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Contacts

The *International Energy Outlook* is prepared by the Energy Information Administration (EIA). General questions concerning the contents of the report should be referred to John J. Conti, Director, Office of Integrated Analysis and Forecasting (john.conti@eia.doe.gov, 202-586-2222), or Glen E. Sweetnam, Director, International, Economic, and Greenhouse Gases Division (glen.sweetnam@eia.doe.gov, 202-586-2188). Specific questions about the report should be referred to Linda E. Doman (202-586-1041) or the following analysts:

World Energy Demand and Economic Outlook	Linda Doman	(linda.doman@eia.doe.gov,	202-586-1041)
Liquid Fuels	John Staub	(john.staub@eia.doe.gov,	202-586-6344)
	Lauren Mayne	(lauren.mayne@eia.doe.gov,	202-586-3005)
Natural Gas	Justine Barden	(justine.barden@eia.doe.gov	202-586-3508)
	Phyllis Martin	(phyllis.martin@eia.doe.gov,	202-586-9592)
Coal	Michael Mellish	(michael.mellish@eia.doe.gov,	202-586-2136)
	Diane Kearney	(diane.kearney@eia.doe.gov,	202-586-2415)
	Stephanie Kette	(stephanie.kette@eia.doe.gov,	202-586-3627)
Electricity	Linda Doman	(linda.doman@eia.doe.gov,	202-586-1041)
Projections for Nuclear Power	Lori Aniti	(lori.aniti@eia.doe.gov,	202-586-2867)
Uranium Reserves	Brian Murphy	(brian.murphy@eia.doe.gov,	202-586-1398)
Transportation Sector Energy Use	Barry Kapilow-Cohen	(bcohen@eia.doe.gov,	202-586-5359)
Energy-Related Carbon Dioxide Emissions	Perry Lindstrom	(perry.lindstrom@eia.doe.gov,	202-586-0934)

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Telephone: 202/586-8800
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E-mail: *infoctr@eia.doe.gov*
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Preface

This report presents international energy projections through 2030, prepared by the Energy Information Administration, including outlooks for major energy fuels and associated carbon dioxide emissions.

The *International Energy Outlook 2008* (*IEO2008*) presents an assessment by the Energy Information Administration (EIA) of the outlook for international energy markets through 2030. U.S. projections appearing in *IEO2008* are consistent with those published in EIA's *Annual Energy Outlook 2008* (*AEO2008*), which was prepared using the National Energy Modeling System (NEMS). *IEO2008* is provided as a service to energy managers and analysts, both in government and in the private sector. The projections are used by international agencies, Federal and State governments, trade associations, and other planners and decisionmakers. They are published pursuant to the Department of Energy Organization Act of 1977 (Public Law 95-91), Section 205(c).

Projections in *IEO2008* are divided according to Organization for Economic Cooperation and Development members (OECD) and non-members (non-OECD). There are three basic country groupings in the OECD: North America (United States, Canada, and Mexico); OECD Europe; and OECD Asia (Japan, South Korea, and Australia/New Zealand) (see Appendix K for complete regional definitions). Non-OECD is divided into five separate regional subgroups: non-OECD Europe and Eurasia, non-OECD Asia, Africa, Middle East, and Central and South America. Russia is represented in non-OECD Europe and Eurasia; China and India are represented in non-OECD Asia; and Brazil is represented in Central and South America.

IEO2008 focuses exclusively on marketed energy. Nonmarketed energy sources, which continue to play an important role in some developing countries, are not included in the estimates. The *IEO2008* projections are based on U.S. and foreign government laws in effect on January 1, 2008. The potential impacts of pending or proposed legislation, regulations, and standards are not reflected in the projections, nor are the impacts of legislation for which the implementing mechanisms have not yet been announced.

The report begins with a review of world trends in energy demand and the major macroeconomic assumptions used in deriving the *IEO2008* projections, along with the major sources of uncertainty in the forecast. The time frame for historical data begins with 1980 and extends to 2005, and the projections extend to 2030. High economic growth and low economic growth cases were developed to depict a set of alternative growth paths for the energy projections. The two cases consider higher and lower growth paths for regional gross domestic product (GDP) than are assumed in the reference case. *IEO2008* also includes a high price case and, alternatively, a low price case. The resulting projections—and the uncertainty associated with international energy projections in general—are discussed in Chapter 1, "World Energy Demand and Economic Outlook."

Regional projections for energy consumption by fuel—liquids (primarily petroleum), natural gas, and coal—are presented in Chapters 2, 3, and 4, along with reviews of the current status of each fuel on a worldwide basis. Chapter 5 discusses the projections for world electricity markets—including nuclear power, hydropower, and other commercial renewable energy resources—and presents forecasts of world installed generating

Objectives of the *IEO2008* Projections

The projections in *IEO2008* are not statements of what will happen, but what might happen given the specific assumptions and methodologies used. The projections provide an objective, policy-neutral reference case that can be used to analyze international energy markets. As a policy-neutral data and analysis organization, EIA does not propose, advocate, or speculate on future legislative and regulatory changes.

Models are abstractions of energy production and consumption activities, regulatory activities, and producer and consumer behavior. The projections are highly dependent on the data, analytical methodologies, model structures, and specific assumptions used in their development. Trends depicted in the analysis are indicative of tendencies in the real world rather than representations of specific real-world outcomes. Even where trends are stable and well understood, the projections are subject to uncertainty. Many events that shape energy markets are random and cannot be anticipated, and assumptions concerning future technology characteristics, demographics, and resource availability are necessarily uncertain.

capacity. Chapter 6 includes a detailed look at the world's transportation energy use. Finally, Chapter 7 discusses the outlook for global energy-related carbon dioxide emissions.

Appendix A contains summary tables for the *IEO2008* reference case projections of world energy consumption, GDP, energy consumption by fuel, carbon dioxide emissions, and regional population growth. Summary tables of projections for the high and low economic growth cases are provided in Appendixes B and C, respectively, and projections for the high and low price cases are provided in Appendixes D and E, respectively. Reference case projections of delivered energy consumption by end-use sector and region are presented in Appendix F. Appendix G contains summary tables of projections for world liquids production in all cases. Appendix H contains summary tables of reference case projections for installed electric power capacity by fuel and regional electricity generation by fuel. Appendix I includes a set of comparisons of projections from the International Energy Agency's *World Energy Outlook 2007* with the *IEO2008* projections. Comparisons of the *IEO2008* and *IEO2007* projections are also presented in Appendix I. Appendix J describes the models used to generate the *IEO2008* projections, and Appendix K defines the regional designations included in the report.

Highlights

World marketed energy consumption is projected to increase by 50 percent from 2005 to 2030. Total energy demand in the non-OECD countries increases by 85 percent, compared with an increase of 19 percent in the OECD countries.

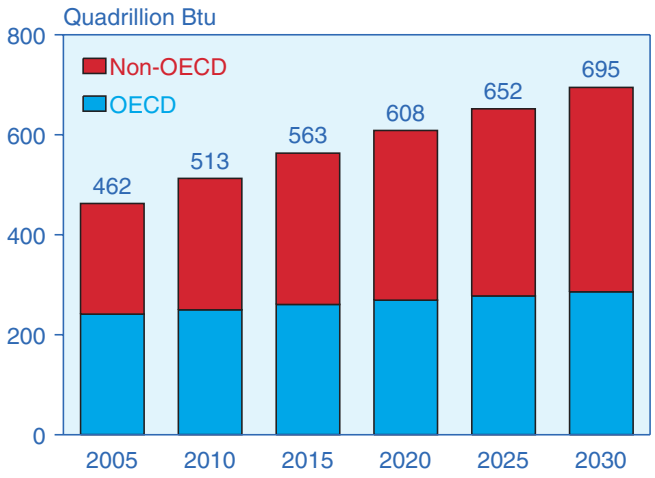
In the *IEO2008* reference case—which reflects a scenario where current laws and policies remain unchanged throughout the projection period—world marketed energy consumption is projected to grow by 50 percent over the 2005 to 2030 period. Total world energy use rises from 462 quadrillion British thermal units (Btu) in 2005 to 563 quadrillion Btu in 2015 and then to 695 quadrillion Btu in 2030 (Figure 1). Global energy demand grows despite the sustained high world oil prices that are projected to persist over the long term.

The most rapid growth in energy demand from 2005 to 2030 is projected for nations outside the Organization for Economic Cooperation and Development (non-OECD nations). Total non-OECD energy demand increases by 85 percent in the *IEO2008* reference case projection, as compared with an increase of 19 percent in OECD energy use. The robust growth in demand among the non-OECD nations is largely the result of strong projected economic growth. In all the non-OECD regions combined, economic activity—as measured by GDP in purchasing power parity terms—increases by 5.2 percent per year on average, as compared with an average of 2.3 percent per year for the OECD countries.

The *IEO2008* reference case projects increased world consumption of marketed energy from all fuel sources over the 2005 to 2030 projection period (Figure 2). Fossil fuels (liquid fuels and other petroleum,[1] natural gas, and coal) are expected to continue supplying much of the energy used worldwide. Liquids supply the largest share of world energy consumption over the projection period, but their share falls from 37 percent in 2005 to 33 percent in 2030, largely in response to a reference case scenario in which world oil prices are expected to remain relatively high.

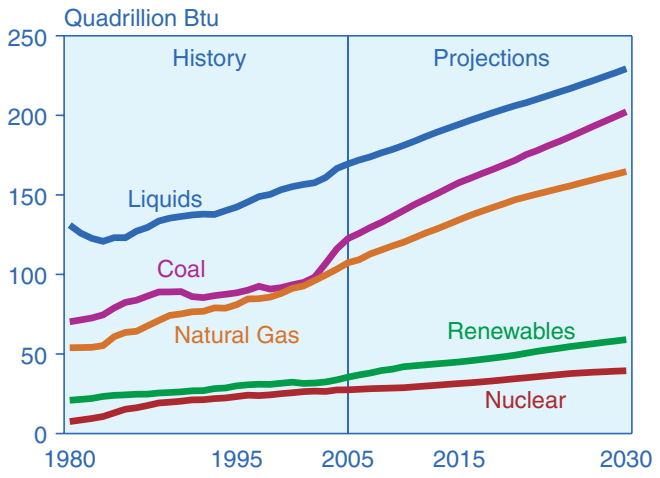
Average world oil prices in every year since 2003 have been higher than the average for the previous year. Prices in 2007 were nearly double the 2003 prices in real terms. Prices rose further into the third quarter of 2008, reaching $147 per barrel in mid-July, when they were well above the historical inflation-adjusted record price for a barrel of oil set in the early 1980s. A variety of factors have caused oil prices to increase rapidly since 2003, including strong demand growth in non-OECD Asia and the Middle East, no growth in production between 2005 and 2007 from the members of the Organization of the Petroleum Exporting Countries (OPEC),

Figure 1. World Marketed Energy Consumption, 2005-2030



Sources: **2005:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Figure 2. World Marketed Energy Use by Fuel Type, 1980-2030



Sources: **2005:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

[1]Liquid fuels and other petroleum include petroleum-derived fuels and non-petroleum-derived fuels, such as ethanol and biodiesel, coal-to-liquids, and gas-to-liquids. Petroleum coke, which is a solid, is included. Also included are natural gas liquids, crude oil consumed as a fuel, and liquid hydrogen.

rising costs for oil exploration and development, across-the-board increases in commodity prices, and a weaker U.S. dollar.

In the *IEO2008* reference case, prices ease somewhat in the medium term, as anticipated new production—both conventional and unconventional (in Azerbaijan, Brazil, Canada, Kazakhstan, and the United States, for example)—reaches the marketplace. Ultimately, however, markets are expected to remain relatively tight. In nominal terms, world oil prices in the *IEO2008* reference case decline from current high levels to around $70 per barrel in 2015, then rise steadily to $113 per barrel in 2030 ($70 per barrel in inflation-adjusted 2006 dollars).

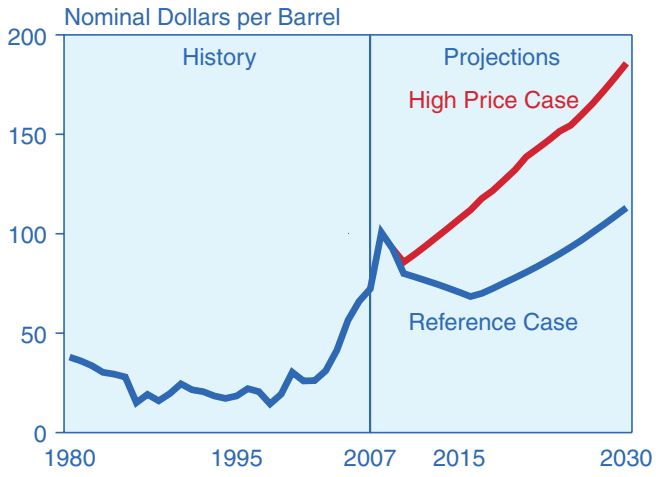
In addition to the reference case, *IEO2008* includes a high price case that helps to quantify the uncertainly associated with long-term projections of future oil prices. In the high price case, world oil prices in 2030—at $186 per barrel in nominal terms—are nearly 65 percent higher than projected in the reference case (Figure 3). Given current market conditions, it appears that world oil prices are on a path that more closely resembles the projection in the high price case than in the reference case. With higher world oil prices slowing the growth of demand in the long term, world liquids consumption in the high price case totals only 99.3 million barrels per day in 2030, 13 million barrels per day lower than in the reference case.

Liquids are expected to remain the world's dominant energy source throughout the *IEO2008* reference case projection, given their importance in the transportation and industrial end-use sectors. World use of liquids and other petroleum grows from 83.6 million barrels oil equivalent per day in 2005 to 95.7 million barrels per day in 2015 and 112.5 million barrels per day in 2030. The liquids share of world energy consumption declines through 2030, however, as other fuels replace liquids where possible. In most regions of the world, the role of liquid fuels outside the transportation sector continues to be eroded. Liquids remain the most important fuels for transportation, because there are few alternatives that can compete widely with liquid fuels. On a global basis, the transportation sector accounts for 74 percent of the total projected increase in liquids use from 2005 to 2030, with the industrial sector accounting for virtually all of the remainder.

To meet the increment in world liquids demand in the *IEO2008* reference case, total supply in 2030 is projected to be 28.2 million barrels per day higher than the 2005 level of 84.3 million barrels per day. The reference case assumes that OPEC producers will choose to maintain their market share of world liquids supply, and that OPEC member countries will invest in incremental production capacity so that their conventional oil production represents approximately 40 percent of total global liquids production throughout the projection. Increasing volumes of conventional liquids (crude oil and lease condensate, natural gas plant liquids, and refinery gain) from OPEC members contribute 12.4 million barrels per day to the total increase in world liquids production, and conventional liquids supplies from non-OPEC countries add another 8.6 million barrels per day (Figure 4).

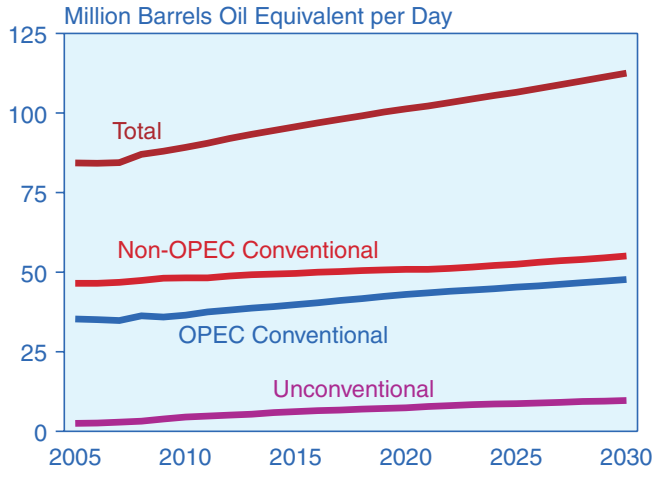
Unconventional resources (including oil sands, extra-heavy oil, biofuels, coal-to-liquids, and gas-to-liquids) from both OPEC and non-OPEC sources are expected to become increasingly competitive in the reference case. World production of unconventional resources, which totaled only 2.5 million barrels per day in 2005, increases

Figure 3. World Oil Prices in Two Cases, 1980-2030



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), web site www.eia.doe.gov/oiaf/aeo.

Figure 4. World Liquids Production, 2005-2030



Sources: **2005:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, Generate World Oil Balance Model (2008).

to 9.7 million barrels per day in 2030, accounting for 9 percent of total world liquids supply in 2030 on an oil equivalent basis. Biofuels, including ethanol and biodiesel, will be an increasingly important source of unconventional liquids supplies, largely because of the growth in U.S. biofuels production. In the *IEO2008* reference case, the United States accounts for nearly one-half of the rise in world biofuels production, at 1.2 million barrels per day in 2030.

The composition of supply differs substantially between the reference and high price cases. High prices encourage the development of previously uneconomical unconventional supplies, which account for a much larger portion of total liquids supply than in the reference case in 2030 (nearly 20 percent, as compared with about 9 percent in the reference case). Conventional supplies decline over the projection period in the high price case, by 1.5 million barrels per day, compared with an increase of 21.0 million barrels per day in the reference case. The high price case assumes that OPEC member countries will maintain their production at near current levels. As a result, OPEC is willing, in this case, to sacrifice market share as global demand for liquids continues to grow. The high price case also assumes that oil resources in non-OPEC countries will be less accessible and/or more expensive than in the reference case.

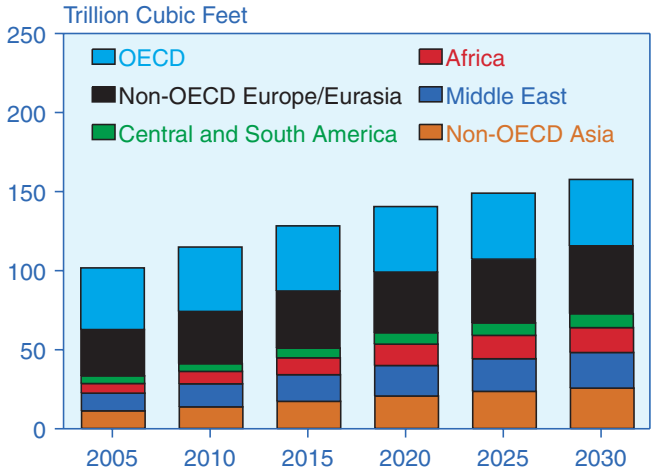
Worldwide natural gas consumption in the *IEO2008* reference case increases from 104 trillion cubic feet in 2005 to 158 trillion cubic feet in 2030. Natural gas is expected to replace oil wherever possible. Moreover, because natural gas combustion produces less carbon dioxide than coal or petroleum products, governments may encourage its use to displace the other fossil fuels as national or regional plans to reduce greenhouse gas emissions begin to be implemented. Natural gas is expected to remain a key energy source for industrial sector uses and electricity generation throughout the projection period. The industrial sector, which is the world's largest consumer of natural gas, accounts for 43 percent of projected natural gas use in 2030. In the electric power sector, natural gas is an attractive choice for new generating plants because of its relative fuel efficiency. Electricity generation accounts for 35 percent of the world's total natural gas consumption in 2030.

Much of the world's growing demand for natural gas is projected to be met by increased production from non-OECD nations. In the *IEO2008* reference case, non-OECD countries account for more than 90 percent of the world's total growth in production from 2005 to 2030 (Figure 5). A significant portion of the non-OECD production (excluding Russia and the other nations of Eurasia) is expected to be in the form of export projects—particularly liquefied natural gas (LNG) projects. The Middle East and Africa are at the forefront of the trend toward LNG: natural gas production in the two regions combined increases by 21.0 trillion cubic feet between 2005 and 2030, but their combined demand for natural gas increases by only 9.9 trillion cubic feet. Significant increases in natural gas production are also projected for the countries of non-OECD Asia, but those supply increases are expected to be used largely for consumption within the region rather than for export.

In the absence of national policies and/or binding international agreements that would limit or reduce greenhouse gas emissions, world coal consumption is projected to increase from 123 quadrillion Btu in 2005 to 202 quadrillion Btu in 2030, at an average annual rate of 2.0 percent. Coal's share of world energy use has increased sharply over the past few years, largely because of strong increases in coal use in China, which nearly doubled from 2000 to 2005 and is poised to increase strongly in the future. With its large domestic base of coal resources and continuing strong economic growth, China alone accounts for 71 percent of the increase in world coal consumption in the *IEO2008* reference case. The United States and India—both of which also have extensive domestic coal resources—each account for 9 percent of the world increase.

World net electricity generation nearly doubles in the *IEO2008* reference case, from about 17.3 trillion kilowatthours in 2005 to 24.4 trillion kilowatts in 2015 and 33.3 trillion kilowatthours in 2030. Non-OECD developing countries show the strongest growth in electricity demand as they expand their power grids to support sustained robust economic growth. Total electricity generation in the non-OECD countries increases by an average of 4.0 percent per year from 2005 to 2030, as

Figure 5. World Natural Gas Production, 2005-2030



Sources: **2005:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

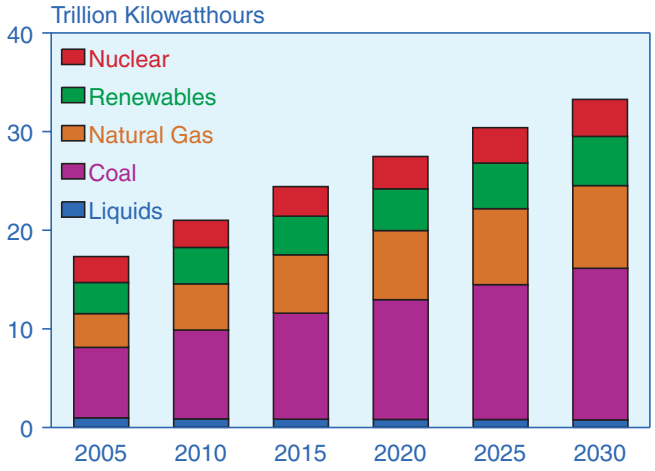
compared with a projected average increase of 1.3 percent per year for OECD electricity generation.

Coal and natural gas account for the largest increments in fuel consumption for electricity generation over the projection period. The 3.1-percent projected annual growth rate for coal-fired electricity generation worldwide is exceeded only by the 3.7-percent rate for natural-gas-fired generation (Figure 6). Sustained high prices for oil and natural gas make coal-fired generation more attractive economically, especially for coal-rich nations like China, India, and the United States.

The outlook for fossil-fuel-fired generation could be altered substantially by international agreements to reduce greenhouse gas emissions. The electric power sector offers some of the most cost-effective opportunities for reducing carbon dioxide emissions in many countries. Coal—the world's most widely used source of energy for power generation—is also the most carbon-intensive. If a cost, either implicit or explicit, were applied to emitters of carbon dioxide, there are several alternative no- or low-emission technologies that currently are commercially proven or under development, which could be used to replace some coal-fired generation. Implementing the technologies would not require expensive, large-scale changes in the power distribution infrastructure or in electricity-using equipment.

Technology transformation in the end-use sectors—such as transportation—could be more difficult, to the extent that extensive changes in the motor vehicle fleet, fueling stations, and fuel distribution infrastructure may be needed. Efficiency improvements are an alternative for reducing emissions from equipment that uses either electricity or other fuels.

Figure 6. World Electricity Generation by Fuel, 2005-2030



Sources: **2005:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, System for the Analysis of Global Energy Markets/Global Electricity Module (2008).

Electricity generation from nuclear power is projected to increase from about 2.6 trillion kilowatthours in 2005 to 3.8 trillion kilowatthours in 2030, as concerns about rising fossil fuel prices, energy security, and greenhouse gas emissions support the development of new nuclear generation. Higher capacity utilization rates have been reported for many existing nuclear facilities, and it is anticipated that most of the older nuclear power plants in the OECD countries and non-OECD Eurasia will be granted extensions to their operating lives. Still, there is considerable uncertainty associated with nuclear power.

Issues that could slow the expansion of nuclear power in the future include plant safety, radioactive waste disposal, and the proliferation of nuclear weapons, which continue to raise public concerns in many countries and may hinder the development of new nuclear power reactors. Moreover, high capital and maintenance costs may keep some nations from expanding their nuclear power programs. Nevertheless, the *IEO2008* reference case incorporates the improved prospects for world nuclear power. The *IEO2008* projection for nuclear electricity generation in 2025 is 31 percent higher than the projection published in *IEO2003* only 5 years ago.

In the *IEO2008* reference case, the world's installed nuclear capacity grows from 374 gigawatts in 2005 to 498 gigawatts in 2030. Declines in nuclear capacity are projected only for OECD Europe, where several countries (including Germany and Belgium) have either plans or mandates to phase out nuclear power, and where some older reactors are expected to be retired and not replaced. On a regional basis, *IEO2008* projects the strongest growth in nuclear power for the countries of non-OECD Asia. Of the 68 gigawatts of additional installed nuclear generating capacity projected for non-OECD Asia between 2005 and 2030, 45 gigawatts is in China and 17 gigawatts in India. Outside Asia, the largest increase in installed nuclear capacity among the non-OECD nations is projected for Russia, which is expected to add 18 gigawatts of new nuclear generating capacity over the mid-term projection.

High prices for oil and natural gas, which are expected to persist in the reference case, also encourage expanded use of renewable fuels. Renewable energy sources are attractive for environmental reasons, especially in countries where reducing greenhouse gas emissions is of particular concern. Government policies and incentives to increase the use of renewable energy sources for electricity generation are expected to encourage the development of renewable energy even when it cannot compete economically with fossil fuels. Worldwide, the consumption of hydroelectricity and other renewable energy sources increases by 2.1 percent per year in the *IEO2008* reference case, from 35 quadrillion Btu in 2005 to 59 quadrillion Btu in 2030.

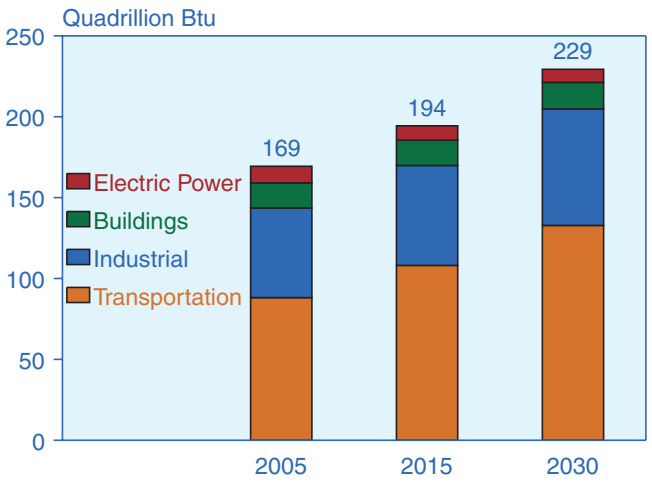
In the non-OECD nations, much of the growth in renewable energy consumption is projected to come from mid- to large-scale hydroelectric facilities in Asia and in Central and South America, where several countries have hydropower facilities either planned or under construction. Among the OECD nations, hydroelectricity is fairly well established, and with the exception of Canada and Turkey there are few plans to undertake major hydroelectric power projects in the future. Instead, increases in OECD renewable energy consumption are expected to be in the form of nonhydroelectric renewables, especially wind and biomass. Many individual OECD countries have incentives in place to increase the penetration of nonhydroelectric renewable electricity sources, both to reduce greenhouse gas emissions and to promote energy security, and in the *IEO2008* projections OECD renewable generation grows by 1.6 percent per year from 2005 to 2030, faster than all the other sources of electricity of generation except natural gas.

Over the next 25 years, world demand for liquid fuels and other petroleum is expected to increase more rapidly in the transportation sector than in any other end-use sector (Figure 7). The transportation share of total liquids consumption increases from 52 percent in 2005 to 58 percent in 2030 in the *IEO2008* reference case. Much of the growth in transportation energy use is projected for the non-OECD nations, where transportation energy use increases at an average rate of 2.9 percent per year, doubling between 2005 and 2030. Strong growth in income per capita supports the growth in transportation energy demand, and the reference case anticipates that many of the world's emerging economies will experience rapid modernization of their transportation systems in order to move products and raw materials to market, particularly in developing rural areas where economic growth often is achieved by increasing product exports.

The transportation infrastructure in OECD countries generally is considered to be well-established. Motorization levels (as measured by vehicles per 1,000 people) are fairly high in the OECD nations, where roads and highways connect most of the population centers. Mature transportation sectors and relatively slow projected growth rates for gross domestic product (GDP) and population among the OECD economies lead to the expectation that transportation energy demand will increase only modestly. Transportation energy demand in the OECD economies is projected to grow at an average annual rate of 0.7 percent in the *IEO2008* reference case (about one-fifth the rate projected for the non-OECD economies), with North America accounting for approximately one-half of the total increase in OECD consumption of liquid fuels for transportation.

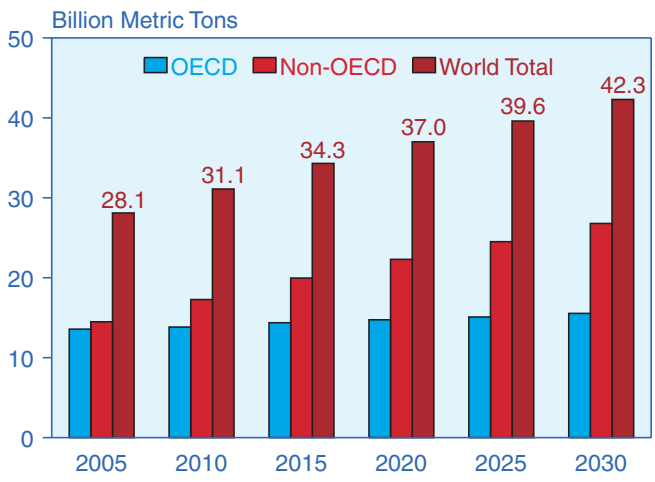
World energy-related carbon dioxide emissions continue to increase steadily in the *IEO2008* reference case, from 28.1 billion metric tons in 2005 to 34.3 billion metric tons in 2015 and 42.3 billion metric tons in 2030—an increase of 51 percent over the projection period. With strong economic growth and continued heavy reliance on fossil fuels expected for most of the non-OECD economies, much of the increase in carbon dioxide emissions is projected to occur among the developing, non-OECD nations. In 2005, non-OECD emissions exceeded OECD emissions by 7 percent. In 2030, however, non-OECD emissions are projected to exceed OECD emissions by 72 percent (Figure 8).

Figure 7. World Liquids Consumption by End-Use Sector, 2005-2030



Sources: **2005:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Figure 8. World Carbon Dioxide Emissions, 2005-2030



Sources: **2005:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

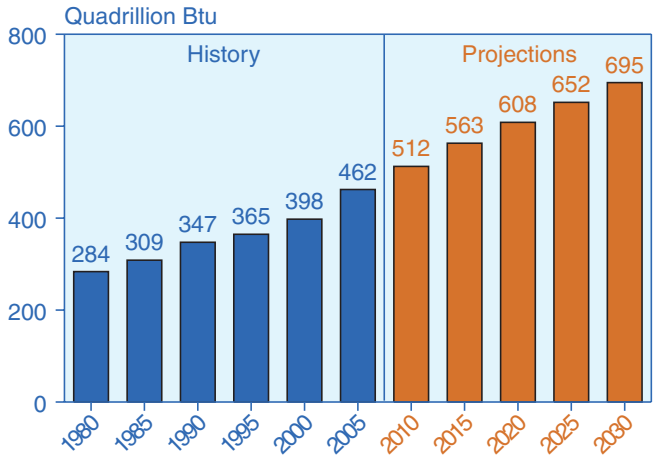
Chapter 1
World Energy Demand and Economic Outlook

In the IEO2008 projections, total world consumption of marketed energy is projected to increase by 50 percent from 2005 to 2030. The largest projected increase in energy demand is for the non-OECD economies.

