | 3.2 | 0.5 | 4.5 |
| 1960 | 0.5 | 0.4 | 3.7 | 0.4 | 5.1 |
| 1965 | 0.7 | 0.5 | 4.4 | 0.4 | 6.0 |
| 1970 | 1.0 | 0.7 | 5.6 | 0.4 | 7.8 |
| 1975 | 1.0 | 1.0 | 6.5 | 0.4 | 9.0 |
| 1980 | 1.1 | 1.3 | 6.4 | 0.7 | 9.5 |
| 1985 | 1.2 | 1.5 | 6.7 | 0.4 | 9.8 |
| 1990 | 1.5 | 1.7 | 7.1 | 0.5 | 10.9 |
| 1995 | 1.5 | 2.0 | 7.7 | 0.5 | 11.7 |
| 2000 | 1.7 | 2.4 | 8.4 | 0.5 | 13.0 |
| 2005 | 1.6 | 2.8 | 8.9 | 0.5 | 13.8 |

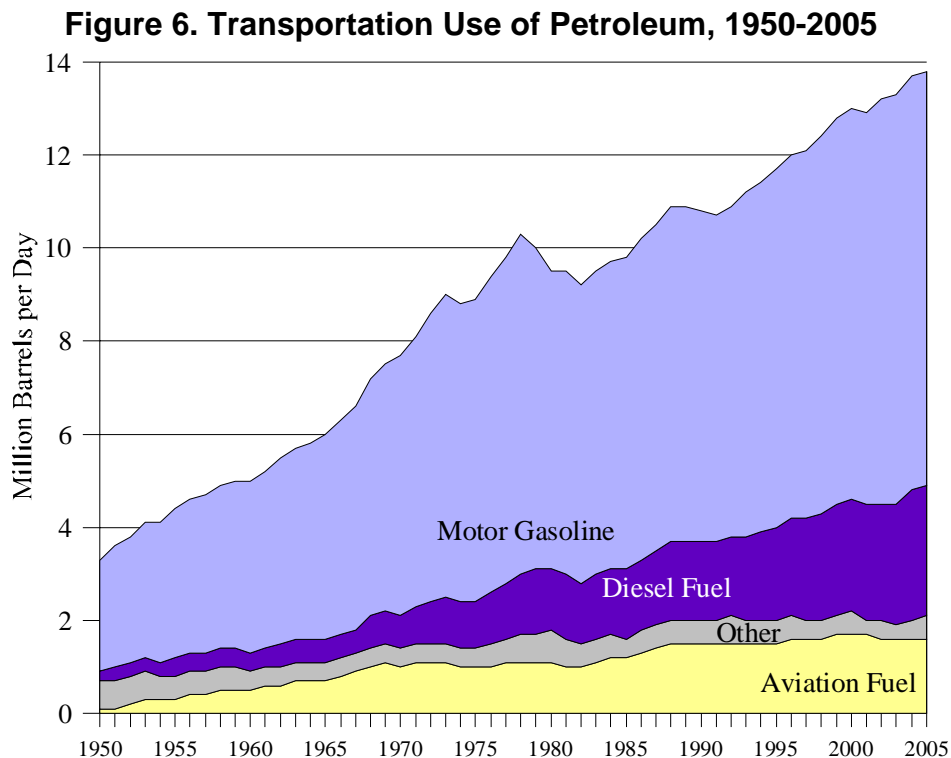
Source: EIA, *Annual Energy Review 2005*, Table 5.12c.

Aviation fuel includes both aviation gasoline and kerosene jet fuel. In 1950 aviation was almost entirely gasoline powered; by 2000 it was 99% jet fueled. The growth in flying is illustrated by the fact that aviation fuel was only 3% of petroleum consumption for transportation in 1950, but had grown to 12% in 1965 and has maintained that share since then.

Diesel fuel consumption showed a similar dramatic increase. About 6% of total petroleum consumption for transportation in 1950, it rose to 11% by 1975 and to 20% in 2005. Diesel fuel is used by a number of transportation sectors. Part of the increase involved the change of railroads from coal-fired steam to diesel and diesel-electric power. Diesel fuel is used also in the marine transportation sector, and some private automobiles are diesel-powered. The major part of diesel fuel consumption in transportation is by large commercial trucks. Total diesel fuel consumption increased from about 200,000 barrels per day in 1950 to 2.8 million barrels per day in 2005.

Most of the petroleum consumed in the transportation sector is motor gasoline. In 1950 it was 71% of total sector consumption, and by 2003, despite the increase in aviation fuel and diesel, it was 67%. In that half century, gasoline consumption increased by a factor of 3.5.

Of the other petroleum products consumed in the transportation sector, the largest is residual fuel oil, most of which is used in large marine transport. Consumption of residual fuel oil in the transportation sector was about 500,000 barrels in 1950, and declined gradually to about 400,000 in 2000.

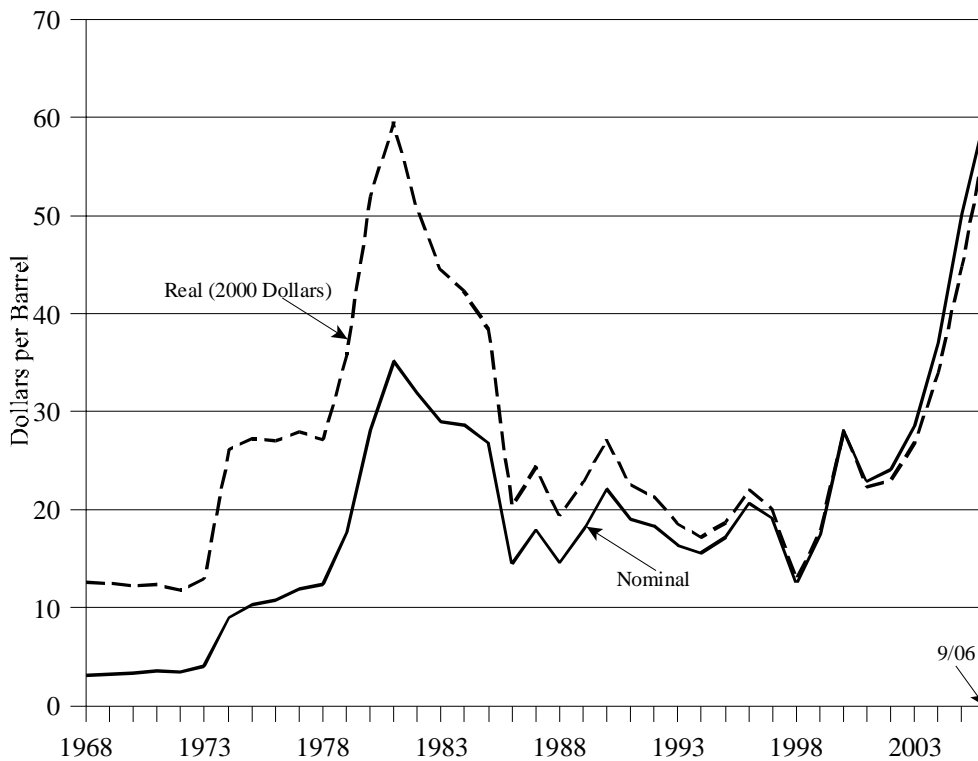


Source: EIA, *Annual Energy Review 2005*, Table 5.13c.

Petroleum Prices: Historical Trends

Most commodity prices are typically volatile. Because oil is widely consumed, and is so important at all levels of the economy, its price is closely watched and analyzed. Especially since the 1970s, when a generally stable market dominated by a few large oil companies was broken by the Organization of Petroleum Exporting Countries (OPEC) cartel and a relatively open world market came into being, the price of crude oil has been particularly volatile, as illustrated in **Figure 7**.

