

## World Energy Overview: 1994-2004

The International Energy Annual presents information and trends on world energy production and consumption for petroleum, natural gas, coal, and electricity. Production and consumption data are reported in standard United States physical units as well as British thermal units (Btu). Reserve estimates are shown for petroleum, natural gas, and coal and trade data are provided for these three fuels and for electricity. Data are provided on crude oil refining capacity and electricity installed capacity by type. Prices are included for selected crude oils. Population data are also provided.

**(Note:** In the discussion that follows, the data for total **production** of primary energy in 1994 and 2004 each include production in the United States of 2.4 quadrillion Btu of renewable energy not used for electricity generation (Table F.9). This renewable energy production includes ethanol blended into motor gasoline and geothermal, solar, and wood and waste energy not used for electricity generation. Likewise, the data for total **consumption** of primary energy in 1994 and 2004 include consumption in the United States of 2.3 and 2.1 quadrillion Btu, respectively, of renewable energy not used for electricity generation. (Table E.8). Included are geothermal, solar, and wood and waste energy not used for electricity generation.)

### World Primary Energy Production Trends

Between 1994 and 2004, the world's total output of primary energy -- petroleum, natural gas, coal, and electric power (hydro, nuclear, geothermal, solar, wind, and wood and waste)--increased at an average annual rate of 2.2 percent (Table 2.9). World production increased from 355 quadrillion Btu in 1994 to 443 quadrillion Btu in 2004.

In 2004, petroleum (crude oil and natural gas plant liquids) continued to be the world's most important primary energy source, accounting for 37.5 percent, or 166 quadrillion Btu, of world primary energy production (Table 2.9). Between 1994 and 2004, petroleum production increased by 13.3 million barrels per day, or 19.9 percent, rising from 66.6 to 79.9 million barrels per day (Tables 2.2 and 2.3). The Middle East had the largest production gain, followed by Eurasia, and Africa. Their combined gains over the period from 1994 to 2004 were 10.9 million barrels per day.

Coal ranked second as a primary energy source in 2004, accounting for 25.6 percent of world primary energy production (Table 2.9). World coal production totaled 6.1 billion short tons, or 113 quadrillion Btu, in 2004, and it increased by 22.8 percent from the 1994 level of 5.0 billion short tons (Tables 2.1 and 2.9).

Dry natural gas ranked third as a primary energy source, accounting for 23.1 percent of world primary energy production in 2004 (Table 2.9). Production of dry natural gas was 98.6 trillion cubic feet, or 102 quadrillion Btu, in 2004 (Tables 2.1 and 2.9). Production increased by 21.7 trillion cubic feet from 76.9 trillion cubic feet in 1994, a gain of 28.2 percent.

Hydro, nuclear, and other (geothermal, solar, wind, and wood and waste) electric power generation ranked fourth, fifth, and sixth, respectively, as primary energy sources in 2004, accounting for 6.21, 6.20, and 0.9 percent, respectively, of world primary energy production (Table 2.9). Together they accounted for a combined total of 5.7 trillion kilowatthours, or 59 quadrillion Btu, in 2004 (Tables 2.1 and 2.9). Nuclear electric power generation increased significantly between 1994 and 2004, rising from 2.1 trillion kilowatthours to 2.6 trillion kilowatthours, a 23.2-percent increase. Hydroelectric power contributed 2.7 trillion kilowatthours in 2004, up 17.3 percent from 2.3 trillion kilowatthours in 1994. Geothermal, solar, wind, and wood and waste electric power generation also increased significantly over the same period, rising from 164 billion kilowatthours to 334 billion kilowatthours, a 103.7-percent increase.

In 2004, United States production of 2.4 quadrillion Btu of renewable energy not used for electricity generation ranked seventh as a primary energy source, accounting for 0.5 percent of world primary energy production (Table 2.9).

## Major Energy Producers and Consumers

In 2004, three countries--the United States, China, and Russia--were the leading producers and consumers of world energy (Tables F.1 and E.1). These three countries produced 40 percent and consumed 43 percent of the world's total energy.

The United States, China, Russia, Saudi Arabia, and Canada were the world's five largest producers of energy in 2004, supplying 49.8 percent of the world's total energy (Table F.1). The next five leading producers of primary energy were Iran, India, Norway, Australia, and Mexico, and together they supplied an additional 12.4 percent of the world's total energy. The United States supplied 70.4 quadrillion Btu of primary energy, significantly more than the 55.9 quadrillion Btu produced by China or the 51.7 quadrillion Btu produced by Russia.