World energy consumption is projected to expand by 50 percent from 2005 to 2030 in the *IEO2008* reference case projection (Figure 9 and Table 1). Although high prices for oil and natural gas, which are expected to continue throughout the period, are likely to slow the growth of energy demand in the long term, world energy consumption is projected to continue increasing strongly as a result of robust economic growth and expanding populations in the world's developing countries. OECD member countries are, for the most part, more advanced energy consumers.[2] Energy demand in the OECD economies is expected to grow slowly over the projection period, at an average annual rate of 0.7 percent, whereas energy consumption in the emerging economies of non-OECD countries is expected to expand by an average of 2.5 percent per year (Figure 10).

China and India—the fastest growing non-OECD economies—will be key contributors to world energy consumption in the future. Over the past decades, their energy consumption as a share of total world energy use has increased significantly. In 1980, China and India together accounted for less than 8 percent of the world's total energy consumption; in 2005 their share had grown to 18 percent. Even stronger growth is projected over the next 25 years, with their combined energy use more than

Figure 9. World Marketed Energy Consumption, 1980-2030



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Table 1. World Marketed Energy Consumption by Country Grouping, 2005-2030
(Quadrillion Btu)

Region	2005	2010	2015	2020	2025	2030	Average Annual Percent Change, 2005-2030
OECD	**240.9**	**249.7**	**260.5**	**269.0**	**277.6**	**285.9**	**0.7**
North America	121.3	126.4	132.3	137.8	143.4	148.9	0.8
Europe	81.4	83.9	86.8	88.5	90.4	92.0	0.5
Asia	38.2	39.3	41.4	42.7	43.7	44.9	0.7
Non-OECD	**221.3**	**262.8**	**302.5**	**339.4**	**374.2**	**408.8**	**2.5**
Europe and Eurasia	50.7	55.1	59.5	63.3	66.0	69.1	1.2
Asia	109.9	137.1	164.2	189.4	215.3	240.8	3.2
Middle East	22.9	26.4	29.5	32.6	34.7	36.8	1.9
Africa	14.4	16.5	18.9	20.9	22.5	23.9	2.0
Central and South America	23.4	27.7	30.5	33.2	35.7	38.3	2.0
Total World	**462.2**	**512.5**	**563.0**	**608.4**	**651.8**	**694.7**	**1.6**

Note: Totals may not equal sum of components due to independent rounding.
Sources: **2005:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

[2]For consistency, OECD includes all members of the organization as of May 1, 2008, throughout all the time series presented in this report.

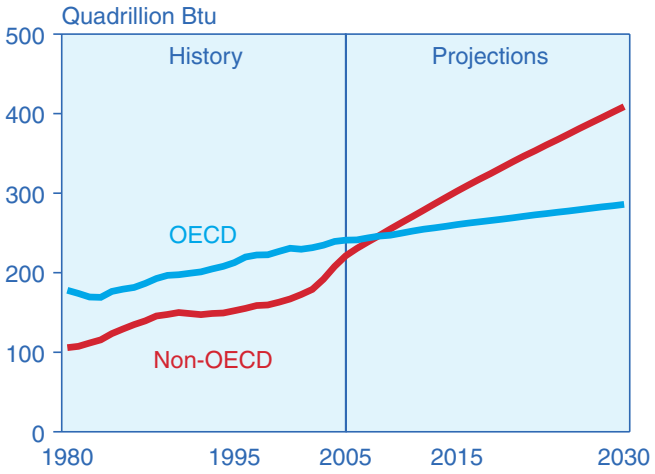
doubling and their share increasing to one-quarter of world energy consumption in 2030 in the *IEO2008* reference case. In contrast, the U.S. share of total world energy consumption is projected to contract from 22 percent in 2005 to about 17 percent in 2030.

Energy consumption in other non-OECD regions also is expected to grow strongly from 2005 to 2030, with increases of around 60 percent projected for the Middle East, Africa, and Central and South America (Figure 11). A smaller increase, about 36 percent, is expected for non-OECD Europe and Eurasia (including Russia and the other former Soviet Republics), as substantial gains in energy efficiency result from the replacement of inefficient Soviet-era capital stock and population growth rates decline.

This chapter presents an overview of the *IEO2008* outlook for global marketed energy consumption by energy source and by end-use sector. It includes discussions of the major assumptions that form the basis for the *IEO2008* projections, including macroeconomic assumptions for the key OECD and non-OECD economies.

As with any set of projections, there is significant uncertainty associated with the *IEO2008* energy projections. Two sets of sensitivity cases, which vary some of the assumptions behind the projections, are also examined in this chapter: the high and low macroeconomic growth cases and high and low energy price cases. The sensitivity cases are intended to illustrate alternative scenarios rather than to identify any bounds on uncertainty, which can be affected by policy and technology developments as well as by price and growth paths. Also included is a discussion of the possible effects of future trends in energy intensity (the relationship between energy use and economic growth) on the reference case projections.

Figure 10. World Marketed Energy Consumption: OECD and Non-OECD, 1980-2030

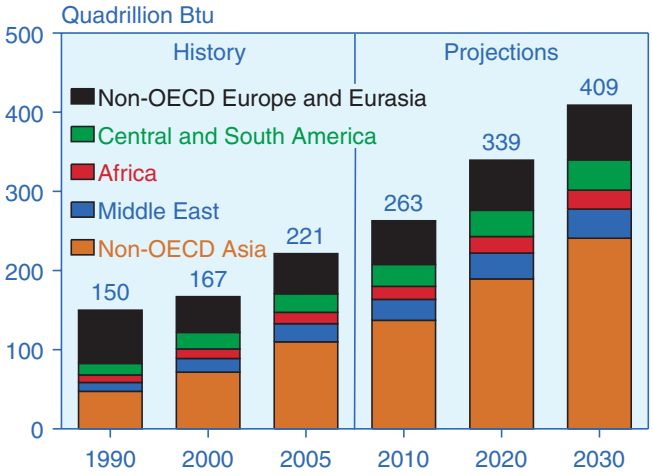


Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Outlook for World Energy Consumption by Source

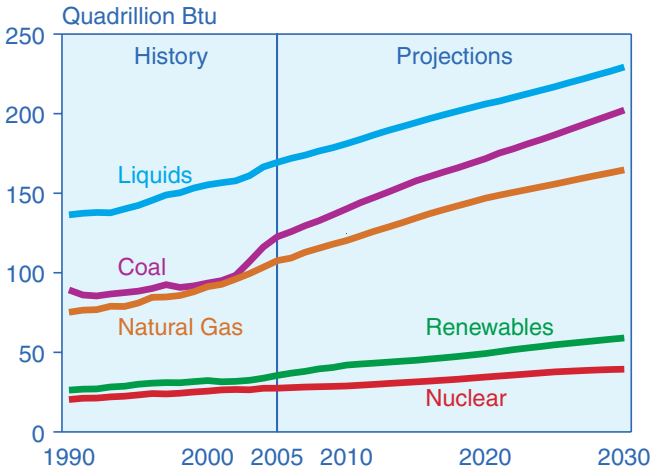
The use of all energy sources increases over the time frame of the *IEO2008* reference case (Figure 12). Given expectations that world oil prices will remain relatively

Figure 11. Marketed Energy Use in the Non-OECD Economies by Region, 1990-2030



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Figure 12. World Marketed Energy Use by Fuel Type, 1990-2030



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

high throughout the projection, liquid fuels[3] are the world's slowest growing source of energy; liquids consumption increases at an average annual rate of 1.2 percent from 2005 to 2030. Renewable energy and coal are the fastest growing energy sources, with consumption increasing by 2.1 percent and 2.0 percent, respectively. Projected high prices for oil and natural gas, as well as rising concern about the environmental impacts of fossil fuel use, improve prospects for renewable energy sources. Coal's costs are comparatively low relative to the costs of liquids and natural gas, and abundant resources in large energy-consuming countries (including China, India, and the United States) make coal an economical fuel choice.

Although liquid fuels and other petroleum are expected to remain important sources of energy throughout the projections, the liquids share of marketed world energy consumption declines from 37 percent in 2005 to 33 percent in 2030 in the reference case as high world oil prices lead many consumers to switch from liquid fuels and other petroleum when feasible. For example, the projections show a steady decline in the use of liquids for electricity generation in all regions of the world except the Middle East. Whereas the *IEO2007* reference case projected a 0.4-percent average annual increase in liquids use for electricity generation worldwide from 2005 to 2030, *IEO2008* projects an average decrease of 1.0 percent per year.

Efficiency gains and fuel substitution slow the growth of liquids consumption in the industrial sector, especially in the non-OECD regions, where there are more opportunities for fuel switching. World liquids consumption for energy in the industrial sector increases by 1.1 percent per year in the *IEO2008* reference case.

The *IEO2008* high price case reflects a price path that is closer, in real terms, to prices prevailing during the first 8 months of 2008. In this case, world liquids consumption increases by an average of only 0.7 percent per year from 2005 to 2030, as compared with 1.2-percent average annual growth in the reference case. In the high price case, the liquids share of total energy consumption falls to 30 percent in 2030.

Natural gas remains an important fuel for electricity generation worldwide, because it is more efficient and less carbon intensive than other fossil fuels. In the *IEO2008* reference case, total natural gas consumption increases by 1.7 percent per year on average, from 104 trillion cubic feet to 158 trillion cubic feet, while its share of world electricity generation increases from 20 percent in 2005 to 25 percent in 2030. Growth in world demand for natural gas is slower in *IEO2008* than was projected in *IEO2007*, however, primarily because of the smaller increases in natural-gas-fired generating capacity expected for some countries. For example, natural-gas-fired generation in the United States in 2030 is 14 percent lower in *IEO2008* than was projected in last year's outlook. Higher natural gas prices, along with U.S. tax incentives for clean coal technologies, are expected to discourage the construction of new natural-gas-fired plants in favor of coal-fired plants.

Coal's share of world energy use has increased sharply over the past few years, and without significant changes in existing laws and polices, particularly those related to greenhouse gas emissions, robust growth is likely to continue. Coal accounted for 24 percent of total world energy use in 2002 and 27 percent in 2005, largely as a result of rapid increases in coal use in China. After growing at an average rate of 3 percent per year from 1990 to 2001, China's coal consumption increased by 17 percent per year on average from 2002 to 2005. As a result, coal use in China has nearly doubled since 2000, and given the country's rapidly expanding economy and large domestic coal deposits, its demand for coal is projected to continue growing strongly.

Worldwide, coal consumption is projected to increase by 2.0 percent per year from 2005 to 2030 (by 35 quadrillion Btu from 2005 to 2015 and by another 44 quadrillion Btu from 2015 to 2030) and to account for 29 percent of total world energy consumption in 2030. In the absence of policies or legislation that would limit the growth of coal use, the United States, China, and India are expected to turn to coal in place of more expensive fuels. Together, the three nations account for 90 percent of the projected increase from 2005 to 2030 (Figure 13). The only countries for which decreases in coal consumption are projected are OECD Europe and Japan, where populations are either growing slowly or declining, electricity demand growth is slow, and natural gas, nuclear power, and renewables are likely to be used for electricity generation rather than coal.

Net electricity generation worldwide is projected to total 33.3 trillion kilowatthours in 2030, nearly double the 2005 total of 17.3 trillion kilowatthours. The strongest growth in electricity generation is projected for the non-OECD countries. Non-OECD electricity generation increases by 4.0 percent per year in the *IEO2008* reference case, as rising standards of living increase demand for home appliances and the expansion of commercial services, including hospitals, office buildings, and shopping malls. In the OECD nations, where infrastructures are well established and population growth is relatively

[3]In *IEO2008*, "liquid fuels" includes a full array of liquid product supplies, both conventional and unconventional. Conventional liquids include crude oil and lease condensate, natural gas plant liquids, and refinery gain; unconventional liquids include biofuels, gas-to-liquids, coal-to-liquids, and unconventional petroleum products (extra-heavy oils, oil shale, and bitumen).

slow, much slower growth in generation is expected, averaging 1.3 percent per year from 2005 to 2030.

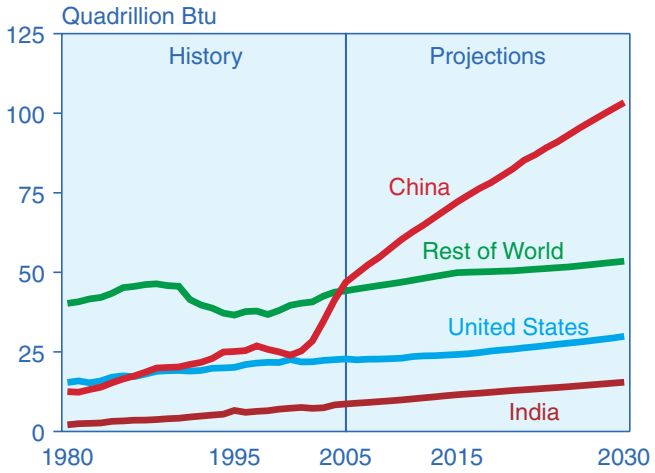
Natural gas and coal, which currently are the fastest growing fuel sources for electricity generation worldwide, continue to lead the increase in fuel use in the electric power sector in the *IEO2008* reference case (Figure 14). The natural gas share increases from 20 percent in 2005 to 25 percent in 2030, and the coal share increases from 41 percent to 46 percent. Because natural gas is an efficient fuel for electric power generation and produces less carbon dioxide than coal or petroleum products, it is an attractive choice in many nations; however, in the United States and non-OECD Asia, where coal resources are ample, higher prices for oil and natural gas make coal a more economical source of energy for electricity generation.

Electricity generation from nuclear power increases from 2.6 trillion kilowatthours in 2005 to 3.0 trillion kilowatthours in 2015 and 3.8 trillion kilowatthours in 2030 in the *IEO2008* reference case. Concerns about rising fossil fuel prices, energy security, and greenhouse gas emissions support the development of new nuclear generating capacity. Higher capacity utilization rates have been reported for many existing nuclear facilities, and it is anticipated that most of the older plants now operating in OECD countries and in non-OECD Eurasia will be granted extensions to their operating lives.

There is still considerable uncertainty about the future of nuclear power, however, and a number of issues could slow the development of new nuclear power plants. Plant safety, radioactive waste disposal, and the proliferation of nuclear weapons, which continue to raise public concerns in many countries, may hinder plans for new installations, and high capital and maintenance costs may keep some countries from expanding their nuclear power programs. Nevertheless, the *IEO2008* projection for world nuclear electricity generation in 2025 is 31 percent higher than the projection in *IEO2003* just 5 years ago.

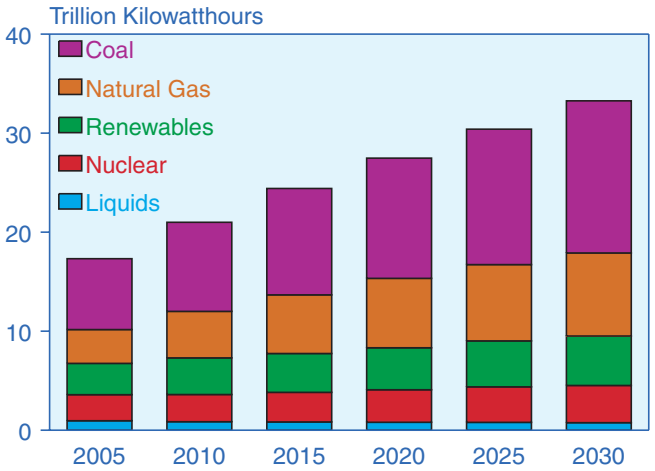
Most of the expansion of installed nuclear power capacity is expected in non-OECD countries (Figure 15). Russia, China, and India account for almost two-thirds of the projected net increment in world nuclear power capacity between 2005 and 2030. In the reference case,

Figure 13. Coal Consumption in Selected World Regions, 1980-2030



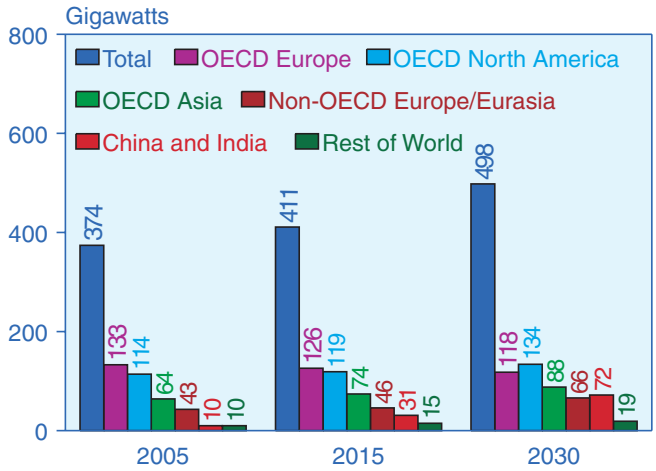
Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Figure 14. World Electricity Generation by Fuel, 2005-2030



Sources: **2005:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Figure 15. World Nuclear Generating Capacity by Region, 2005, 2015, and 2030



Sources: **2005:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Russia adds 18 gigawatts of nuclear capacity between 2005 and 2030, India 17 gigawatts, and China 45 gigawatts. Several OECD nations with existing nuclear programs also add new capacity in the reference case, including South Korea with 14 gigawatts, Japan with 11 gigawatts, and Canada with 6 gigawatts. In the United States, rules issued by the Internal Revenue Service in 2006 governing the production tax credit for new nuclear plants that was included in the Energy Policy Act of 2005 (EPACT2005), along with high fossil fuel prices, support the addition of 16.6 gigawatts of capacity at newly built nuclear power plants and 2.7 gigawatts expected from uprates of existing plants, while 4.5 gigawatts of existing capacity is expected to be retired.

The use of hydroelectricity and other grid-connected renewable energy sources continues to expand in the reference case projection. With consumption projected to increase by an average of 2.1 percent per year from 2005 to 2030, renewable fuels are the fasting growing source of energy in the *IEO2008* reference case. Higher fossil fuel prices, particularly for natural gas in the electric power sector, along with government policies and programs supporting renewable energy, allow renewable fuels to compete economically.

Much of the growth in renewable energy consumption is projected to come from mid- to large-scale hydroelectric facilities in non-OECD Asia and Central and South America, where several countries have hydropower facilities either planned or under construction. In non-OECD Asia, China's 18,200-megawatt Three Gorges Dam project is nearing completion at the end of 2008, and the China Yangtze River Three Gorges Project Development Corporation has already announced plans to increase its total installed capacity to 22,400 megawatts. In addition, work continues on the 12,600-megawatt Xiluodu project on the Jisha River (scheduled for completion in 2020 as part of a 14-facility hydropower development plan) and on the country's third-largest hydroelectric facility, the 6,300-megawatt Longtan project on the Hongshui River [*1*].

In India, more than 14,500 megawatts of hydropower capacity currently is under construction [*2*]. Work has begun on what will be India's largest hydroelectric facility to date, the 2,000-megawatt Lower Subansiri in Arunachal Pradesh [*3*]. In Central and South America, Brazil has plans for a number of new hydropower projects that the country hopes to complete in order to keep up with electricity demand after 2010, including the 3,150-megawatt Santo Antonio and 3,300-megawatt Jirau projects on the Rio Madeira River, along with the first phase of the 5,500-megawatt Belo Monte dam project on the Xingo River [*4*].

Outside of Canada and Turkey, hydropower capacity is not expected to grow substantially in the OECD nations, where most hydroelectric resources already have been developed or lie far from population centers. Instead, most of the increase in OECD renewable energy consumption is expected to come from nonhydroelectric resources, such as wind, solar, geothermal, municipal solid waste, and biomass. In 2007, installed wind power capacity in the United States increased by 4,287 megawatts (or 38 percent), supported by the Federal production tax credit and a number of renewable portfolio standards in individual States that encourage growth of renewable energy [*5*]. Wind energy markets have also grown strongly in non-OECD Asia, where China added more than 3,400 megawatts and India about 8,000 megawatts of new wind capacity in 2007 [*6*].

OECD Europe, where many countries are obligated to reduce greenhouse gas emissions under the Kyoto Protocol treaty, remains a key market for wind power, adding 8,554 megawatts of new capacity in 2007 alone. The European Union (EU) has set a target of increasing the renewable energy share to 20 percent of gross domestic energy consumption by 2020, including a mandatory minimum of 10 percent for biofuels [*7*]. Most EU member countries offer incentives for renewable energy production, including subsides and grants for capital investments and premium prices for generation from renewable sources. Installation of wind-powered generating capacity has been particularly successful in Germany and Spain, which had 22,247 megawatts and 15,145 megawatts of installed capacity, respectively, at the end of 2007 [*8*].

Delivered Energy Consumption by End-Use Sector

Understanding patterns in the consumption of energy delivered to end users is an important part of developing projections of global energy use. Outside the transportation sector, which at present is dominated by liquid fuels and other petroleum products, the mix of energy use in the residential, commercial, and industrial sectors varies widely by region, depending on a combination of regional factors, such as the availability of energy resources, the level of economic development, and political, social, and demographic factors.

Residential Sector

Energy use in the residential sector, which accounted for about 15 percent of worldwide delivered energy consumption in 2005, is defined as the energy consumed by households, excluding transportation uses. For residential buildings, the physical size of the structures is one key indicator of the amount of energy used by their occupants. Larger homes require more energy to provide heating, air conditioning, and lighting, and they tend to include more energy-using appliances, such as televisions and laundry equipment. Smaller structures

require less energy, because they contain less space to be heated or cooled, produce less heat transfer with the outdoor environment, and typically have fewer occupants. For instance, residential energy consumption is lower in China, where the average residence currently has an estimated 300 square feet of living space or less per person, than in the United States, where the average residence has an estimated 680 square feet of living space per person [***9***].

The type and amount of energy used by households vary from country to country, depending on income levels, natural resources, climate, and available energy infrastructure. In general, typical households in the OECD use more energy than those in non-OECD nations, in part because higher income levels allow OECD households to purchase more energy-using equipment. In the United States, for example, GDP per capita in 2005 was about $37,000 (in real 2000 dollars per person) and residential energy use per capita was estimated at 38.7 million Btu. In contrast, China's per-capita income in 2005, at $5,900, was only about one-sixth the U.S. level, and residential energy use per capita was 3.2 million Btu.

Although the IEO2008 projections account for marketed energy use only, households in many non-OECD countries still rely heavily on traditional, non-marketed energy sources, including wood and waste, for heating and cooking. Much of Africa remains unconnected to a power grid; and in 2004, an estimated 93 percent of the rural inhabitants of sub-Saharan Africa used biomass as their primary fuel source for cooking [***10***]. Some areas of China and India also rely heavily on woodfuel, woodwaste, and charcoal for cooking. In China, about 55 percent of the rural population uses biomass for cooking, as does 87 percent of the rural population in India. Regional economic development should displace some of that use as incomes rise and marketed fuels, such as propane and electricity, become more widely accessible.

Commercial Sector

The commercial sector—often referred to as the services sector or the services and institutional sector—consists of businesses, institutions, and organizations that provide services. The sector encompasses many different types of buildings and a wide range of activities and energy-related services. Examples of commercial sector facilities include schools, stores, correctional institutions, restaurants, hotels, hospitals, museums, office buildings, banks, and stadiums that hold sporting events. Most commercial energy use occurs in buildings or structures, supplying services such as space heating, water heating, lighting, cooking, and cooling. Energy consumed for services not associated with buildings, such as for traffic lights and city water and sewer services, is also categorized as commercial sector energy use.

Economic trends and population growth drive commercial sector activity and the resulting energy use. The need for services (health, education, financial, government) increases as populations increase. The degree to which additional needs are met depends in large measure on economic resources—whether from domestic or foreign sources—and economic growth. Economic growth also determines the degree to which additional activities are offered and utilized in the commercial sector. Higher levels of economic activity and disposable income lead to increased demand for hotels and restaurants to meet business and leisure requirements; for office and retail space to house and service new and expanding businesses; and for cultural and leisure space such as theaters, galleries, and arenas. In the commercial sector, as in the residential sector, energy use per capita in the non-OECD countries is much lower than in the OECD. Non-OECD commercial energy consumption per capita averaged only 1.2 million Btu in 2005, compared with the OECD average of 16.4 million Btu.

Slow population growth in most of the OECD nations contributes to slower anticipated rates of increase in the commercial energy demand. In addition, continued efficiency improvements are projected to moderate the growth of energy demand over time, as energy-using equipment is replaced with newer, more efficient stock. Conversely, strong economic growth is expected to include continued growth in business activity, with its associated energy use, in areas such as retail and wholesale trade and business, financial, and leisure services. The United States is the largest consumer of commercial delivered energy in the OECD and is expected to remain in that position throughout the projection period. U.S. commercial energy use accounts for about 45 percent of the OECD total through 2030.

In the non-OECD nations, economic growth and commerce are expected to increase rapidly, fueling additional demand for energy in the service sectors. Faster population growth is also expected, relative to that in the OECD countries, portending increases in the need for education, health care, and social services and the energy required to provide them. The energy needed to fuel growth in commercial buildings will be substantial, with total delivered commercial energy use among the non-OECD nations expected to rise by 3.3 percent per year, faster than any other end-use sector.

Meeting the fast-paced growth in demand for energy in the commercial sectors of non-OECD nations is likely to present a challenge. In China, for instance, a large number of existing commercial buildings are classified as "high energy-consuming," with energy use per square foot at levels that are two or three times as high as those in the western world [***11***]. The country's eleventh 5-year plan, for 2006-2010, included a goal to transform all existing buildings into "energy-saving" buildings by

2020 and required that all buildings constructed after 2005 incorporate natural ventilation, natural lighting, and other provisions aimed at reducing energy intensity.

Industrial Sector

Energy is consumed in the industrial sector by a diverse group of industries—including manufacturing, agriculture, mining, and construction—and for a wide range of activities, such as process and assembly uses, space conditioning, and lighting. Inputs that typically are considered energy products are included in industrial sector energy use. For example, natural gas and petroleum products used as feedstocks to produce non-energy products, such as plastics, are counted as energy used in the industrial sector. Industrial sector energy demand varies across regions and countries of the world, based on level and mix of economic activity, technological development, and population, among other factors.

The OECD economies generally have more energy-efficient industrial operations and a mix of industrial output that is more heavily weighted toward non-energy-intensive sectors than do the non-OECD countries. In the United States, for example, the manufacturing share of total economic output has declined steadily over the past two decades, while the output share for service industries (included in the commercial sector) has increased. Similar developments are expected for the other OECD economies, as increasing international trade fosters a shift toward a less energy-intensive mix of industrial activity.

The non-OECD economies generally have higher industrial sector energy consumption relative to GDP than do the OECD countries. On average, the ratio is almost 40 percent higher in the non-OECD countries. In particular, Russia and the Eastern European countries still have energy-inefficient capital stock remaining from the days of central planning. For example, 85 percent of Russia's cement production uses the "wet" process, which requires 70 percent more fuel than the "dry" method. In the United States, by comparison, less than 19 percent of the cement produced in 2003 was made using the wet process [***12***].

As inefficient facilities and production techniques in non-OECD Europe and Eurasia are replaced with modern ones, industrial energy intensity (industrial energy use per dollar of GDP) in the region is expected to decline rapidly. Some former Soviet Republics, such as Ukraine and Georgia, have reduced their energy intensity by at least 5.5 percent a year from 2000 to 2005, compared with an average annual decline of 1.2 percent in the OECD countries [***13***]. In the *IEO2008* reference case, industrial energy intensity in non-OECD Europe and Eurasia is projected to decline by 3.0 percent per year between 2005 and 2030, compared with a worldwide average decline of 2.1 percent per year.

China, India, and the other non-OECD Asian nations are expected to have the most rapid increases worldwide in industrial sector energy consumption over the projection period. Whereas the OECD economies have largely been moving away from heavy, energy-intensive industries (such as steel and cement) toward light manufacturing and service activities, energy-intensive heavy manufacturing is growing in many of the non-OECD countries. Currently, about 77 percent of the delivered energy use in China is attributed to the industrial sector. Although that share is expected to begin declining, even by 2030 the industrial sector accounts for 72 percent of China's total delivered energy use. In India and the other non-OECD Asian economies, industrial sector energy use also remains high throughout the projection period, accounting for about 60 percent of total delivered energy use for non-OECD Asia through 2030.

Transportation Sector

Energy use in the transportation sector includes the energy consumed in moving people and goods by road, rail, air, water, and pipeline. The road transport component includes light-duty vehicles, such as automobiles, sport utility vehicles, minivans, small trucks, and motorbikes, as well as heavy-duty vehicles, such as large trucks used for moving freight and buses for passenger travel. Growth in economic activity and population growth are the key factors that determine transportation sector energy demand. Economic growth spurs increased industrial output, which requires the movement of raw materials to manufacturing sites, as well as movement of manufactured goods to end users.

A primary factor contributing to the expected increase in energy demand for transportation is steadily increasing demand for personal travel in both the non-OECD and OECD economies. Increases in urbanization and in personal incomes have contributed to increases in air travel and to increased motorization (more vehicles) in the growing economies. Modal shifts in the transport of goods are expected to result from continued economic growth in both OECD and non-OECD economies. For freight transportation, trucking is expected to lead the growth in demand for transportation fuels. In addition, as trade among countries increases, the volume of freight transported by air and marine vessels is expected to increase rapidly over the projection period. Chapter 6 includes a more extensive examination of the world's transportation energy use.

World Economic Outlook

Economic growth is among the most important factors to be considered in projecting changes in world energy consumption. In the *IEO2008* projections, assumptions about regional economic growth—measured in terms of real GDP in 2000 U.S. dollars at purchasing power parity rates—underlie the projections of regional energy demand.

The macroeconomic framework employed for the economic growth projections reflects the interaction of many important economic variables and underlying relationships, both in the short term and in the medium to long term. In the short term, the spending decisions made by households and businesses (the demand side) determine economic activity and thus the short-term economic outlook. Spending decisions, in turn, are influenced by current economic and financial conditions—for example, income, interest rates, and the price of goods to be purchased.

Over the 2005 to 2030 period, the world's real GDP growth on a purchasing power parity basis is projected to average 4.0 percent annually in the reference case (Table 2 and Figure 16). In the long term, it is the ability to produce goods and services (the supply side) that determines the growth potential of any country's

Table 2. Average Annual Growth in World Gross Domestic Product by Selected Countries and Regions, 1980-2030
(Percent per Year)

Region	History				Projections			
	1980-2005	2005	2006	2007	2008	2008-2015	2015-2030	2005-2030
OECD North America	**3.0**	**3.0**	**3.0**	**2.3**	**1.9**	**2.8**	**2.5**	**2.6**
United States	3.1	3.1	2.9	2.1	1.6	2.8	2.4	2.5
Canada	2.8	3.1	2.8	2.5	2.9	2.6	2.2	2.4
Mexico	2.5	2.8	4.8	3.3	3.7	4.1	3.8	3.9
OECD Europe	**2.4**	**2.2**	**3.3**	**3.1**	**2.7**	**2.3**	**2.1**	**2.3**
OECD Asia	**2.9**	**2.3**	**2.7**	**2.6**	**2.9**	**2.2**	**1.5**	**1.8**
Japan	2.3	1.9	2.2	2.0	2.3	1.4	0.7	1.1
South Korea	6.8	4.2	5.0	4.9	5.7	4.4	2.7	3.5
Australia/New Zealand	3.3	2.7	2.6	3.3	2.9	3.1	3.0	3.0
Total OECD	**2.7**	**2.6**	**3.1**	**2.7**	**2.4**	**2.5**	**2.2**	**2.3**
Non-OECD Europe and Eurasia	**0.3**	**6.7**	**7.9**	**7.9**	**7.1**	**5.1**	**3.4**	**4.4**
Russia	-0.1	6.4	6.7	7.0	6.5	4.8	3.1	4.0
Other	0.8	7.0	9.4	9.0	7.8	5.3	3.8	4.8
Non-OECD Asia	**7.1**	**8.8**	**9.2**	**9.3**	**8.7**	**6.6**	**4.7**	**5.8**
China	9.8	10.4	11.1	11.5	10.5	7.3	5.0	6.4
India	5.9	9.2	9.4	9.0	8.5	7.1	4.6	5.8
Other	5.4	6.0	6.0	5.8	5.7	5.0	4.2	4.6
Middle East	**2.6**	**5.7**	**5.0**	**4.6**	**5.0**	**4.4**	**3.7**	**4.0**
Africa	**2.9**	**5.2**	**5.5**	**6.0**	**5.8**	**4.9**	**4.1**	**4.5**
Central and South America	**2.4**	**4.8**	**5.4**	**5.4**	**5.1**	**4.1**	**3.6**	**3.9**
Brazil	2.5	2.9	3.7	4.6	4.8	3.8	3.3	3.6
Total Non-OECD	**4.0**	**7.5**	**8.0**	**8.1**	**7.6**	**5.9**	**4.4**	**5.2**
Total World								
Purchasing Power Parity Rates	**3.3**	**4.9**	**5.4**	**5.4**	**5.0**	**4.4**	**3.5**	**4.0**
Market Exchange Rates	**2.9**	**3.5**	**3.9**	**3.6**	**3.4**	**3.2**	**2.7**	**3.0**

Note: All regional real GDP growth rates presented in this table are based on 2000 purchasing power parity weights for the individual countries in each region, except for the final line of the table, which presents world GDP growth rates based on 2000 market exchange rate weights for all countries.