Figure 7. Nominal and Real Price of Crude Oil, 1968-2005 and September 2006

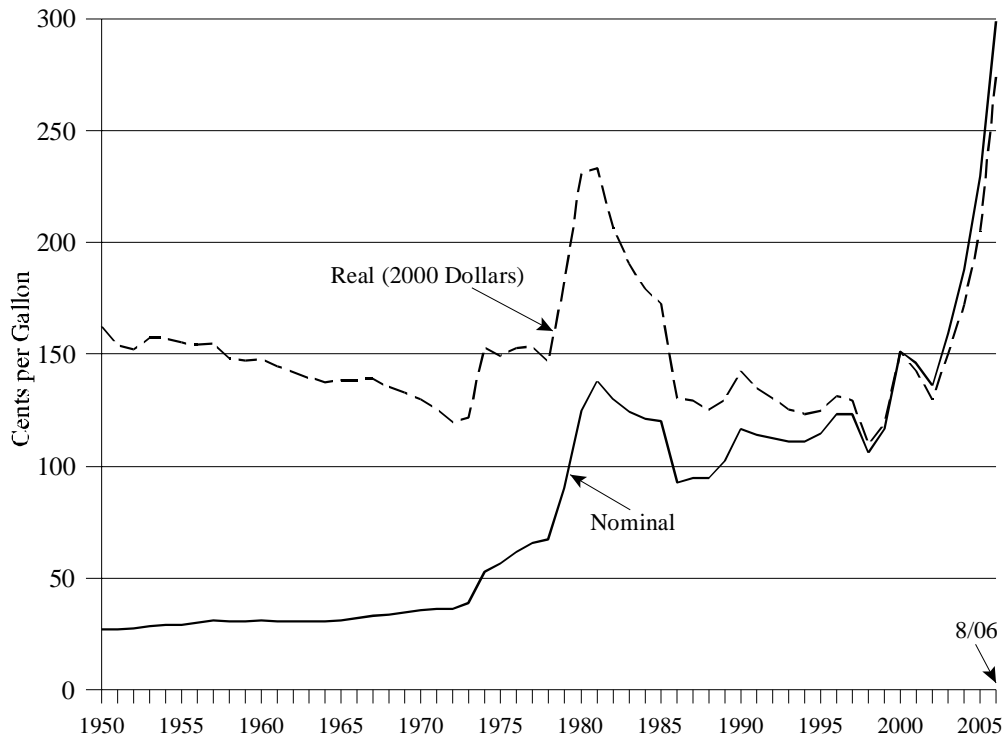


Source: EIA, *Annual Energy Review 2005*, Table 5.21 and *Monthly Energy Review*, November 2006, Table 9.1.

Note: Price is the Composite Crude Oil Refiner Acquisition Cost, as reported by EIA.

At the consumer level, prices of products such as motor gasoline and heating oil have reacted to price and supply disruptions in ways that have been modulated by various government and industry policies and international events. A significant and not often noted fact is that, like many commodities, the long-term trend in gasoline prices, adjusted for inflation and excluding temporary surges, has been down. As shown in **Figure 8**, the real price of gasoline peaked in 1980, then fell precipitously in the mid-1980s. The recent surge in prices brought the price above the peak of 1980 (in real dollars). (For more current data on gasoline price trends, see CRS Report RL33521, *Gasoline Prices: New Legislation and Proposals*, by Carl Behrens and Carol Glover.)

Figure 8. Nominal and Real Price of Gasoline, 1950-2005 and August 2006

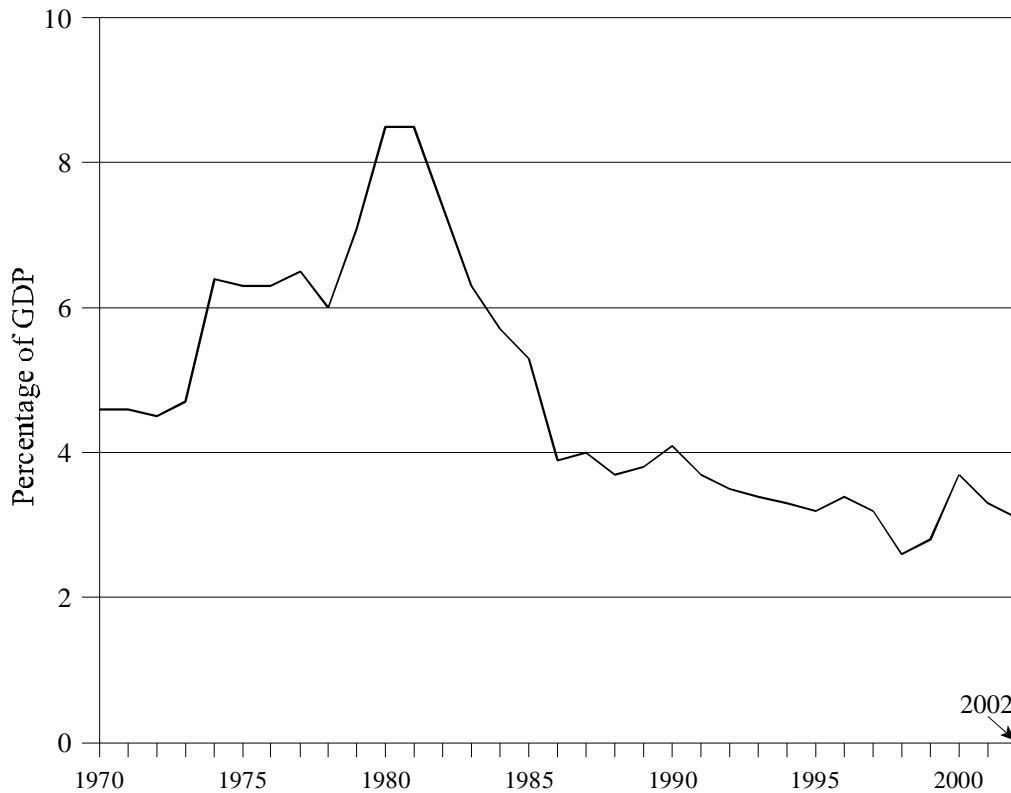


Source: EIA, *Annual Energy Review 2005*, Table 5.24 and *Monthly Energy Review*, November 2006, Table 9.4.

Note: Average national retail price per gallon of unleaded regular gasoline, including taxes.

Figure 9 illustrates the proportion of the gross domestic product (GDP) dedicated to consumer spending on oil. The price surges in the 1970s pushed this ratio from about 4.5% before the Arab oil embargo to about 8.5% following the crisis in Iran late in the decade. Following that, it declined to less than 4%, but figures for the period during the recent run-up of prices are not yet available.

