The United States was self-sufficient in energy until the late 1950s when energy consumption began to outpace domestic production. At that point, the Nation began to import more energy to fill the gap. In 2008, net imported energy accounted for 26 percent of all energy consumed.

After 1970, the amount of energy consumed to produce a dollar’s worth of the Nation’s output of goods and services trended down. The decline resulted from efficiency improvements and structural changes in the economy. The level in 2008 was 53 percent below that of 1970.

Most energy consumed in the United States comes from fossil fuels. Renewable energy resources supply a relatively small but steady portion. In the late 1950s, nuclear fuel began to be used to generate electricity, and in most years since 1988, nuclear electric power surpassed renewable energy.
In the long view of American history, wood served as the preeminent form of energy for about half of the Nation’s history. Around 1885, coal surpassed wood’s usage. Despite its tremendous and rapid expansion, coal was in turn overtaken by petroleum in the middle of the 20th century. Natural gas, too, experienced rapid development into the second half of the 20th century, and coal began to expand again. Late in the 20th century still another form of energy, nuclear electric power, was developed and made significant contributions.

While the Nation’s energy history is one of large-scale change as new forms of energy were developed, the outlook for the next couple of decades (assuming current laws, regulations, and policies) is for continued reliance on fossil fuels (with coal growing faster than liquid fuels and natural gas); modest growth in hydroelectric power and nuclear electric power; and a doubling of non-hydroelectric renewable energy by 2030.
All four major economic sectors of the economy recorded tremendous growth in their use of energy. The industrial sector used the biggest share of total energy and showed the greatest volatility; in particular, steep drops occurred in the sector in 1975, 1980-1982, 2001, 2005, and 2008 largely in response to high oil prices and economic slowdown.

Coal, once the predominant form of energy in the industrial sector, gave way to natural gas and petroleum in the late 1950s. Both natural gas and petroleum use expanded rapidly until the early 1970s, and then fluctuated widely over the following decades. Use of electricity and biomass trended upward.

In the 1950s and 1960s, coal, which had been important to residential and commercial consumers, was gradually replaced by other forms of energy. Petroleum consumption peaked in the early 1970s. Natural gas consumption grew fast until the early 1970s, and then, with mild fluctuations, held fairly steady in the following years. Meanwhile, electricity use (and related losses) expanded dramatically.

Most energy produced in the United States came from fossil fuels—coal, natural gas, and crude oil. Coal, the leading source at the middle of the 20th century, was surpassed by crude oil and then by natural gas. By the mid-1980s, coal again became the leading energy source produced in the United States, and crude oil declined sharply. In the 1970s, electricity produced from nuclear fuel began to make a significant contribution and expanded rapidly in the following decades.

The United States almost always produced more than enough coal for its own requirements. For many years, the United States was also self-sufficient in natural gas, but after 1967, it produced less than it consumed each year. Petroleum production fell far short of domestic demands, requiring the Nation to rely on imported supplies.

Since the mid-1960s, the Nation imported more energy than it exported. In 2008, the United States imported 33 quadrillion Btu of energy and exported 7 quadrillion Btu. Most imported energy was in the form of petroleum; since 1986, natural gas imports expanded rapidly as well. Through 1992, most exported energy was in the form of coal; after that, petroleum exports often exceeded coal exports.
When U.S. petroleum production peaked at 11.3 million barrels per day in 1970, net imports stood at 3.2 million barrels per day. By 1996, net imports exceeded production. In 2008, production was 6.7 million barrels per day, and net imports were 11.0 million barrels per day.

The amount of crude oil produced per day per well rose sharply in the 1960s and reached a peak of 18.6 barrels per day per well in 1972. After 1972, productivity generally declined. The 2008 rate of 9.4 barrels per day per well was 49 percent below the peak and the lowest level since the Energy Information Administration began reporting oil well productivity.

Crude oil production peaked in the 48 States at 9.4 million barrels per day in 1970. As production fell in the 48 States, Alaska’s production came on-line and helped supply U.S. needs. Alaskan production peaked at 2.0 million barrels per day in 1988; in 2008, Alaska’s production stood at 34 percent of its peak level.