Sources: **Historical Growth Rates:** Global Insight, Inc., *World Overview* (Lexington, MA, various issues). **Projected GDP Growth Rates:** Global Insight, Inc., *World Overview*, Fourth Quarter 2007 (Lexington, MA, January 2008); and Energy Information Administration, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington DC, June 2008). GDP growth rates for China and India were adjusted downward, based on the analyst's judgment.

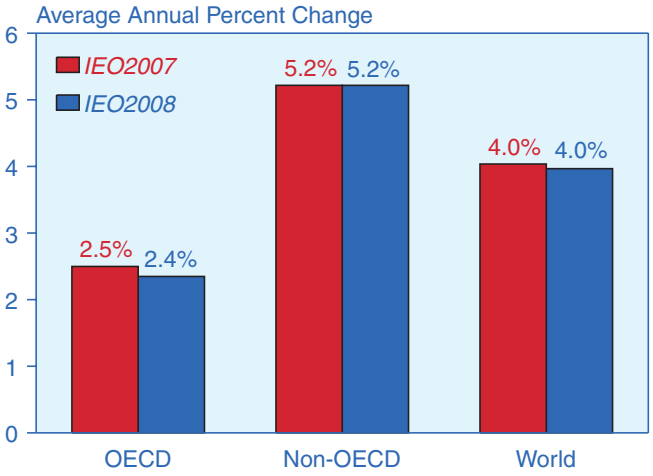
economy. Growth potential is influenced by population growth, labor force participation rates, capital accumulation, and productivity improvements. In addition, for the developing economies, progress in building human and physical capital infrastructures, establishing credible regulatory mechanisms to govern markets, and ensuring political stability play more important roles in determining their medium- to long-term growth potential.

Annual growth in world GDP over the 25-year projection period is higher than the rate recorded over the past 25 years, mainly because the countries that are expected to see more rapid growth, such as China and India, make up an increasing share of world GDP. A number of the developing non-OECD nations have undertaken significant reforms over the past several years. Improved macroeconomic policies, trade liberalization, more flexible exchange rate regimes, and lower fiscal deficits have lowered their national inflation rates, reduced uncertainty, and improved their overall investment climates. More microeconomic structural reforms, such as privatization and regulatory reform, have also played key roles. In general, such reforms have resulted in growth rates that are above historical trends in many of the developing economies over the past 5 to 10 years.

OECD Economies

The U.S. economy, after weakening substantially in 2001 and 2002, recovered rapidly in 2003 and from then until 2006 recorded robust growth despite sustained increases in energy prices. Since 2006, however, a downturn in the housing sector has been a major hindrance to economic growth. In the *IEO2008* reference case, the U.S. economy is expected to recover by 2009 as fiscal and monetary stimuli boost domestic demand, and to stabilize at its long-term growth path by 2010. GDP in the United States is projected to grow by an average of 2.5 percent per year from 2005 to 2030—slower than the 3.1-percent annual average growth from 1980 to 2005, because of the retirement of the baby boom generation and the resultant slowing of labor force growth.

Figure 16. Comparison of *IEO2007* and *IEO2008* Projections for OECD, Non-OECD, and World GDP Growth Rates, 2005-2030



Sources: ***IEO2007***: Energy Information Administration, *International Energy Outlook 2007*, DOE/EIA-0484(2007) (Washington, DC, May 2007), web site www.eia.doe.gov/oiaf/ieo. ***IEO2008***: Derived from Global Insight, Inc., *World Overview*, Fourth Quarter 2007 (Lexington, MA, January 2008).

Like the United States, Canada is expected to maintain healthy growth in productivity and standard of living. In 2006 and 2007, strong commodity and energy prices countered the weakening effect of appreciation in the Canadian dollar. Canada's labor force growth is projected to slow in the medium to long term, however, as the country's own baby boom generation retires. Canada's overall economic growth is projected to fall from 3.1 percent per year in 2005 to averages of 2.6 percent per year from 2008 to 2015 and 2.2 percent per year from 2015 to 2030.

Mexico's real GDP is projected to grow by an average of 3.9 percent per year from 2005 to 2030. The country's strong performance over the past 5 years has been the result of favorable developments in several areas. First, lower inflation has allowed the central bank to lower key policy rates, which has encouraged domestic demand through greater investment. Second, high oil prices continue to spur government spending, including investment in infrastructure projects. Third, remittances from Mexicans working abroad continue to grow rapidly, boosting domestic consumption. Finally, Mexico's industrial production follows, and is heavily influenced by, U.S. GDP growth and outsourcing of employment. Global financial markets remain friendly to Mexico in terms of the availability and cost of credit and the volume of foreign direct investment. In general, strong trade ties with the United States are expected to help cushion Mexico from deeper economic troubles. By the same token, Mexico's future growth is also more dependent on U.S. growth.

The economy of OECD Europe grew by more than 3 percent in both 2006 and 2007; however, recent data provide mixed signals about its likely short-term performance. Recent turbulence in international financial markets and weaker growth in the United States are pointing to a likely slowdown to 2.7-percent growth in 2008. Over the long term, OECD Europe's GDP growth is projected to average 2.3 percent per year from 2005 to 2030, in line with what OECD considers to be potential output growth in the region's economies [***14***]. According to the International Monetary Fund, OECD Europe's long-term growth prospects depend on its ability to accelerate improvements in labor productivity and employment growth and to improve structural flexibility in the various national economies [***15***].

After a decade of stagnation and several false starts, Japan's economic growth has been relatively robust since 2003. Although it is low by the standards of pre-1990 Japan, the recent annual growth in GDP exceeds the potential (no more than 2 percent real growth) for a country with a declining labor force and population and an industrial technology that has already caught up with, and in some cases surpassed, the best elsewhere in the world [***16***]. With the continued decline in its labor force over the projection period, Japan's annual GDP growth is projected to slow, averaging 1.4 percent from 2008 to 2015 and 0.7 percent from 2015 to 2030. In the short term, Japan's highly skilled labor force and strong work ethic are expected to support the projected average growth rate, as more flexible labor policies allowing greater mobility for workers are adopted.

Economic growth in the rest of OECD Asia is expected to be stronger than in Japan. In contrast to the GDP growth of 1.1 percent per year anticipated for Japan from 2005 to 2030 in the *IEO2008* reference case, South Korea is projected to see average increases of 3.5 percent per year and Australia/New Zealand 3.0 percent per year. In the medium to long term, South Korea's growth is projected to taper off and be sustained by productivity growth as the growth of its labor force slows. Prospects in both Australia and New Zealand are healthy, given their consistent track records of fiscal prudence and structural reforms aimed at maintaining competitive product markets and flexible labor markets.

Non-OECD Economies

Over the period from 2005 to 2030, economic growth in non-OECD Europe and Eurasia as a whole is projected to average 4.4 percent annually. For the past several years, the non-OECD nations of Europe and Eurasia have largely been sheltered from global economic uncertainties, recording strong economic growth in each year since 2000, primarily as a result of robust domestic demand, the growth bonus associated with ascension of some countries (including Estonia, Latvia, Lithuania, and Slovenia) to the European Union, and the impacts of rising oil prices on oil-exporting nations (including Russia, Kazakhstan, Azerbaijan, and Turkmenistan). High world oil prices have stimulated investment outlays, especially in the energy sector of the Caspian region; however, given the volatility of energy market prices, it is unlikely that the region's economies will be able to sustain the growth rates recently achieved until diversification from energy becomes more broadly based. The long-term growth prospects for the former Soviet Republic economies of Eurasia hinge on their success in economic diversification, as well as further improvements in domestic financial and product markets.

Much of the growth in world economic activity between 2005 and 2030 is expected to occur among the nations of non-OECD Asia, where regional GDP growth is projected to average 5.8 percent per year. China, non-OECD Asia's largest economy, is expected to continue playing a major role on both the supply and demand sides of the global economy. *IEO2008* projects an average annual growth rate of approximately 6.4 percent for China's economy from 2005 to 2030—the highest among all the world's economies.

Structural issues that have implications for medium- to long-term growth in China include the pace of reform affecting inefficient state-owned companies and a banking system that is carrying a significant amount of nonperforming loans. In the *IEO2008* reference case, development of domestic capital markets is expected to continue, providing macroeconomic stability and ensuring that China's large savings are used more efficiently.

India is another Asian country with a rapidly emerging economy. The medium-term prospects for India's economy are positive, as it continues to privatize state enterprises and increasingly adopts free market policies. Average annual GDP growth in India over the 2005 to 2030 projection period is 5.8 percent. Accelerating structural reforms—including ending regulatory impediments to the consolidation of labor-intensive industries, labor market and bankruptcy reforms, and agricultural and trade liberalization—remain essential for stimulating potential growth and reducing poverty in the medium to long term. With its vast and relatively cheap English-speaking labor force, India is well positioned to reap the benefits of globalization.

Except for China, direct exposure of non-OECD Asia's financial institutions to mortgage-backed securities (or subprime risks) is limited. [***17***]. As a result, economic activity is expected to remain robust in the nations of non-OECD Asia. Effects of the recent turmoil in world financial centers are expected to be minimal for most of the non-OECD Asia economies. Over the medium term, from 2005 to 2015, national economic growth rates are expected to be roughly constant, before tapering off gradually to an average of 4.7 percent per year from 2015 to 2030 as labor force growth rates decline and economies mature.

Rising oil production and prices have helped boost economic growth in the oil-exporting countries of the Middle East, many of which have also benefited from spillover effects on trade, tourism, and financial flows from the region's oil exporters. In recent years, real GDP growth rates in the Middle East have averaged around 5 percent. Medium-term prospects for the region remain favorable, given that a significant portion of the recent

increase in oil revenues is expected to continue throughout the projection period.

Economic growth in Africa has maintained a healthy pace of more than 4 percent per year since 2000, based on increased earnings from fossil fuel exports, strong global demand and favorable international prices for some other export commodities, vigorous domestic demand, and significant foreign direct investment and foreign aid [*18*]. Africa's combined economy is projected to grow at an average annual rate of 4.5 percent from 2005 to 2030—a projection that is optimistic by historical standards but is supported by the region's strong economic activity over the past 5 years, resulting from expansion of primary exports and robust domestic demand in many of Africa's national economies. Nevertheless, both economic and political factors—such as low savings and investment rates, lack of strong economic and political institutions, limited quantity and quality of infrastructure and human capital, negative perceptions on the part of international investors, protracted civil unrest and political disturbances, and especially the impact of HIV/AIDS on population growth—present formidable obstacles to growth in a number of African countries.

Although the nations of Central and South America registered a combined 6-percent increase in GDP in 2004 (their best performance in 20 years), the region's growth prospects have been hampered by a weak international credit environment, as well as domestic economic and/or political problems in a number of countries. With economic growth in Central and South America remaining heavily dependent on foreign capital flows, 3.9-percent average annual growth in GDP is projected from 2005 through 2030.

Major Sources of Uncertainty in the Projections

Alternative Macroeconomic Growth Cases

Expectations for the future rates of economic growth are a major source of uncertainty in the *IEO2008* projections. To illustrate the uncertainties associated with economic growth trends, *IEO2008* includes a high macroeconomic growth case and a low macroeconomic growth case in addition to the reference case. The two alternative growth cases use different assumptions about future economic growth paths, while maintaining the same relationship between changes in GDP and changes in energy consumption that is used in the reference case.

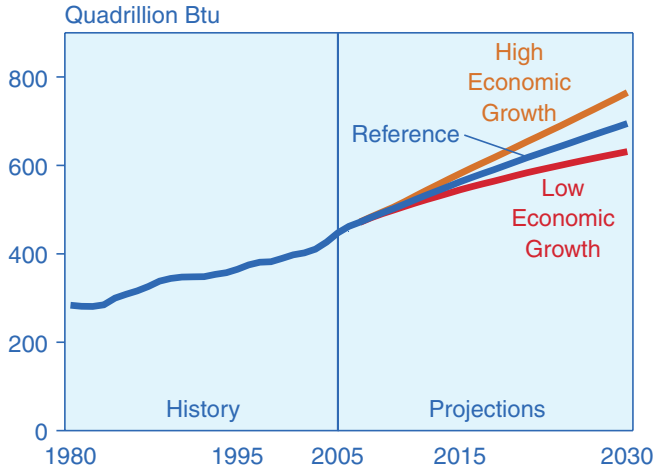
In the high economic growth case, 0.5 percentage point is added to the growth rate assumed for each country or country grouping in the reference case. In the low economic growth case, 0.5 percentage point is subtracted from the reference case growth rate. The *IEO2008* reference case shows total world energy consumption reaching 695 quadrillion Btu in 2030—286 quadrillion Btu in the OECD countries and 409 quadrillion Btu in the non-OECD countries. In the high growth case, world energy use in 2030 is projected to total 765 quadrillion Btu, or 70 quadrillion Btu (about 35 million barrels oil equivalent per day) higher than in the reference case. In the low growth case, world energy consumption in 2030 is projected to be 63 quadrillion Btu (32 million barrels oil equivalent per day) lower than in the reference case. Thus, the projections for 2030 in the high and low macroeconomic growth cases define a range of uncertainty equal to 113 quadrillion Btu (Figure 17).

Alternative Price Cases

The impacts of energy prices on the level and composition of energy demand are another large source of uncertainty in the *IEO2008* projections. To illustrate the impacts, *IEO2008* includes two alternative price cases. In the *IEO2008* high price case, world oil prices (in nominal terms) climb from $66 per barrel in 2006 to $186 per barrel in 2030; in the low price case, they decline to $46 per barrel in 2016 and increase slowly thereafter to $69 per barrel in 2030; and by comparison, in the reference case, they rise to $113 per barrel in 2030 (Figure 18).

Despite the considerable difference between oil prices in the low and high price cases in 2030 (about $117 per barrel), the projections for total world energy consumption in the reference and alternative price cases do not vary substantially. There is, however, a larger impact on the energy mix. The projections for total world energy use in 2030 in the high and low price cases are separated by only 47 quadrillion Btu (Figure 19). In comparison, the difference between the low and high macroeconomic growth case projections is 113 quadrillion Btu.

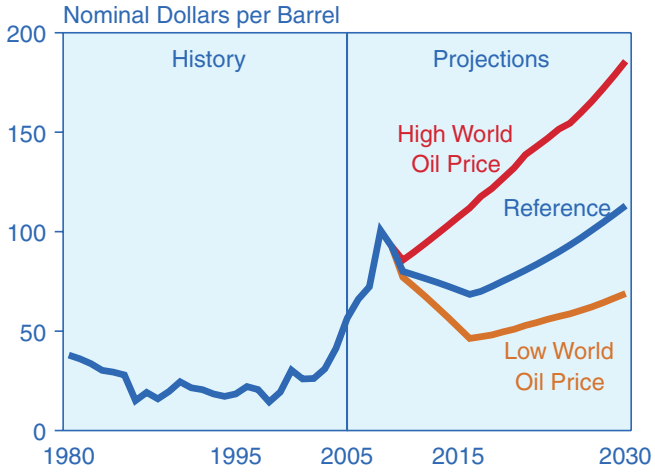
Figure 17. World Marketed Energy Consumption in Three Economic Growth Cases, 1980-2030



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

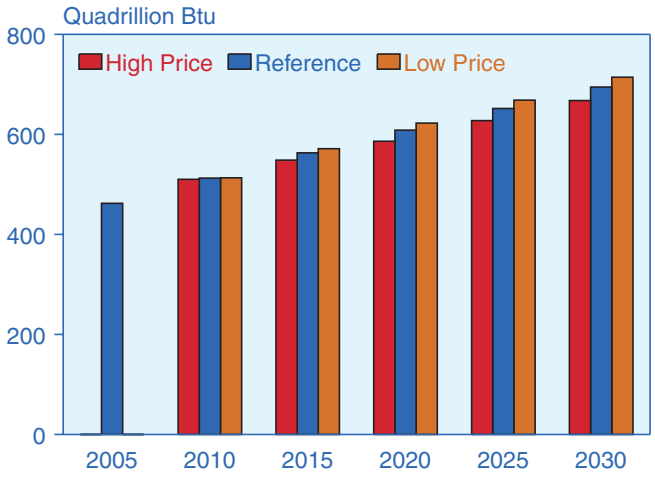
The potential effects of higher and lower oil prices on world GDP can also be seen in the low and high price cases. In the long run, the projections for economic growth are not affected substantially by the price assumptions. The most significant variations are GDP increases of around 1 percent in the low price case relative to the reference case in 2015 for some regions outside the Middle East and, in the oil-exporting Middle East region only, a 1-percent drop in GDP in 2015. In 2030, however, there are virtually no differences among GDP projections for any region in the different cases, because the world's economies have had more time to adjust to the lower or higher prices.

Figure 18. World Oil Prices in Three Price Cases, 1980-2030



Source: Energy Information Administration (EIA), *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), web site www.eia.doe.gov/oiaf/aeo.

Figure 19. World Marketed Energy Consumption in Three Price Cases, 2005-2030



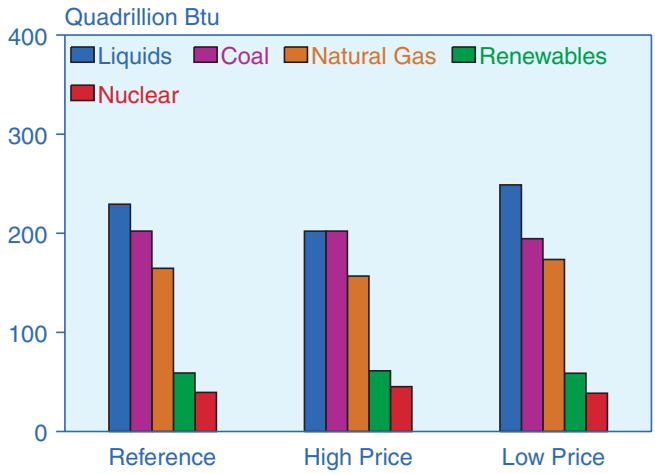
Sources: **2005:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

The most substantial impacts of the high and low price assumptions are on the mix of energy fuels consumed in each region, particularly liquids and coal (Figure 20). In the high price case, total world energy use in 2030 is about 27 quadrillion Btu lower, as is world liquids consumption, than projected in the reference case. Natural gas consumption is also lower in 2030, by a more modest 8 quadrillion Btu, whereas the projections for coal, nuclear power, and renewable energy consumption are higher than those in the reference case.

In the low price case, lower prices both allow consumers to increase their use of liquids for transportation purposes and discourage the migration away from liquids to other energy sources in sectors where fuel substitution is fairly easy to achieve (as opposed to the transportation sector, where there are relatively few alternatives to liquid fuels). Total liquids consumption in 2030 is 20 quadrillion Btu higher in the low price case than projected in the reference case, reflecting increased demand in all the end-use sectors. The transportation sector shows the largest increase in liquids consumption (7 quadrillion Btu) in 2030 in the low world oil price relative to the reference case (Figure 21).

In the *IEO2008* reference case, world oil prices rise steadily after 2015, to $113 per barrel in 2030. As a result, liquids consumption is curtailed in countries that have other fuel options available—especially in the electric power sector, where coal and other fuels can be substituted. In the reference case, worldwide use of liquids for electricity generation falls by 2.3 quadrillion Btu from 2005 to 2030. In the low price case, consumption of liquids for electricity generation increases by 2.0 quadrillion Btu, as the non-OECD countries retain their oil-fired generating capacity in the lower price environment.

Figure 20. World Marketed Energy Consumption in Three Price Cases, 2030

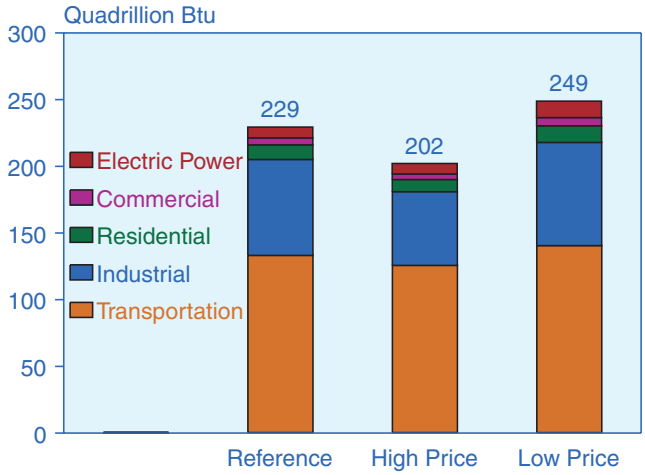


Source: Energy Information Administration, World Energy Projections Plus (2008).

Trends in Energy Intensity

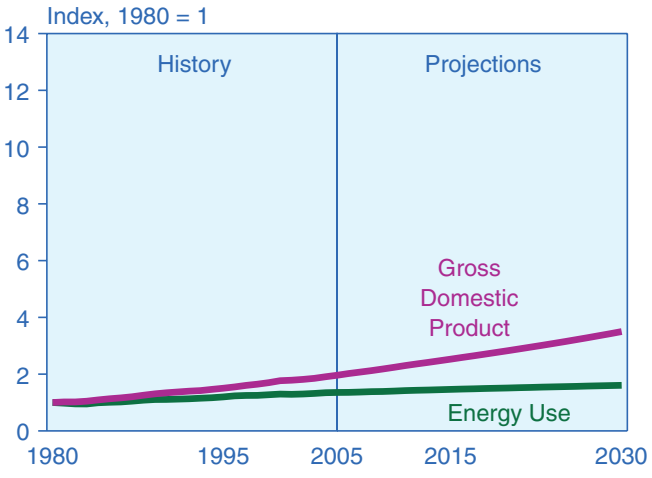
Another major source of uncertainty in the projections is the changing relationship of energy use to GDP—or energy intensity—over time. Economic growth and energy demand are linked, but the strength of that link varies among regions. In the OECD nations, history shows the link to be a relatively weak one, with energy demand lagging behind economic growth (Figure 22). In the non-OECD nations, except for non-OECD Europe and Eurasia, economic growth has been closely correlated with energy demand growth for much of the past three decades (Figure 23).

Figure 21. World Liquids Consumption in Three Price Cases, 2030



Source: Energy Information Administration, World Energy Projections Plus (2008).

Figure 22. Growth in Energy Use and Gross Domestic Product for the OECD Economies, 1980-2030

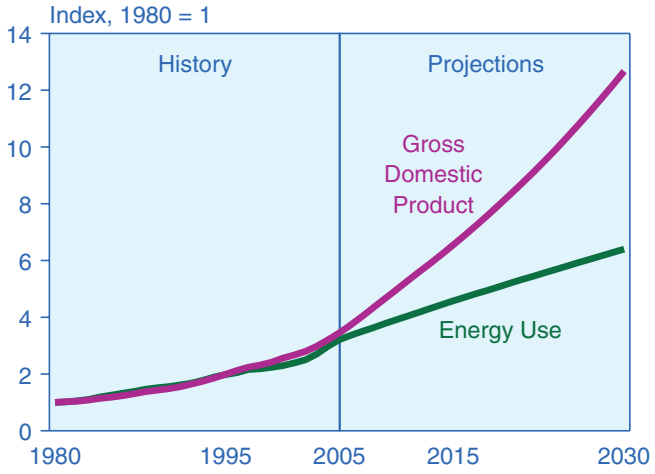


Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Historically, non-OECD Europe and Eurasia have had higher levels of energy intensity than either the OECD or other non-OECD economies. In non-OECD Europe and Eurasia, energy consumption generally grew more rapidly than GDP until 1990 (Figure 24), when the collapse of the Soviet Union created a situation in which both income and energy use declined but GDP fell more quickly. As a result, energy intensity increased. Only since the late 1990s, after the 1997 devaluation of the Russian ruble, did the Russian and Ukrainian industrial sectors begin to strengthen. Since then, economic growth in non-OECD Europe and Eurasia has begun to outpace growth in energy use significantly, and energy intensity has begun a precipitous decline. The region's energy intensity is projected to continue declining in the *IEO2008* reference case, while still remaining higher than in any other part of the world (Figure 25).

The stage of economic development and the standard of living of individuals in a given region strongly influence the link between economic growth and energy demand. Advanced economies with high living standards have relatively high levels of energy use per capita, but they also tend to be economies where per-capita energy use is stable or changes very slowly. In the OECD economies, there is a high penetration rate of modern appliances and motorized personal transportation equipment. To the extent that spending is directed to energy-consuming goods, it involves more often than not purchases of new equipment to replace old capital stock. The new stock generally is more efficient than the equipment it replaces, resulting in a weaker link between income and energy demand in the future.

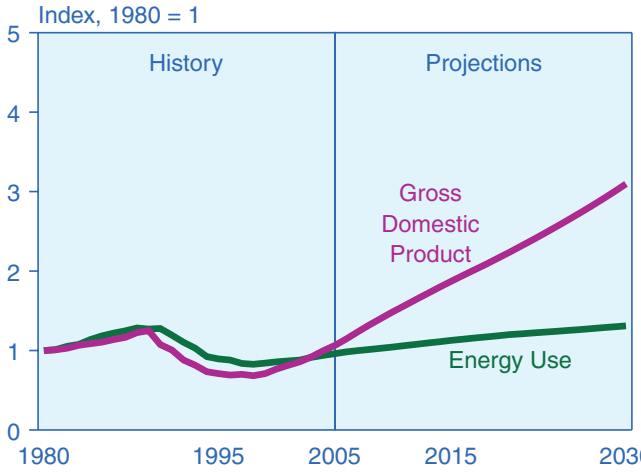
Figure 23. Growth in Energy Use and Gross Domestic Product for the Non-OECD Economies, 1980-2030



Note: Non-OECD economies in this figure exclude non-OECD Europe and Eurasia.

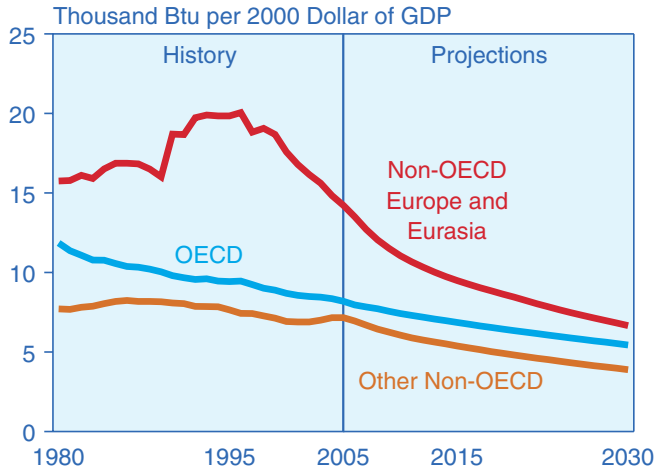
Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Figure 24. Growth in Energy Use and Gross Domestic Product for the Non-OECD Economies of Europe and Eurasia, 1980-2030



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Figure 25. Energy Intensity by Region, 1980-2030



Sources: **History:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

The pace of improvement in energy intensity may change, given different assumptions of macroeconomic growth over time. Faster growth in income generally leads to a faster rate of improvement (decline) in energy intensity. In the *IEO2008* high macroeconomic growth case, worldwide energy intensity is projected to decline by 2.3 percent per year on average from 2005 to 2030, as compared with 2.2 percent in the reference case. On the other hand, slower economic growth generally leads to a slower rate of improvement in energy intensity. In the low macroeconomic growth case, world energy intensity is projected to decline by an average of only 2.0 percent per year over the projection period.

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Chapter 2
Liquid Fuels

World liquids consumption increases from 84 million barrels per day in 2005 to 99 million barrels per day in 2030 in the IEO2008 high price case. In the reference case, which reflects a price path that departs significantly from prices prevailing in the first 8 months of 2008, liquids use rises to 113 million barrels per day in 2030.

The demand for liquid fuels and other petroleum[4] increases strongly in the *IEO2008* reference case. World use of liquids grows from 83.6 million barrels oil equivalent per day[5] in 2005 to 95.6 million barrels per day in 2015 and 112.5 million barrels per day in 2030. Much of the increase in total liquids consumption is projected for the nations of non-OECD Asia and the Middle East, where strong economic growth is expected, and nearly three-quarters is projected for use in the transportation sector.

In addition to the reference case, *IEO2008* includes a high price case that helps to quantify the uncertainty associated with long-term projections of future oil prices. In the high price case, which reflects a price path that is closer, in real terms, to prices prevailing during the first 8 months of 2008, world liquids consumption increases by only 0.7 percent per year on average from 2005 to 2030, as compared with 1.2 percent per year in the reference case. World liquids use in the high price case totals 99.3 million barrels per day in 2030, as the liquids share of total energy consumption declines from 37 percent in 2005 to 30 percent in 2030.

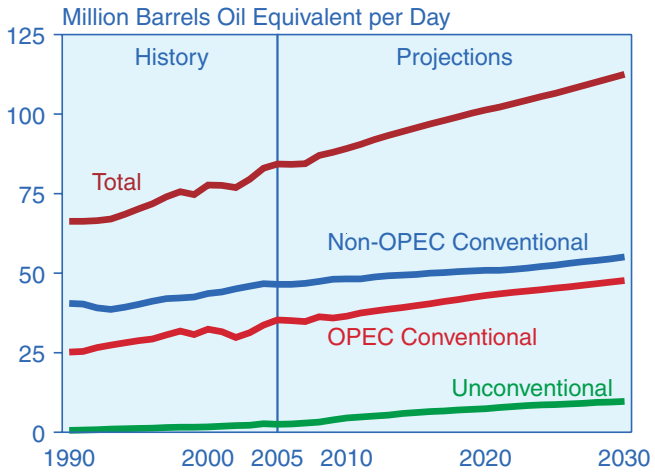
To meet the increment in world liquids demand in the *IEO2008* reference case, 28 million barrels per day of additional supply will be required by 2030 (Figure 26 and Table 3). In the reference case projections, sustained high world oil prices bolster the economic prospects for development of unconventional resources and enhanced recovery of conventional resources, as well as for conventional supplies in OPEC and a number of non-OPEC nations (such as Kazakhstan and Brazil) with significant potential for development of conventional resources. Total non-OPEC liquids production in 2030 is projected to be 15 million barrels per day higher than in 2005, representing 53 percent of the increase in total world production over the 2005 total.

Unconventional resources (including oil sands, extra-heavy oil, biofuels, coal-to-liquids [CTL], and gas-to-liquids [GTL]) from both OPEC and non-OPEC sources are expected to become increasingly competitive in the reference case (Figure 27). World production of unconventional resources, which totaled only 2.5 million barrels per day in 2005, increases to 9.7 million barrels per day in 2030, accounting for 9 percent of total world liquids supply in 2030 on an oil equivalent basis. Biofuels, including ethanol and biodiesel, will be an increasingly important source of unconventional liquids supplies, largely because of the growth in U.S. biofuels production. In the *IEO2008* reference case, U.S. biofuels production in 2030 is projected to be 1.2 million barrels per day, accounting for nearly one-half of the increase in world biofuels production over the projection period.