Figure 9. Consumer Spending on Oil as a Percentage of GDP, 1970-2002



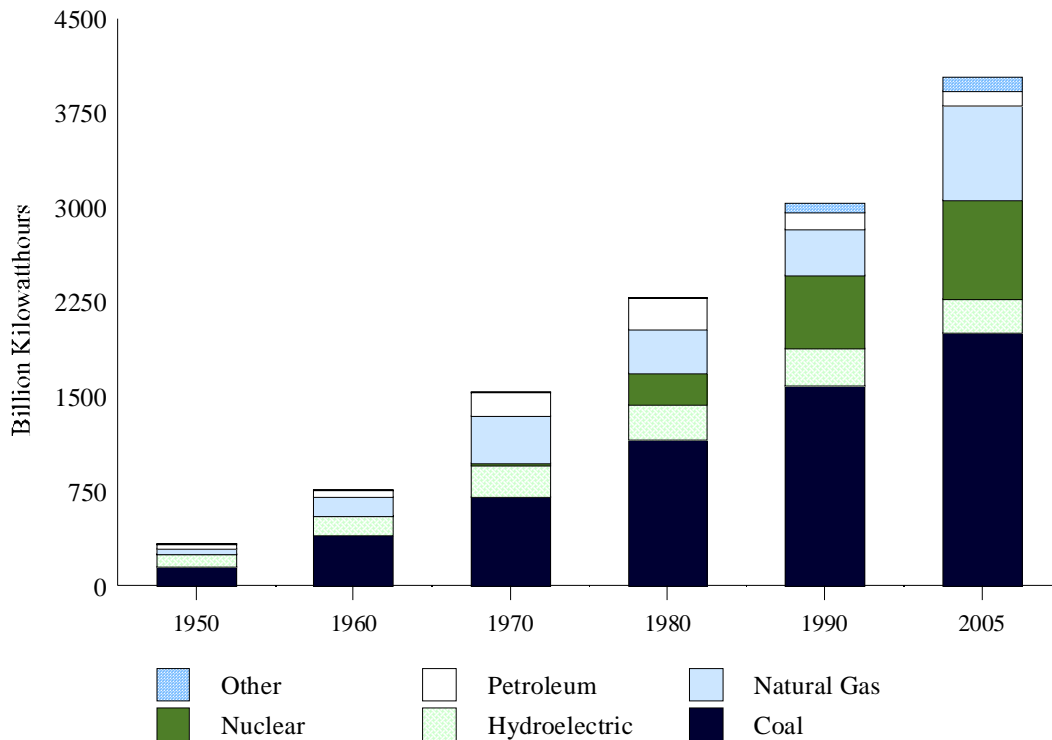
Source: EIA, *Annual Energy Review, 2005*, Tables 3.5 and D1.

Gasoline Taxes. The federal tax on gasoline is currently 18.4 cents per gallon. An extensive list of the gasoline and diesel fuel tax rates imposed by each state per gallon of motor fuel is maintained and updated by the American Petroleum Institute (API), “Notes to State Motor Fuel Excise and Other Tax Rates,” at [http://www.api.org/policy/tax/stateexcise/upload/NOTES_TO_STATE_MOTOR_FUEL_EXCISE_AND_OTHER_TAX_RATES.pdf].

Electricity

While overall energy consumption in the United States increased nearly three-fold since 1950, electricity consumption increased even more rapidly. Annual power generation is ten times what it was in 1950. **Figure 10** illustrates the trend.

Figure 10. Electricity Generation by Source, Selected Years, 1950-2005.



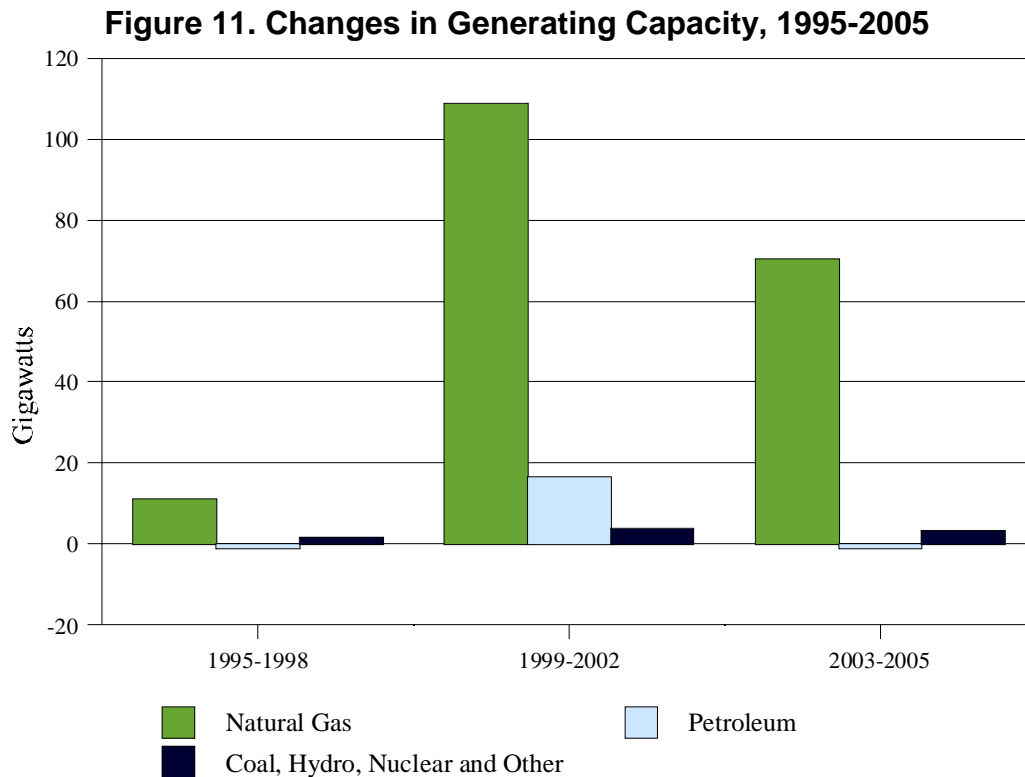
Source: EIA, *Annual Energy Review 2005*, Table 8.2a.

Throughout this period, coal was used to generate about half the rapidly increasing amount of electricity consumed. Petroleum became briefly important as a source of power generation in the late 1960s because it resulted in lower emissions of air pollutants, and consumption continued in the 1970s despite the price surge because natural gas was in short supply. By the 1980s, however, oil consumption by utilities dropped sharply, and in 2005, less than 3% of power generation was oil-fired.

Natural gas generation has a more complicated history. Consumption by the electric power industry increased gradually as access by pipeline became more widespread. With the price increase in oil in the 1970s, demand for gas also increased, but interstate prices were regulated, and gas availability declined. In addition, federal energy policy viewed generation of electricity by gas to be a wasteful use of a diminishing resource. The Fuel Use Act of 1978 prohibited new power generators from using gas and set a timetable for shutting down existing gas-fired plants. Gas prices were later deregulated, resulting in increased production, and the Fuel Use Act was repealed, but in the meantime generation of electricity from gas fell from 24% in 1970 to 12% in 1985. In the 1990s gas became more popular, and by 2000 was supplying 16% of total electric generation. Most capacity additions in the last decade have been gas-fired, as illustrated in **Figure 11**. The increased demand contributed to high prices in 2000 that were felt particularly in California.

Nuclear power started coming on line in significant amounts in the late 1960s, and by 1975, in the midst of the oil crisis, was supplying 9% of total generation. However, increases in capital costs, construction delays, and public opposition to nuclear power following the Three Mile Island accident in 1979 curtailed expansion of the technology, and many construction projects were cancelled. Continuation of some construction increased the nuclear share of generation to 20% in 1990, where it remains currently. Recently, plans have been announced for license applications for up to 30 new reactors, but no new plants are currently under construction or on order.

Construction of major hydroelectric projects has also essentially ceased, and hydropower's share of electricity generation has gradually declined from 30% in 1950 to 15% in 1975 and less than 10% in 2000. However, hydropower remains highly important on a regional basis.



Source: EIA, *Electric Power Annual 2005*, Table 2.1.