Rotary rig activity declined sharply from 1955 to 1971. After 1971, the number of rigs in operation began to climb again, and a peak of nearly 4 thousand rigs in operation was registered in 1981. In 2008, 1,879 rigs were in operation, more than double the level in 2002, but only 47 percent of the peak level in 1981.
Petroleum Consumption and Prices

Transportation was the largest consuming sector of petroleum and the one showing the greatest expansion. In 2008, 13.7 million barrels per day of petroleum products were consumed for transportation purposes, accounting for 70 percent of all petroleum used.

Motor gasoline was the single largest petroleum product consumed in the United States. Its consumption stood at 9.0 million barrels per day in 2008, 46 percent of all petroleum consumption. Distillate fuel oil, liquefied petroleum gases (LPG), and jet fuel were other important products. The use of residual fuel oil fell off sharply after 1977.

Unadjusted for inflation (nominal dollars), the refiner acquisition composite (domestic and foreign) cost of crude oil reached $35.24 per barrel in 1981. Over the years that followed, the price fell dramatically to a low of $12.52 per barrel in 1998 before rising again. The preliminary nominal price reported for 2008 was $94.73 per barrel, a new peak level and up 39 percent over the 2007 price.

In nominal (unadjusted for inflation) dollars, Americans paid an average of 65¢ per gallon for motor gasoline in 1978. The 2008 average price of $3.32 was more than five times the 1978 rate; adjusted for inflation, it was 90 percent higher.
Petroleum Trade

U.S. crude oil imports grew rapidly from mid-20th century until the late 1970s, but fell sharply from 1979 to 1985 due to conservation efforts and improved efficiency. After 1985, the upward trend resumed and stood at 9.8 million barrels per day in 2008. Exports totaled 1.8 million barrels per day in 2008, mainly in the form of petroleum coke and residual fuel oil.

Among OPEC countries, Saudi Arabia, Venezuela, and Nigeria—nations from three different continents—were key suppliers of petroleum to the U.S. market. Each experienced wide fluctuation in the amount of petroleum it sold to the United States over the decades. In 2008, 0.6 million barrels per day of petroleum came into the United States from Iraq.

U.S. petroleum imports rose sharply in the 1970s, and reliance on petroleum from the Organization of the Petroleum Exporting Countries (OPEC) grew. In 2008, 46 percent of U.S. petroleum imports came from OPEC countries, down from 70 percent in 1977. After 1992, more petroleum came into the United States from non-OPEC countries than from OPEC countries.

Canada and Mexico were the largest non-OPEC suppliers of petroleum to the United States. In 2008, imports from Canada reached a new high of 2.5 million barrels per day. Imports from Mexico were insignificant until the mid-1970s, when they began to play a key role in U.S. supplies. Canadian and Mexican petroleum together accounted for 29 percent of all U.S. imports in 2008.
Through 1983, the Nation held most of its petroleum storage in the form of products, which were ready for the market. After 1983, most petroleum in storage was in the form of crude oil (including that held by the government in the Strategic Petroleum Reserve) that still needed to be refined into usable end products. At the end of 2008, petroleum stocks totaled 1.7 billion barrels, 59 percent crude oil and 41 percent products.

Most crude oil in the SPR was imported and came in during the early 1980s. In fact, from 1991 through 1997, only 14 million barrels were imported for the reserve, and in 3 of those years, no oil at all was imported for the reserve. SPR imports picked up again after 1997, and stored another 159 million barrels from 1998 through 2008.

In 1977, the United States began filling the Strategic Petroleum Reserve (SPR), a national reserve of petroleum stocks in case of emergency. At the end of 2008, the SPR held 702 million barrels of crude oil, 40 percent of all U.S. petroleum stocks.