World Liquids Consumption

World liquids consumption in the *IEO2008* reference case increases from 84 million barrels per day in 2005 to 113 million barrels per day in 2030, mainly as a result of increases among the emerging economies of the world, where strong economic growth is expected throughout the projection period. Liquids remain the

Figure 26. World Liquids Production in the Reference Case, 1990-2030



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea.. **Projections:** EIA, Generate World Oil Balance Model (2008).

[4]Liquid fuels and other petroleum (also referred to as liquids) include petroleum-derived fuels and non-petroleum-derived fuels, such as ethanol and biodiesel, coal-to-liquids, and gas-to-liquids. Petroleum coke, which is a solid, is included. Also included are natural gas liquids, crude oil consumed as a fuel, and liquid hydrogen.

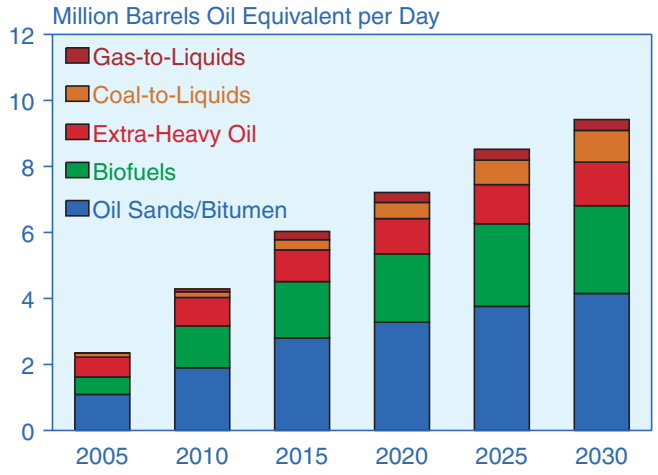
[5]Throughout this chapter, liquids consumption and production are reported in million barrels oil equivalent per day.

Table 3. World Liquid Fuels Production, 2005-2030
(Million Barrels Oil Equivalent per Day)

Source	2005	2010	2015	2020	2025	2030	Average Annual Percent Change, 2005-2030
OPEC							
Conventional Oil[a]	35.3	36.5	39.8	43.0	45.3	47.7	1.2
Extra-Heavy Oil	0.6	0.9	0.9	1.0	1.1	1.3	3.0
Bitumen	0.0	0.0	0.0	0.0	0.0	0.0	—
Coal-to-Liquids	0.0	0.0	0.0	0.0	0.0	0.0	—
Gas-to-Liquids	0.0	0.0	0.2	0.2	0.3	0.3	—
Biofuels	0.0	0.0	0.0	0.0	0.0	0.0	—
OPEC Total	**36.1**	**37.4**	**40.9**	**44.4**	**46.7**	**49.3**	**1.3**
Non-OPEC							
Conventional Oil[a]	46.5	48.2	49.6	50.9	52.5	55.1	0.7
Extra-Heavy Oil	0.0	0.0	0.0	0.0	0.0	0.1	—
Bitumen	1.1	1.9	2.8	3.3	3.8	4.2	5.5
Coal-to-Liquids	0.1	0.2	0.3	0.5	0.7	1.0	8.2
Gas-to-Liquids	0.0	0.1	0.1	0.1	0.1	0.1	—
Biofuels	0.5	1.3	1.7	2.1	2.5	2.7	6.7
Non-OPEC Total	**48.2**	**51.8**	**54.7**	**57.0**	**59.8**	**63.2**	**1.1**
World							
Conventional Oil[a]	81.9	84.8	89.4	93.9	97.8	102.9	0.9
Extra-Heavy Oil	0.6	0.9	1.0	1.1	1.2	1.3	3.2
Bitumen	1.1	1.9	2.8	3.3	3.8	4.2	5.5
Coal-to-Liquids	0.1	0.2	0.3	0.5	0.7	1.0	8.2
Gas-to-Liquids	0.0	0.1	0.2	0.3	0.3	0.3	—
Biofuels	0.5	1.3	1.7	2.1	2.5	2.7	6.7
World Total	**84.3**	**89.2**	**95.7**	**101.3**	**106.5**	**112.5**	**1.2**

[a]Includes conventional crude oil and lease condensate, natural gas plant liquids (NGPL), and refinery gain.
OPEC = Organization of the Petroleum Exporting Countries (OPEC-13).
Sources: **History:** Energy Information Administration (EIA), Office of Energy Markets and End Use. **Projections:** Generate World Oil Balance Model (2008).

Figure 27. World Production of Unconventional Liquid Fuels, 2005-2030



Sources: **2005:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, Generate World Oil Balance Model (2008).

most important fuels for transportation, because there are few alternatives that can compete widely with liquid fuels. With world oil prices remaining relatively high through 2030, the increasing cost-competitiveness of non-liquid fuels causes many stationary uses of liquids (that is, for electric power generation and for end uses in the industrial and building sectors) to be replaced by alternative energy sources, which increases the transportation share of liquids consumption. On a global basis, the transportation sector accounts for 74 percent of the total projected increase in liquids use from 2005 to 2030; the industrial sector accounts for virtually all of the remainder (Figure 28).

Strong expansion of liquids use is projected for the non-OECD countries, fueled by robust economic growth, burgeoning industrial activity, and rapidly expanding transportation use. The most robust regional growth in liquids consumption is projected for non-OECD Asia and the Middle East (Figure 29). In non-OECD Asia, liquids use expands by 16 million

barrels per day over the projection period, from 15.3 million barrels per day in 2005 to 30.8 million barrels per day in 2030. Among the nations of non-OECD Asia, China and India account for much of the growth in liquids demand, and together they account for 11.5 million barrels per day (74 percent) of the regional increment in liquids use. Liquids consumption in non-OECD Asia is projected to surpass that in the United States (currently the world's largest liquids-consuming nation) by 2020, and in 2030 it is projected to exceed U.S. consumption by nearly 40 percent.

In the Middle East, liquids consumption is projected to increase by 3.6 million barrels per day from 2005 to 2030. Three major factors contribute to the growth in oil consumption in the Middle East:

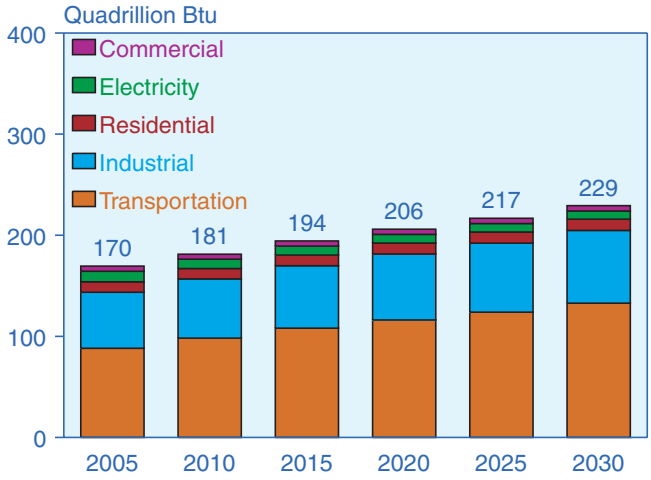
- First, although the population in the Middle East is relatively small, the nations of the region have recorded relatively high birth rates over the past several decades, so that at present a substantial portion of the population is young and reaching driving age, increasing the demand for personal motorization [*1*].
- Second, energy use is heavily subsidized in many of the resource-rich nations of the region. In Iran, for example, gasoline prices average $0.42 per gallon, shielding consumers from the high free-market price of gasoline. As a result, consumption has continued to increase strongly in Iran, by an estimated 9 percent per year since 2004 [*2*].
- Finally, many of the world's major oil-exporting nations are in the Middle East, and as world oil prices have continued to rise, so too have their per-capita incomes. As standards of living have improved, demand for personal motorization has increased, and many nations of the region have seen double-digit growth in automobile sales in recent years [*3*].

In contrast to the non-OECD nations, liquids consumption in the OECD nations generally grows more slowly, reflecting expectations of slow growth or declines in population and relatively slow economic growth in most of the OECD nations over the next two decades. Whereas liquids consumption in the non-OECD countries is expected to increase by 2.2 percent per year on average from 2005 to 2030, OECD liquids use increases by 0.3 percent per year. Sustained high world oil prices are expected to have a more pronounced impact on the use of liquids in the OECD countries, where many consumers are not shielded from high market prices by subsidies like those in place in many of the larger non-OECD consumer nations, including China, India, and many of the OPEC member countries. As a result, OECD countries respond more rapidly to high oil prices in the *IEO2008* reference case projection, switching away from liquids wherever possible and reducing demand in the transportation sector by adopting more efficient motor vehicles and reducing vehicle-miles traveled.

World Oil Prices

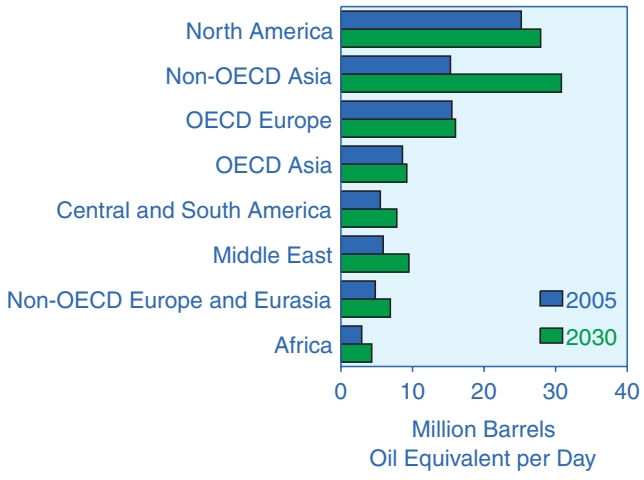
A major factor in the *IEO2008* projections is the assumption for future world oil prices. The impacts of world oil prices on energy demand are a considerable source of uncertainty in the mid-term projections. Following the large increases in world oil prices over the past several years, expectations for future prices also have been raised. In 2006 U.S. dollars, oil prices in the *IEO2008* reference case are about 94 percent higher in 2025 than projections made only 5 years ago in EIA's *International Energy Outlook 2003*. The world oil price cases in

Figure 28. World Liquids Consumption by Sector, 2005-2030



Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Figure 29. World Liquids Consumption by Region and Country Group, 2005 and 2030



Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

IEO2008 are consistent with those in the *Annual Energy Outlook 2008*.

In every year since 2003, the average price of West Texas Intermediate (WTI) crude oil, which is indicative of world oil prices as a whole, has been higher than the average for the previous year. Prices in 2007 were nearly double 2003 prices in real terms. Prices rose further into the third quarter of 2008. A variety of factors have caused the increases, including strong demand growth in non-OECD Asia and the Middle East, no growth in production from the members of the Organization of the Petroleum Exporting Countries[6] (OPEC) since 2005, rising costs for oil exploration and development, across-the-board increases in commodity prices, and a weaker U.S. dollar.

In the *IEO2008* reference case, prices ease somewhat in the medium term, as anticipated new production—both conventional and unconventional (in Azerbaijan, Brazil, Canada, Kazakhstan, and the United States, for example)—reaches the marketplace. Ultimately, however, markets are expected to remain relatively tight. In nominal terms, world oil prices in the *IEO2008* reference case decline from their current highs to around $70 per barrel in 2015, then rise steadily to $113 per barrel in 2030 ($70 per barrel in inflation-adjusted 2006 dollars).

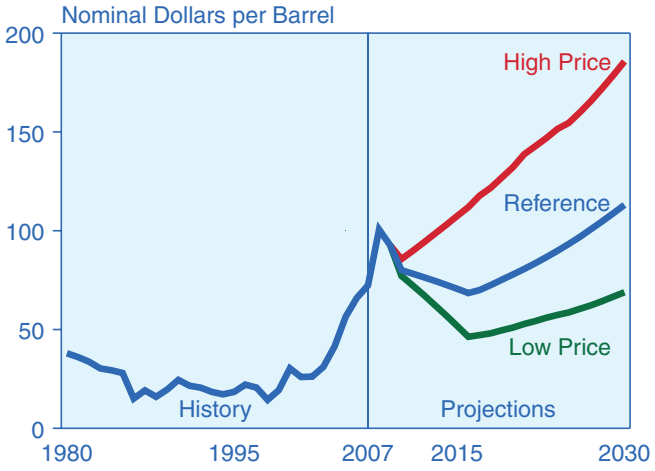
In addition to the reference case, *IEO2008* includes high and low price cases, which help to quantify the considerable uncertainty associated with long-term projections of future oil prices (Figure 30). Given the price levels that prevailed in the first 8 months of 2008, however, the high price case appears to provide a better reflection of current oil market conditions than does the *IEO2008* reference case. The low and high price cases define a substantial range of $117 per barrel (in nominal dollars). In the high price case, world oil prices in 2030 are nearly 65 percent higher than projected in the reference case, at $186 per barrel in nominal terms. Because high world oil prices slow the growth of demand in the long term, world liquids consumption in the high price case totals only 99.3 million barrels per day in 2030, 13 million barrels per day lower than in the reference case.

In the long term, four factors determine the price of oil: growth in world liquids demand, high production costs for accessible non-OPEC conventional liquids resources, OPEC investment and production behavior, and the cost and availability of unconventional liquids supply. It is essential to distinguish between factors that affect prices in the short term versus the long term, particularly given the current price environment.

The reference case assumes that OPEC producers will choose to maintain their market share of world liquids supply, and that OPEC member countries will invest in incremental production capacity so that their conventional oil production represents approximately 40 percent of total global liquids production throughout the projection. As a result, strong economic growth, especially in the developing world, supports a consistent upward trend in world oil prices after 2015.

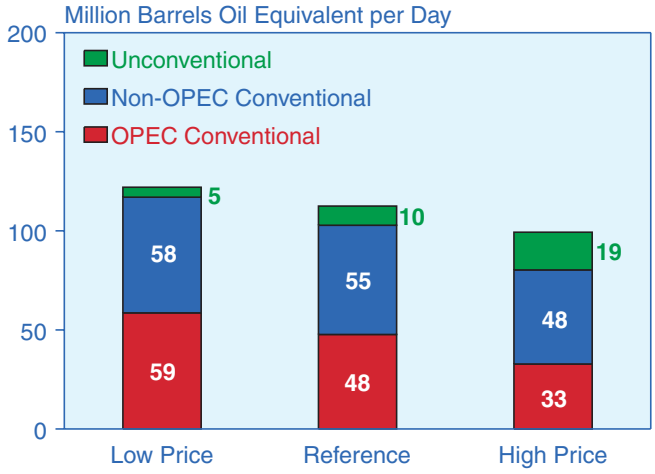
The composition of supply also differs substantially between the reference and high price cases (Figure 31).

Figure 30. Nominal World Oil Prices in Three Cases, 1980-2030



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), web site www.eia.doe.gov/oiaf/aeo.

Figure 31. World Liquids Supply in Three Cases, 2030



Source: Energy Information Administration, Generate World Oil Balance Model (2008).

[6]Ecuador officially rejoined OPEC on October 1, 2007. Throughout this chapter, all references to OPEC include Ecuador. In addition, all time series have been updated to reflect country groupings as of March 1, 2008, so that Ecuador's liquids production is included in the OPEC totals for 1980 through 2030.

As prices rise in the high price case, the development of previously uneconomical unconventional supplies is encouraged. As a result, unconventional resources account for a much larger portion of total liquids supply than in the reference case in 2030 (nearly 20 percent, as compared with about 9 percent in the reference case). Conventional supplies decline over the projection period in the high price case, by 1.5 million barrels per day, compared with an increase of 21.0 million barrel per day in the reference case. The high price case assumes that OPEC member countries will maintain their production at near current levels, and that they will be willing to sacrifice market share as demand for global liquids continues to grow. The high price case also assumes that oil resources in non-OPEC countries will be less accessible and/or more expensive than assumed in the reference case.

Multiple factors restrict conventional liquids production in the high price case, so that more expensive unconventional liquids are needed to meet world demand. In particular, access to non-OPEC resources is expected to be limited, with resource-rich countries such as Kazakhstan and Mexico being unable to increase their conventional liquids production or unwilling to do so for geopolitical reasons. In addition, OPEC is expected to constrain total liquids production to current levels, reducing the OPEC market share of conventional liquid supplies to 33 percent in 2030 in the high price case. Although conventional production in the OECD countries decreases slightly (by 4 percent over the 2005-2030 period), their total liquids production (both conventional and unconventional) is expected to increase relative to the reference case, as higher prices make the extraction of additional barrels of unconventional petroleum liquids, such as oil sands, more economical. The higher prices and limited access to conventional resources also result in more significant increases in production of unconventional liquids in non-OPEC developing countries than are projected in the reference case.

In the low price case, OPEC is assumed to increase its conventional oil production to obtain approximately a 44-percent share of total world liquids production. The low price case also assumes that conventional oil resources in non-OPEC countries will be more accessible and/or less costly to bring to market, because of more rapid technology advances, more attractive fiscal regimes, or both, than in the reference case. As a result, non-OPEC conventional oil production is higher in the low price case than in the reference case. Nominal world oil prices decline to about $46 per barrel in 2016 in the low price case, before climbing to $69 per barrel in 2030. The low world oil prices discourage fuel conservation and reduce the incentive for development of non-petroleum liquids. In the low price case, conventional supplies in 2030 are 14 million barrels per day higher than in the reference case. Non-OPEC conventional production totals 58.4 million barrels per day in 2030 in the low price case, compared with 55.1 million barrels per day in the reference case.

Non-OPEC nations increase international access to domestic resources in the low price case and improve the financial regimes governing the extraction of those resources. OPEC is assumed to increase its conventional liquids production share of total liquids to 48 percent in 2030 from 42 percent in 2005. Changes in the political and fiscal environments of the OPEC member countries are expected to result in increased production of relatively inexpensive conventional resources, thus reducing the economic competitiveness of unconventional liquids production around the world and of conventional liquids production in the industrialized OECD nations and reducing unconventional liquids production to approximately one-half the level projected in the reference case.

World Liquids Production

In the *IEO2008* reference case, world liquids production increases by 28 million barrels per day from 2005 to 2030 to meet projected growth in demand. Increases in production are expected for both OPEC and non-OPEC producers. About 47 percent of the total world increase in liquids supplies is expected to come from OPEC member countries. Thus, in 2030, OPEC production is projected to total 49 million barrels per day and non-OPEC production 63 million barrels per day.

The reference case assumes that OPEC producers will choose to maintain their market share of world liquids supply, and that OPEC member countries will invest in incremental production capacity so that their conventional oil production represents approximately 40 percent of total global liquids production throughout the projection. Increasing volumes of conventional liquids (crude oil and lease condensate, natural gas plant liquids, and refinery gain) from OPEC members contribute 12.4 million barrels per day to the total increase in world liquids production, and conventional liquids supplies from non-OPEC countries add another 8.6 million barrels per day.

The *IEO2008* projections are based on a two-stage analytical approach. Projections of liquids production before 2015 are based largely on a project-by-project assessment of production volumes and associated scheduling timelines, with consideration given to the decline rates of active projects, planned exploration and development activity, and country-specific geopolitical situations and fiscal regimes. There are often lengthy delays between the point at which supply projects are

announced and when they begin producing. The extensive and detailed information available about such projects, including project scheduling and the investment and development plans of companies and countries, makes it possible to take a detailed approach to modeling supply.

Because projects generally are not publicized more than 7 to 10 years before their first production, project-by-project analyses are unlikely to provide an accurate representation of company or country production plans and achievable production volumes after 2015. Instead, production decisions made after 2015 are assumed to be based predominantly on resource availability and the resulting economic viability of production. Geopolitical and other "above-ground" constraints[7] are not assumed to disappear entirely after 2015, however. Longstanding above-ground factors for which there are no indications of significant future changes—for instance, the government-imposed investment conditions currently in place in Iran, or OPEC adherence to production quotas—are expected to continue to affect world supplies long after 2015.

For some resource-rich countries it is assumed that current political barriers to increasing production will not continue after 2015. For instance, both Mexico and Venezuela currently have legislation that restricts foreign ownership of hydrocarbon resources. Their nationalization of resources has discouraged investment—both foreign and domestic—and hindered their ability to increase or even maintain historical production levels. In the reference case, both Mexico and Venezuela are assumed to ease restrictions at some point after 2015, allowing some additional foreign investment or involvement in their oil sectors that will facilitate increases in liquids production, including from deepwater prospects in Mexico and heavy oils in Venezuela's Orinoco belt.

Iraq is another resource-rich country where currently there are significant impediments to investment in the upstream hydrocarbon sector. Liquids production in Iraq dropped substantially after the U.S.-led invasion in 2003. From 2003 to 2004 production declined from 2.0 million barrels per day to 1.3 million barrels per day, and it has been relatively slow to recover since then, not yet reaching the peak production level of 2.6 million barrels per day that was achieved in 2000. Although Iraq's production levels are not expected to increase substantially in the near term, it is assumed that the conflict will end eventually and that renewed investment and development activity will ensue, resulting in fairly significant growth in production from 2015 through 2030.

Non-OPEC Production

The world oil prices projected in the *IEO2008* reference case are expected to encourage producers in non-OPEC nations to continue investment in conventional liquids production capacity and increase investment in enhanced oil recovery (EOR) projects and unconventional liquids production. Non-OPEC production increases steadily in the projection, from 48 million barrels per day in 2005 to 63 million barrels per day in 2030, as high prices attract investment in areas previously considered uneconomical.

Non-OPEC conventional liquids production in the reference case increases from 47 million barrels per day in 2005 to 50 million barrels per day in 2015 and 55 million barrels per day in 2030. Unconventional liquids production from non-OPEC suppliers rises to 5 million barrels per day in 2015 and 8 million barrels per day in 2030. In the high price case, non-OPEC unconventional liquids production rises to 16 million barrels per day in 2030, as high prices encourage the development of these alternative fuel sources. In contrast, in the low price case, fewer unconventional resources become economically competitive, and non-OPEC production of unconventional liquids rises to only 4 million barrels per day in 2030.

Among non-OPEC producers, the lack of prospects for new, large conventional petroleum liquids projects and declines in production from existing conventional fields result in heavy investment in the development of smaller fields. Producers are expected to concentrate their efforts on more efficient exploitation of fields already in production, either through the use of more advanced technology for primary recovery efforts or through EOR. Those efforts are expected to allow non-OPEC producers to maintain or slow production declines but not to raise production volumes.

Large increases in non-OPEC production of conventional petroleum liquids are expected to come from regions with recent large discoveries that have high undiscovered resource potential but are not yet producing. Significant gains in conventional production are projected for the Caspian area (Kazakhstan) and South America (Brazil) (Figure 32). Canada also is expected to be a major non-OPEC supplier of liquids, with bitumen (oil sands) production more than compensating for projected declines in its conventional oil production.

The most significant decline in non-OPEC liquids production is projected for the North Sea, which includes offshore production from Norway, the United Kingdom, the Netherlands, and Germany. The production projections for the North Sea are lower in *IEO2008* than

[7] "Above-ground" constraints refer to those nongeological factors that might affect supply, including: government policies that limit access to resources; conflict; terrorist activity; lack of technological advances or access to technology; price constraints on the economical development of resources; labor shortages; materials shortages; weather; and other short- and long-term geopolitical considerations.

they were in *IEO2007*, because the anticipated rates of production decline are steeper than expected previously and because of delays in the startup of offshore fields by Norway and by the United Kingdom (which accounted for a combined 98 percent of total North Sea production in 2006). Although the long-term projections of production levels have been reduced, there are positive indications of future prospects for both Norway (with the opening of the Barents Sea for exploration) and the United Kingdom (with the development of Buzzard field).

Liquids production from non-OECD Europe and Eurasian producers rises from 11.9 million barrels per day in 2005 to 18.9 million barrels per day in 2030. More than one-half of the increase is attributed to production increases in Russia, which is the country with the largest projected increase (by volume) in non-OPEC liquids production in the *IEO2008* reference case, at 4.0 million barrels per day from 2005 to 2030.

The Caspian Basin region accounts for a sizable portion of the liquids production projected for non-OECD Europe and Eurasia in *IEO2008*. Overall, production from the Caspian Basin is projected to grow at an average rate of 3.6 percent per year, resulting in an increment of 3.0 million barrels per day over the 2005-2030 period. Kazakhstan alone accounts for 2.3 million barrels per day of the projected increase, primarily as a result of the development of its Kashagan field and the expansion of gas reinjection at Tengiz, but also because undiscovered fields in its Caspian territory are expected to be developed before 2030. The growth of Kazakhstan's production will depend not only on resource availability and extractability, however, but also, because of its geographical position, on the opening of export routes—a task that will require regional cooperation.

Azerbaijan and Turkmenistan are other Caspian producers expected to increase their production in the reference case. Turkmenistan's production is projected to grow by more than 6 percent per year in the mid-term and somewhat more slowly in the long term, in light of the government's evolving attitude toward foreign investment. Azerbaijan's production is projected to grow rapidly, to a peak production of 1.3 million barrels per day in the next decade, followed by a decline to 1.0 million barrels per day in 2030.

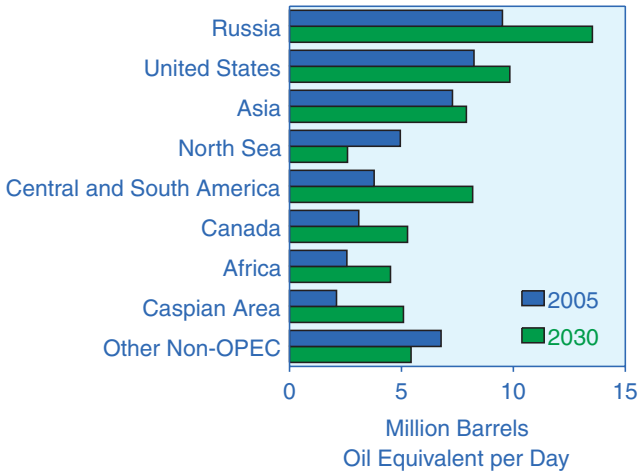
In Central and South America, Brazil's liquids production is projected to grow at an average annual rate of 4.4 percent from 2005 to 2030, resulting in an increase of 3.8 million barrels per day over the period. Capacity expansions at Brazil's currently producing fields result in production increases through 2015, and recent discoveries in the Campos and Santos Basins—which suggest the presence of other large fields in the same formation—are projected to lead to additional production increases in the longer term.

North America's conventional liquids production is projected to fall by an average of 0.5 percent per year from 2005 to 2030, mainly as a consequence of the expected exhaustion of attractive conventional prospects in Canada and a lack of available capital for the development of conventional resources in Mexico, especially in the deepwater Gulf of Mexico. Increasingly, North America's future liquids production is expected to rely on unconventional production—especially, from Canada's bitumen resources. In total, North America's liquids production is projected to increase by 2.9 million barrels per day over the period, at an average annual rate of 0.7 percent.

In the United States, total liquids production increases from 8.2 million barrels per day in 2005 to 10.3 million barrels per day in 2022, then falls to 9.8 million barrels per day in 2030. The near-term profile of U.S. liquids production is determined largely by lower 48 offshore production. Deepwater production in the Gulf of Mexico increases from just under 1.0 million barrels per day in 2005 to a peak of 2.0 million barrels per day between 2013 and 2019 before beginning to decline. U.S. biofuels production is projected to rise from 0.2 million barrels per day in 2005 to 1.2 million barrels per day in 2030 (on an oil equivalent basis), with the United States accounting for nearly one-half of the total increment in world biofuels production in the *IEO2008* reference case.

In Africa, almost 70 percent of non-OPEC conventional liquids production currently comes from four countries: Egypt (28 percent), Equatorial Guinea (16 percent), Sudan (15 percent), and Congo-Brazzaville (10 percent).

Figure 32. Non-OPEC Conventional Liquids Production by Region, 2005 and 2030



Sources: **2005:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **2030:** Energy Information Administration, Generate World Oil Balance Model (2008).

In combination, the four are expected to retain approximately a 70-percent share of Africa's non-OPEC conventional production through 2030. Although the resources of Egypt, the current top producer of conventional petroleum liquids, are well developed and primary recovery from many of its fields already is in decline, secondary recovery and EOR efforts are expected to stabilize Egypt's production from previously developed reservoirs in the mid-term. In 2030, Sudan is expected to be the largest non-OPEC producer in Africa, at 0.9 million barrels per day, with most of the growth occurring after 2020.

Conventional liquids production in Congo-Brazzaville more than doubles in the *IEO2008* reference case, from 0.2 million barrels per day in 2005 to 0.6 million barrels per day in 2030, which would make it the region's third largest non-OPEC producer. Recent field discoveries, including Moho Nord Marine 1 and Pegase Nord Marine 1, have served both to increase international interest in the region and to promote the possibility of additional large finds in the future. Given that most of the recent discoveries have been in deepwater locations where there has been little previous exploration, growth in the country's production is expected to come from known and potential deepwater resources.

Non-OPEC producers in Asia are projected to increase their total liquids production from 7.2 million barrels per day in 2005 to 8.6 million barrels per day in 2030. China is Asia's largest non-OPEC producer of total liquids by far, at 3.7 million barrels per day in 2005, followed by India at 0.8 million barrels per day, and Malaysia at 0.7 million barrels per day. China's production is expected to be maintained at about 4.0 million barrels per day through 2030, and India's production is projected to increase to slightly more than 1.2 million barrels per day in 2030.

Liquids production from Australia/New Zealand is projected to increase from 0.6 million barrels per day in 2005 to 0.7 million barrels per day in 2030. Near-term increases in crude oil and condensate production are expected for both Australia and New Zealand, mainly as a result of recent discoveries and developments in offshore basins (such as the Carnarvon Basin). A decline to lower, relatively stable production levels is projected over the longer term. For both countries, production of natural gas plant liquids (NGPL) is projected to remain around current levels in the near term, followed by significant growth as recently discovered large fields are developed and the natural gas is extracted and processed. With the expected surge in NGPL production, total conventional liquids production is projected to increase slightly from 2005 to 2030.

In addition to increasing their production of conventional liquids, both China and India are expected to increase biofuels and CTL production. Unconventional liquids production in China rises to 0.4 million barrels per day in 2030, with CTL accounting for 65 percent and biofuels the remainder. In India, unconventional production rises to 0.2 million barrels per day in 2030, with 44 percent attributed to CTL and 56 percent to biofuels. Advances in technologies—for instance, direct coal liquefaction that would improve the efficiency of CTL production and make it more economical—are not expected to become commercially viable until late in the projection period.

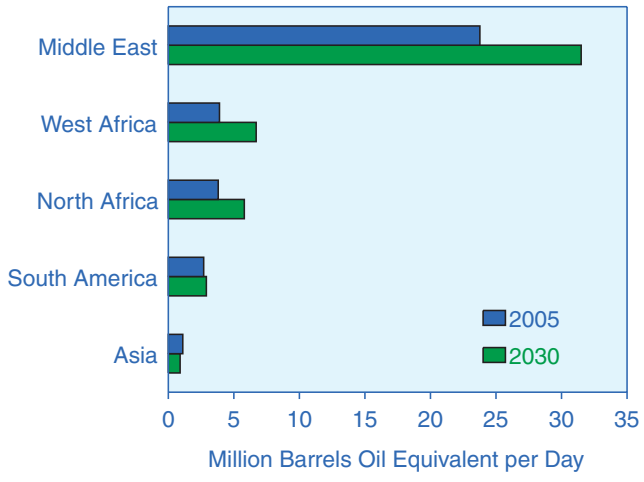
OPEC Production

OPEC's total liquids production increases at a 1.3-percent average annual rate from 2005 to 2030 in the *IEO2008* reference case, resulting in the production of 49.3 million barrels of liquids per day in 2030, of which 31.8 million barrels per day originates in the Middle East (Figure 33). By volume, the largest increase in the individual OPEC countries' liquids production is projected for Saudi Arabia: from 11.1 million barrels per day in 2005 to 13.7 million barrels per day in 2030.