The United States, China, Russia, Japan, and India were the world's five largest consumers of primary energy in 2004, accounting for 51.1 percent of world energy consumption (Table E.1). They were followed by Germany, Canada, France, the United Kingdom, and Brazil, which together accounted for an additional 13.1 percent of world energy consumption. The United States consumed 100.4 quadrillion Btu, more than one and two-thirds times as much as the 59.6 quadrillion Btu consumed by China, while Russia consumed 30.1 quadrillion Btu.

## Regional Energy Production and Consumption

Comparisons of energy production and consumption by region help to highlight key energy trends since 1994. In North America, the overall production of energy rose by 4.2 quadrillion Btu between 1994 and 2004 (Table F.1). The supply of natural gas increased by 1.6 quadrillion Btu, while nuclear electric power generation increased by 1.4 quadrillion Btu (Tables F.4 and F.7). Energy consumption in North America increased by 13.8 quadrillion Btu between 1994 and 2004, the second largest increase for any region (Table E.1). The largest North American increases occurred in the consumption of petroleum, 7.0 quadrillion Btu, coal, 2.7 quadrillion Btu, natural gas, 2.6 quadrillion Btu, and nuclear electric power, 1.4 quadrillion Btu (Tables E.2, E.4, E.3, and E.6).

Overall production of energy in the Central & South America region increased by 7.4 quadrillion Btu between 1994 and 2004, led by increases in crude oil production, 2.5 quadrillion Btu, natural gas production, 2.2 quadrillion Btu, and hydroelectric power generation, 1.2 quadrillion Btu (Tables F.1, F.2, F.4, and F.6). Energy consumption in the Central & South America region increased by 5.7 quadrillion Btu over the same period (Table E.1). The largest increases occurred in the consumption of petroleum, 2.3 quadrillion Btu, natural gas, 1.7 quadrillion Btu, and hydroelectric power, 1.2 quadrillion Btu (Tables E.2, E.3, and E.5).

In 2004, total energy production in Europe was 2.4 quadrillion Btu higher than in 1994 (Table F.1). Gains between 1994 and 2004 were greatest for natural gas, 2.6 quadrillion Btu, nuclear electric power generation, 1.4 quadrillion Btu, and geothermal, solar, wind and wood and waste electric power, 1.0 quadrillion Btu (Tables F.4, F.7, and F.8, ). These increases more than offset a 2.6-quadrillion-Btu drop in coal production and an 0.2 quadrillion-Btu drop in crude oil production (Tables F.5 and F.2 ). European energy consumption increased by 10.9 quadrillion Btu between 1994 and 2004 (Table E.1). The increase was led by natural gas, 6.5 quadrillion Btu, petroleum, 2.9 quadrillion Btu, and nuclear electric power, 1.4 quadrillion Btu, which together more than offset a 1.0 quadrillion Btu decrease in coal consumption (Tables E.3, E.2, E.6, and E.4).

Between 1994 and 2004, energy production in Eurasia increased by 13.4 quadrillion Btu (Table F.1). The largest increases in energy production were in crude oil, 7.8 quadrillion Btu, natural gas, 3.2 quadrillion Btu, and coal, 1.2 quadrillion Btu, (Table F.2, Table F.4, and Table F.5,) that more than offset an 0.2-quadrillion-Btu decrease in hydroelectric power generation (Table F.6). Consumption in this region increased by only 1.0 quadrillion Btu (Table E.1). Increases in natural gas, 2.1 quadrillion Btu, and nuclear electric power, 0.8 quadrillion Btu, (Tables E.3 and E.6) more than offset decreases in petroleum, 1.8 quadrillion Btu, and hydroelectric power, 0.2 quadrillion Btu (E.2, and E.5).

Since 1994, energy production in the Middle East increased by 14.8 quadrillion Btu, the second largest increase for any region (Table F.1). The increase was concentrated in crude oil, 8.0 quadrillion Btu, natural gas, 5.5 quadrillion Btu, and natural gas plant liquids, 1.3 quadrillion Btu (Tables F.2, F.4 and F.3). The increase in energy consumption in the Middle East between 1994 and 2004 was smaller, only 7.5 quadrillion Btu (Table E.1). The largest consumption increases were in natural gas, 4.3 quadrillion Btu, and petroleum, 3.1 quadrillion Btu (Tables E.3 and E.2).

