III. Worldwide energy consumption by energy type

Overview

(See Tables 5-7, Maps 4 and 5.)

Total global energy use exceeds 350 quadrillion British thermal units[4] (BTUs) per year, which is equivalent to over 170 million barrels of oil each day[5]. Global energy consumption draws from six primary sources: 44% petroleum, 26% natural gas, 25% coal, 2.4% hydroelectric power, 2.2% nuclear power, and 0.2% nonhydro renewable[6] energy.

The developing and developed worlds demonstrate striking disparities in annual energy consumption per capita (Figure 1). While the average person in the developing countries consumes 32 million British thermal units (BTUs) per year, equivalent to about 6 barrels of oil, the average person in the developed countries consumes 210 million BTUs/year, equivalent to nearly 40 barrels of oil. The poorest 10% of countries consumes only 3.4 million BTUs per capita per year, while the richest 10% consumes 218 million BTUs per capita per year. This over 60-fold difference is equivalent to about 39 more barrels of oil consumed per person per year by the richest countries than by the poorest. Also striking are disparities within the developing world: the middle-income countries annually consume 50 million BTUs (about nine barrels of oil) per capita, while the low-income countries annually consume only 13 million BTUs (about two and a half barrels of oil) per capita. These relationships between wealth and energy consumption suggest that as a country becomes richer, its people tend to consume substantially more energy.

Even though average per capita energy consumption is quite different among the income groups, the ranges of total per capita energy consumption among countries in each group demonstrate a great degree of overlap. Among the low-income states, energy consumption ranges from 0.36 million BTUs/year per capita (Chad) to 107 million BTUs/year per capita (Ukraine). At 3.8 million BTUs/year per capita, Kiribati has the lowest energy consumption among the middle-income countries while Bahrain, at 536 million BTUs/year per capita, has the highest. French Polynesia consumes 50 million BTUs per capita, the least among the high-income countries, and demonstrates that the range for high-income countries overlaps with the other two groups. The high-income country with the greatest per capita consumption is the Virgin Islands, with 1154 million BTUs consumed per person each year.

Not only do the three income groups show wide disparities in energy consumption per capita, but they also exhibit different trends in the composition of energy types consumed. With all income groups, petroleum is consumed the most, but the next most-consumed energy source in the developing world is coal, while it is natural gas for the high-income countries. Among the developing countries, hydropower is the next most consumed energy source after natural gas, while the developed countries consume more nuclear energy than hydropower. Renewable energy generated from sources such as

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[4] 1 BTU = 1055.1 joules

[5] Based on year 2000 data from the *International Energy Annual 2001 Edition* released by the Energy Information Administration of the US Department of Energy.

[6] Renewables in this part of the discussion include energy generated from sources such as geothermal, wind, solar, wood, and waste fuels. This percentage does not include the domestic use of fuelwood and other biomass common in developing countries, but does include energy derived from electric power generation using these fuels.

geothermal, solar, wood, and waste fuels was the least consumed energy type among all income groups. This analysis does not include the domestic use of fuelwood and other biomass common in developing countries, but does include energy derived from electric power generation using these fuels.

Energy consumption per US$ of GDP is much less disparate among the income groups. Moreover, lower-income countries generally use more energy to create a dollar of GDP than the high-income countries (Figure 2). The developing world consumes 24,650 BTUs of energy per US$ of GDP, with the poorest 10% consuming 14,978 BTUs/US$GDP, the low-income countries consuming 28,896 BTUs/US$GDP, and the middle-income countries consuming 23,880 BTUs/US$GDP. The developed world consumes less energy per US$ of GDP (7487 BTUs), about a threefold decrease from the developing countries.

Petroleum

(See Tables 6 and 7, Map 6.)

Petroleum is the most consumed energy type per capita among all income groups—with every country consuming at least some petroleum—but there is great disparity in consumption between groups (Figure 1). The low-income countries consume 4 million BTUs/year per capita, less than one barrel of oil per person per year, while the poorest 10% consume less than half a barrel per person per year. The middle-income countries consume 20 million BTUs/year per capita, and the average among all developing countries is 13 million BTUs/year per capita. In contrast, the consumption per capita among the high-income countries is 102 million BTUs/year, and 106 million BTUs/year for the richest 10% of all countries.

Within the low-income countries, several former Soviet states tend to be among the top petroleum consumers per capita. Five out of the ten top consumers are former Soviet countries: Azerbaijan (6.2 barrels/year per capita), Georgia (2.2 barrels/year per capita), Uzbekistan (2.0 barrels/year per capita), Ukraine (1.9 barrels/year per capita), and Moldova (1.9 barrels/year per capita). Another low-income country with relatively high consumption is Mauritania (3.3 barrels/year per capita). Most of the remaining low-income countries consume less than one barrel/year per capita.