The most rapid growth in OPEC production is projected for Qatar, where total liquids production rises at an average annual rate of 4.3 percent over the projection period, including an increase in GTL production to 0.2 million barrels per day in 2030. In addition, Qatar's NGPL production increases at an average annual rate of 6.1 percent, and its crude oil and condensate production increases by an average of 3.1 percent per year.

The second-fastest growth rate in liquids production among the OPEC countries is projected for Angola, averaging 3.7 percent per year from 2005 to 2030. Almost all

Figure 33. OPEC Conventional Liquids Production by Region, 2005 and 2030



Sources: **2005:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **2030:** Energy Information Administration, Generate World Oil Balance Model (2008).

the increase is expected to consist of crude oil and lease condensate production from offshore projects. Established OPEC production targets (in December 2007, Angola received a target of 1.9 million barrels per day) are not expected to impede project development in Angola, and its production in 2030 is projected to be 3.1 million barrels per day in the reference case.

Iraq's liquids production also grows substantially, by an average of 3.1 percent per year, depending on developments in the country's political situation. The *IEO2008* projections assume that the conflict in Iraq will be resolved well before 2030, making resource availability the main determining factor in its ability to meet growing domestic demand. From 2005 to 2015, Iraq's liquid fuels production is projected to grow by only 1.4 percent per year, but from 2015 to 2030 the average annual growth rate increases to 4.3 percent.

Total liquids production in Iran also is expected to be restricted by geopolitical factors through 2015. Those factors are not limited to international relations but also include a variety of other non-resource-related factors that range from the effectiveness of the national oil company's operations to the ability of the government and foreign investors to agree on contractual terms. In the *IEO2008* reference case, Iran's oil production remains relatively stable through 2015, both because of financial and political constraints on developing new oil or natural gas prospects and because of anticipated competing demands for natural gas that would limit its use (and thus effectiveness) for improving oil recovery through natural gas reinjection. The reference case does not project large increases in Iran's liquids production, because it does not assume improvements in either the political or investment environment for the country.

For Venezuela, liquids production is constrained by investor concerns over government actions that nationalized the upstream hydrocarbon sector, as well as the possibility of further mandated changes in contract terms. Venezuela's total liquids production falls somewhat in the reference case, from 2.9 million barrels per day in 2005 to 2.5 million barrels per day in 2010, before beginning a steady recovery to 3.5 million barrels per day in 2030. This is a much more pessimistic outlook for Venezuela's production profile than in past *IEO*s. In *IEO1999*, which was published only a month after Hugo Chavez assumed the Venezuelan Presidency, the country's annual liquids production was projected to reach 5.5 million barrels per day in 2020—2.4 million barrels per day more than projected in the *IEO2008* reference case.

Unconventional Production

Unconventional liquids play an increasingly important role in meeting demand for liquid fuels over the course of the *IEO2008* projection. In the reference case, 8.6 percent of world liquids supply in 2030 is projected to come from unconventional sources, including 1.6 million barrels per day originating from OPEC and 8.1 million from non-OPEC countries. Although unconventional production volumes vary between the *IEO2008* price cases (from 19.0 percent in the high price case to 4.0 percent in the low price case), the geographic locations and types of unconventional production remain relatively unchanged.

OPEC's unconventional production consists predominantly of extra-heavy Orinoco oil production in Venezuela and GTL production in Qatar, with 2030 production volumes ranging from 1.1 to 2.1 million barrels per day and 0.2 to 0.5 million barrels per day, respectively, in the high and low price cases. Although the resources to support production at those levels abound in the two countries, large investments will be required to produce them, and the timing of such investments is uncertain.

Outside the OPEC member countries, unconventional liquids production comes from a much more diverse group of countries and resource types. As a whole, non-OPEC unconventional liquids production is projected to increase by more than 6.4 million barrels per day from 2005 to 2030, with 72.4 percent coming from OECD countries. By volume, the largest contributors to the non-OPEC increase are expected to be bitumen (Canadian oil sands) and biofuels, with production increases of 3.1 and 2.2 million barrels oil equivalent per day, respectively, from 2005 to 2030.

Although bitumen and biofuels are viewed as having the most potential for significant contributions to global liquids supply, they also show the most significant variations in production levels among the price cases as a result of the effects of different price assumptions on production economics and competing supply from conventional liquids. The projected increases from 2005 to 2030 in Canada's bitumen production range from less than 0.3 million barrels per day in the low price case to 7.6 million barrels per day in the high price case, and the increases in biofuels production ranging from 1.2 million barrels per day in the low price case to 3.7 million barrels per day in the high price case. In the reference case, the most significant increases in biofuels production from 2005 to 2030 are projected for the United States (1.0 million barrels per day) and Brazil (0.5 million barrels per day). Increases of approximately 60 thousand barrels per day are projected for South Africa, China, India, and Argentina.

Like biofuels production, CTL production volumes vary among the price cases, although they do not add as much to total liquids production. In the low price case,

South Africa is the largest CTL supplier, producing 112,000 barrels per day in 2030, with China, India, and the United States contributing smaller volumes. In the reference case, the United States and China increase their CTL production by 242,000 and 246,000 barrels per day, respectively, from 2005 to 2030; South Africa increases its production by only 209,000 barrels per day but still remains the dominant CTL supplier, at 340,000 barrels per day in 2030. In the high price case, improved production economics result in the expansion of CTL projects around the world and the production of 2.7 million barrels per day in 2030—2.5 million barrels per day more than was produced in 2005.

In all three cases, non-OPEC production of extra-heavy oil, GTL, and shale oil contributes a relatively small fraction of liquids to the world market. Mexico is expected to be the only non-OPEC supplier of extra-heavy oil, with volumes ranging from 19,000 to 120,000 barrels per day in 2030 in the low and high price cases, respectively. In the reference and low price cases, South Africa is the world's only non-OPEC supplier of GTL; however, in the high price case the United States and South Africa produce approximately the same volumes, at just over 120,000 barrels per day in 2030. Similarly, shale oil production is expected to originate from only one country in the reference and low price cases (Estonia), but in the high price case the United States produces 144,000 barrels of shale oil per day in 2030.

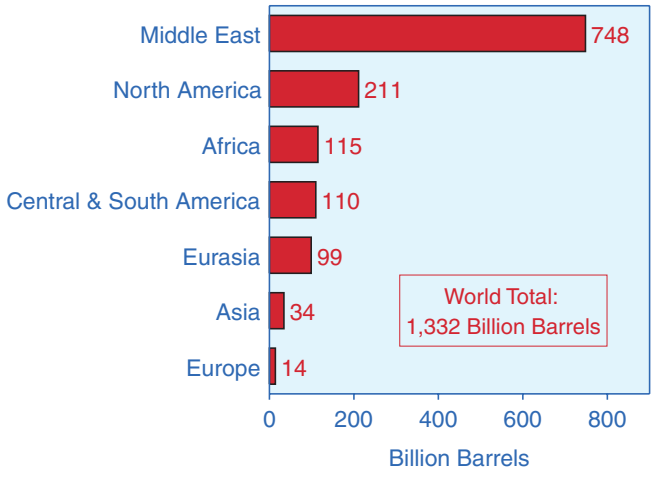
Oil Reserves and Resources

As of January 1, 2008, proved world oil reserves, as reported by the *Oil & Gas Journal*, were estimated at 1,332 billion barrels—14 billion barrels (about 1 percent) higher than the estimate for 2007 [***4***]. According to the *Oil & Gas Journal*, 56 percent of the world's proved oil reserves are located in the Middle East (Figure 34). Among the top 20 reserve holders in 2008, 11 are OPEC member countries that, together, account for 69 percent of the world's total reserves (Table 4).

Proved reserves of crude oil are the estimated quantities that geological and engineering data demonstrate with reasonable certainty can be recovered in future years from known reservoirs, assuming existing technology and current economic and operating conditions. Companies whose stocks are publicly traded on U.S. stock markets are required by the U.S. Securities and Exchange Commission (SEC) to report their holdings of domestic and international proved reserves, following specific guidelines. Country-level estimates of proved reserves are developed from the data reported to the SEC, from foreign government reports, and from international geologic assessments. Estimates are not always updated annually.

Whereas proved reserves include only those estimated quantities of crude oil from known reservoirs, they are only a subset of the entire potential oil resource base. Resource base estimates include estimated quantities of both discovered and undiscovered liquids that have the

Figure 34. World Proved Oil Reserves by Geographic Region as of January 1, 2008



Source: "Worldwide Look at Reserves and Production," *Oil & Gas Journal*, Vol. 105, No. 48 (December 24, 2007), pp. 24-25.

Table 4. World Oil Reserves by Country as of January 1, 2008
(Billion Barrels)

Country	Oil Reserves
Saudi Arabia	264.3
Canada	178.6
Iran	138.4
Iraq	115.0
Kuwait	101.5
United Arab Emirates	97.8
Venezuela	87.0
Russia	60.0
Libya	41.5
Nigeria	36.2
Kazakhstan	30.0
United States	21.0
China	16.0
Qatar	15.2
Algeria	12.2
Brazil	12.2
Mexico	11.7
Angola	9.0
Azerbaijan	7.0
Norway	6.9
Rest of World	70.3
World Total	**1,331.7**

Source: "Worldwide Look at Reserves and Production," *Oil & Gas Journal*, Vol. 105, No. 48 (December 24, 2007), pp. 24-25.

potential to be classified as reserves at some time in the future. The resource base may include oil that currently is not technically recoverable but could conceivably become recoverable in the future as technologies advance.

Readers may notice that, in some cases in the *IEO2008* projections, country-level volumes for cumulative production through 2030 exceed the estimates of proved reserves. This does not imply that resources and the physical limits of production have not been considered in the development of production forecasts, or that the projections assume a rapid decline in production immediately after the end of the projection period as reserves are depleted. EIA carefully considers resource availability in all long-term country-level projections, the aggregation of which gives the total world production projection; however, proved reserves are not an appropriate measure for judging total resource availability in the long run.

In order to construct realistic and plausible projections for liquids production, and especially for petroleum liquids production, underlying analysis must both consider production beyond the intended end of the projection period and base production projections on the physical realities and limitations of production. The importance of approaching an assessment of liquids production in this way is illustrated by the recent history of U.S. reserve estimates. Whereas the United States reported 22.1 billion barrels of proved reserves in 1998, proved reserves of 21.0 billion barrels were reported in 2008—a decrease of only 1.1 billion barrels despite the cumulative 32.1 billion barrels of liquids supplied from U.S. reserves between 1998 and 2007.

Proved reserves cannot provide an accurate assessment of the physical limits on future production but rather are intended to provide insight as to company- or country-level development plans in the very near term. In fact, because of the particularly rigid requirements for the classification of resources as proved reserves, particularly by the U.S. SEC,[8] even the cumulative production levels from individual development projects may exceed the initial estimates of proved reserves.

EIA attempts to address the lack of applicability of proved reserves estimates to long-term production projections by developing a production methodology based on the true physical limits of production (see box on page 34). By basing the long-term EIA production assessments on resources, rather than reserves, EIA is able to present projections that are physically achievable and can be supported beyond the 2030 projection horizon in *IEO2008*. The realization of such production levels depends, however, on future growth in world demand, taking into consideration such above-ground limitations on production as profitability and specific national regulations, among others.

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2. International Energy Agency, "Oil Market Report" (March 11, 2008), p. 18, web site http://omrpublic.iea.org/omrarchive/11mar08full.pdf; and *Middle East Economic Survey*, Vol. 50, No. 13 (March 26, 2007), web site www.mees.com (subscription site)
3. R. Kirk, "Explosive Oil Consumption Growth in the Top Oil Exporting States," *Energy Bulletin* (July 25, 2006), web site www.energybulletin.net/node/18475.
4. "Worldwide Look at Reserves and Production," *Oil & Gas Journal*, Vol. 105, No. 48 (December 24, 2007), pp. 24-25, web site www.ogj.com (subscription site).

[8]The U.S. SEC guidelines are seen as particularly rigid because of the limited extraction technologies they recognize, and because they base the economic viability of reserves on oil prices for the last day of trading in a year rather than an annual average. Under current rules, a company can generally meet the "reasonable certainty" standard necessary to establish proved reserves only by using actual production or flow tests. In June 2008, the SEC formally proposed changes to the guidelines that would not only expand the extraction technologies recognized and the price used to determine economic viability but also expand the resources eligible to be classified as oil reserves by including oil sands and other unconventional oil deposits.

Defining the Limits of Oil Production

Preparing mid-term projections of oil production requires an assessment of the availability of resources to meet production requirements, particularly for the later years of the 2005-2030 projection period in *IEO-2008*. The *IEO2008* oil production projections were limited by three factors: the estimated quantity of petroleum in place before production begins ("petroleum-initially-in-place" or IIP), the percentage of IIP extracted over the life of a field (ultimate recovery factor), and the amount of oil that can be produced from a field in a single year as a function of its remaining reserves.

Total IIP resources are the quantities of petroleum—both conventional and unconventional—estimated to exist originally in naturally occurring accumulations.[a] IIP resources are those quantities of petroleum which are estimated, on a given date, to be contained in known accumulations, plus those quantities already produced, as well as those estimated quantities in accumulations yet to be discovered. The estimate of IIP resources includes both recoverable and unrecoverable resources.

Published estimates of global IIP resources vary widely across sources, from about 13 trillion barrels to more than 24 trillion barrels. An estimate of 20.8 trillion barrels is used for the *IEO2008* reference case (see table below). Conventional crude oil and lease condensate account for about 40 percent (9 trillion barrels) of the total IIP worldwide, and unconventional petroleum resources account for the remainder. For instance, there are an estimated 2.3 trillion barrels of extra-heavy oil in Venezuela and an estimated 2.1 trillion barrels of petroleum in shale rock in the United States alone.

The second factor that limits oil production is the ultimate recovery factor. For most producing fields, the ultimate recovery factor is larger than the current recovery factor, which is defined as the sum of cumulative production plus remaining reserves as a percentage of IIP. Typically, estimates of the current recovery factor for a particular field increase over time, reflecting the effects of three interrelated factors: technology, economics, and knowledge about the field.

In general, as producers develop a field they learn more about its characteristics and are able to apply additional or more efficient recovery techniques. In addition, the efficiency of recovery can also be improved by developments in technology, either in the oil industry specifically (such as new reservoir fracturing techniques) or in industry generally (such as more powerful computer processors). Such efficiency gains can lower the cost of extracting a field's reserves significantly, making production more profitable and lowering the price at which production is justified.

Remaining reserves, by definition, are limited to those quantities considered economical to produce. Thus, estimates of current recovery factors based on reserves are affected by changes in production costs, oil prices, and fiscal regimes (such as tax rates). Estimates of current recovery factors can decline if adverse economic factors—such as low oil prices, high production taxes, or inadequate investment in field maintenance—arise and are expected to persist. For example, the two latter factors currently affect both Russia and Venezuela.

Current recovery factors for oil fields around the world typically range between 10 and 60 percent; some are over 80 percent. The wide variance is due largely to the diversity of fluid and reservoir characteristics for different deposits. For example, Canada's oil sands are markedly different from Saudi Arabia's Ghawar field

(continued on page 35)

Petroleum-Initially-In-Place Resource Estimates Used in the *IEO2008* Reference Case
(Trillion Barrels)

Resource	OPEC Middle East	Other OPEC	United States	Other Non-OPEC	Total
Conventional Crude and Condensate	2.6	2.6	0.9	2.9	**9.0**
Natural Gas Plant Liquids	0.3	0.3	0.2	0.4	**1.2**
Extra-Heavy Crude	0.0	2.3	0.0	0.0	**2.3**
Bitumen	0.0	0.0	0.0	2.4	**2.4**
Shale Oil	0.0	0.0	2.1	0.7	**2.8**
Source Rock	0.9	0.9	0.3	1.0	**3.1**
Total	**3.8**	**6.1**	**3.5**	**7.4**	**20.8**

Sources: I.H.S. Energy, web site http://energy.ihs.com (subscription site); U.S. Geological Survey, "Oil and Gas Resources," web site http://energy.usgs.gov/oilgas.html; Nehring Associates, "Significant Oil and Gas Fields of the United States Database," web site www.nehringdatabase.com (subscription site); World Energy Council, "Survey of Energy Resources 2007," (London, UK, September 2007), web site www.worldenergy.org/documents/ser2007_final_online_version_1.pdf; and EIA analysis.

[a]World Petroleum Council, "Petroleum Resources," *The WPC Newsletter*, No. 20 (January 2000), web site www.world-petroleum.org/newsletter/issue20.htm.

Defining the Limits of Oil Production (Continued)

in terms of both fluid properties and the geophysical characteristics of the rock that contains the oil. For the global average ultimate recovery factor, petroleum engineers often cite a value of one-third for conventional oil deposits; however, no verifiable studies have been conducted to estimate ultimate recovery factors at the field level for all fields worldwide. Even if such a study were conducted it would not provide a definitive value for the upper limit of global recovery, because technologies, oil prices, and taxes change over time.

In 2005, the U.S. Department of Energy commissioned "basin potential studies," with the goal of providing a better understanding of the potential impact of technology advances on recovery factors for conventional oil in the United States.[b] The results suggested that long-term recovery factors in the United States could vary from as little as 40 percent for mid-continent resources to as much as 72 percent for resources in the Gulf Coast States. To put those percentages in perspective, cumulative U.S. oil production as a percentage of estimated discovered IIP averages 33 percent and ranges from 23 percent to 44 percent, depending on the U.S. region. The studies suggest that improvements in technology have the potential to raise ultimate recovery factors to 60 percent for U.S. areas that already are in production or open to exploration.

An additional factor limiting oil production is the fraction of a field's reserves that can be produced in a given year—which in turn is affected both by the physical characteristics of oil flowing through a porous rock reservoir and by financial considerations. Oil flows more slowly through fields with thicker oil and/or lower permeability. Unless a field is close to the end of its productive life, it is physically difficult to produce more than 10 to 15 percent of its remaining reserves in a single year. From a financial standpoint, oil producers maximize returns on investment by matching the timing of investments to the timing of physical oil production. They will lose money if they expand production facilities by too much or too long before the oil begins to flow.

On a field-by-field or regional basis, the proportion of reserves produced in a single year may vary widely. For example, in the United States, 13.3 percent of the onshore reserves in Texas and 5.1 percent of the reserves in Utah were produced in 2006. For the United States as a whole, 7.9 percent of reserves were produced in 2006.

[b]Office of Fossil Energy – Office of Oil and Natural Gas, U.S. Department of Energy, "Ten Basin-Oriented CO2-EOR Assessments Examine Strategies for Increasing Domestic Oil Production" (prepared by Advanced Resources International, Arlington, VA, February 2006), web site http://fossil.energy.gov/programs/oilgas/eor/Ten_Basin-Oriented_CO2-EOR_Assessments.html; and *Evaluating the Potential for "Game Changer" Improvements in Oil Recovery Efficiency from CO_2 Enhanced Oil Recovery* (prepared by V.A. Kuuskraa and G.J. Koperna, Advanced Resources International, Arlington, VA, February 2006), web site http://fossil.energy.gov/programs/oilgas/publications/eor_co2/Game_Changer_Document_2_06_with_appendix.pdf.

Chapter 3
Natural Gas

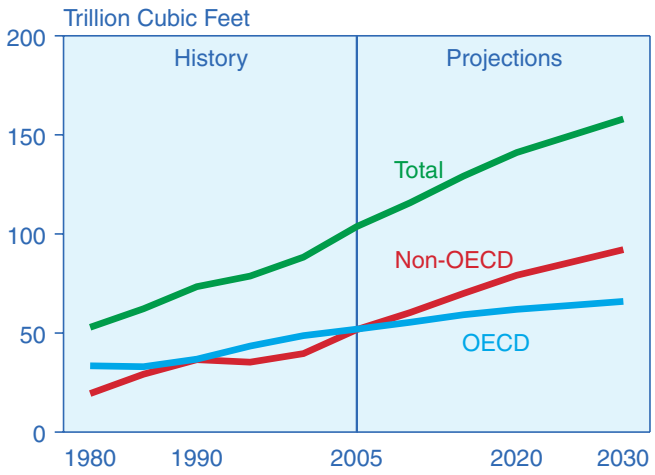
In the IEO2008 reference case, natural gas consumption in the non-OECD countries grows more than twice as fast as in the OECD countries. Production increases in the non-OECD region account for more than 90 percent of the growth in world production from 2005 to 2030.

Worldwide, total natural gas consumption increases from 104 trillion cubic feet in 2005 to 158 trillion cubic feet in 2030 in the *IEO2008* reference case (Figure 35). World oil prices are expected to remain high, and as a result natural gas replaces oil wherever possible. In addition, because natural gas produces less carbon dioxide when it is burned than does either coal or petroleum, governments implementing national or regional plans to reduce greenhouse gas emissions may encourage its use to displace other fossil fuels.

Natural gas remains a key energy source for industrial sector uses and electricity generation throughout the projection. The industrial sector, which is the world's largest consumer of natural gas, accounts for 43 percent of projected natural gas use in 2030. In the electric power sector, natural gas is an attractive choice for new generating plants because of its relative fuel efficiency and low carbon dioxide intensity. Electricity generation accounts for 35 percent of the world's total natural gas consumption in 2030.

In 2005, OECD member countries and non-OECD countries each consumed 52 trillion cubic feet of natural gas. Preliminary data for 2006 indicate that natural gas consumption in non-OECD countries has surpassed that in OECD countries. In the *IEO2008* reference case, natural gas consumption in the non-OECD countries grows more than twice as fast as consumption in the OECD countries, with 2.3-percent average annual growth from 2005 to 2030 for non-OECD countries, compared with an average of 1.0 percent for the OECD countries. Natural gas demand in the non-OECD countries accounts for 74 percent of the total world increment in natural gas consumption over the projection period. Natural gas use in the non-OECD countries increases from 50 percent of the world total in 2005 to 58 percent in 2030.

Figure 35. World Natural Gas Consumption, 1980-2030



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

The OECD countries accounted for 38 percent of the world's total natural gas production and 50 percent of natural gas consumption in 2005; in 2030, they account for 27 percent of production and 42 percent of consumption. As a result, the OECD countries are projected to rely increasingly on imports to meet natural gas demand, with a growing percentage of natural gas imports coming in the form of liquefied natural gas (LNG). In 2030, more than one-third of the natural gas consumed in OECD countries is projected to come from non-OECD sources, up from one-quarter in 2005.

World Natural Gas Demand

OECD Countries

Natural gas consumption in OECD North America is projected to increase at an average annual rate of 0.6 percent from 2005 to 2030 (Figure 36). For the United States the average annual increase is 0.1 percent, significantly lower than for Canada and Mexico, largely because higher natural gas prices in the U.S. market are expected to dampen the use of natural gas for electricity generation. As North America's largest user of natural gas, the United States accounted for 81 percent of the 27.4 trillion cubic feet consumed in North America in 2005. In 2030 the U.S. share falls to 72 percent, reflecting relatively slow growth in U.S. demand and robust growth in Canada and Mexico.

In 2005, natural-gas-fired plants accounted for 19 percent of net electricity generation in the United States and coal-fired plants 50 percent. The natural gas share is projected to rise to 21 percent in 2010, after which higher natural gas prices discourage the construction of new natural-gas-fired plants. U.S. natural gas consumption for electricity generation increases in the near term, from

5.9 trillion cubic feet in 2005 to 6.6 trillion cubic feet in 2015, then declines steadily to 5.0 trillion cubic feet in 2030. As more coal-fired plants are built after 2010, the natural gas share of generation falls to 14 percent and the coal share rises to 54 percent in 2030. Nuclear and renewables also gain market share at the expense of natural gas.

Canada's total natural gas consumption is projected to increase steadily, at a rate of 1.5 percent per year, from 3.4 trillion cubic feet in 2005 to 5.0 trillion cubic feet in 2030. In contrast to the decline in natural gas consumption for electricity generation in the United States, in Canada it increases by one-third from 2005 to 2030, growing at an average annual rate of 1.5 percent. Even more rapid growth is projected for Canada's industrial natural gas consumption, averaging 2.0 percent per year, and including vast quantities of natural gas consumed in the mining of the country's oil sands deposits.

By volume, the total increase in Canada's industrial use of natural gas from 2005 to 2030 equals 1.2 trillion cubic feet, compared with an increase of 0.2 trillion cubic feet for electricity generation. The growth in domestic consumption, coupled with a projected decline in Canada's natural gas production, leaves less Canadian natural gas available for export. Canada is projected to consume 93 percent of its own production in 2030, compared with 52 percent in 2005.

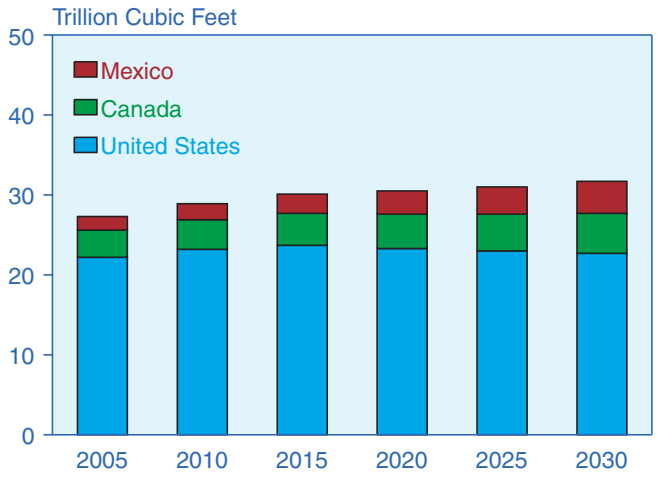
In Mexico, strong growth in natural gas consumption is expected in all sectors, with total consumption more than doubling from 2005 to 2030. Industrial natural gas consumption nearly doubles, and consumption for electricity generation nearly triples over the projection period. Consumption in the residential and commercial sectors also expands strongly (by 3.6 percent per year), although the absolute quantities are small.

Because the expected growth in Mexico's natural gas consumption over the period (an increase of 2.3 trillion cubic feet in 2030 compared with 2005) far exceeds its production growth, its dependence on pipeline imports from the United States and imports of LNG from overseas increases. Imports from the United States are offset somewhat by exports of regasified LNG to the United States, from a new facility in Baja California that is scheduled to begin operation in 2008; however, Mexico remains a net importer of U.S. natural gas throughout the projection.

In OECD Europe, natural gas consumption is projected to grow by an average of 1.4 percent per year—from 19.3 trillion cubic feet in 2005 to 22.8 trillion cubic feet in 2015 and 27.2 trillion cubic feet in 2030 (Figure 37)—mostly as a result of increasing use for power generation. Many of the OECD Europe nations have made commitments to reduce carbon dioxide emissions, bolstering the incentive for governments to encourage the use of natural gas in place of other fossil fuels. With renewable energy sources projected to remain more expensive than natural gas in OECD Europe, natural gas is expected to be the fuel of choice for new generating capacity. Natural-gas-fired generation in the region increases by 3.9 percent per year in the *IEO2008* reference case, from 0.7 trillion kilowatthours in 2005 to 1.2 trillion kilowatthours in 2015 and then to 1.9 trillion kilowatthours in 2030.

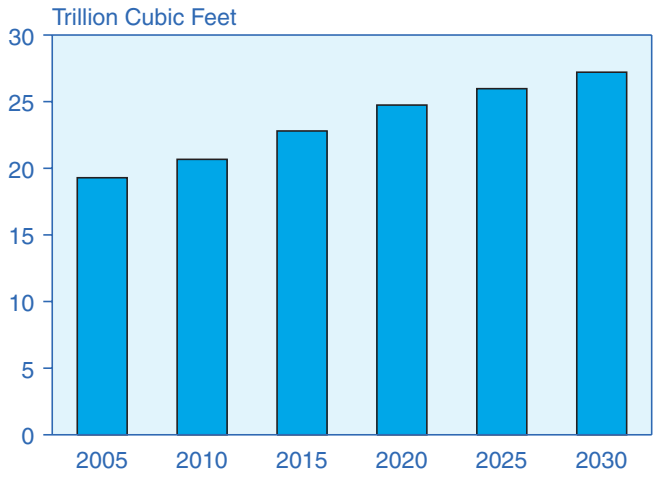
Natural gas consumption in Japan and South Korea is projected to grow on average by 0.7 percent and 2.2 percent per year, respectively, over the projection period, with each country adding less than 1 trillion cubic feet of

Figure 36. Natural Gas Consumption in North America by Country, 2005-2030



Sources: **2005:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Figure 37. Natural Gas Consumption in OECD Europe, 2005-2030



Sources: **2005:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

gas consumption between 2005 and 2030 (Figure 38). Recent growth in natural gas consumption in both countries has been strong, with outages at nuclear power plants in Japan compounding the increase. LNG imports into Japan for 2007 reportedly totaled 3.1 trillion cubic feet of natural gas (66.8 million tons of LNG), up by 7.6 percent from 2006. The current nuclear issues are expected to be resolved before 2010, however [***1***], and continued growth in nuclear output, along with a modest GDP growth rate, is expected to slow the growth of Japan's natural gas consumption over the longer term.

In Australia and New Zealand, the industrial sector currently is the predominant consumer of natural gas and is projected to account for more than 50 percent of all natural gas consumption in the region throughout the projection period. Natural gas is the fastest growing fuel in Australia and New Zealand in the *IEO2008* reference case, accounting for just over 30 percent of the projected growth in the region's total energy consumption from 2005 to 2030. It is also the fastest growing fuel in the region's electric power sector. Australia's ratification of the Kyoto Protocol treaty in March 2008 is likely to increase the country's use of natural gas to displace more carbon-dioxide-intensive coal. In addition, several policies have been enacted by state governments in Australia to stimulate the use of natural gas for electric power generation and moderate the anticipated growth of generation using coal, of which Australia has large reserves.

Non-OECD Countries

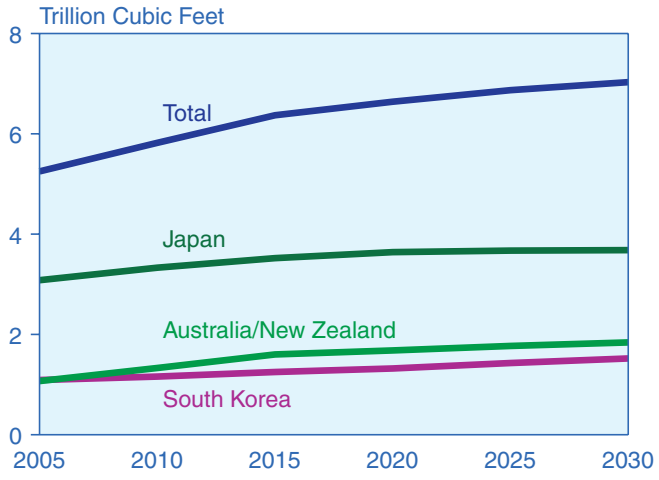
In total, the countries of non-OECD Europe and Eurasia rely on natural gas for 51 percent of their energy needs—a larger share than for any other country grouping in the *IEO2008* projections. Russia is second only to the United States in total natural gas consumption, with demand totaling 16.2 trillion cubic feet in 2005 and representing 55 percent of Russia's total energy consumption (Figure 39). The other countries of non-OECD Europe and Eurasia met 46 percent of their combined total energy needs with natural gas in 2005, consuming 9.1 trillion cubic feet. With ample natural gas resources, non-OECD Europe and Eurasia is expected to continue its reliance on natural gas in the future.

Natural gas consumption in non-OECD Europe and Eurasia grows at an average annual rate of 1.1 percent over the projection period, almost maintaining its share in the overall energy mix (although the growth rates for consumption of liquids and nuclear energy are slightly higher). The increase in natural gas consumption accounts for 45 percent of the total increase in energy consumption in non-OECD Europe and Eurasia from 2005 to 2030.