Energy production in Africa increased by 9.1 quadrillion Btu between 1994 and 2004, led by increases in the production of crude oil, 4.4 quadrillion Btu, natural gas, 2.7 quadrillion Btu, and coal, 1.3 quadrillion Btu (Tables F.1, F.2, F.4, and F.5). Energy consumption in Africa grew more slowly over the same period, rising by only 3.3 quadrillion Btu, led by petroleum, 1.2 quadrillion Btu, natural gas, 1.0 quadrillion Btu, and coal, 0.7 quadrillion Btu (Tables E.1, E.2, E.3, and E.4).

The largest regional increase in primary energy production between 1994 and 2004 occurred in the Asia & Oceania region, where production increased by 36.6 quadrillion Btu (Table F.1). Coal production accounted for 25.8 quadrillion Btu or 71 percent of the increase, natural gas production for 5.2 quadrillion Btu, and hydroelectric power generation for 2.0 quadrillion Btu (Tables F.5, F.4, and F.6). Consumption in this region increased by 47.0 quadrillion Btu over the same period, also the largest increase for any region (Table E.1). Coal accounted for 51 percent, or 24.2 quadrillion Btu, of this increase, while petroleum accounted for another 27 percent, or 12.6 quadrillion Btu (Tables E.4 and E.2). At the same time, the consumption of natural gas rose by 6.4 quadrillion Btu, hydroelectric power by 2.0 quadrillion Btu, and nuclear electric power by 1.4 quadrillion Btu (Tables E.3, E.5, and E.6).

## **Petroleum**

Global production of petroleum (crude oil and natural gas plant liquids) increased by 13.3 million barrels per day between 1994 and 2004, an average annual rate of growth of 1.8 percent (Tables 2.2 and 2.3). Saudi Arabia, Russia, and the United States were the three largest producers of petroleum in 2004. Together, they produced 33.7 percent of the world's petroleum. Production from Iran and Mexico accounted for an additional 9.9 percent.

In 2004, the United States consumed 20.7 million barrels per day of petroleum--25 percent of world consumption (Table 1.2). China and Japan ranked a distant second and third in consumption, with 6.4 and 5.4 million barrels per day, respectively, followed by Russia and Germany.

## **Natural Gas**

World production of dry natural gas increased by 21.7 trillion cubic feet, or at an average annual rate of 2.5 percent, over the period from 1994 to 2004 (Table 2.4). Russia was the leading producer in 2004 at 22.4 trillion cubic feet, followed by the United States at 18.8 trillion cubic feet. Together these two countries produced 42 percent of the world total. Canada ranked a distant third in production at 6.5 trillion cubic feet, followed by the United Kingdom and the Netherlands, with 3.4 and 3.0 trillion cubic feet, respectively. These three countries accounted for 13 percent of the world total.

In 2004, the United States, which was the leading consumer of dry natural gas at 22.4 trillion cubic feet, and Russia, which ranked second at 16.0 trillion cubic feet, together accounted for 39 percent of world consumption (Table 1.3). Germany ranked a distant third in consumption, with 3.6 trillion cubic feet, followed by the United Kingdom and Canada, at 3.5 and 3.4 trillion cubic feet, respectively.

## **Coal**

Coal production increased by 1.1 billion short tons between 1994 and 2004, or at an average annual rate of 2.1 percent (Table 2.5). China was the leading producer in 2004 at 2.2 billion short tons--equivalent to 43.0 quadrillion Btu (Tables 2.5 and F.5). The United States was the second leading producer in 2004 with 1.1 billion short tons--equivalent to 22.7 quadrillion Btu. India ranked a distant third at 444 million short tons--equivalent to 7.3 quadrillion Btu, followed by Australia , at 391 million short tons--equivalent to 7.9 quadrillion Btu, and Russia at 309 million short tons--equivalent to 5.9 quadrillion Btu. Together, these five countries accounted for 73 percent of world coal production in 2004 (Table 2.5).

China was also the largest consumer of coal in 2004, using 2.1 billion short tons, followed by the United States, which consumed 1.1 billion short tons, India, Germany , and Russia (Table 1.4). These five countries together accounted for 69 percent of world coal consumption.

## **Hydroelectric Power**

The generation of hydroelectric power increased by 406 billion kilowatthours between 1994 and 2004, or at an average annual rate of 1.6 percent (Table 2.6). Canada, China, Brazil, the United States, and Russia, were the five largest producers of hydroelectric power in 2004. Their combined hydroelectric power generation accounted for 51 percent of the world total. Canada led the world with 334 billion kilowatthours or 3.35 quadrillion Btu (Tables 2.6 and F.6). China ranked second with 328 billion kilowatthours or 3.28 quadrillion Btu and Brazil was third with 318 billion kilowatthours or 3.18 quadrillion Btu. The United States was fourth with 268 billion kilowatthours or 2.7 quadrillion Btu, followed by Russia with 165 billion kilowatthours or 1.7 quadrillion Btu.