Stocks are often measured by the number of days of total net imports of petroleum that could be met by the reserve in an emergency. The peak level occurred in 1985 when the Strategic Petroleum Reserve (SPR) could have supplied 115 days of petroleum net imports, at the 1985 level. The rate trended down for many years, falling to 50 days in 2001. In 2008, SPR held 64 days of net imports.
Motor Vehicles

The composite motor vehicle fuel rate (miles per gallon) rose 42 percent from 1973 to 1991 and then varied little over the next 15 years. Mileage (miles per vehicle) grew steadily from 1973 to 1985 and then hovered around 12 thousand miles per vehicle per year through 2007. Fuel consumption (gallons per vehicle) fell 21 percent from 1973 to 1991, regained 9 percent from 1991 to 1999, and then trended down through 2007.


Note: Motor vehicles include passenger cars, motorcycles, vans, pickup trucks, sport utility vehicles, trucks, and buses.

Average fuel consumption rates for trucks greatly exceeded those for other vehicles, and trended upward over time—doubling from 2.3 thousand gallons per truck in 1966 to 4.6 thousand gallons per truck in 2002. Average fuel consumption rates for passenger cars, and vans, pickup trucks, and sport utility vehicles were much lower and generally trended downward.

Fuel rates (miles per gallon) for passenger cars, and vans, pickup trucks, and sport utility vehicles (SUVs), improved noticeably from the late 1970s through the early 1990s. Fuel rates for passenger cars improved further in subsequent years; rates for vans, pickup trucks, and SUVs fell in 2002 and 2003, but increased in 2005 through 2007. Fuel rates for trucks, which were much lower than for other vehicles, showed far less change over time.
Natural Gas

U.S. natural gas production and consumption were nearly in balance through 1986. After that, consumption began to outpace production, and imports of natural gas rose to meet U.S. requirements for the fuel. In 2008, production stood at 20.6 trillion cubic feet (Tcf), net imports at 3.0 Tcf, and consumption at 23.2 Tcf.

Net imports of natural gas as a share of consumption was in the 4- to 6-percent range from 1970 through 1987. Then, during a period when consumption outpaced production, the share rose from 4.2 percent in 1986 to 16.4 percent in 2007. In 2008, the share was 12.7 percent.

The industrial sector was both the largest consuming sector of natural gas and the sector with the greatest volatility due to variability in industrial output. In 2008, the industrial sector accounted for 34 percent of all natural gas consumption, and the electric power sector accounted for 29 percent.

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Natural gas well productivity, measured as gross withdrawals per day per well, grew rapidly in the late 1960s, peaked in 1971, and then fell sharply until the mid-1980s. Productivity remained fairly steady from 1985 through 1999, fell annually through 2006, and turned up slightly in 2007 and 2008.

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Coal


In the 1950s, most coal was consumed in the industrial sector, many homes were still heated by coal, and the transportation sector consumed coal in steam-driven trains and ships. By the 1960s, most coal was used for generating electricity. In 2008, the electric power sector accounted for 93 percent of all coal consumption, on a tonnage basis.

Electricity Net Generation and Useful Thermal Output

Total electricity net generation in all sectors grew from 0.3 trillion kilowatthours in 1949 to 4.1 trillion kilowatthours in 2008, failing to increase in only 3 years (1982, 2001, and 2008) over the entire span. Most generation was in the electric power sector, but some occurred in the commercial and industrial sectors.

Most generating facilities exist to produce only electricity, but some function as combined-heat-and-power (CHP) plants that produce both electricity and heat from a single heat source. Rather than being wasted, the heat from a CHP plant is used for processes and applications in addition to electricity generation.

The non-electrical output at a CHP plant is called useful thermal output. Useful thermal output is thermal energy that is available from the plant for use in industrial or commercial processes or heating or cooling applications. In 2008, the industrial sector generated 1.3 quadrillion Btu of useful thermal output; the electric power and commercial sectors generated much smaller quantities.

Most electricity net generation came from coal. In 2008, fossil fuels (coal, petroleum, and natural gas) accounted for 71 percent of all net generation, while nuclear electric power contributed 20 percent, and renewable energy resources 9 percent. In 2008, 67 percent of the net generation from renewable energy resources was derived from conventional hydroelectric power.