Sources of power generation vary greatly by region (see **Table 6**). Hydropower in the Pacific Coast states, for instance, supplies over 40% of total generation, and natural gas almost 35%. In 2000, the combination of a drought-caused shortage of hydropower, a tightening of gas supply, and California's new electric regulatory scheme and market manipulation caused very sharp increases in electricity prices in that region. Other regions are heavily dependent on coal generation: the north central and east south central states, as well as the mountain states, generate more than 60% of their electricity from coal, whereas other regions, such as New England and the

Pacific Coast, use relatively little coal. The west south central region generates 45% of its electricity from gas. New England in the 1970s and 1980s was heavily dependent on oil-generated power; in 2005, despite an increased use of natural gas, oil produced 10% of New England's power, compared with the national average of 2.5%.

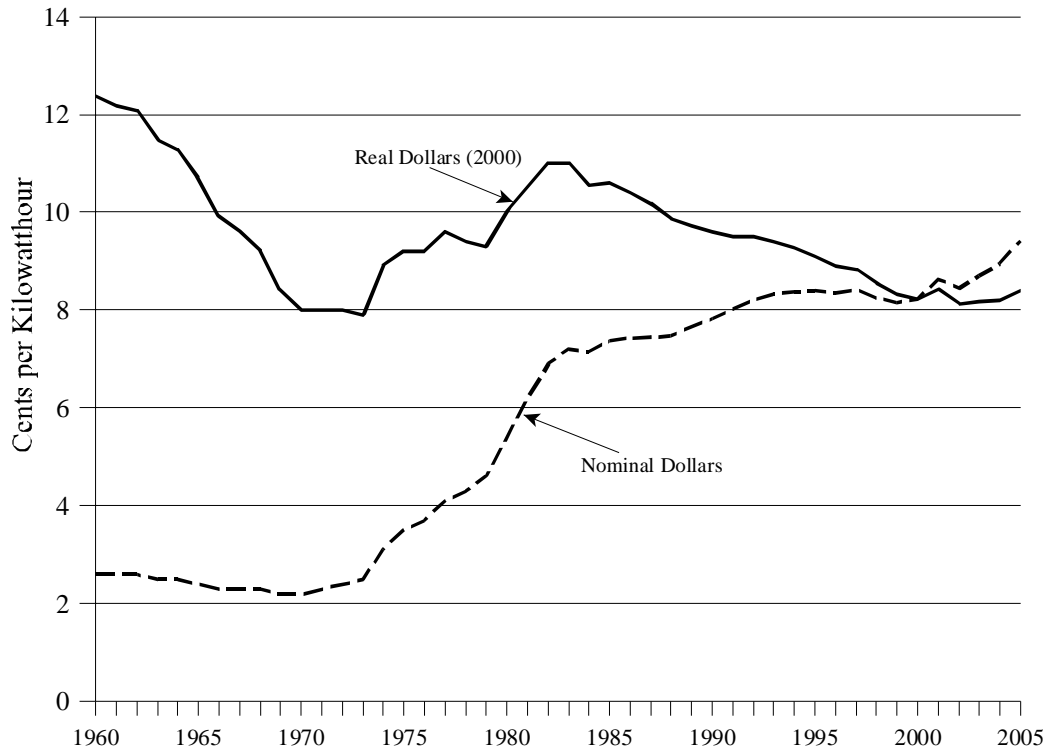
Table 6. Electricity Generation by Region and Fuel, 2005

| Region | Total Generation (billion kwh) | Percentage Generated by | | | | | |
|--------------------------|--------------------------------------|-------------------------|-----------|----------------|---------|-------|-------|
| | | Coal | Petroleum | Natural Gas | Nuclear | Hydro | Other |
| New England | 135.9 | 14.9 | 10.0 | 37.6 | 25.4 | 5.5 | 6.5 |
| Middle Atlantic | 424.0 | 36.3 | 6.8 | 13.9 | 35.1 | 6.2 | 1.7 |
| East North Central | 663.9 | 70.0 | 0.3 | 4.8 | 22.7 | 0.7 | 1.6 |
| West North Central | 301.7 | 77.0 | 0.5 | 3.7 | 14.3 | 2.7 | 1.9 |
| South Atlantic | 820.0 | 52.3 | 4.9 | 13.8 | 23.9 | 2.0 | 3.1 |
| East South Central | 377.9 | 64.3 | 0.6 | 8.4 | 18.4 | 5.9 | 2.5 |
| West South Central | 602.5 | 38.3 | 0.4 | 45.2 | 11.2 | 1.3 | 3.5 |
| Mountain | 346.4 | 64.1 | 0.1 | 18.7 | 7.5 | 8.3 | 1.4 |
| Pacific Contiguous | 347.6 | 4.6 | 0.1 | 32.5 | 12.8 | 40.9 | 9.1 |
| Pacific Noncontiguous | 18.2 | 12.6 | 52.2 | 22.6 | 0.0 | 8.5 | 4.1 |
| U.S. Total | 4,038.0 | 49.9 | 2.5 | 18.6 | 19.3 | 6.6 | 3.1 |

Source: EIA, *Electric Power Monthly*, March 2006, Tables 1.6B, 1.7B, 1.8B, 1.10B, 1.12B, and 1.13B.

Note: "Other" includes renewables other than hydro, plus pumped storage, petroleum coke, gases other than natural gas, and other sources.

The price of electricity varies by region, depending on the fuel mix and the local regulatory system, among other factors. The nationwide average retail price to residential consumers increased during the 1970s energy crises but has declined since then, as indicated by **Figure 12**. An increase in recent years has resulted from the expiration in numerous regions of price caps that had been previously imposed when utilities were deregulated.

Figure 12. Price of Retail Residential Electricity, 1960-2005

Source: EIA, *Annual Energy Review 2005*, Table 8.10. Price includes taxes.

Other Conventional Energy Resources

Natural Gas

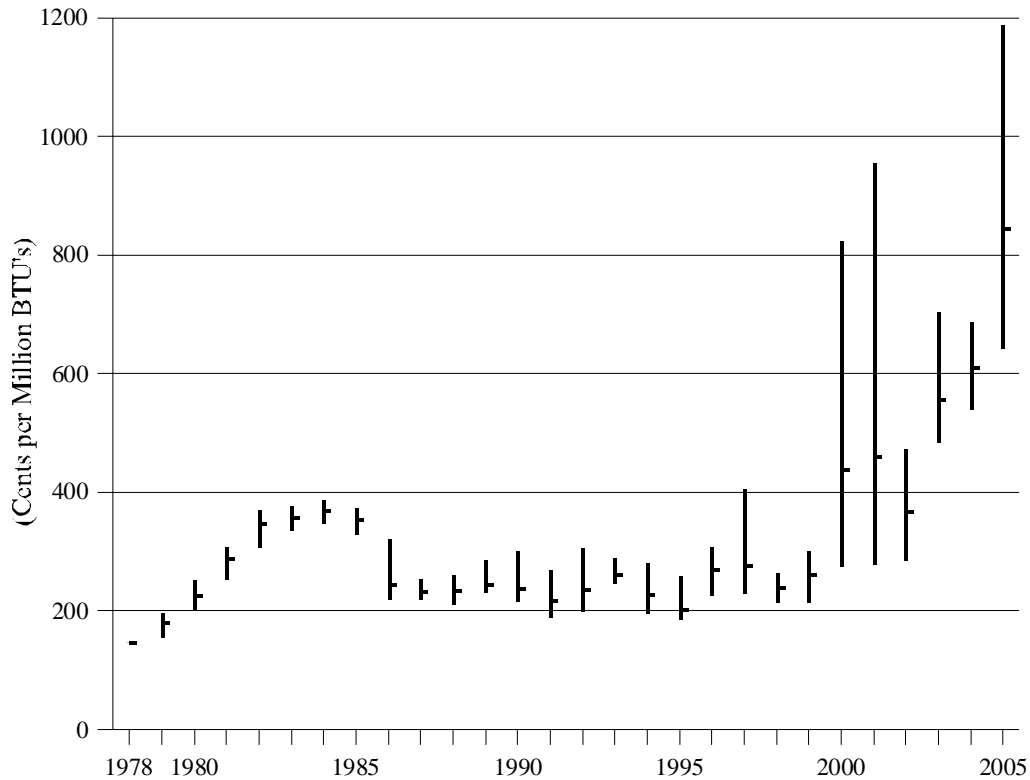
Consumption of natural gas was about four times as great in 2005 as it was in 1950. Throughout the period, consumption in the residential and commercial sector grew at about the same rate as total consumption, in the range of 30% to 40% of the total. As shown in **Table 7**, consumption for electric power generation increased from about 10% in 1950 to more than 20% at the end of the century. The proportion of total gas consumption by the industrial sector declined correspondingly, from more than 50% in 1950 to less than 40%.