Petroleum ranks highest among all income groups in consumption per unit of GDP, with the developing countries consuming more (9607 BTUs/US$GDP) than the developed world (3645 BTUs/US$GDP) (Figure 2). However, within the developing world, middle-income consumption (9414 BTUs/US$GDP) is similar to low-income consumption (10,752 BTUs/US$GDP) and consumption among the poorest 10% of countries (9691 BTUs/US$GDP).

Natural gas

(See Tables 6 and 7, Map 7.)

The next most consumed energy type per capita, at least for the high-income countries, is dry natural gas. The low-, middle-, and high-income groups consume 50 to 75 percent as much energy per capita in the form of natural gas as they do petroleum (Figure 1). However, the low-income countries consume more energy in the form of coal than natural gas. Again, there is a large disparity in per capita consumption between the

developing and the developed world. The low-income countries consume 3 million BTUs/year per capita, about 3360 cubic feet of gas per person per year, while the poorest 10% consume about 830 cubic feet of gas person per year. The middle-income countries consume 12 million BTUs/year per capita, and the average among all developing countries is 8 million BTUs/year per capita. In contrast, the consumption per capita among the high-income countries is 55 million BTUs/year, and 56 million BTUs/year for the richest 10% of all countries.

Forty-eight out of sixty-nine countries in the low-income group do not consume any natural gas, and natural gas consumption occurs in only three of the 10% poorest countries (Nigeria, Mozambique, and Tajikstan). As with petroleum, the former Soviet states dominate per capita natural gas consumption within the low-income group. Eight of the ten top consumers are former Soviet countries: Uzbekistan, Ukraine, Azerbaijan, Moldova, Kyrgyzstan, Armenia, Georgia, and Tajikstan.

Natural gas consumption is more common among the middle-income countries, although thirty-four (out of seventy-nine) countries in this group do not consume any natural gas. Ironically, natural gas is less common among the high-income countries than among the middle-income countries. Twenty-six out of fifty-seven high-income countries do not consume natural gas. Also, the three greatest consumers per capita of natural gas in the high-income group also happen to be the three Middle Eastern countries with the greatest oil reserves: Kuwait (171 thousand cubic feet), United Arab Emirates (382 thousand cubic feet), and Qatar (909 thousand cubic feet). They are not, however, the highest per capita consumers of petroleum.

As with petroleum, the developing world (6363 BTUs/US$GDP) consumes far more natural gas per unit of GDP than the developed nations (1927 BTUs/US$GDP) (Figure 2). However, largely because its use is less ubiquitous among developing countries, natural gas consumption per unit of GDP varies more than with petroleum. The poorest 10% of countries consumes 3706 BTUs/US$GDP, the low-income countries consume 8362 BTUs/US$GDP, and the middle-income countries consume 6001 BTUs/US$GDP. In contrast, the high-income countries consume 1927 BTUs/US$GDP.

Coal

(See Tables 6 and 7, Map 8.)

As noted previously, coal is the next-most consumed form of energy after petroleum for the developing world. However, per capita coal consumption among the high-income states (40.2 million BTUs/year) is still about four times that of the developing countries (10.1 million BTUs/year) (Figure 1). This difference constitutes a 1.7 short ton disparity in per capita coal consumption between the developing and developed worlds. Again, consumption inequalities also occur among the developing countries: the middle income countries consume fifteen-million BTUs/year of coal per capita, while the low-income countries consume four-million BTUs/year per capita and the poorest 10% consume only 46,000 BTUs/year per capita.

Although more common than natural gas, coal consumption in the developing world is by no means ubiquitous. Thirty-six countries in the low-income group consume no coal whatsoever, while 23 more countries in this group have per capita rates that do not exceed one million BTUs/year. In contrast, the top coal per capita coal consumers among the low-income states, North Korea, Mongolia, and Ukraine, consume 81.7

million BTUs/year, 39.5 million BTUs/year, and 32.7 million BTUs, respectively. Twenty-eight countries in the middle-income group consume no coal, with another 28 failing to exceed one million BTUs/year per capita. The greatest per capita consumers among the middle-income states are Czech Republic (117.6 million BTUs/year), Bulgaria (75.5 BTUs/year), and Macedonia (73.5 BTUs/year).

The high-income countries also include 28 countries that consume no coal, and most per capita rates do not exceed the maximum rates among the developing countries. The only exceptions are Australia (126.7 BTUs/year) and Greece (118.2 BTUs/year).

As with petroleum and natural gas, the developing countries tend to consume more coal per unit of GDP than does the developed world (Figure 2). The low-income countries consume 8711 BTUs/US$GDP and the middle-income countries consume 7553 BTUs/US$GDP. In contrast, the high-income countries consume 1438 BTUs/US$GDP. The poorest 10% of countries consumes only 201 BTUs/US$GDP, because only 40% of these countries consume any coal at all.