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Electricity Prices, Sales, and Trade

Over the decades, industrial consumers paid the lowest rates for electricity; residential customers usually paid the highest prices. Inflation-adjusted prices rose in all sectors in 2005, 2006, and 2008 but remained well below the peak price levels of the mid-1980s.

Figure 47. Average Real¹ Retail Prices of Electricity by Sector

Enormous growth occurred in the amount of electricity retail sales to the three major sectors—residential, commercial, and industrial. Industrial sector sales showed the greatest volatility. Sales to residences exceeded sales to industrial sites beginning in the early 1990s, and sales to commercial sites surpassed industrial sales beginning in the late 1990s.

Figure 48. Electricity Retail Sales by Sector

Except for a few years in the 1960s when imported and exported electricity were nearly equal, the United States imported more electricity than it exported. Most electricity trade occurred with Canada; very small exchanges occurred between the United States and Mexico. In 2008, net imported electricity was less than 0.9 percent of all electricity used in the United States.

Figure 49. Electricity Trade
Nuclear Electric Power


Over the latter part of the last century, nuclear electric power began to play a key role in meeting the Nation’s rapidly growing electricity requirements. In 2008, 20 percent of U.S. total electricity net generation came from nuclear electric power.

Figure 50. Nuclear Full-Power Operating Licenses Issued

Figure 51. Nuclear Operable Units

Figure 52. Nuclear Net Summer Capacity

Figure 53. Nuclear Capacity Factor

Figure 54. Nuclear Share of Net Generation

A total of 132 nuclear full-power operating licenses, or equivalent permission, were issued in the United States since the nuclear industry got its start in the 1950s. Most of the licenses were granted between 1962 and 1990. After 1990, one license was issued in 1993 and one in 1996.

Out of the 132 nuclear units that were granted full-power operating licenses, or equivalent permission, over time, 28 were permanently shut down. The largest number of units ever operable in the United States was 112 in 1990. From 1998 through 2008, 104 units were operable.

Nuclear capacity factors measure actual nuclear power generation as a share of maximum possible output. Factors for the industry, which were in the 50- to 60-percent range through the 1980s, generally improved in later years and stood at 92 percent in 2008.

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Renewable Energy

Total renewable energy consumption generally followed the pattern of hydroelectric power output, which was the largest component of the total for most of the years shown. In 2008, hydroelectric power accounted for 34 percent of the total. Wood was the next largest source of renewable energy, followed by biofuels, wind, waste, geothermal, and solar/photovoltaic.

Most renewable energy was consumed by the electric power sector to generate electricity. After 1958, the industrial sector was the second largest consuming sector of renewable energy; the residential sector was the third largest consuming sector of renewable energy until it was exceeded by the transportation sector in 2006.

After 1959, the industrial sector consumed the most biomass (wood, waste, fuel ethanol, and biodiesel). Residential use of biomass (wood) fell through 1973, expanded from 1974 through 1985, and then trended downward again. Transportation consumption of biomass (fuel ethanol and biodiesel) expanded after 1996 and by 2006 exceeded the electric power sector’s consumption of biomass (wood and waste).

Notes: • Data were not collected for 1985. • Shipments include all domestically manufactured collectors plus imports.
From 1970 to 2006, world primary energy production grew by 118 percent, reaching 469 quadrillion Btu in 2006. Growth occurred in all types of energy. In 2006, fossil fuels accounted for 86 percent of all energy produced worldwide, renewable energy 8 percent, and nuclear electric power 6 percent.

Figure 58. World Primary Energy Production by Source

Figure 59. World Primary Energy Production by Region

Twenty-one percent of the 469 quadrillion Btu of energy produced worldwide in 2006 came from North America. The largest regional energy producer was Asia and Oceania with 26 percent of the world total in 2006.

Figure 60. World Primary Energy Production by Region

World crude oil production totaled 74 million barrels per day in 2008, up 1 percent from the level in 2007. OPEC’s share of the world total in 2008 was 44 percent, compared to the peak level of 53 percent in 1973.