## **Nuclear Electric Power**

The generation of nuclear electric power increased by 494 billion kilowatthours between 1994 and 2004, or at an average annual rate of 2.1 percent (Table 2.7). The United States led the world in nuclear electric power generation in 2004 with 789 billion kilowatthours or 8.2 quadrillion Btu (Tables 2.7 and F.7). France was second with 426 billion kilowatthours or 4.4 quadrillion Btu and Japan ranked third with 272 billion kilowatthours or 2.8 quadrillion Btu. In 2004, these three countries generated 57 percent of the world's nuclear electric power (Table 2.7).

## **Geothermal, Solar, Wind, and Wood and Waste Electric Power**

The generation of geothermal, solar, wind, and wood and waste electric power increased by 170 billion kilowatthours between 1994 and 2004, or at an average annual rate of 7.4 percent (Table 2.8). The United States led the world in geothermal, solar, wind, and wood and waste electric power generation in 2004 with 97 billion kilowatthours. Germany was second with 39 billion kilowatthours, followed by Spain with 21 billion kilowatthours, Brazil with 17.2 billion kilowatthours, and Japan with 15.0 billion kilowatthours. These five countries accounted for 52 percent of the world geothermal, solar, wind, and wood and waste electric power generation in 2004.

## Carbon Dioxide Emissions from the Consumption and Flaring of Fossil Fuels

Total world carbon dioxide emissions from the consumption of petroleum, natural gas, and coal, and the flaring of natural gas increased from 21.7 billion metric tons of carbon dioxide in 1994 to 27.0 billion metric tons in 2004, or by 24.9 percent (Table H.1co2). The average annual growth rate of carbon dioxide emissions over the period was 2.2 percent (**Note: Carbon dioxide emissions are measured here in metric tons of carbon dioxide. Tons of carbon dioxide can be converted to tons of carbon equivalent by multiplying by 12/44. )** The United States, China, Russia, Japan, and India were the world's five largest sources of carbon dioxide emissions from the consumption and flaring of fossil fuels in 2004, producing 54 percent of the world total. The next five leading producers of carbon dioxide emissions from the consumption and flaring of fossil fuels were Germany, Canada, the United Kingdom, South Korea, and Italy, and together they produced an additional 11 percent of the world total. In 2004, total United States carbon dioxide emissions from the consumption and flaring of fossil fuels were 5.9 billion metric tons of carbon dioxide, more than one and one-fourth times as much as the 4.7 billion metric tons produced by China, while Russia produced 1.7 billion metric tons.

In 2004, the consumption of petroleum was the world's primary source of carbon dioxide emissions from the consumption and flaring of fossil fuels, accounting for 40.1 percent of the total (Tables H.2co2 and H.1co2). Between 1994 and 2004 emissions from the consumption of petroleum increased by 1.7 billion metric tons of carbon dioxide, or 18.1 percent, rising from 9.2 to 10.8 billion metric tons. The United States was the largest producer of carbon dioxide from the consumption of petroleum in 2004 and accounted for 24 percent of the world total. China was the second largest producer, followed by Japan, Russia, and Germany, and together these four countries accounted for an additional 20 percent.

Coal ranked a close second as a source of carbon dioxide emissions from the consumption and flaring of fossil fuels in 2004, accounting for 39.2 percent of the total (Tables H.4co2 and H.1co2). World carbon dioxide emissions from the consumption of coal totaled 10.6 billion metric tons of carbon dioxide in 2004, up 30.8 percent from the 1994 level of 8.1 billion metric tons. China and the United States were the two largest producers of carbon dioxide from the consumption of coal in 2004 and together they accounted for 56 percent of the world total. India, Russia, and Japan accounted for an additional 15 percent.

Carbon dioxide emissions from the consumption and flaring of natural gas accounted for the remaining 20.7 percent of carbon dioxide emissions from the consumption and flaring of fossil fuels in 2004 (Tables H.3co2 and H.1co2). Emissions from the consumption and flaring of natural gas increased from 4.4 billion metric tons of carbon dioxide in 1994 to 5.6 billion metric tons in 2004, or by 28.4 percent. The United States and Russia were the two largest producers of carbon dioxide from the consumption and flaring of natural gas in 2004 and together they accounted for 37 percent of the world total. The United Kingdom, Iran, and Germany accounted for an additional 10 percent.

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