Hydroelectric power

(See Tables 6 and 7, Map 9.)

After fossil fuels, hydroelectric power is the next most consumed form of energy among the developing countries, but not among the high-income nations (Figure 1). Nevertheless, per capita hydroelectric power consumption is still much greater among the high-income countries (5 million BTUs/year) than among the developing countries (900,000 BTUs/year). Hydroelectric power consumption is also greater for the middle-income countries (1.4 million BTUs/year per capita) than for the low-income countries (350,000 BTUs/year per capita).

Hydroelectric power consumption is relatively common among the developing countries. Sixty percent of the poorest 10% of countries consume hydroelectric power, not only making it more common than coal consumption, but also resulting in greater per capita consumption of hydropower (310,000 BTUs/year) than of coal (46,000 BTUs/year) for this group. In total, fifty-two countries in the low-income group (75%) and sixty-six in the middle-income group (78%) consume hydroelectric power, compared to only twenty-nine (51%) among the high-income countries. Those countries in the middle- and high- income groups that consume no hydroelectric power tend to be either island or Middle Eastern states.

Similar to other forms of energy, hydroelectric power consumption per unit of GDP among developing countries far exceeds that for high-income nations (Figure 2). Hydroelectric power consumption per unit of GDP is greatest among the poorest 10% of countries (1379 BTUs/US$GDP) while figures for the low- and middle-income countries are similar (758 and 687 BTUs/US$GDP, respectively). In contrast, consumption among the developed countries is only 180 BTUs/US$GDP.

Nuclear power

(See Tables 6 and 7, Map 10.)

Nuclear power is the most consumed form of energy among the high-income countries after coal (Figure 1). The developed world consumes 7.7 million BTUs/year per capita of nuclear energy, compared to only 290,000 BTUs/year per capita in the

developing world, and zero consumption of nuclear power among the poorest 10% of countries.

For all income groups, consumption of nuclear energy is concentrated in only a few countries. Only four low-income countries consume nuclear energy: Pakistan, India, Armenia, and Ukraine. Thirteen middle-income countries and thirteen high-income also consume nuclear energy. Among the developing countries, the countries with greatest per capita nuclear energy consumption tend to be Eastern European or former Soviet states. South Africa and South Korea are also prominent consumers. In the high-income group, those countries with highest per capita nuclear energy consumption tend to be Western European states, in addition to Canada, Japan, and the United States.

Nuclear energy consumption per unit of GDP is quite similar between income groups (Figure 2). Except for the poorest 10% of countries, which consumes no nuclear power, all income categories consume between 200 and 300 BTUs per US$GDP.

Renewable energy sources
(See Tables 6 and 7, Map 11.)

This category, which includes electricity from geothermal, solar, wind, wood, and waste power generation, is the least consumed form of energy across all income groups (Figure 1). Per capita consumption rates do not exceed 100,000 BTUs/year in the developing country categories, and do not exceed 1 million BTUs/year in the high-income category. Only five low-income countries consume renewable electric energy: Nicaragua, Kenya, Indonesia, India, and Ethiopia. Renewable energy consumption is more common among the middle-income states, but still only thirty of these countries consume any renewable energy. Twenty-four high-income countries consume renewable energy, making it more widespread than nuclear power among developed countries, but still the least in per capita consumption. Among all countries, Iceland leads in per capita consumption (15.3 million BTUs/year per capita) while the United States leads by far in total consumption (292.7 million BTUs/year, compared to the next highest, 64.8 million BTUs/year in Japan).

Renewable energy is also the least in terms of consumption per unit of GDP (Figure 2). Rates are quite similar among the income groups. Although the poorest 10% of countries consumes less than 1 BTU/year per capita, the low-, middle-, and high-income groups consume between 16 to 27 BTUs/year per capita.