Figure 61. World Crude Oil Production

From 1974 through 1991, the former U.S.S.R. was the world’s leading crude oil producer. After 1991, Saudi Arabia was the top producer until 2006, when Russia’s production exceeded Saudi Arabia’s for the first time. U.S. production peaked in 1970 but still ranked third in 2008.

Figure 62. Leading Crude Oil Producers

The United States accounted for 24 percent of world petroleum consumption in 2007. China and Japan, the next two leading consumers, together accounted for 15 percent. Russia, Germany, and India were the next largest consumers of petroleum in 2007.

Figure 63. Leading Petroleum Consumers
The combustion of fossil fuels—coal, petroleum, and natural gas—to release their energy creates emissions of carbon dioxide, the most significant greenhouse gas. Total carbon dioxide emissions stood at 6 billion metric tons of gas in 2007, 20 percent higher than the 1990 level.

While real gross domestic product (GDP) grew by 62 percent from 1990 to 2007, energy-related carbon dioxide emissions grew by 19 percent. From 2000 to 2007, GDP rose 17 percent, and energy-related carbon dioxide emissions rose 2 percent.

Carbon dioxide emitted by the industrial sector fell by 8 percent from 1980 to 2007. By 1999, transportation sector carbon dioxide emissions exceeded industrial sector emissions. Of the major sectors, the commercial sector generated the least carbon dioxide, but recorded the largest growth (67 percent) since 1980.

In 2007, methane emissions accounted for 10 percent of total U.S. greenhouse gas emissions, weighted by global warming potential. Most methane emissions came from energy, waste management, and agricultural sources. The production, processing, and distribution of natural gas accounted for 61 percent of the energy-related methane emissions in 2007.
Data for Energy Perspectives, 1949-2008, figures and text are derived from the following Annual Energy Review 2008 tables and additional sources:

1. Table 1.1.
2. Table 1.5.
3. Table 1.5.
4. Table 1.3.
5. Tables 1.3, 10.1, and E1.
6. Energy Information Administration, Annual Energy Outlook 2009 (April 2009), Updated Reference Case Tables, Table 1, "Total Energy Supply and Disposition Summary."
7. Table 2.1a.
8. Tables 2.1b and 2.1c.
9. Table 2.1d.
10. Tables 2.1e, 5.13c, and 5.14c.
11. Table 1.2.
12. Tables 5.1, 6.1, and 7.1.
13. Table 1.4.
14. Table 5.1.
15. Table 5.2.
16. Table 5.2.
17. Table 4.4.
18. Tables 5.13a-d.
19. Table 5.11.
20. Table 5.21.
21. Table 5.24.
22. Tables 5.3 and 5.5.
23. Table 5.4.
24. Table 5.4.
25. Table 5.4.
26. Table 5.16.
27. Table 5.16.
28. Table 5.17.
29. Table 5.17.
30. Table 2.8.
31. Table 2.8.
32. Table 2.8.
33. Table 2.8.
34. Table 6.1.
35. Table 6.4.
36. Table 6.3.
37. Table 6.5.
38. Table 7.1.
39. Table 7.3.
40. Table 7.6.
41. Table 7.2.
42. Table 7.2.
43. Tables 8.2a, 8.2b, and 8.2d.
44. Table 8.2a.
45. Table 8.2c.
46. Tables 8.3b and 8.3c.
47. Table 8.10.
48. Table 8.9.
49. Table 8.1.
50. Table 9.1.
51. Table 9.1.
52. Table 9.2.
53. Table 9.2.
54. Table 9.2.
55. Table 10.1.
56. Tables 10.2a–10.2c.
57. Tables 10.2a–10.2c.
58. Table 10.6.
59. Table 11.1.
60. Table 11.2.
61. Table 11.5.
62. Table 11.5.
63. Table 11.10.
64. Table 12.1.
65. Table 12.2.
66. Tables 1.5 and 12.2.
67. Tables 12.1 and 12.5.