Table 7. Natural Gas Consumption by Sector, 1950-2005

| | Total Consumption (trillion cubic feet) | Percentage Consumed by | | |
|------|---|----------------------------|------------|----------|
| | | Residential- Commercial | Industrial | Electric |
| 1950 | 5.77 | 27.5 | 59.4 | 10.9 |
| 1955 | 8.69 | 31.7 | 52.2 | 13.3 |
| 1960 | 11.97 | 34.5 | 48.2 | 14.4 |
| 1965 | 15.28 | 35.0 | 46.5 | 15.2 |
| 1970 | 21.14 | 34.2 | 43.8 | 18.6 |
| 1975 | 19.54 | 38.0 | 42.8 | 16.2 |
| 1980 | 19.88 | 37.0 | 41.2 | 18.5 |
| 1985 | 17.28 | 39.7 | 39.7 | 17.6 |
| 1990 | 19.17 | 36.6 | 43.1 | 16.9 |
| 1995 | 22.21 | 35.5 | 42.3 | 19.1 |
| 2000 | 23.33 | 35.1 | 39.8 | 22.3 |
| 2001 | 22.24 | 35.0 | 38.1 | 24.0 |
| 2002 | 23.01 | 34.9 | 37.5 | 24.6 |
| 2003 | 22.28 | 37.1 | 37.1 | 23.1 |
| 2004 | 22.48 | 35.8 | 37.2 | 24.4 |
| 2005 | 21.98 | 35.9 | 35.1 | 26.4 |

Source: EIA, *Annual Energy Review*, 2005, Table 6.5.

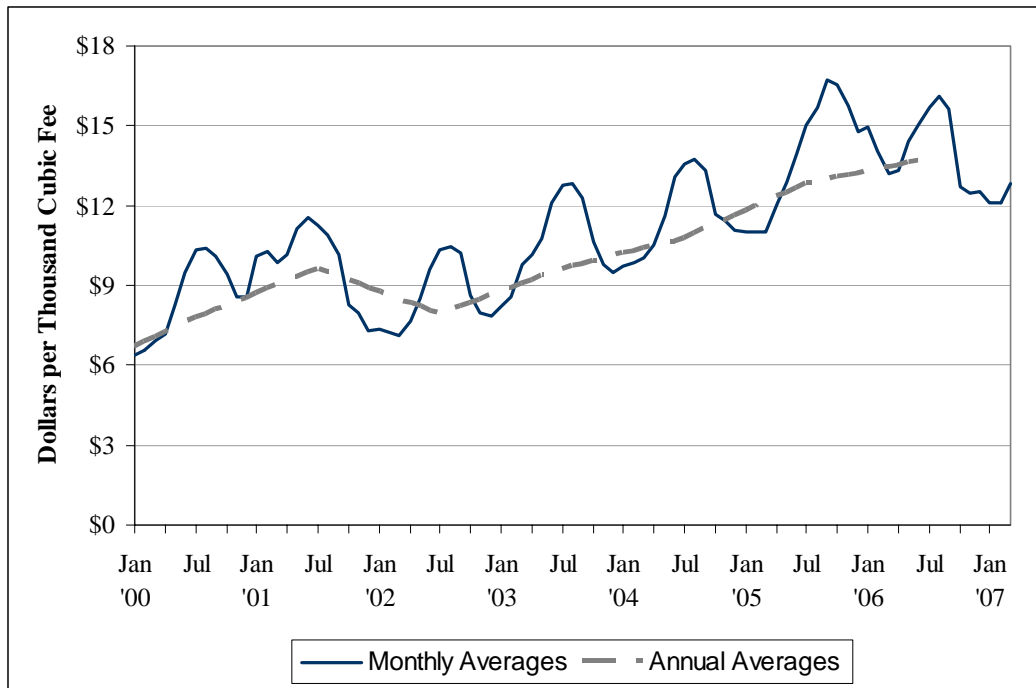
In part because of increased demand by electric utilities, natural gas prices have become extremely volatile in recent years, as illustrated by **Figure 13**, which shows high, low, and yearly average prices for gas delivered to electricity generators.

Figure 13. Natural Gas Prices to Electricity Generators, 1978-2005

Source: EIA, *Monthly Energy Review*, October 2006, Table 9.11.

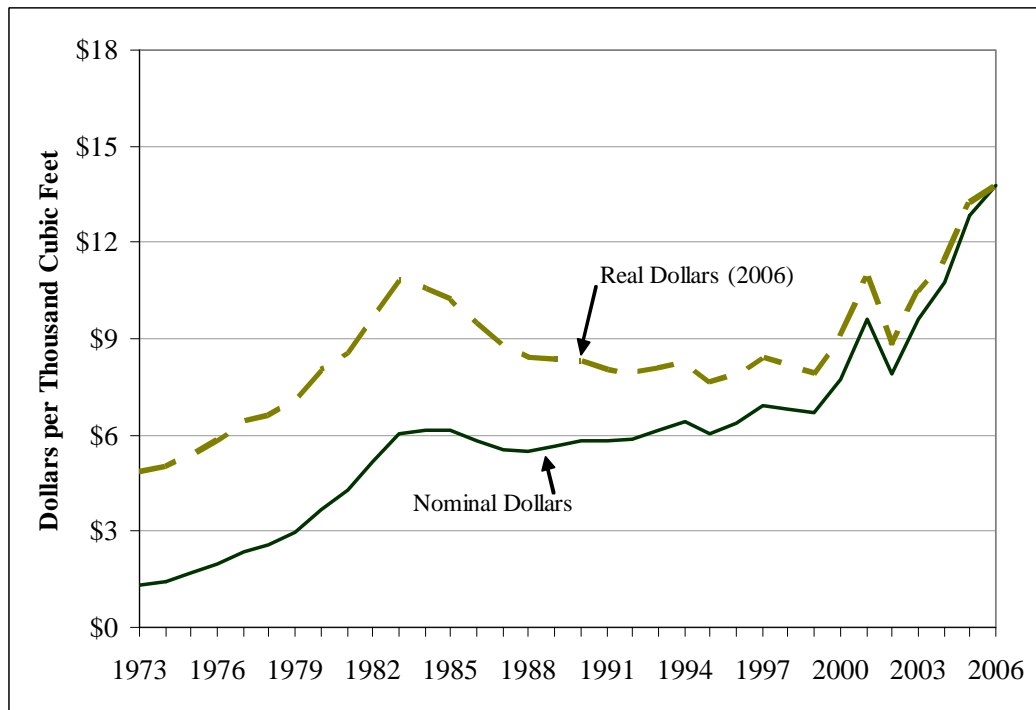
Because rates for residential natural gas are regulated, they have been less volatile than those for electric utility consumers, although considerable seasonal fluctuations are common, as shown in **Figure 14**. The long-term trend in residential natural gas prices, both in current dollars and in constant 2006 dollars, is shown in **Figure 15**.