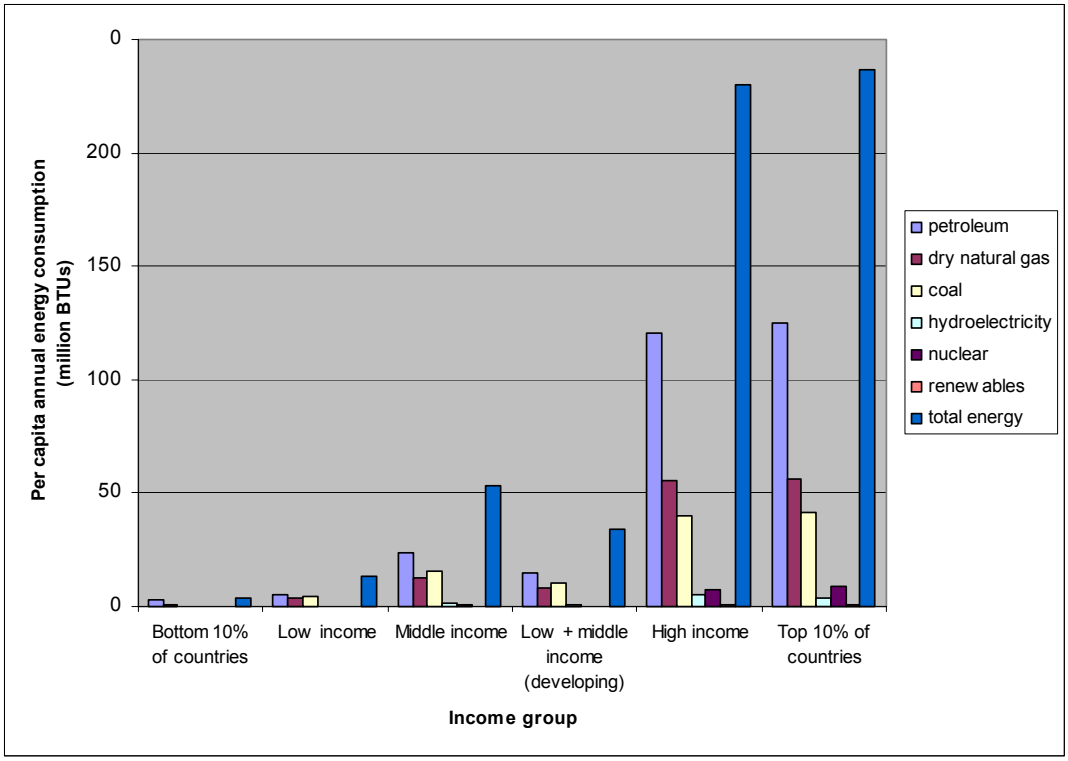

Figure 1. Per capita consumption of major energy types, by income group, in 2000.

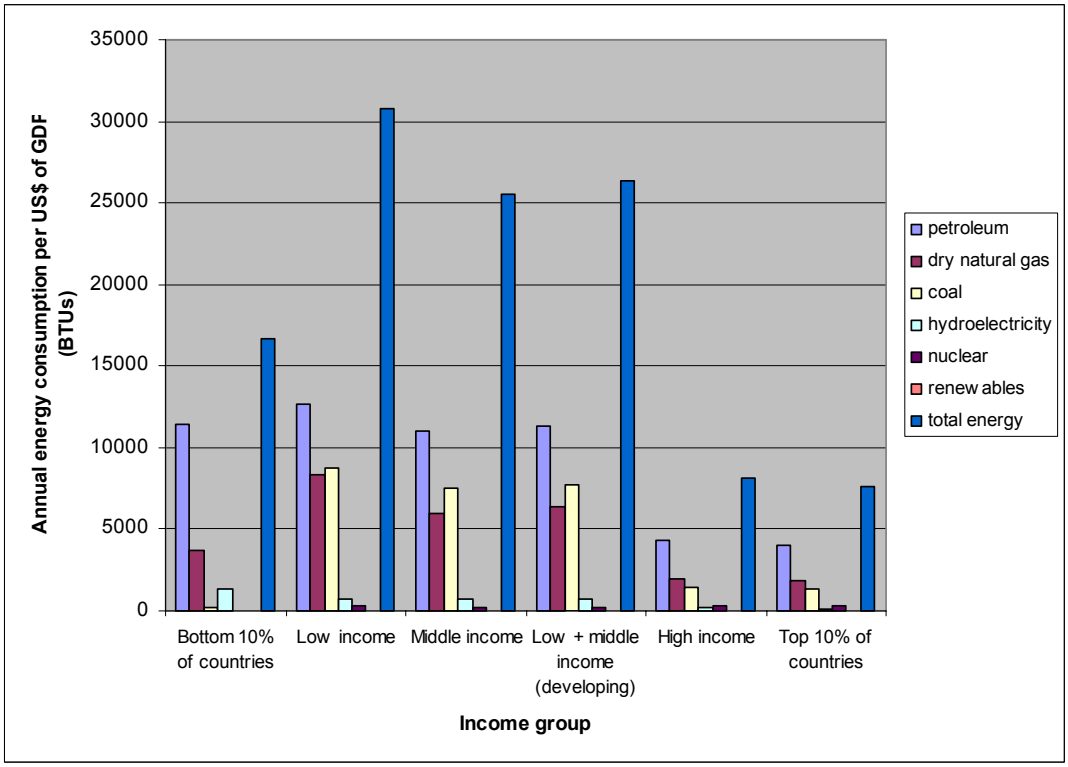

Figure 2. Consumption of energy types per US$ of GDP, by income group, in 2000.