Non-OECD Asia, which accounted for only 9.0 percent of the world's total consumption of natural gas in 2005, shows the most rapid growth in natural gas use in the reference case and accounts for 33 percent of the total increase in world natural gas consumption from 2005 to 2030. Natural gas consumption in non-OECD Asia nearly triples, from 9.3 trillion cubic feet in 2005 to 27.4 trillion cubic feet in 2030, expanding by 4.4 percent per year on average over the projection period (Figure 40).

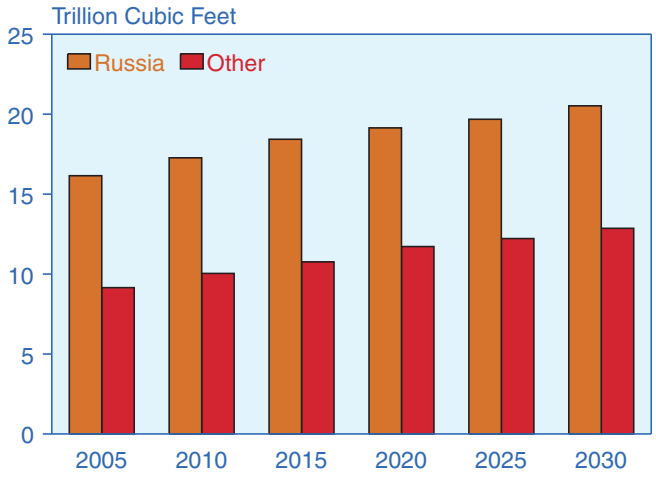
In both China and India, natural gas is currently a minor fuel in the overall energy mix, representing only 3 percent and 8 percent, respectively, of total primary energy consumption in 2005. In the *IEO2008* reference case, both countries' natural gas consumption rises rapidly, growing by 5.5 percent per year in China and 4.6 percent per

Figure 38. Natural Gas Consumption in OECD Asia by Country, 2005-2030



Sources: **2005:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Figure 39. Natural Gas Consumption in Non-OECD Europe and Eurasia, 2005-2030



Sources: **2005:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

year in India on average from 2005 to 2030, as LNG imports and new domestic production help the two countries meet continued demand growth.

Natural gas consumption grows at average annual rates of 1.9 percent in the Middle East and 3.5 percent in Africa from 2005 to 2030 (Figure 41). Algeria, Nigeria, Egypt, and Libya, the major African producers, are also the major consumers, as there is very little infrastructure on the continent for intraregional trade of natural gas. The two notable exceptions are the Mozambique-South Africa pipeline, with a capacity of 0.1 trillion cubic feet per year, and the West African Gas Pipeline project of similar capacity. South Africa has been importing natural gas from its neighbor to feed the industrial complex at Sasolburg since completion of the pipeline from Mozambique in 2004. The West Africa pipeline, still under construction, is expected to bring natural gas from Nigeria to consumers in Benin, Ghana, and Ivory Coast.

In Central and South America, natural gas is the second-fastest-growing energy source after nuclear power (although nuclear generation is growing from a very small base and remains only a minor part of the region's total energy consumption). Natural gas demand increases on average by 2.8 percent per year, from 4.4 trillion cubic feet in 2005 to 8.7 trillion cubic feet in 2030. For Brazil, the region's largest economy, natural gas consumption nearly triples—from 0.7 trillion cubic feet in 2005 to 1.8 trillion cubic feet in 2030.

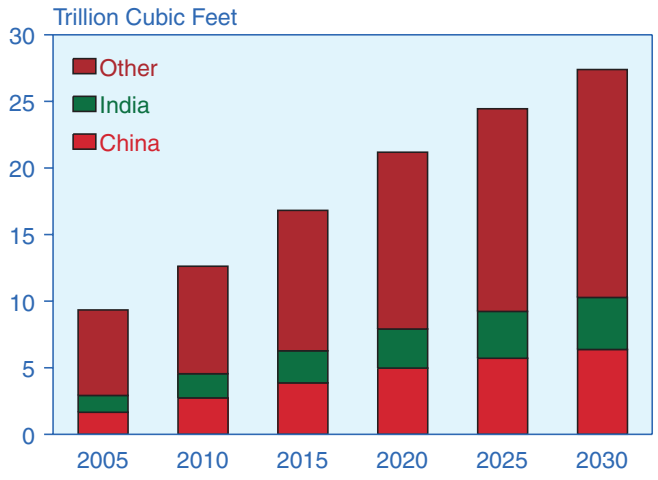
World Natural Gas Supply

The non-OECD nations are projected to account for 90 percent of the world's total increase in natural gas production from 2005 to 2030. Non-OECD natural gas production grows by an average 2.5 percent per year in the reference case, from 63 trillion cubic feet in 2005 to 116 trillion cubic feet in 2030 (Table 5). Over the same period, production in the OECD countries grows by only 0.3 percent per year, from 39 trillion cubic feet to 42 trillion cubic feet.

A significant portion of non-OECD natural gas production (excluding Russia and the other nations of Eurasia) is expected to be for export projects. The Middle East and Africa are at the forefront of the trend to develop export projects—particularly, LNG exports. For the two regions combined, natural gas production increases by 21.0 trillion cubic feet from 2005 to 2030, while their combined demand for natural gas increases by only 9.9 trillion cubic feet. LNG projects are expected to account for a significant portion of natural gas exports from the Middle East and Africa. In Qatar, for instance, export facilities with a total capacity of approximately 3.6 trillion cubic feet of natural gas (77 million metric tons of LNG) are expected to be in operation by 2015, as compared with the country's 2005 LNG exports of 1 trillion cubic feet. The increase in exports from Qatar alone would account for 14 percent of the total projected increase in production from 2005 to 2015 for the non-OECD countries, excluding non-OECD Europe and Eurasia.

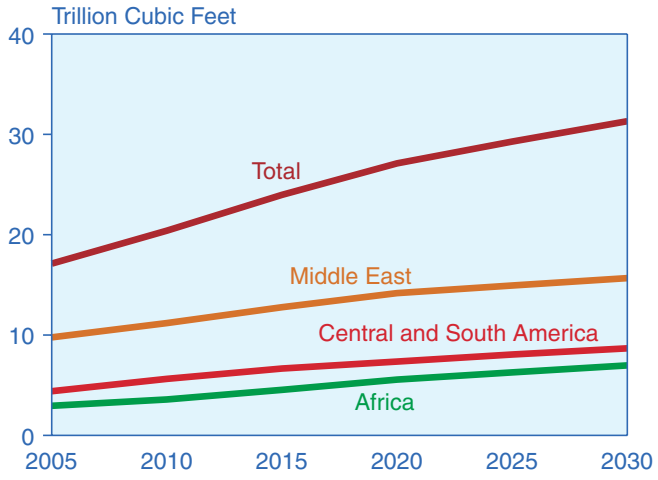
Significant increases in natural gas production are also projected for the countries of non-OECD Asia, but those supply increases are expected to be used largely for consumption in non-OECD Asia. China and India are projected to almost double their production volumes from 2005 to 2015, bringing production from India's Krishna

Figure 40. Natural Gas Consumption in Non-OECD Asia, 2005-2030



Sources: **2005:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Figure 41. Natural Gas Consumption in Central and South America, Africa, and the Middle East, 2005-2030



Sources: **2005:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Godavari Basin and China's Sichuan province, as well as from smaller projects, to market. Some new export projects are expected to be brought on line in non-OECD Asia by 2015—most notably, the Tangguh LNG project in Indonesia—but production increases are aimed primarily at meeting rapid demand growth in the region. In 2005, net exports accounted for 17 percent of total production in non-OECD Asia, down from 30 percent in 1995. As rapid increases in production continue to be outpaced by consumption growth, non-OECD Asia is projected to become a net importer of natural gas after 2015.

In non-OECD Europe and Eurasia, natural gas production is projected to grow from 29.3 trillion cubic feet in 2005 to 36.1 trillion cubic feet in 2015 and 43.0 trillion cubic feet in 2030, although pricing and payment disputes currently are continuing to affect supplies. In March 2008, Russia's Gazprom reduced supplies of natural gas to Ukraine in a dispute over payment for deliveries [2]. The reduction lasted for only 3 days, however, and did not affect supplies to downstream customers in OECD Europe. Production increases are projected to outpace growth in natural gas demand in non-OECD Europe and Eurasia, and the *IEO2008* reference case anticipates that Eurasian producers will remain important suppliers for their neighbors, especially in OECD Europe.

The expansion of natural gas trade between Eurasia and its western neighbors has not evolved without some difficulties. Exports of natural gas from Azerbaijan began to flow through the new South Caucasus pipeline to Georgia in March 2007 and to Turkey in July 2007 [3]. Turkey then began re-exporting Azeri gas to Greece after a new pipeline connecting Turkey and Greece

Table 5. World Natural Gas Production by Region and Country, 2005-2030
(Trillion Cubic Feet)

Region/Country	2005	Projections					Average Annual Percent Change, 2005-2030
		2010	2015	2020	2025	2030	
OECD North America	**26.5**	**27.2**	**27.1**	**27.1**	**27.3**	**27.6**	**0.2**
United States[a]	18.4	19.4	19.6	19.8	19.7	19.5	0.2
Canada	6.6	6.1	5.7	5.3	5.3	5.4	-0.8
Mexico	1.5	1.7	1.8	2.0	2.3	2.7	2.3
OECD Europe	**10.9**	**11.3**	**11.2**	**10.7**	**10.5**	**10.3**	**-0.3**
OECD Asia	**1.8**	**2.2**	**2.9**	**3.7**	**4.0**	**4.3**	**3.7**
Japan	0.2	0.2	0.2	0.2	0.2	0.2	0.2
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.4
Australia/New Zealand	1.6	2.0	2.7	3.5	3.8	4.1	3.9
Total OECD	**39.2**	**40.8**	**41.2**	**41.5**	**41.8**	**42.2**	**0.3**
Non-OECD Europe and Eurasia	**29.3**	**33.1**	**36.1**	**38.4**	**40.4**	**43.0**	**1.6**
Russia	22.6	24.9	26.9	28.7	30.6	33.0	1.5
Other	6.6	8.2	9.3	9.6	9.8	10.0	1.7
Non-OECD Asia	**11.2**	**13.7**	**17.2**	**20.6**	**23.5**	**25.6**	**3.3**
China	1.8	2.5	3.2	3.8	4.2	4.3	3.6
India	1.1	1.5	2.0	2.4	2.7	2.9	4.1
Other non-OECD Asia	8.4	9.7	12.0	14.5	16.6	18.4	3.2
Middle East	**11.2**	**14.6**	**16.9**	**19.3**	**20.7**	**22.5**	**2.8**
Africa	**6.1**	**7.9**	**10.7**	**13.5**	**14.8**	**15.8**	**3.9**
Central and South America	**4.9**	**6.2**	**7.3**	**7.9**	**8.8**	**9.5**	**2.7**
Brazil	0.3	0.5	0.7	0.9	1.1	1.3	5.3
Other Central /South America	4.5	5.7	6.5	7.0	7.7	8.3	2.4
Total Non-OECD	**62.7**	**75.5**	**88.3**	**99.7**	**108.1**	**116.4**	**2.5**
Total World	**101.9**	**116.2**	**129.5**	**141.2**	**149.9**	**158.6**	**1.8**

[a]Includes supplemental production or forecast discrepancy. For details, see Energy Information Administration (EIA), *Annual Energy Outlook 2008*, p. 139, Table A13, "Natural Gas Supply, Disposition, and Prices."

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

Sources: **History:** EIA, *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections: United States:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), web site www.eia.doe.gov/oiaf/aeo. **Others:** EIA, World Energy Projections Plus (2008).

opened in November 2007. In January 2008, Turkmenistan cut natural gas exports to Iran. Turkmenistan cited technical issues on the pipeline, later saying that Iran's failure to keep current on payments was hindering pipeline repairs [*4*]. The real reason for the halt in supplies, however, was widely believed to be a pricing dispute. Turkmenistan had proposed doubling the price Iran paid for imports, from $1.91 per million Btu ($70 per thousand cubic meters) to $3.83 per million Btu, and Iran reacted by cutting exports to Turkey to make up for the lost imports from Turkmenistan. In turn, Turkey then cut re-exports of Azeri gas to Greece to make up for the lost imports from Iran. Subsequently, Russia's Gazprom increased its exports of natural gas to Turkey, diffusing the situation [*5*].

Brazil has the fastest-growing natural gas production in the *IEO2008* reference case, with average annual increases of 5.2 percent from 2005 to 2030; however, it starts from a very low level of 0.3 trillion cubic feet in 2005. As a whole, Central and South America's production increases by 2.7 percent per year, from 4.9 trillion cubic feet in 2005 to 9.5 trillion cubic feet in 2030. Despite adequate reserves that support healthy prospects for long-term production growth in South America, the region has begun importing LNG to supplement current domestic supplies, which have failed to keep up with demand (especially, peak seasonal demand). Argentina became the first country in South America to import LNG, receiving its first cargo in May 2008. Brazil and Chile are expected to follow: the arrival of Brazil's first LNG cargo is planned for late 2008, and Chile's first LNG import facility is expected to begin operating in 2009.

In the OECD, Australia/New Zealand is projected to have the strongest growth in natural gas production. Much of the growth in Australia's production is expected to support planned or proposed LNG export projects, however, and increasing costs for liquefaction projects have delayed project commitments in Australia and around the world. New projects in Western Australia face further hurdles. The first is a government policy requiring new export projects to reserve 15 percent of production for domestic use. The second is the intention of the state and federal governments to identify a single hub for liquefaction facilities serving the Browse Basin, in order to minimize environmental impacts from the separate facilities being proposed by various companies.

In contrast, development of coalbed methane (CBM) reserves in Queensland and New South Wales is progressing rapidly, with production from fiscal year 2000-2001[9] to 2005-2006 growing by 30 percent per year on average [*6*] and accounting for roughly 5 percent of production and 8 percent of consumption in 2005 and 2006. Production from CBM represents a higher percentage of total natural gas consumption than total production, because no CBM is being exported currently. That may change, however, as four LNG projects have been proposed with CBM as the feed gas [*7*].

In OECD North America, the United States has historically been both the largest producer and the largest consumer of natural gas, and Canada has been the primary source of U.S. natural gas imports. In 2005, Canada provided 86 percent of gross U.S. imports of natural gas. Although Canada's unconventional production is expected to increase over the projection period and LNG imports into Canada are projected to begin by the end of the decade, the combined increases in supply are not sufficient to offset a decline in conventional production in Canada's largest producing basin, the Western Canadian Sedimentary Basin. Increasing costs are expected to prevent the development of Canada's McKenzie Delta natural gas resource in the reference case, and Canada's production is projected to decline steadily, at an average annual rate of 0.8 percent. U.S. gross imports of LNG are projected to exceed gross pipeline imports from Canada after 2017, and Canada's share of U.S. gross imports is projected to decline to 32 percent in 2030.

In the United States, rising natural gas prices are expected to provide sufficient incentive for an Alaska natural gas pipeline, which has long been in the planning stages, to come on line. The pipeline is expected to begin transporting natural gas from Alaska to the lower 48 States in 2020, making a significant contribution to U.S. domestic supply. Alaska's natural gas production is expected to account for 100 percent of the projected growth in domestic U.S. conventional natural gas production.

A large portion of North America's remaining technically recoverable natural gas resource base consists of unconventional sources, which include tight sands, shale, and coalbed methane. With most of the large onshore conventional fields in the United States already having been discovered, the United States, like Canada, must look to these costlier sources of supply to make up for declines in conventional production. Unconventional production is expected to be a significant source of U.S. incremental supply, increasing from 7.9 trillion cubic feet (44 percent of total domestic production) in 2005 to 9.5 trillion cubic feet (49 percent) in 2030. With the increases in unconventional production and production from Alaska more than offsetting the decline in conventional production, U.S. production grows by an average of 0.2 percent per year.

[9]The Australian Bureau of Agricultural and Resource Economics (ABARE) reports production on a fiscal year basis, which extends from July 1 through June 30 of the following year.

The largest source of incremental natural gas supply for the United States is expected to be LNG imports, which increase from 0.6 trillion cubic feet in 2005 to 2.8 trillion cubic feet in 2030. As of January 2008, five U.S. LNG import facilities were in operation, with a total peak capacity of slightly more than 5.8 billion cubic feet per day. Four additional facilities are under construction in the Gulf of Mexico and two in the offshore waters of New England. When completed, the new terminals will more than double U.S. LNG import capacity.

U.S. gross imports of LNG are expected to grow rapidly through 2015, increasing from 631 billion cubic feet in 2005 to 2.1 trillion cubic feet in 2015, as new domestic regasification capacity comes on line and new liquefaction projects are completed worldwide. The growth in LNG imports slows after 2015, however, as natural gas prices in general rise and demand declines. In the reference case projection, LNG imports reach 2.8 trillion cubic feet in 2030 (Figure 42). The emerging LNG markets in Canada and Mexico also show their strongest growth in the early years of the forecast.

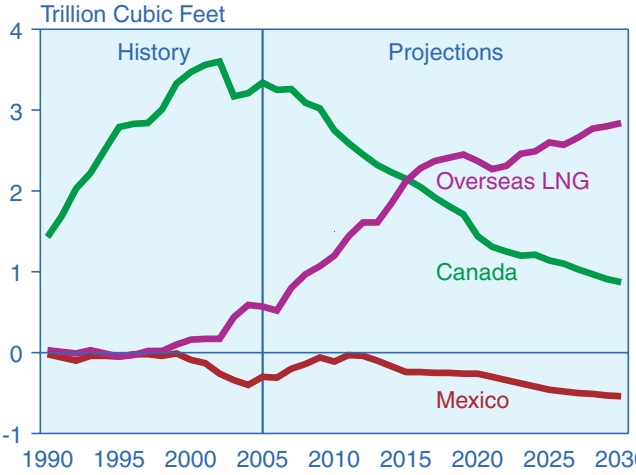
There are significant untapped reserves of natural gas in Mexico; however, the state-owned oil company, PEMEX, does not have the resources needed to develop them fully, and the constitutional provision that prohibits foreign ownership of Mexico's oil and natural gas resources makes it difficult to attract foreign direct investment in the country's energy sector. Still, Mexico's natural gas production is expected to increase significantly, from 1.5 trillion cubic feet in 2005 to 2.7 trillion cubic feet in 2030.

Reserves and Resources

Historically, world natural gas reserves have generally trended upward (Figure 43). As of January 1, 2008, proved world natural gas reserves, as reported by *Oil & Gas Journal*,[10] were estimated at 6,186 trillion cubic feet—virtually unchanged from the estimate for 2007 of 6,168 trillion cubic feet [*8*]. Reserves have remained relatively flat since 2004, despite growing demand for natural gas, implying that, thus far, producers have been able to continue replenishing reserves successfully with new resources over time.

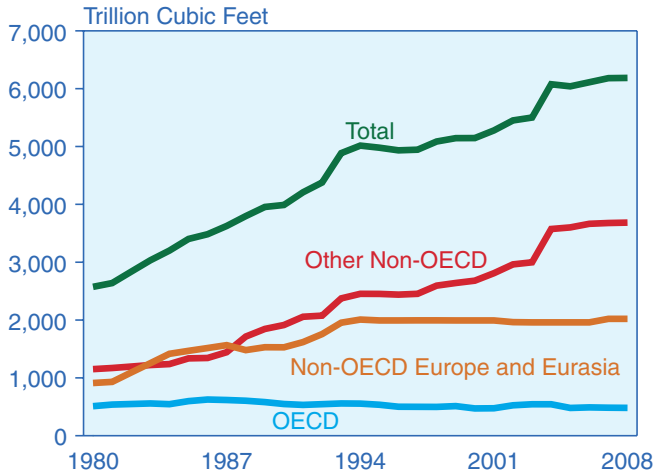
The largest additions to natural gas reserve estimates in 2008 were reported for Venezuela and Saudi Arabia. Venezuela added an estimated 14 trillion cubic feet (a 9-percent increase over 2007 proved reserves) and Saudi Arabia 13 trillion cubic feet (5 percent). There were smaller, but still substantial, reported increases in reserves in Malaysia and Angola—both of which added around 8 trillion cubic feet. The reserve addition in Malaysia represents an 11-percent increase in its proved reserves. The addition in Angola represents an increase of more than 300 percent. The United States also had a fairly substantial 6-percent increase in reserves, almost 7 trillion cubic feet over the 2007 estimate.

Figure 42. U.S. Net Imports of Natural Gas by Source, 1990-2030



Source: Energy Information Administration, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), web site www.eia.doe.gov/oiaf/aeo.

Figure 43. World Natural Gas Reserves by Country Grouping, 1980-2007



Sources: **1980-1993:** "Worldwide Oil and Gas at a Glance," *International Petroleum Encyclopedia* (Tulsa, OK: PennWell Publishing, various issues). **1994-2008:** *Oil & Gas Journal* (various issues).

[10]Proved reserves, as reported by the *Oil & Gas Journal*, are estimated quantities that can be recovered under present technology and prices. Natural gas reserves reported by the *Oil & Gas Journal* are compiled from voluntary survey responses and do not always reflect the most recent changes. U.S. proved reserves of natural gas are reported by the Energy Information Administration and are defined as the estimated quantities of natural gas reserves as of December 31, 2007, which analysis of geological and engineering data demonstrate with reasonable certainty to be recoverable in future years from known reservoirs under existing economic and operating conditions. Significant natural gas discoveries made in 2007 are not likely to be reflected in the reported reserves.

The largest reported declines in natural gas reserves were reported for Iran (a decrease of 26 trillion cubic feet) and Qatar (5 trillion cubic feet); however, given the vast reserves in each of those countries, the declines represent relatively modest decreases of 3 percent and 1 percent, respectively. A more significant drop in reserves was reported for Papua New Guinea—just over 4 trillion cubic feet, or a 34-percent decrease in the country's total natural gas reserves. Other decreases in proved natural gas reserves were reported for Indonesia (4 trillion cubic feet), Norway, Thailand, Algeria, and Libya (about 3 trillion cubic feet each).

Almost three-quarters of the world's natural gas reserves are located in the Middle East and Eurasia (Figure 44). Russia, Iran, and Qatar together accounted for about 57 percent of the world's natural gas reserves as of January 1, 2008 (Table 6).

Despite high rates of increase in natural gas consumption, particularly over the past decade, most regional reserves-to-production ratios are substantial. Worldwide, the reserves-to-production ratio is estimated at 63 years [9]. By region, the highest ratios are about 48 years for Central and South America, 78 years for Russia, 79 years for Africa, and more than 100 years for the Middle East.

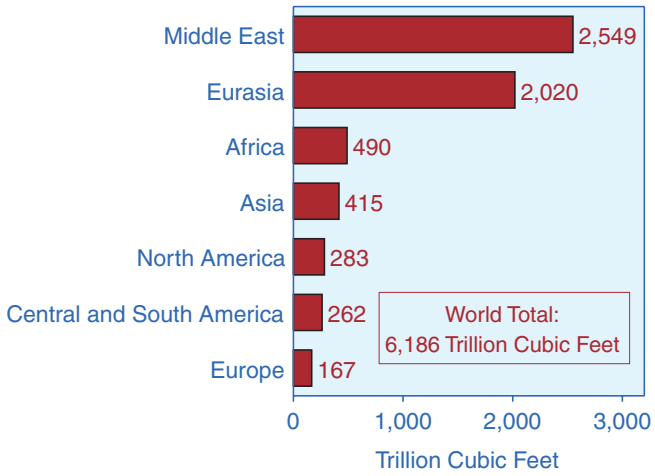
The U.S. Geological Survey (USGS) periodically assesses the long-term production potential of worldwide petroleum resources (oil, natural gas, and natural gas liquids). According to the most recent USGS estimates, released in the *World Petroleum Assessment 2000* and adjusted to reflect current proved reserves, a significant volume of natural gas remains to be discovered. Worldwide undiscovered natural gas is estimated at 4,133 trillion cubic feet (Figure 45). Of the new natural gas resources expected to be added through 2025, reserve growth accounts for 2,347 trillion cubic feet.

Table 6. World Natural Gas Reserves by Country as of January 1, 2008

Country	Reserves (Trillion Cubic Feet)	Percent of World Total
World	**6,186**	**100.0**
Top 20 Countries	**5,606**	**90.6**
Russia	1,680	27.2
Iran	948	15.3
Qatar	905	14.6
Saudi Arabia	253	4.1
United Arab Emirates	214	3.5
United States	211	3.4
Nigeria	184	3.0
Venezuela	166	2.7
Algeria	159	2.6
Iraq	112	1.8
Turkmenistan	100	1.6
Kazakhstan	100	1.6
Indonesia	94	1.5
Malaysia	83	1.3
China	80	1.3
Norway	79	1.3
Uzbekistan	65	1.1
Egypt	59	0.9
Canada	58	0.9
Kuwait	56	0.9
Rest of World	**580**	**9.4**

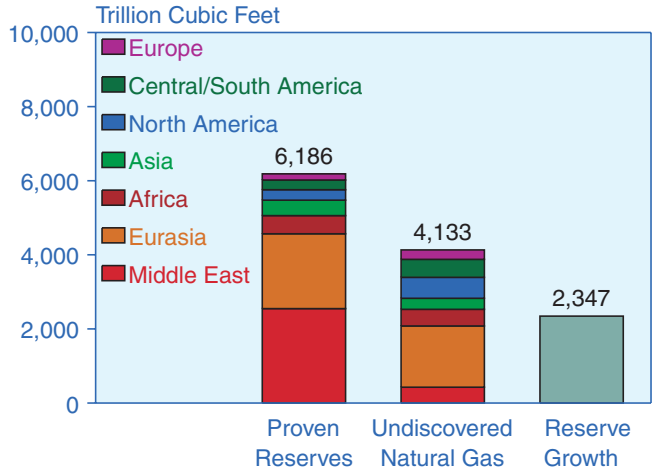
Source: "Worldwide Look at Reserves and Production," *Oil & Gas Journal*, Vol. 105, No. 48 (December 24, 2007), pp. 24-25.

Figure 44. World Natural Gas Reserves by Geographic Region as of January 1, 2008



Source: "Worldwide Look at Reserves and Production," *Oil & Gas Journal*, Vol. 105, No. 48 (December 24, 2007), pp. 24-25.

Figure 45. World Natural Gas Resources by Geographic Region, 2008-2025



Source: U.S. Geological Survey, *World Petroleum Assessment 2000*, web site http://greenwood.cr.usgs.gov/energy/WorldEnergy/DDS-60; "Worldwide Look at Reserves and Production," *Oil & Gas Journal*, Vol. 105, No. 48 (December 24, 2007), pp. 24-25; and Energy Information Administration estimates.

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Chapter 4
Coal

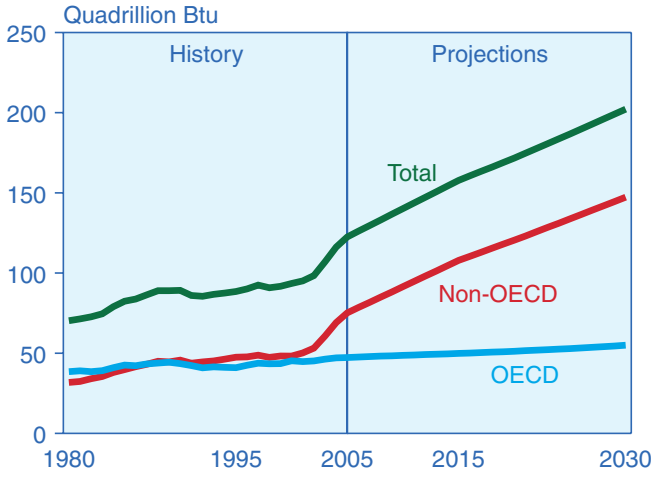
In the IEO2008 reference case, world coal consumption increases by 65 percent and international coal trade increases by 53 percent from 2005 to 2030, and coal's share of world energy consumption increases from 27 percent in 2005 to 29 percent in 2030.

In the *IEO2008* reference case, world coal consumption increases by 65 percent over the projection period, from 122.5 quadrillion Btu in 2005 to 202.2 quadrillion Btu in 2030 (Figure 46). The increase in coal consumption averages 2.6 percent per year from 2005 to 2015, then slows to an average of 1.7 percent per year from 2015 to 2030. World GDP and primary energy consumption also grow more rapidly in the first half than in the second half of the projections, reflecting a gradual slowdown of economic activity, especially in non-OECD Asia. Regionally, increased use of coal in non-OECD countries accounts for 91 percent of the total growth in world coal consumption over the entire period.

In 2005, coal accounted for 27 percent of world energy consumption (Figure 47). Of the coal produced worldwide in 2005, 63 percent was shipped to electricity producers, 34 percent to industrial consumers, and most of the remaining 3 percent went to coal consumers in the residential and commercial sectors. Coal's share of total world energy consumption is projected to increase to 29 percent in 2030, and its share in the electric power sector is projected to rise from 42 percent in 2005 to 46 percent in 2030.

International coal trade increases by 53 percent in the reference case, from 18.4 quadrillion Btu in 2005 to 28.1 quadrillion Btu in 2030. Because the largest increase in consumption is projected for coal that is produced and consumed domestically in China, the share of total world coal consumption accounted for by internationally traded coal declines slightly, from 15 percent in 2005 to 14 percent in 2030.

Figure 46. World Coal Consumption by Country Grouping, 1980-2030



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

World Coal Consumption

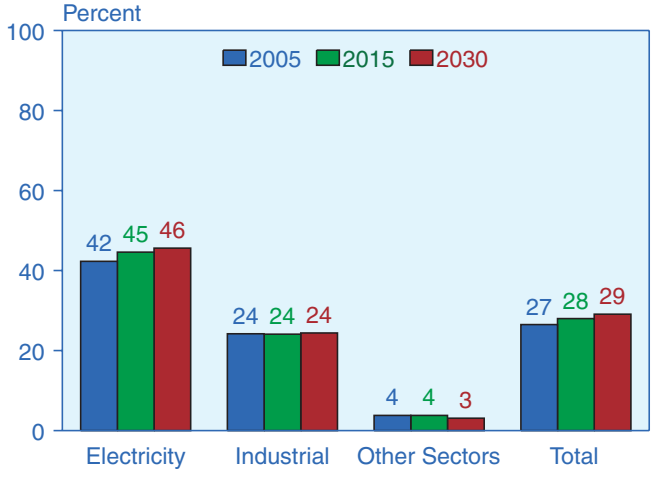
OECD Countries

Coal consumption in the OECD countries increases in the reference case from 47.3 quadrillion Btu in 2005 to 49.9 quadrillion Btu in 2015 and 55.0 quadrillion Btu in 2030 (Figure 48). The increase represents average growth of 0.6 percent per year over the entire period and 0.7 percent per year from 2015 to 2030. Coal consumption in the OECD countries represented 39 percent of the world total in 2005. In 2030 it is only 27 percent of the total, despite increases in North America and OECD Asia.

North America

Coal use in the United States totaled 22.8 quadrillion Btu in 2005, accounting for 92 percent of total coal use in North America and 48 percent of the OECD total. U.S.

Figure 47. Coal Share of World Energy Consumption by Sector, 2005, 2015, and 2030



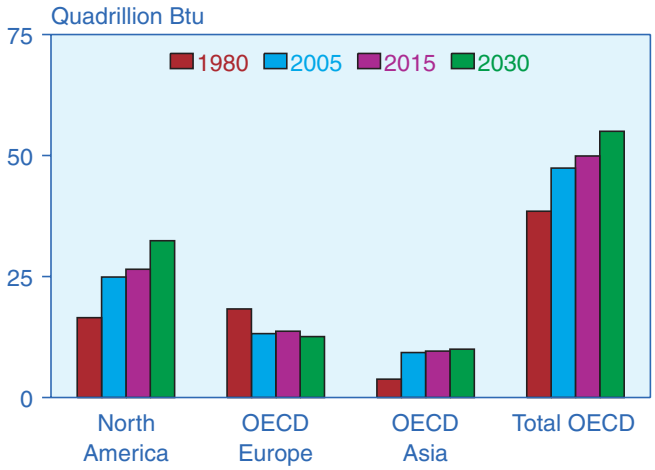
Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **2015 and 2030:** EIA, World Energy Projections Plus (2008).

coal demand rises to 29.9 quadrillion Btu in 2030 in the *IEO2008* reference case. The United States has substantial coal reserves and relies heavily on coal for electricity generation, a position that continues in the projections. Coal's share of total U.S. electricity generation (including electricity produced at combined heat and power plants in the industrial and commercial sectors) declines from 50 percent in 2005 to 49 percent in 2015, then rises to 54 percent in 2030.