Figure 14. Monthly and Annual Residential Natural Gas Prices, 2000-March 2007



Source: EIA, *Monthly Energy Review*, June 2007, Table 9.11.

Figure 15. Annual Residential Natural Gas Prices, 1973-2006



Source: EIA, *Monthly Energy Review*, June 2007, Table 9.11 and FY2008 Budget, Historical Tables, Table 10.1 for GDP Chained Price Index.

Coal

Consumption of coal about doubled in the half-century from 1950 to 2000, but during that period coal as an energy source changed from a widely used resource to a single-use fuel for generating electricity. (See **Table 8.**) In 1950 the residential and commercial sector consumed almost a quarter of total coal consumed; by 1980 less than 1% of coal went to that sector. In transportation, steam locomotives (and some coal-fired marine transportation) consumed 13% of coal; by 1970 they were all replaced with diesel-burning or electric engines. Industry consumed 46% of coal in 1950; by 2000 less than 10% of coal was consumed by that sector. Meanwhile, the electric power sector, which consumed less than 20% of the half-billion tons of coal burned in 1950, used more than 90% of the billion-plus tons consumed in 2004.

Table 8. Coal Consumption by Sector, 1950-2005

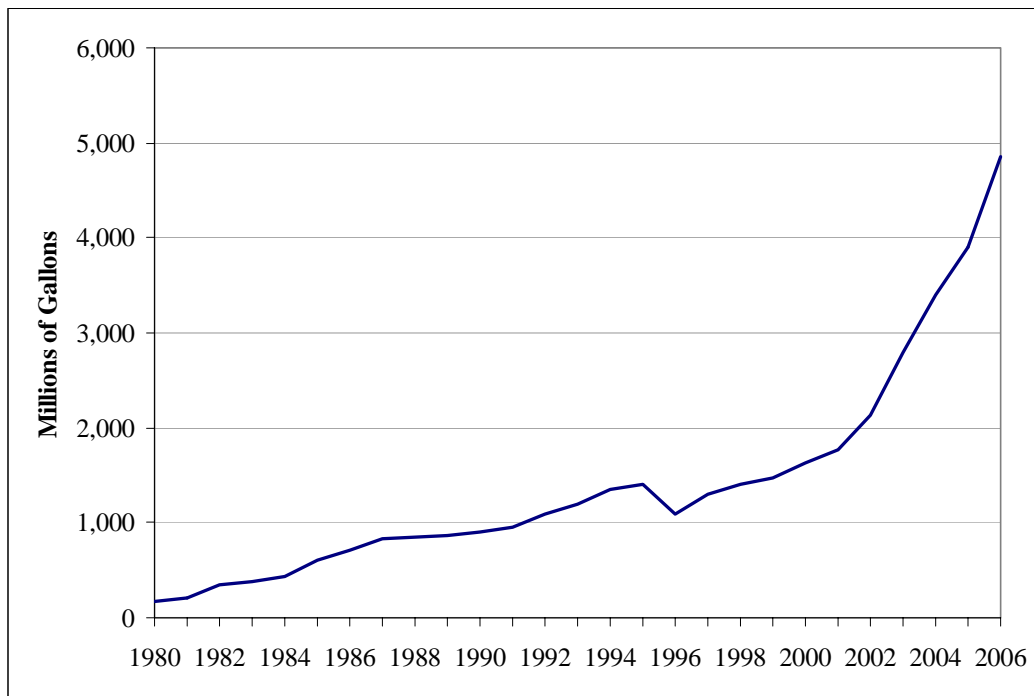
| | Total Consumption (Million Tons) | Percent Consumed by: | | | |
|------|--|----------------------------|------------|----------------|----------|
| | | Residential- Commercial | Industrial | Transportation | Electric |
| 1950 | 494.1 | 23.2 | 45.5 | 12.8 | 18.6 |
| 1955 | 447.0 | 15.3 | 48.7 | 3.8 | 32.2 |
| 1960 | 398.1 | 10.3 | 44.6 | 0.8 | 44.4 |
| 1965 | 472.0 | 5.4 | 42.6 | 0.1 | 51.9 |
| 1970 | 523.2 | 3.1 | 35.7 | 0.1 | 61.2 |
| 1975 | 562.6 | 1.7 | 26.2 | — | 72.2 |
| 1980 | 702.7 | 0.9 | 18.1 | — | 81.0 |
| 1985 | 818.0 | 1.0 | 14.2 | — | 84.8 |
| 1990 | 904.5 | 0.7 | 12.7 | — | 86.5 |
| 1995 | 962.1 | 0.6 | 11.0 | — | 88.4 |
| 2000 | 1084.1 | 0.4 | 8.7 | — | 90.9 |
| 2005 | 1128.3 | 0.5 | 7.5 | — | 92.1 |

Source: EIA, *Annual Energy Review 2005*, Table 7.3.

Renewable Energy

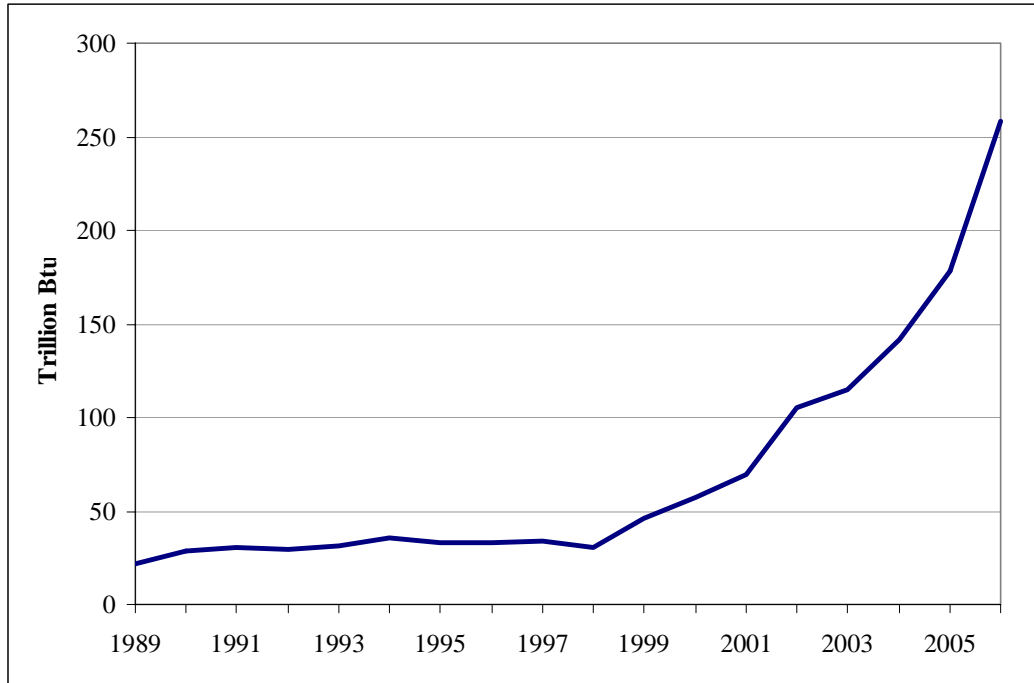
The major supply of renewable energy in the United States, not counting hydroelectric power generation, is fuel ethanol. Consumption in the United States in 2006 was almost 5 billion gallons, mainly blended into E10 gasohol (a blend of 10% ethanol and 90% gasoline). This figure represents 3.6% of the approximately 140 billion gallons of gasoline consumption in the same year. As **Figure 16** indicates, fuel ethanol production has increased rapidly in recent years, especially since the phasing out of the fuel additive methyl tertiary butyl ether (MTBE).

Figure 16. U.S. Ethanol Production, 1980-2006



Source: Renewable Fuels Association, June 14, 2007, [<http://www.ethanolrfa.org/industry/statistics/>].

Another rapidly growing renewable resource is wind-generated electric power, as shown in **Figure 17**. The 250 trillion Btus of wind energy in 2006 is equivalent to approximately 73 billion kilowatt hours, about 1.8% of the 4,000 billion kwh of total electricity generation in that year.

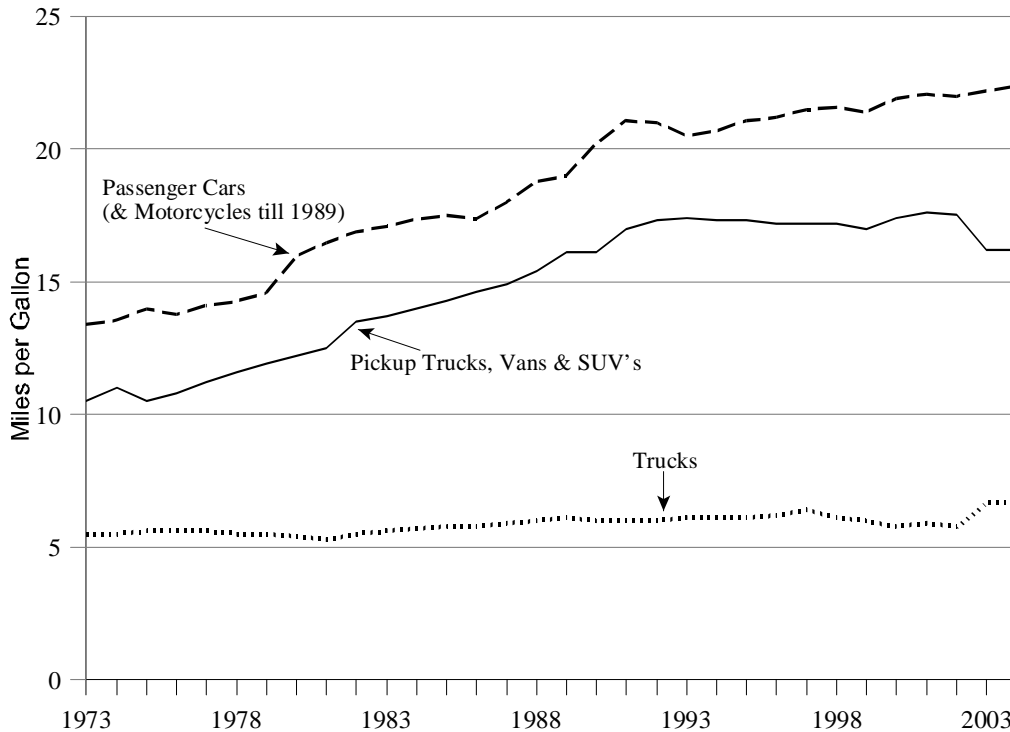
Figure 17. Wind Electricity Net Generation, 1988-2006

Source: Monthly Energy Review, June 2007, Table 10.1.

Conservation and Energy Efficiency

Vehicle Fuel Economy

Energy efficiency has been a popular goal of policy makers in responding to the repeated energy crises of recent decades, and efforts to reduce the energy intensity of a broad spectrum of economic activities have been made both at the government and private level. Because of the transportation sector's near total dependence on vulnerable oil supplies, improving the efficiency of motor vehicles has been of particular interest. (For an analysis of legislative policies to improve vehicle fuel economy, see CRS Report RL33982, *Corporate Average Fuel Economy (CAFE): A Comparison of Selected Legislation in the 110th Congress*, by Brent D. Yacobucci and Robert Bamberger.) **Figure 14** illustrates the trends in this effort for passenger cars and for light trucks, vans, and sport utility vehicles, as well as the general lack of improvement in heavy trucks.

Figure 18. Motor Vehicle Fuel Efficiency Rates, 1973-2004

Source: EIA, *Monthly Energy Review*, October 2006, Table 1.9.

Further analysis by the Environmental Protection Agency (EPA), involving the composition of the fleet as well as the per-vehicle fuel rates, indicates that light vehicle fuel economy has declined on average between 1988 and 2003. This is largely because of increased weight, higher performance, and a higher proportion of sport utility vehicles and light trucks sold. In 2003, SUVs, pickups and vans comprised 48% of all sales, more than twice their market share in 1983. (The EPA study is available online at [<http://www.epa.gov/otaq/fetrends.htm>].)

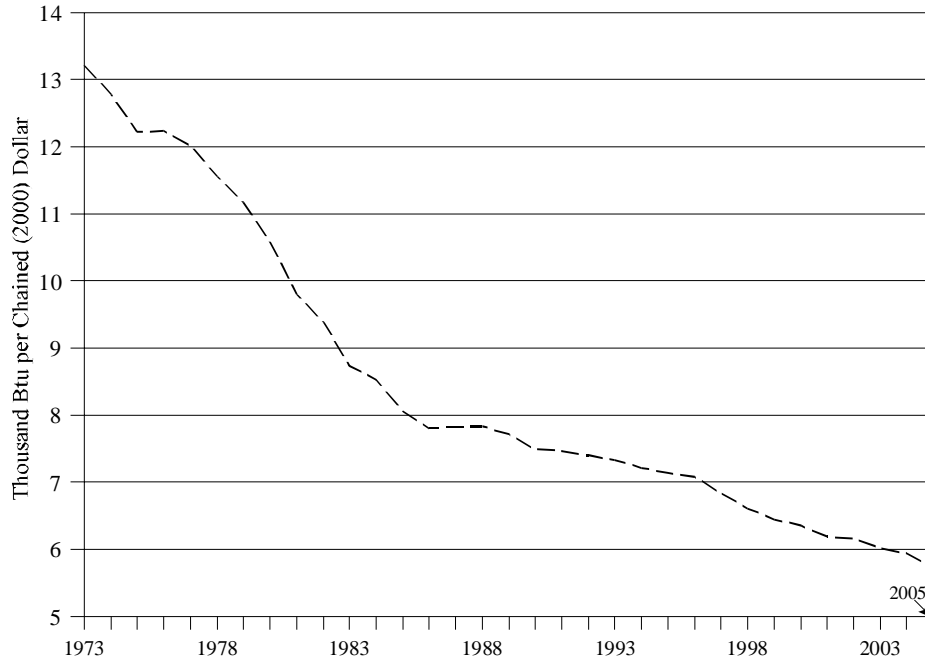
Energy Consumption and GDP

A frequent point of concern in formulating energy policy is the relationship between economic growth and energy use. It seems obvious that greater economic activity would bring with it increased energy consumption, although many other factors affecting consumption make the short-term relationship highly variable. Over a longer period, for some energy-related activities, the relationship with economic growth has been essentially level. For the period from 1973 to 2003, for instance, consumption of electricity remained close to 0.45 kwh per constant dollar of GDP. Similarly, the number of miles driven by all vehicles was close to 3 miles per constant dollar of GDP throughout the same period.