Much of the projected growth in U.S. coal consumption occurs after 2015, when a substantial amount of new coal-fired generating capacity is projected to come on line. Between 2005 and 2015, natural gas continues to be the top choice for new generating capacity, with renewables and coal accounting for most of the remaining additions during the period. After 2015, the combination of increased need for baseload generating capacity, rising natural gas prices, continuing growth in electricity demand, and the absence of national-level restrictions on greenhouse gas emissions gradually tips capacity expansion decisions toward new coal-fired power plants. From 2015 to 2030, 86 gigawatts of new coal-fired capacity is projected to be built, representing 82 percent of all the new coal-fired generating plants built in the United States from 2005 through 2030. The projections could change significantly, however, if changes were made in U.S. laws and policies, particularly those regarding greenhouse gas emissions.

In Canada and Mexico, small increases in coal consumption (0.3 and 0.1 quadrillion Btu, respectively) are expected over the period. As a result, the two countries essentially maintain their combined 8-percent share of North America's total coal consumption through 2030. In Mexico, 0.7 gigawatts of coal-fired generating capacity currently is under construction at Lazaro Cardenas on the Pacific coast. In addition, Mexico's Energy Ministry has indicated the potential for additional coal-fired generating projects in the next decade, contingent on the confirmation of newly discovered coal reserves in the Sabinas region and subject to future fuel prices.

Figure 48. OECD Coal Consumption by Region, 1980, 2005, 2015, and 2030



Sources: **1980 and 2005:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **2015 and 2030:** EIA, World Energy Projections Plus (2008).

OECD Europe

Total coal consumption in the countries of OECD Europe declines slightly in the reference case, from 13.2 quadrillion Btu in 2005 (28 percent of the OECD total) to 12.6 quadrillion Btu in 2030. In 2005, the major coal-consuming countries of OECD Europe included Germany, Poland, the United Kingdom, Spain, Turkey, and the Czech Republic. Low-Btu coal is an important domestic source of energy for the nations of OECD Europe, which also rely heavily on imports of hard coal.[11] In 2005, lignite accounted for 47 percent of their total combined coal consumption on a tonnage basis and 24 percent on a Btu basis [***1***]. Plans to replace or refurbish existing coal-fired capacity in a number of the countries of OECD Europe are an indication that coal will continue to play an important role in their overall energy mix [***2***].

Coal consumption remains fairly flat throughout 2030, as governments enact policies to discourage the use of the fuel, largely in response to environmental concerns. Among the most important factors preventing OECD Europe's coal consumption from increasing in the long term is relatively slow growth in overall energy consumption, averaging 0.5 percent per year. Other factors include continued penetration of natural gas in both the electricity and the industrial sectors, growing use of renewable fuels, and continuing pressure on member countries of the European Union to reduce subsidies that support domestic production of hard coal.

OECD Asia

In addition to remaining prominent consumers of coal, the nations of OECD Asia play an important role in international coal trade. In 2005 they used 9.3 quadrillion Btu of coal, representing 20 percent of total OECD coal consumption. OECD Asia's coal demand is projected to increase by 0.6 quadrillion Btu over the projection period, to 10.0 quadrillion Btu in 2030 (18 percent of the OECD total). In 2005, Australia was the world's leading coal exporter, supplying 6.1 quadrillion Btu of coal to the international market, while Japan and South Korea were the world's leading importers, receiving 4.5 and 1.9 quadrillion Btu of coal, respectively [***3***]. Japan's coal consumption decreases in the long term; Australia,

[11] Internationally, the term "hard coal" is used to describe anthracite and bituminous coal. In data published by the International Energy Agency, coal of subbituminous rank is classified as hard coal for some countries and as brown coal (with lignite) for others.

New Zealand, and South Korea account for nearly all the projected growth in OECD Asia's demand for coal.

Coal consumption in Australia/New Zealand increases by an average of 0.6 percent per year, from 2.6 quadrillion Btu in 2005 to 3.0 quadrillion Btu in 2030. With substantial coal reserves (primarily in Australia), the region continues to rely heavily on coal for electricity generation; however, coal's share of total generation declines gradually as more natural gas is consumed in the electric power sector. Coal-fired power plants supplied 73 percent of the region's total electricity generation in 2005, as compared with a projected 68-percent share in 2030 in the reference case.

South Korea's total coal consumption increases by 0.7 quadrillion Btu from 2005 to 2030, primarily to fuel existing and planned electric power plants. South Korea's generating companies have announced plans to construct more than 6 gigawatts of new coal-fired capacity at existing sites over the next few years, including three 500-megawatt units that began operation at Korea East-West Power Company's Dangjin plant in 2006 and 2007 [*4*].

Non-OECD Countries

Led by strong economic growth and rising demand for energy in China and India, non-OECD coal consumption is projected to rise to 147.3 quadrillion Btu in 2030, nearly double the quantity consumed in 2005 (Figure 49). The increase of 72.1 quadrillion Btu, which represents 90 percent of the projected increase in total world coal consumption, underscores the growing importance of coal in meeting overall energy demand in the non-OECD nations. Total coal consumption in the non-OECD countries grows at an average annual rate of 3.7 percent from 2005 to 2015, then slows to 2.1 percent per year from 2015 to 2030 as the region's overall rate of economic growth begins to moderate in the later years of the projection period.

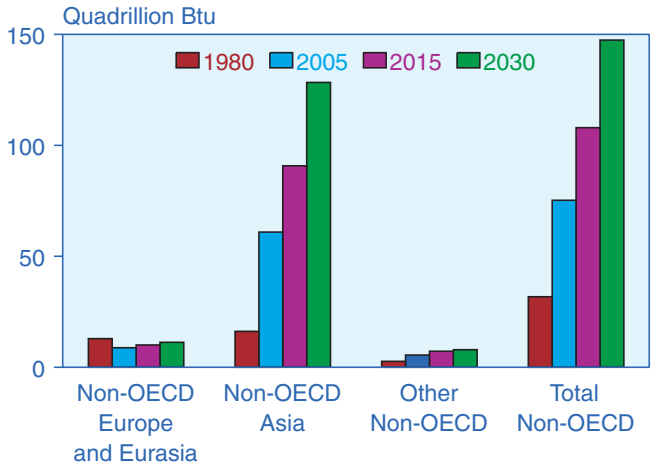
Non-OECD Asia

China and India together account for 79 percent of the projected increase in world coal consumption from 2005 to 2030. Strong economic growth is projected for both countries (averaging 6.4 percent per year in China and 5.8 percent per year in India from 2005 to 2030), and much of the increase in their demand for energy, particularly in the electric power and industrial sectors, is expected to be met by coal.

Coal use in China's electricity sector is projected to increase from 22.2 quadrillion Btu in 2005 to 60.6 quadrillion Btu in 2030, at an average rate of 4.1 percent per year (Figure 50). In comparison, coal consumption in the U.S. electric power sector is projected to grow by 1.1 percent annually, from 20.7 quadrillion Btu in 2005 to 27.5 quadrillion Btu in 2030. At the end of 2005, China had an estimated 299 gigawatts of coal-fired capacity in operation. To meet the demand for electricity that is expected to accompany its rapid economic growth, an additional 735 gigawatts of coal-fired capacity (net of retirements) is projected to be brought on line in China by 2030, requiring large financial investments in new coal-fired power plants and associated transmission and distribution systems.

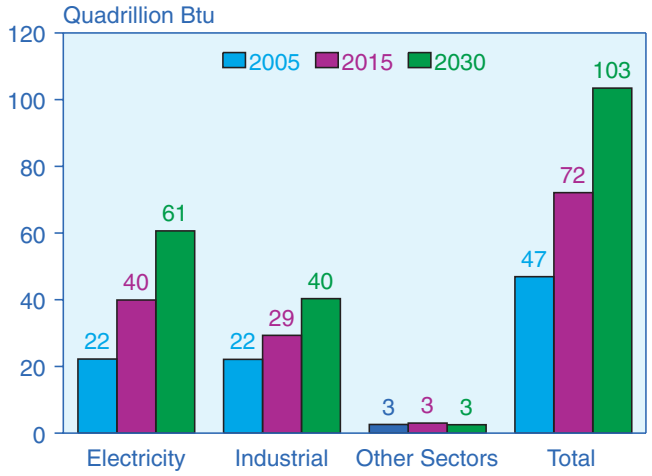
More than one-half (53 percent) of China's coal use in 2005 was in the non-electricity sectors, primarily in the industrial sector. China was the world's leading producer of both steel and pig iron in 2005 [*5*]. Over the projection period, coal demand in China's non-electricity

Figure 49. Non-OECD Coal Consumption by Region, 1980, 2005, 2015, and 2030



Sources: **1980 and 2005:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **2015 and 2030:** EIA, World Energy Projections Plus (2008).

Figure 50. Coal Consumption in China by Sector, 2005, 2015, and 2030



Sources: **2005:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **2015 and 2030:** EIA, World Energy Projections Plus (2008).

sectors is expected to increase by 18.1 quadrillion Btu, to 73 percent above the 2005 level. Despite such substantial growth, however, the non-electricity share of total coal demand declines to 41 percent in 2030. Because China has only limited reserves of oil and natural gas, coal remains the primary source of energy in its industrial sector, even as electricity's share of total industrial energy use rises from 17 percent in 2005 to 27 percent in 2030.

With a substantial portion of the increase in China's demand for both liquids and natural gas projected to be met by imports, the Chinese government is actively pursuing the development of a coal-to-liquids industry. Production of coal-based synthetic liquids is scheduled to commence in late 2008 at the country's first commercial-scale coal-to-liquids plant. Located in the Inner Mongolia Autonomous Region, the direct coal liquefaction facility is being built by the state-owned Shenhua Group and will have an initial capacity of approximately 20,000 barrels per day [*6*]. Although initial plans foresaw an increase in liquids production at the site to 100,000 barrels per day by 2010, the schedule for expansion is now indefinite, depending on the successful startup and commercial operation of the first phase.

A number of other coal-to-liquids projects, representing total productive capacity in excess of 0.2 million barrels per day, are currently at various stages of development, ranging from feasibility studies to early construction phases [*7*]. Shenhua is involved in a number of these projects as well, and two other Chinese companies—the Yankuang and Lu'an Groups—also are moving forward with their own coal-to-liquids projects. Despite strong interest by the Chinese government and industry in developing a coal-to-liquids industry, substantial uncertainty and risks are associated with the move, including potential strains on water resources, the general financial risks associated with technological uncertainties, and the substantial investment requirements. In the *IEO2008* reference case, China's coal-to-liquids production is projected to reach 0.2 million barrels per day in 2030, indicating an annual coal requirement of approximately 1 quadrillion Btu, or about 1 percent of China's total projected coal use in 2030. In comparison, China's coal-to-liquids production in 2030 is projected to be 0.1 million barrels per day in the *IEO2008* low price case and 0.5 million barrels day in the *IEO2008* high price case.

Nearly 74 percent of the growth in India's coal consumption is expected to be in the electric power sector and most of the remainder in the industrial sector. In 2005, India's coal-fired power plants consumed 6.0 quadrillion Btu of coal, representing 70 percent of the country's total coal demand. Coal use for electricity generation in India is projected to grow by 2.5 percent per year, to 11.1 quadrillion Btu in 2030, as an additional 95 gigawatts of coal-fired capacity (net of retirements) is brought on line. As a result, India's coal-fired generating capacity more than doubles in the reference case, from 79 gigawatts in 2005 to 173 gigawatts in 2030.

Currently, India's government has tentative plans to add more than 50 gigawatts of new coal-fired generating capacity during the period covered by its eleventh power plan (a 5-year period ending in March 2012) [*8*]. During India's most recent 5-year power plan period, which ended in March 2007, only about 12 of the 20 gigawatts of new coal-fired generating capacity that had been planned was actually completed. In addition to the coal projects listed in the preliminary documents for the eleventh power plan, including one "ultra mega" coal-fired plant with a capacity of 4 gigawatts, the Indian government is pursuing the development of eight more "ultra mega" projects with a total combined coal-fired generating capability of 32 gigawatts [*9*].

In the other nations of non-OECD Asia, coal consumption is projected to grow by an average of 2.3 percent per year, from 5.3 quadrillion Btu in 2005 to 9.3 quadrillion Btu in 2030, with increases in both the electric power and industrial sectors. In the electric power sector, significant growth in coal consumption is expected in Taiwan, Vietnam, Indonesia, and Malaysia, where considerable amounts of new coal-fired generating capacity are either planned or under construction.

Non-OECD Europe and Eurasia

Coal consumption in non-OECD Europe and Eurasia is projected to increase at an average rate of 0.9 percent per year, from 8.8 quadrillion Btu in 2005 to 11.2 quadrillion Btu in 2030. Russia alone has an estimated 173 billion tons of recoverable reserves (19 percent of the world total), and the other countries of non-OECD Europe and Eurasia have an additional 95 billion tons (10 percent of the world total).[12]

Russia is the largest coal consumer among the nations of non-OECD Europe and Eurasia, at 4.8 quadrillion Btu in 2005, or 54 percent of the total for non-OECD Europe and Eurasia. In 2030, Russia's coal consumption is projected to total 5.7 quadrillion Btu. Coal supplied 16 percent of Russia's total energy requirements in 2005, and coal-fired power plants provided 24 percent of its electricity. In the *IEO2008* reference case, coal's share of Russia's total energy consumption drops slightly to 14 percent in 2030, and its share of electricity generation declines to 22 percent. More than one-half of the projected growth in electricity demand from 2005 to 2030 is met by natural-gas-fired power plants, with coal and nuclear plants accounting for most of the remainder. The

[12]Throughout this chapter, tons refer to short tons (2,000 pounds).

natural gas share of Russia's total electricity generation increases from 40 percent in 2005 to 46 percent in 2030.

In March 2008, the Russian government approved a new long-range plan for the country's electric power sector through 2020 [***10***]. In general, the plan lays out a detailed road map of capacity additions and retirements and new transmission infrastructure. One of the key objectives of the plan on the generation side is to curb growth in natural-gas-fired generation in order to free up natural gas for export. The plan anticipates some additional growth in natural gas consumption in the power sector through 2020, as does the *IEO2008* reference case, but it differs from the *IEO2008* projection in that it anticipates more generation from coal-fired and nuclear power plants and more rapid growth in total electricity generation.

One of the key uncertainties in Russia's new long-range power plan results from the current activities of the country's former power monopoly, Unified Energy System (UES), which is completing the process of selling off the many regional generating companies it once controlled. It remains to be seen how the government's new plan for the power sector will be worked out with the many private-sector companies that own or soon will own the various regional generating entities, as the specific planned additions and retirements outlined in the government plan may not turn out to be the most economical choices from the perspective of the individual generating companies.

In the other non-OECD Europe and Eurasia nations, coal consumption is projected to increase from 4.0 quadrillion Btu in 2005 to 5.5 quadrillion Btu by 2030, growing by 1.2 percent per year on average. Plans for both new coal-fired capacity and the refurbishment of existing capacity in a number of countries, including Albania, Bosnia and Herzegovina, Bulgaria, Montenegro, Romania, Serbia, and Ukraine, are a significant indication that coal will continue to be an important source of energy for the region [***11***].

Africa

Africa's coal consumption is projected to increase by 1.4 quadrillion Btu from 2005 to 2030. South Africa currently accounts for 90 percent of the coal consumed on the continent and is expected to continue to account for much of the increase in Africa's total coal consumption over the projection period in both the electricity and industrial sectors.

In South Africa, increasing demand for electricity in recent years has led to a decision by Eskom, the country's state-owned electricity supplier, to restart three large coal-fired plants (Camden, Grootvlei, and Komati) that have been closed for more than a decade [***12***]. The individual units at those plants, with a combined generating capacity of 3.8 gigawatts, are scheduled to return to service between 2006 and 2011. In addition, Eskom is also proceeding with the construction of a new 4.5-gigawatt coal-fired power plant consisting of six units, which are scheduled to be fully operational by 2015. Recent power shortages and the general lack of spare generating capacity in southern Africa have also led to increased interest in new coal-fired power projects in Botswana, Mozambique, and Tanzania [***13***].

In the industrial sector, increasing use of coal in Africa is expected for several purposes, including the production of steam and process heat for industrial applications, production of coke for the steel industry, and production of coal-based synthetic liquids. Currently, two commercial-size coal-to-liquids plants in South Africa (Sasol II and Sasol III) supply about 25 percent of the country's total liquid fuel requirements [***14***]. The two plants together are capable of producing 150,000 barrels of synthetic liquids per day.

Central and South America

Central and South America consumed 0.9 quadrillion Btu of coal in 2005. Brazil, with the world's tenth-largest steel industry in 2005, accounted for 51 percent of the region's coal demand. Chile, Colombia, Puerto Rico, Peru, and Argentina accounted for most of the remainder [***15***].

In the projections, coal consumption in Central and South America increases by 1.0 quadrillion Btu from 2005 to 2030, with 76 percent of the increase in Brazil, primarily for coke manufacture and electricity generation. Brazil's steel companies currently plan to expand production capacity by a substantial amount over the next few years to meet increasing domestic and international demand for steel [***16***].

Middle East

Countries of the Middle East consumed 0.4 quadrillion Btu of coal in 2005. Israel accounted for 87 percent of the total and Iran most of the remainder. The region's coal use increases only slightly in the reference case, to 0.5 quadrillion Btu in 2030.

World Coal Production

From 2005 to 2030, coal production in China, the United States, and India is projected to increase by 52.4 quadrillion Btu, 6.0 quadrillion Btu, and 4.3 quadrillion Btu, respectively, in the *IEO2008* reference case (Table 7), which assumes that most of the demand for coal in the three countries will continue to be met by domestic production. Coal production in Australia is also projected to rise substantially (by 5.0 quadrillion Btu) over the projection period, primarily to supply an expanding market for world coal trade. The projected increases in coal production for these four countries dominate the overall trends for the OECD and non-OECD, accounting for 99

percent of the increase in net production for all the OECD countries and 82 percent of the increase for the non-OECD countries. Rising international trade also is expected to support production increases in Russia, other non-OECD Asia, Africa, and Central and South America (excluding Brazil).

World Coal Trade

Because relatively few countries export coal, a disruption in one segment of the international coal supply chain can reverberate throughout the global market and limit the availability of coal for trade. In 2007 and 2008, several such disruptions took place. Power shortages at coal mines in South Africa and rail car shortages in Russia restricted the availability of coal in 2007. In early 2008, flooding in Australian coal mines and continued port congestion caused delays and even cancellations of coal deliveries. Also in 2008, heavy snow in China and the rail transportation problems it caused contributed to tight coal markets. As domestic coal stockpiles dwindled, the Chinese government temporarily stopped all coal exports.

Despite the potential for disruptive events, bottlenecks and temporary supply problems in major coal exporting countries are expected to be overcome in the long run, and the volumes of coal traded internationally are projected to increase through 2030. The upward trend in coal trade reflects the worldwide growth in coal consumption projected through 2030. International coal trade made up 15 percent of total world consumption in

Table 7. World Coal Production by Region, 2005-2030
(Quadrillion Btu)

Region	2005	2010	2015	2020	2025	2030	Average Annual Percent Change, 2005-2030
OECD North America	**25.1**	**26.5**	**27.3**	**28.1**	**29.8**	**32.1**	**1.0%**
United States	23.2	24.0	24.7	25.4	27.0	29.2	0.9%
Canada	1.7	2.2	2.5	2.6	2.6	2.7	1.9%
Mexico	0.2	0.2	0.2	0.2	0.2	0.2	-0.3%
OECD Europe	**7.8**	**8.4**	**7.9**	**7.5**	**7.2**	**6.9**	**-0.5%**
OECD Asia	**8.7**	**10.7**	**11.7**	**12.5**	**13.0**	**13.7**	**1.9%**
Japan	0.0	0.0	0.0	0.0	0.0	0.0	—
South Korea	0.1	0.1	0.1	0.1	0.1	0.1	—
Australia/New Zealand	8.6	10.6	11.6	12.4	13.0	13.6	1.9%
Total OECD	**41.6**	**45.5**	**46.9**	**48.1**	**50.1**	**52.7**	**1.0%**
Non-OECD Europe and Eurasia	**10.2**	**10.7**	**12.2**	**12.6**	**12.8**	**13.5**	**1.1%**
Russia	6.1	6.8	7.4	7.7	7.7	8.2	1.2%
Other	4.1	3.9	4.8	4.9	5.1	5.3	1.0%
Non-OECD Asia	**62.7**	**74.5**	**87.8**	**98.9**	**111.1**	**123.3**	**2.7%**
China	48.9	59.9	71.3	81.3	91.5	101.3	3.0%
India	7.8	7.9	8.6	9.5	10.7	12.0	1.8%
Other	6.0	6.7	7.9	8.1	8.9	9.9	2.1%
Middle East	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**—**
Africa	**5.9**	**6.7**	**7.4**	**7.8**	**8.1**	**8.2**	**1.3%**
Central and South America	**1.9**	**2.8**	**3.7**	**4.8**	**5.0**	**5.0**	**3.9%**
Brazil	0.1	0.2	0.2	0.2	0.2	0.2	4.3%
Other	1.8	2.6	3.5	4.6	4.8	4.8	3.9%
Total Non-OECD	**80.7**	**94.7**	**111.1**	**124.0**	**137.0**	**150.0**	**2.5%**
Total World	**122.2**	**140.2**	**158.0**	**172.1**	**187.1**	**202.7**	**2.0%**

Note: With the exception of North America, non-seaborne coal trade is not represented in the *IEO2008* cases. As a result, the projected levels of production assume that net non-seaborne coal trade will balance out across the world regions. Currently, a significant amount of non-seaborne coal trade takes place in Eurasia, represented by exports of steam coal from Kazakhstan to Russia and exports of coking coal from Russia to Ukraine.

Sources: **2005:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008); and National Energy Modeling System, run IEO2008.D061008B.

2005, and in the *IEO2008* reference case, it is projected to grow at an average annual rate of 1.5 percent, from about 19.7 quadrillion Btu in 2006 to 28.1 quadrillion Btu in 2030 (Table 8). Because the largest increases in coal consumption through 2030 are projected for non-OECD Asia—particularly China, which is expected to meet most of the increase in its coal demand with domestic supply rather than imports—the share of coal trade as a percentage of global coal consumption declines slightly, to 14 percent in 2030. Australia and Indonesia are geographically well situated to continue as the leading suppliers of internationally traded coal, especially to Asia, over the period. South America is projected to expand its role as an international supplier of coal, primarily as a result of increasing coal production in Colombia.

Although both steam and metallurgical coal are traded internationally, most of the trade is in steam coal, which is projected to represent 72 percent of world coal trade in 2030. In 2006, 56 percent of the world's exported steam coal was imported by Asian countries, and their share of the total in 2030 is projected to be 61 percent. The share of metallurgical coal imports destined for Asian countries also increases, from 61 percent in 2006 to 65 percent in 2030.

Coal Exporters

The top four exporters of steam coal in 2006 were Indonesia, Australia, South America (Colombia and Venezuela), and southern Africa (South Africa, Mozambique, and Botswana). Although Indonesia currently is the world's largest exporter of steam coal, Australia is expected to be the leading exporter in most years of the *IEO2008* projections. China is only the sixth-largest exporter of steam coal in 2030. For coking coal, Australia, Canada, and the United States continue to be ranked among the top three exporters over the projection period. Among the countries expected to expand their international coal trade in 2030 are Australia, Russia, and Colombia. Indonesia and Vietnam, like China, are projected to see increasing domestic demand for coal, which is expected to constrain their coal exports.

Already the world's leading exporter of coal, Australia is projected to dominate future international coal trade. Australia continues to improve its inland transportation and port infrastructure to expedite coal shipments to international markets. For example, expansions and new terminals at the port of Newcastle could add more than 1.0 quadrillion Btu of additional coal export capacity in New South Wales [***17***]. Queensland's Dalrymple Bay port is expected to complete its Phase I expansion to 1.8 quadrillion Btu in early 2008, followed by an increase to about 2.3 quadrillion Btu in subsequent expansions [***18***]. Australia remains the primary exporter of metallurgical coal to Asian markets, supplying 75 percent of Asia's import demand for coking coal over the projection period.

After the breakup of the Soviet Union in 1991, Russian coal supply was characterized by low mine productivity, relatively poor coal quality, and long distances between mines and markets. The productivity of its coal mines has improved since then, however, lowering mining costs and compensating in part for the expense of transporting coal to ports. Rail and port infrastructure investments are critical for the continued expansion of Russia's coal exports, and in addition, growth in the country's domestic coal consumption could limit the availability of coal for export. Nevertheless, Russia is expected to play a growing role in seaborne world coal trade. Europe (particularly, the United Kingdom) has increasingly sought Russia's low-sulfur coal as its own mines have closed. In 2030, Eurasia's coal exports are projected to total 2.5 quadrillion Btu—63 percent more than in 2006—largely as a result of growth in Russian exports.

South America is projected to be the second-largest exporter of coal worldwide in 2030, primarily as a result of increases in exports from Colombia. The expansion will require investments in mine capacity, rail infrastructure, and port capacity, such as the current proposal to build a tunnel that would expedite coal transportation to Pacific Ocean ports. In Colombia, an expansion project is under development at the Bocas de Ceniza port [***19***], and an additional increase of 0.7 quadrillion Btu of capacity has been proposed for its other Caribbean ports [***20***].

In non-OECD Asia, China, Indonesia, and Vietnam are examples of countries that have the potential to export more coal but are focused instead on meeting domestic demand. From 2003 to 2006, China successively decreased the amount of coal it exported each year. In the wake of domestic supply shortages in 2007, China again diverted coal from the export market for domestic consumption. Thus, the past few years have shown that China has the ability to turn exports on and off depending on domestic needs, contributing to uncertainty and volatility in international coal markets. Overall, China is expected to hold a lower share of world coal trade as its exports stay fairly flat and other suppliers provide more coal.

In the international market for steam coal, Indonesia's coal exports are expected to peak sometime before 2010 as some coal is redirected for domestic consumption. Indonesia has low-cost reserves of low-sulfur coal; many ports, some with the capability to take capesize ships; and proximity to the expanding markets of Asia. Indonesia has also demonstrated its capacity for significant growth, tripling its exports in the past decade. From

Table 8. World Coal Flows by Importing and Exporting Regions, Reference Case, 2006, 2015, and 2030
(Quadrillion Btu)

Exporters	Importers											
	Steam				Coking				Total			
	Europe[a]	Asia	Americas	Total[b]	Europe[a]	Asia[c]	Americas	Total[b]	Europe[a]	Asia	Americas	Total[b]
2006												
Australia	0.10	2.57	0.18	**2.85**	0.82	2.31	0.21	**3.33**	0.91	4.88	0.39	**6.18**
United States	0.12	0.01	0.34	**0.48**	0.45	0.04	0.26	**0.75**	0.57	0.05	0.60	**1.22**
Southern Africa[d]	1.53	0.07	0.02	**1.68**	0.02	0.00	0.00	**0.03**	1.55	0.07	0.03	**1.71**
Eurasia	1.08	0.29	0.02	**1.39**	0.07	0.10	0.00	**0.17**	1.15	0.39	0.02	**1.56**
Poland	0.25	0.00	0.00	**0.25**	0.03	0.00	0.00	**0.03**	0.28	0.00	0.00	**0.28**
Canada	0.01	0.05	0.02	**0.08**	0.21	0.36	0.10	**0.67**	0.21	0.41	0.12	**0.75**
China	0.06	1.44	0.00	**1.51**	0.01	0.10	0.00	**0.12**	0.07	1.55	0.00	**1.62**
South America[e]	0.88	0.00	0.84	**1.72**	0.00	0.00	0.00	**0.00**	0.88	0.00	0.84	**1.72**
Vietnam	0.00	0.52	0.00	**0.52**	0.00	0.00	0.00	**0.00**	0.00	0.52	0.00	**0.52**
Indonesia[f]	0.62	2.90	0.13	**3.66**	0.00	0.53	0.00	**0.53**	0.62	3.43	0.13	**4.19**
Total	**4.65**	**7.85**	**1.55**	**14.12**	**1.60**	**3.45**	**0.57**	**5.63**	**6.25**	**11.30**	**2.12**	**19.74**
2015												
Australia	0.03	4.77	0.00	**4.80**	0.76	3.01	0.36	**4.13**	0.79	7.78	0.36	**8.93**
United States	0.25	0.02	0.18	**0.45**	0.24	0.00	0.42	**0.66**	0.50	0.02	0.59	**1.11**
Southern Africa[d]	1.29	1.06	0.12	**2.47**	0.02	0.00	0.02	**0.04**	1.31	1.06	0.15	**2.51**
Eurasia	1.52	0.54	0.00	**2.06**	0.08	0.23	0.00	**0.31**	1.59	0.77	0.00	**2.36**
Poland	0.14	0.00	0.01	**0.15**	0.03	0.00	0.00	**0.03**	0.17	0.00	0.01	**0.18**
Canada	0.04	0.00	0.00	**0.04**	0.47	0.36	0.13	**0.96**	0.51	0.36	0.13	**1.00**
China	0.00	1.07	0.00	**1.07**	0.00	0.03	0.00	**0.03**	0.00	1.10	0.00	**1.10**
South America[e]	1.95	0.00	1.12	**3.07**	0.00	0.00	0.00	**0.00**	1.95	0.00	1.12	**3.07**
Vietnam	0.00	0.27	0.00	**0.27**	0.00	0.01	0.00	**0.01**	0.00	0.27	0.00	**0.27**
Indonesia[f]	0.00	3.03	0.09	**3.12**	0.00	0.50	0.00	**0.50**	0.00	3.54	0.09	**3.63**
Total	**5.21**	**10.76**	**1.53**	**17.50**	**1.60**	**4.13**	**0.94**	**6.66**	**6.81**	**14.88**	**2.46**	**24.16**
2030												
Australia	0.09	5.39	0.04	**5.51**	0.89	3.79	0.45	**5.13**	0.97	9.18	0.48	**10.64**
United States	0.01	0.01	0.29	**0.31**	0.20	0.00	0.33	**0.53**	0.21	0.01	0.62	**0.84**
Southern Africa[d]	1.20	1.37	0.18	**2.75**	0.01	0.00	0.03	**0.04**	1.22	1.37	0.20	**2.79**
Eurasia	1.45	0.66	0.00	**2.11**	0.16	0.27	0.00	**0.43**	1.61	0.93	0.00	**2.54**
Poland	0.07	0.00	0.03	**0.10**	0.01	0.00	0.00	**0.01**	0.09	0.00	0.03	**0.11**
Canada	0.00	0.00	0.00	**0.00**	0.40	0.47	0.26	**1.13**	0.40	0.47	0.26	**1.13**
China	0.00	1.07	0.00	**1.07**	0.00	0.03	0.00	**0.03**	0.00	1.10	0.00	**1.10**
South America[e]	2.18	0.10	2.12	**4.39**	0.00	0.00	0.00	**0.00**	2.18	0.10	2.12	**4.39**
Vietnam	0.00	0.27	0.00	**0.27**	0.00	0.01	0.00	**0.01**	0.00	0.27	0.00	**0.27**
Indonesia[f]	0.00	3.53	0.22	**3.75**	0.00	0.50	0.00	**0.50**	0.00	4.03	0.22	**4.25**
Total	**5.00**	**12.38**	**2.88**	**20.26**	**1.67**	**5.07**	**1.07**	**7.80**	**6.66**	**17.46**	**3.94**	**28.06**

[a]Europe/Mediterranean, including coal shipments to the Middle East and Africa.
[b]In 2006, total world coal flows include a balancing item used to reconcile discrepancies between reported exports and imports. The 2006 balancing items by coal type were 0.069 quadrillion Btu (steam coal), 0.003 quadrillion Btu (coking coal), and 0.071 quadrillion Btu (total).
[c]Includes 0.49 quadrillion Btu of coal for pulverized coal injection at blast furnaces shipped to Japanese steelmakers in 2006.
[d]Southern Africa includes South Africa, Mozambique, and Botswana.
[e]Coal exports from South America are projected to originate from mines in Colombia and Venezuela.
[f]Includes shipments from other countries not modeled for the projection period. The 2006 exports from other countries by coal type were 0.07 quadrillion Btu (steam coal), 0.03 quadrillion Btu (coking coal), and 0.10 quadrillion Btu (total).
Notes: Data exclude non-seaborne shipments of coal to Europe and Asia. Totals may not equal sum of components due to independent rounding.
Sources: **2006:** SSY Consultancy and Research, Ltd., *SSY's Coal Trade Forecast*, Vol. 16, No. 1 (London, UK, June 2007); and Energy Information Administration, *Quarterly Coal Report*, October-December 2006, DOE/EIA-0121(2006/4Q) (Washington, DC, March 2007). **2015 and 2030:** Energy Information Administration, National Energy Modeling System, run IEO2008.D061008B.