In the case of oil and gas, however, a remarkable drop took place in the ratio of consumption to economic growth following the price spikes and supply disruptions, as illustrated in **Figure 15**. Consumption of oil and gas declined from 14,000 Btus

per constant dollar of GDP in 1973 to a little more than 8,000 in 1985, and has continued to decline at a slower rate since then.

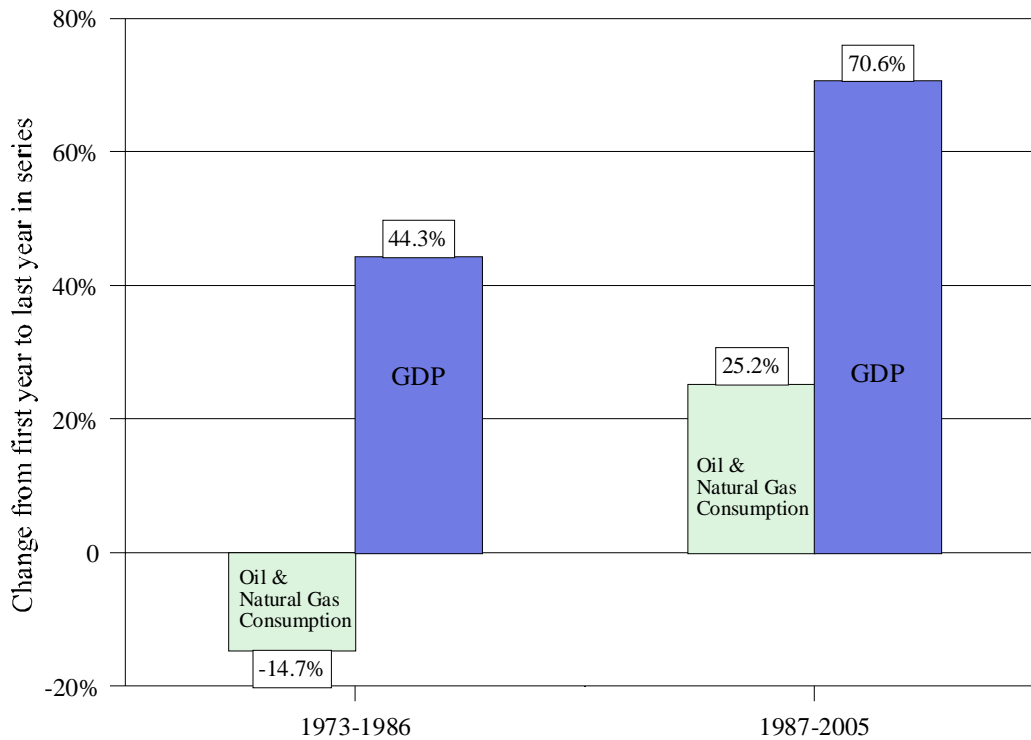
Figure 19. Oil and Natural Gas Consumption per Dollar of GDP, 1973-2005



Source: EIA, *Monthly Energy Review*, November 2006, Table 1.8.

During the earlier period, oil and gas consumption actually declined 15% while GDP, despite many economic problems with inflation and slow growth, was increasing by 44% (see **Figure 16**). During the period 1987 to 2004, oil and gas consumption increased by about 26%, while GDP increased 66%.

Figure 20. Change in Oil and Natural Gas Consumption and Growth in GDP, 1973-2005



Source: EIA, *Monthly Energy Review*, November 2006, Table 1.8.

Major Statistical Resources

Links to Sources

Most of the tables and figures in this report are derived from databases maintained by the Department of Energy's Energy Information Administration (EIA). If other or more detailed information is desired, the agency's website presents the complete text of its many statistical reports in PDF format, and also as spreadsheet files in the format of the program Excel. Some of the more important EIA publications are described below. Other sources used in this report are also listed.

Energy Information Administration

[<http://www.eia.doe.gov>]

"The agency's responsibility is to provide timely, high-quality information and to perform objective, credible analyses. ... EIA collects, evaluates, assembles, analyzes, and disseminates data and information relevant to energy resources, reserves, production, demand, technology, and related economic and statistical information."

Annual Energy Review

[<http://www.eia.doe.gov/aer/contents.html>]

"The *Annual Energy Review (AER)* presents the Energy Information Administration's historical energy statistics. For many series, statistics are given for every year from

1949 through 2001. The statistics cover all major energy activities, including consumption, production, trade, stocks [inventories], and prices, for all major energy commodities, including fossil fuels, electricity, and renewable energy sources.”

Monthly Energy Review

[<http://www.eia.doe.gov/mer/contents.html>]

The *Monthly Energy Review* (MER) presents an overview of the EIA’s recent monthly energy statistics. The statistics cover the major activities of U.S. production, consumption, trade, stocks (inventories) and prices for petroleum, natural gas, coal electricity, and nuclear energy.

International Energy Annual

[<http://www.eia.doe.gov/iea/contents.html>]

The *International Energy Annual* presents information and trends on world energy production and consumption for petroleum, natural gas, coal, and electricity. This report is published to keep the public and other interested parties fully informed of primary energy supplies on a global basis.

Weekly Petroleum Status Report

[http://www.eia.doe.gov/oil_gas/petroleum/data_publications/weekly_petroleum_status_report/wpsr.html]

The *Weekly Petroleum Status Report* (WPSR) provides data on supply and selected prices of crude oil and principal petroleum products in the context of historical data and forecasts. Updated every Wednesday morning.

Electric Power Annual

[http://www.eia.doe.gov/cneaf/electricity/epa/epa_sum.html]

The *Electric Power Annual* provides a statistical review of the domestic electric power industry for the most recent year including information on; industry capability, generation, fossil-fuel consumption, and stocks. Data on retail sales of electricity and average revenue per kilowatt-hour are also presented.

Other Sources

Nuclear Regulatory Commission Information Digest

[<http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1350/>]

Updated annually, this official NRC publication (NUREG-1350) includes general statistics on U.S. and worldwide nuclear power production, U.S. nuclear reactors, and radioactive waste.

American Petroleum Institute (API)

[<http://api-ec.api.org/newsplashpage/index.cfm>]

The primary trade association of the oil and natural gas industry representing more than 400 members. Research, programs, and publications on public policy, technical standards, industry statistics, and regulations. Includes the “Notes to State Motor Fuel Excise and Other Tax Rates,” mentioned above.

[http://www.api.org/policy/tax/stateexcise/upload/NOTES_TO_STATE_MOTOR_FUEL_EXCISE_AND_OTHER_TAX_RATES.pdf]

This site may also be accessed via the API page for Motor Fuel Taxes at [<http://www.api.org/statistics/fueltaxes/index.cfm>]

Bloomberg.Com, Market Data: Commodities, Energy Prices

[<http://www.bloomberg.com/energy/index.html>]

Displays four tables:

- *Petroleum (\$/bbl)* for crude oil. The generally accepted price for crude oil is “WTI Cushing \$” which is listed fourth in the table.
- *Petroleum (¢/gal)* for heating oil and gasoline.
- *Natural Gas (\$/MMBtu)*
- *Electricity (\$/megawatt hour)*

This site is updated two to three times per day.

AAA’s Daily Fuel Gauge Report

[<http://www.fuelgaugereport.com/index.asp>]

At-the-pump retail fuel prices for gasoline and diesel fuel. Gives average price for today, yesterday, a month ago and a year ago for wholesale and crude oil. Also displays line chart showing the averages for the previous 12 months. National, state, and metropolitan data.

International Energy Agency

[<http://www.iea.org>]

The International Energy Agency is an autonomous body within the Organization for Economic Co-operation and Development (OECD). It gathers and analyzes statistics and “disseminates information on the world energy market and seeks to promote stable international trade in energy.”

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