2006 to 2030, Indonesia's annual coal exports are projected to average about 4 quadrillion Btu; however, continued strength in Indonesia's coal exports depends on investment in resource exploration and the development of new mines over the period. Some areas of uncertainty for Indonesian exports include the rate of growth in its domestic coal demand consumption, the adequacy of its internal transportation infrastructure, and environmental concerns. As long as international coal demand is strong and coal exports are profitable, Indonesia is expected to continue to supply coal to other nations.

Despite strong growth in coal exports between 2003 and 2007, the Vietnamese government plans to restrict exports in the future. State-owned Vinacomin, the largest coal producer in Vietnam, has announced plans to reduce exports by 17 percent in 2008 and to begin importing coal from Indonesia [***21***]. Vietnam has been slow to implement coal export reduction policies, however, and was still exporting about 0.7 quadrillion Btu in 2006 and 2007 [***22***]. In the *IEO2008* reference case, Vietnam's coal exports decline to about 0.2 quadrillion Btu in 2013 from an estimated 0.5 quadrillion Btu in 2006 and to remain below 0.3 quadrillion Btu through 2030.

The African countries of Botswana, Mozambique, and Tanzania are expected to play an emerging role in coal trade as importing countries seek to secure additional sources of supply. For example, India and Brazil are investing in mines and infrastructure projects in Africa. India's Tata Steel has acquired a 35-percent stake in a coking coal mine in Mozambique [***23***], and an expansion of the Mozambique port of Beira to a capacity of 0.5 quadrillion Btu to accommodate coal exports is being proposed [***24***].

South Africa currently is the sole source of seaborne coal exports from Africa. In early 2008, an electricity shortage forced the temporary closure of some of the country's coal mines, leading to reduced production and the diversion of some coal, originally intended for export, to domestic power plants. Although South Africa has domestic infrastructure and energy supply problems to solve, and its coal exports have remained flat over the past few years, coal mining is expected to continue playing an important role in its economy. A scheduled expansion of the Richards Bay Coal Terminal to add about 0.5 quadrillion Btu of export capacity in 2009 will support South Africa's continued role as an international coal supplier [***25***].

Coal Imports

Asia

Asia poses a large area of uncertainty for world coal trade projections. In particular, China has the potential to influence the market both as an importer and as an exporter. For example, a significant increase in China's coal imports could put upward pressure on world coal prices. In 2030, China's coal imports are projected to total 3.4 quadrillion Btu and its exports 1.1 quadrillion Btu. Even with a substantial increase in imports, however, most of the coal consumed in China will continue to be supplied by its own coal mines.

In India, demand for coal imports in 2030 is projected to be nearly triple its 2006 demand, as the country continues to encounter problems with domestic coal production and transportation. India is projected to increase imports of both coking coal and steam coal substantially. Its large electricity plants planned for the coast are to be fueled by imported thermal coal. India has domestic resources of coking coal, but their quality is poor in comparison with imports from foreign sources. India plans to expand its steel industry to between 165 and 198 million tons by 2020 from about 50 million tons in 2005 [***26***], with increased imports of coking coal supporting the expansion. Steel production is necessary for India to expand and improve infrastructure essential for economic development.

Although 2001 marked the final year of significant Japanese coal production [***27***], Japan has continued to rely on coal and is expected to remain the world's largest importer of coal through 2030. Japan relies on Australia for about 60 percent of its coal imports (both steam and metallurgical coal) and on China for about 20 percent of its steam coal imports. In addition, its purchases of coal from Indonesia have increased recently, and it has initiated investments in coal production in other countries, including Russia, in order to improve the security of its coal supply [***28***]. Japan is a leader in steel production, ranking second among world steel producers [***29***], and is projected to continue to import coking coal for use in its steelmaking plants in 2030.

South Korea also is expected to continue importing most of the coal it consumes. With planned increases in coal-fired capacity, South Korea and Taiwan together are projected to maintain a share of world imports at about 18 percent in 2030 despite sizable increases in steam coal imports by other countries. Thailand is also projected to increase steam coal imports by 2015, when new coal-fired plants are constructed [***30***].

Europe, Middle East, and Africa

In the *IEO2008* reference case, total coal imports to the Europe/Mediterranean market (including the Middle East and Africa) in 2030 are only slightly above 2006 levels (Figure 51). With most European countries placing greater emphasis on natural gas in the power sector, coal becomes a less significant component of the fuel mix for electricity generation. In Turkey, however, electricity demand and steel industry growth are projected to offset some of the decline in Europe's coal imports. Italy's conversion of power plants from oil to coal also is

projected to increase its coal imports. The initial increase in coal trade to Europe in the projections result in large part from the phaseout of European mining subsidies and higher demand for lower sulfur coal. Germany's hard-coal-fueled power plants are projected to require imported coal when its hard coal mines close by 2018 [*31*]. In the Middle East, Israel accounts for the largest portion of the increase in coal imports over the projection period as it expands its use of coal-fired generation. The demand for lower sulfur coal leads to an increase in the projected share of Europe's coal imports originating from South America and Eurasia.

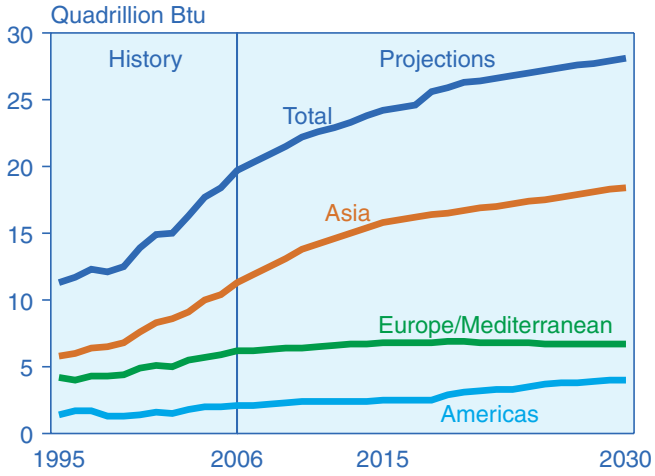
The Americas

In 2008 Kinder Morgan Energy Partners LP will complete a 0.4 quadrillion Btu expansion of its import terminal at Hampton Roads, Virginia; however, with high international coal prices in the near term, the terminal is expected to remain idle while U.S. exports increase to meet short-term international demand [*32*]. In the mid- to long term, port expansions are expected to facilitate U.S. coal imports, which increase by about 1.2 quadrillion Btu from 2006 to 2030. Although imports remain a relatively small share of U.S. coal consumption in 2030 (7 percent), the increase represents a shift for the United States from a net exporter to a net importer of coal. With declining productivity and mining difficulties in Central Appalachia, and with rising domestic demand for coal, imports are expected to become increasingly competitive for coastal States in the East and Southeast. South America (Colombia, in particular) is expected to be an important source of U.S. coal imports.

Although Canada has been the largest importer of U.S. coal in recent years, exports of U.S. steam coal to Canada in 2030 are projected to be about 0.2 quadrillion Btu below their 2006 level. It is expected that a portion of Ontario's coal-fired generating capacity will be shut down for environmental reasons.

Brazil's steelmaking capacity is projected to double by 2011 [*33*]. With rich reserves of iron ore but no coking-grade coal, Brazil's steel industry will need more imports of coking coal from Australia, Southern Africa, Canada, and the United States. Overall, South America's imports of coking coal—driven primarily by demand in Brazil—are projected to grow from about 0.4 quadrillion Btu in 2006 to 0.9 quadrillion Btu in 2030.

Figure 51. Coal Imports by Major Importing Region, 1995-2030



Sources: **History:** SSY Consultancy and Research, Ltd., *SSY's Coal Trade Forecast*, Vol. 16, No. 1 (London, UK, June 2007); International Energy Agency, *Coal Information 2007* (Paris, France, August 2007), and previous issues; and Energy Information Administration (EIA), *Quarterly Coal Report*, October-December 2006, DOE/EIA-0121(2006/4Q) (Washington, DC, March 2007), and previous issues; Btu conversions from short tons are estimates by EIA's Office of Integrated Analysis and Forecasting. **Projections:** EIA, National Energy Modeling System run IEO2008.D061008B.

World Coal Reserves

Total recoverable reserves of coal around the world are estimated at 930 billion tons—reflecting a current reserves-to-production ratio of 143 (Table 9).[13] Historically, estimates of world recoverable coal reserves, although relatively stable, have declined gradually from 1,174 billion tons in 1990 to 1,083 billion tons in 2000 and 930 billion tons in 2006 [*34*]. The most recent assessment of world coal reserves includes a substantial downward adjustment for India, from 102 billion tons in 2003 to 62 billion tons in 2006. Estimated reserves for OECD Europe of 32 billion tons in the most recent assessment are also substantially lower than the 2003 assessment of 43 billion tons. Much of the downward adjustment for OECD Europe is a result of lower estimates for Poland, Turkey, and the Czech Republic. Poland's reassessment of estimated recoverable coal reserves from 15 billion tons in 2003 to 8 billion tons in 2006 reflects the use of more restrictive criteria for geologic reliability [*35*].

Although coal deposits are widely distributed, 76 percent of the world's recoverable reserves are located in five countries: the United States (28 percent), Russia (19 percent), China (14 percent), Australia (9 percent) and India (7 percent). In 2005 those five countries, taken together, produced 4.8 billion tons (94.0 quadrillion Btu) of coal, representing 73 percent (77 percent on a Btu

[13]Recoverable reserves are those quantities of coal which geological and engineering information indicates with reasonable certainty can be extracted in the future under existing economic and operating conditions. Because recoverable reserves are a subset of total coal resources, recoverable reserve estimates for a number of countries, including China and the United States, could increase substantially as coal mining technology improves and as additional geological assessments of the coal resource base are completed. The reserves-to-production ratio is based on the reserves estimates and data on world coal production for 2005 shown in Table 9.

basis) of total world coal production [*36*]. By rank, anthracite and bituminous coal account for 51 percent of the world's estimated recoverable coal reserves on a tonnage basis, subbituminous coal accounts for 32 percent, and lignite accounts for 18 percent.

Quality and geological characteristics of coal deposits are important parameters for coal reserves. Coal is a heterogeneous source of energy, with quality (for example, characteristics such as heat, sulfur, and ash content) varying significantly by region and even within individual coal seams. At the top end of the quality spectrum are premium-grade bituminous coals, or coking coals, used to manufacture coke for the steelmaking process. Coking coals produced in the United States have an estimated heat content of 26.3 million Btu per ton and relatively low sulfur content of approximately 0.9 percent by weight [*37*]. At the other end of the spectrum are reserves of low-Btu lignite. On a Btu basis, lignite reserves show considerable variation. Estimates published by the International Energy Agency for 2005 indicate that the average heat content of lignite in major producing countries varies from a low of 4.4 million Btu per ton in Greece to a high of 12.4 million Btu per ton in Canada [*38*].

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Table 9. World Recoverable Coal Reserves as of January 1, 2006
(Billion Short Tons)

Region/Country	Recoverable Reserves by Coal Rank				2005 Production	Reserves-to-Production Ratio (Years)
	Bituminous and Anthracite	Subbituminous	Lignite	Total		
World Total	**471.8**	**293.6**	**165.0**	**930.4**	**6.5**	**143**
United States[a]	120.6	109.8	33.4	**263.8**	1.1	233
Russia	54.1	107.4	11.5	**173.1**	0.3	540
China	68.6	37.1	20.5	**126.2**	2.4	52
Other Non-OECD Europe and Eurasia	49.1	19.0	27.3	**95.3**	0.3	307
Australia and New Zealand	40.9	2.5	41.6	**85.1**	0.4	203
India	57.6	0.0	4.7	**62.3**	0.5	132
Africa	54.5	0.2	0.0	**54.7**	0.3	198
OECD Europe	9.3	3.4	19.0	**31.7**	0.7	47
Other Central and South America	8.0	2.2	0.0	**10.2**	0.1	138
Other Non-OECD Asia	2.5	2.7	4.5	**9.7**	0.3	34
Brazil	0.0	7.8	0.0	**7.8**	0.0	1,131
Canada	3.8	1.0	2.5	**7.3**	0.1	101
Other[b]	2.9	0.5	0.1	**3.4**	0.0	207

[a]Data for the United States represent recoverable coal estimates as of January 1, 2007.
[b]Includes Mexico, Middle East, Japan, and South Korea.
Sources: **United States:** Energy Information Administration (EIA), unpublished data from the Coal Reserves Database (March 2008). **All Other Countries:** World Energy Council, *2007 Survey of Energy Sources*, 21st Edition (London, UK: Elsevier, September 2007), and EIA, *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea.

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Chapter 5
Electricity

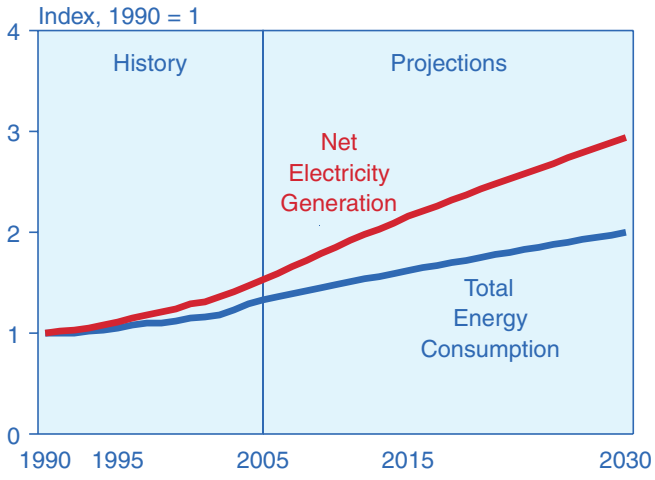
World electricity generation nearly doubles in the IEO2008 reference case from 2005 to 2030. In 2030, generation in the non-OECD countries is projected to exceed generation in the OECD countries by 46 percent.

Over the next 25 years, the world will become increasingly dependent on electricity to meet its energy needs. Electricity is expected to remain the fastest-growing form of end-use energy worldwide through 2030, as it has been over the past several decades. Nearly one-half of the projected increase in energy consumption worldwide from 2005 to 2030 is attributed to electricity generation in the *IEO2008* reference case. Since 1990, growth in net generation has outpaced the growth in total energy consumption (2.9 percent per year and 1.9 percent per year, respectively), and generation is expected to increase at an average annual rate of 2.6 percent through 2030 as the growth in demand for electricity continues to outpace growth in total energy use (Figure 52).

World net electricity generation nearly doubles in the reference case, from 17.3 trillion kilowatthours in 2005 to 24.4 trillion kilowatthours in 2015 and 33.3 trillion kilowatthours in 2030 (Table 10). In general, growth in the OECD countries, where electricity markets are well established and consuming patterns are mature, is slower than in the non-OECD countries, where a large amount of demand remains unsatisfied. The International Energy Agency has estimated that nearly 32 percent of the population in the developing non-OECD countries (excluding non-OECD Europe and Eurasia) do not yet have access to electricity—a total of about 1.6 billion people [*1*]. With the strong economic growth projected for the developing non-OECD nations, substantial increases in electricity generation will be needed to meet demand in the residential, commercial, and industrial sectors.

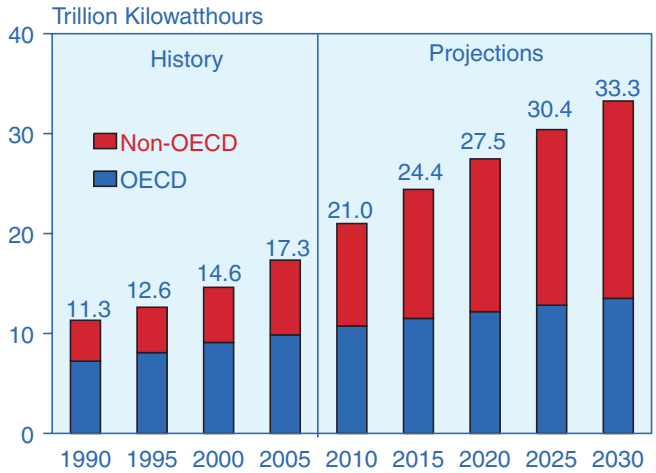
Although the non-OECD nations consumed 24 percent less electricity than the OECD nations in 2005, total non-OECD electricity generation in 2030 is projected to exceed OECD generation by 46 percent (Figure 53). In the developing countries, strong economic growth translates to growing demand for electricity. Increases in per capita income lead to improved standards of living, rising consumer demand for lighting and appliances, and growing requirements for electricity in the industrial sector. As a result, total non-OECD electricity generation increases by an average of 4.0 percent per year in the reference case, as compared with a projected average annual growth rate in OECD electricity generation of 1.3 percent from 2005 to 2030.

Figure 52. Growth in World Electric Power Generation and Total Energy Consumption, 1990-2030



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Figure 53. World Net Electric Power Generation, 1990-2030



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, System for the Analysis of Global Energy Markets/Global Electricity Module (2008).

Electricity Supply by Energy Source

The mix of primary fuels used to generate electricity has changed a great deal over the past two decades on a worldwide basis. Coal has continued to be the fuel most widely used for electricity generation, although generation from nuclear power increased rapidly from the 1970s through the 1980s, and natural-gas-fired generation grew rapidly in the 1980s and 1990s. The use of oil for electricity generation has been declining since the mid-1970s, when the oil embargo by Arab producers in 1973-1974 and the Iranian Revolution in 1979 produced oil price shocks.

High world oil prices—which have moved upward in every year since 2003—in combination with concerns about the environmental consequences of greenhouse gas emissions are raising renewed interest in nuclear power and renewable energy sources as alternatives to the use of coal and natural gas for electric power generation. Projections of future coal use are particularly sensitive to assumptions about future policies that might be adopted to mitigate greenhouse gas emissions.

Coal

In the *IEO2008* reference case, while natural gas is the fastest-growing energy source for electricity generation worldwide, coal continues to provide the largest share, by a wide margin, of the energy used for electric power production (Figure 54). In 2005, coal-fired generation accounted for 41 percent of world electricity supply; in 2030, its share is projected to be 46 percent. Sustained high prices for oil and natural gas make coal-fired generation more attractive economically, particularly in nations that are rich in coal resources, which include China, India, and the United States. The 3.1-percent projected annual growth rate for coal-fired electricity generation worldwide is exceeded only by the 3.7-percent growth rate projected for natural-gas-fired generation.

The outlook for coal-fired generation could be altered substantially by international agreements to reduce greenhouse gas emissions. The electric power sector offers some of the most cost-effective opportunities for reducing carbon dioxide emissions in many countries. Coal is both the world's most widely used source of

Table 10. OECD and Non-OECD Net Electricty Generation by Fuel, 2005-2030
(Trillion Kilowatthours)

Region	2005	2010	2015	2020	2025	2030	Average Annual Percent Change, 2005-2030
OECD							
Liquids and Other Petroleum	0.4	0.3	0.3	0.2	0.2	0.2	-2.4
Natural Gas	1.9	2.4	2.9	3.2	3.4	3.7	2.6
Coal	3.8	4.0	4.1	4.3	4.5	4.8	1.0
Nuclear	2.2	2.3	2.3	2.4	2.5	2.6	0.6
Renewables	1.5	1.8	1.9	2.0	2.2	2.3	1.6
Total OECD	**9.9**	**10.8**	**11.5**	**12.2**	**12.8**	**13.5**	**1.3**
Non-OECD							
Liquids and Other Petroleum	0.6	0.6	0.6	0.6	0.6	0.6	-0.1
Natural Gas	1.5	2.2	3.0	3.8	4.3	4.7	4.7
Coal	3.4	5.0	6.6	7.8	9.2	10.6	4.7
Nuclear	0.4	0.5	0.7	0.9	1.1	1.2	4.5
Renewables	1.6	1.9	2.0	2.2	2.5	2.7	2.1
Total Non-OECD	**7.5**	**10.2**	**12.9**	**15.3**	**17.6**	**19.7**	**4.0**
World							
Liquids and Other Petroleum	1.0	0.9	0.8	0.8	0.8	0.8	-0.9
Natural Gas	3.4	4.7	5.9	7.0	7.7	8.4	3.7
Coal	7.2	9.0	10.7	12.1	13.7	15.4	3.1
Nuclear	2.6	2.7	3.0	3.3	3.6	3.8	1.4
Renewables	3.2	3.7	3.9	4.2	4.6	5.0	1.8
Total World	**17.3**	**21.0**	**24.4**	**27.5**	**30.4**	**33.3**	**2.6**

Note: Totals may not equal sum of components due to independent rounding.
Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www. eia.doe.gov/iea. **Projections:** EIA, System for the Analysis of Global Energy Markets/Global Electricity Module (2008).

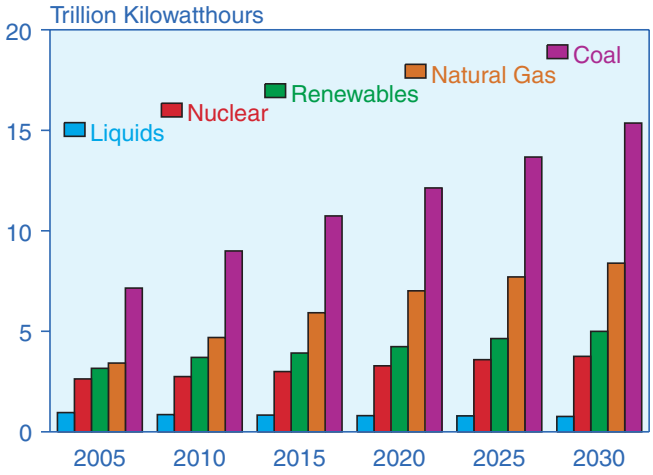
energy for power generation and also the most carbon-intensive energy source. If a cost, either implicit or explicit, were applied to emitters of carbon dioxide, there are several alternative no- or low-emission technologies that currently are commercially proven or under development, which could be used to replace some coal-fired generation. Implementing the technologies would not require expensive, large-scale changes in the power distribution infrastructure or in electricity-using equipment.

It could be more difficult, however, to achieve similar results in the end-use sectors. In the transportation sector, for instance, large-scale reduction of carbon dioxide emissions probably would require extensive changes in the motor vehicle fleet, fueling stations, and fuel distribution systems, at tremendous expense. In contrast, substitution of nuclear power and renewables for fossil fuels in the electric power sector would be a comparatively inexpensive way to reduce emissions, as would improving the efficiency of electric appliances.

Natural Gas

Although natural gas is the fastest-growing energy source for electric power generation in the *IEO2008* reference case projection—increasing from 3.4 trillion kilowatthours in 2005 to 8.4 trillion kilowatthours in 2030—the total amount of electricity generated from natural gas continues to be only about one-half the total for coal, even in 2030. Natural-gas-fired combined-cycle capacity is an attractive choice for new power plants because of its fuel efficiency, operating flexibility (it can be brought on line in minutes rather than the hours it takes for coal-fired and some other generating capacity), relatively short planning and construction times (months instead of the years that nuclear power plants typically require), and capital costs that are lower than those for other technologies.

Figure 54. World Electricity Generation by Fuel, 2005-2030



Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, System for the Analysis of Global Energy Markets/Global Electricity Module (2008).

Liquid Fuels and Other Petroleum

With world oil prices projected to stay relatively high, reaching $113 per barrel (in nominal dollars) at the end of the *IEO2008* projection in 2030, liquids are the only energy source for power generation that is projected to decline on a worldwide basis. As oil prices remain high, nations are expected to reduce or eliminate their use of oil for generation—opting instead for more economical sources of electricity, including coal. Worldwide, generation fueled by liquids is projected to decline by an average of 0.9 percent per year from 2005 to 2030; and in the OECD nations, it is projected to decline by 2.4 percent per year. Only the non-OECD Middle East region, with its ample oil reserves and a current 36-percent share of total electricity generation fueled by oil, is projected to continue relying heavily on oil to meet its electricity needs.

Nuclear Power

Electricity generation from nuclear power is projected to increase from about 2.6 trillion kilowatthours in 2005 to 3.8 trillion kilowatthours in 2030, as concerns about rising fossil fuel prices, energy security, and greenhouse gas emissions support the development of new nuclear generation capacity. High prices for fossil fuels allow nuclear power to become economically competitive with generation from coal, natural gas, and liquids despite the relatively high capital and maintenance costs associated with nuclear power plants. Moreover, higher capacity utilization rates have been reported for many existing nuclear facilities, and it is anticipated that most of the older nuclear power plants in the OECD countries and non-OECD Eurasia will be granted extensions to their operating lives. Still, there is considerable uncertainty associated with nuclear power.

Around the world, nuclear generation is attracting new interest as countries look to increase the diversity of their energy supplies, improve energy security, and provide a low-carbon alternative to fossil fuels. For instance, each of the world's three largest coal-consuming nations (China, the United States, and India) is projected to expand nuclear capacity significantly over the next 25 years (see box on page 64). The nuclear power profile was raised further at the December 2007, United Nations Climate Change Conference in Bali, when International Energy Agency Director Nobuo Tanaka suggested that nuclear power would have to be part of the solution to "stabilize and reduce man-made emissions in the foreseeable future" [2].

Mid-Term Prospects for Nuclear Electricity Generation in China, India, and the United States

Around the world, nuclear power plants are getting renewed attention and consideration as an option for electricity generation to meet rising demand in the future. For many years, analysts expected nuclear power to grow slowly in the short term and decline in the long term. More recently, however, many countries have begun looking anew at nuclear power to displace generation from fossil fuels, in response to both sustained high prices for oil and natural gas and the desire to reduce carbon dioxide emissions. In addition, concerns about energy security among those nations that rely heavily on fossil fuel imports have made nuclear power an attractive option for electricity production.

Still, there are barriers to the nuclear power option, including public concerns about plant safety, disposal of radioactive waste, and nuclear weapons proliferation—not to mention the relatively high capital and maintenance costs of nuclear plants. Even if safety, health, and political concerns were answered sufficiently to allow new nuclear plants to be built, the escalating expense of building them (particularly, in comparison with capital costs for other plant types) could prevent them from being constructed. The costs of commodities such as iron, steel, cement, and concrete, as well as the capital costs of energy equipment and facilities, all have increased substantially in the past few years; and because nuclear plants tend to be more capital intensive than fossil fuel generators, these cost increases tended to make nuclear power less competitive despite the recent surge in fossil fuel prices.

In at least three countries—China, India, and the United States—nuclear power currently is positioned for strong growth (see figure opposite):

- Although China has the youngest nuclear power program of the three nations (its first nuclear power plant began operating in 1991), it is expected to add a net 45 gigawatts of nuclear capacity by 2030. In the *IEO2008* reference case, China's nuclear electricity generation increases from 50 billion kilowatthours in 2005 to 410 billion kilowatthours in 2030, an average annual growth rate of 8.8 percent.
- India is projected to add 17 gigawatts of new nuclear capacity and increase production by 9.4 percent annually. Although India has not signed the international Nuclear Non-Proliferation Treaty (NPT), it is expected to forge an agreement with the United States and the International Atomic Energy Agency (IAEA) that will allow it to import sufficient fuel and reactor parts to achieve the projected increase.
- The United States is projected to add 16.6 gigawatts of new nuclear capacity and 2.7 gigawatts of capacity in the form of uprates to existing plants. Those increases are partially offset, however, by the anticipated retirement of several older reactors.

China

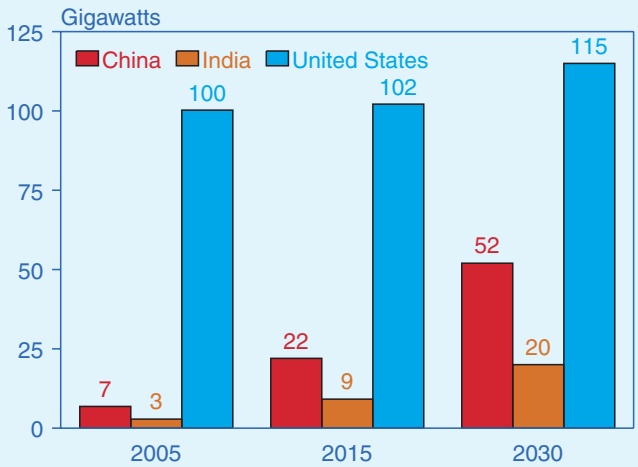
China is trying to diversify its sources of electricity, and increasing nuclear power capacity is seen as a strategy to achieve that goal. Unlike most of the OECD nations, China will be able to expand its nuclear program largely without political deterrents.

At present, China has 11 commercial nuclear power reactors in operation, 6 of which have been brought on line since 2002. Another 6 plants are currently under construction, and several more are in various stages of planning.[a] The Chinese government is also in the process of awarding billions of dollars in contracts to build additional nuclear plants. France's AREVA, Russia's AtomStroyExport, and U.S.-based Westinghouse all have won bids. In the world's largest nuclear power deal to date, China will pay $11.9 billion to AREVA to build two nuclear reactors.

China hopes to construct 30 new reactors by 2020, increasing its nuclear portfolio from 2.3 percent of the

(continued on page 65)

Nuclear Electricity Generation Capacity in China, India, and the United States, 2005, 2015, and 2030



Sources: **2005:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **2015 and 2030:** EIA, System for the Analysis of Global Energy Markets/Global Electricity Module (2008).

[a]International Atomic Energy Association, "Power Reactor Information System," web site www.iaea.org/programmes/a2/index.html; and "China's Nuclear Power Aspirations," *Energy Biz Insider* (December 12, 2007).

Mid-Term Prospects for Nuclear Electricity Generation in China, India, and the United States (Continued)

country's total electricity generation in 2008 to 6 percent in 2020. By 2050, it aims to have at least 150 gigawatts of installed nuclear capacity, providing 22 percent of the country's projected generation mix.[b] In the *IEO2008* reference case, China's installed nuclear capacity reaches 35 gigawatts in 2020, 45 gigawatts in 2025, and 52 gigawatts in 2030, which would supply 5 percent of its total electricity generation in 2030.

India

India's first nuclear power plant became operational in 1969. Since that time, however, the growth in operating nuclear capacity has been slow and, at best, uneven. In 2005 nuclear power accounted for just 2.4 percent of India's electricity generation, and its operating nuclear capacity totaled only 2.8 gigawatts. Because India has refused to sign the NPT, it has been barred from importing nuclear reactors and fuel from the 45-nation Nuclear Suppliers Group (NSG).

In response to rapid growth in electricity demand, India is intent on increasing its generation from nuclear power. The country's Department of Atomic Energy has a goal of increasing nuclear capacity to 20 gigawatts by 2020, more than seven times the current installed nuclear capacity.[c]

To support such an expansion of its nuclear program, India began talks with the United States in July 2005, in an effort to build favorable conditions that will allow it to purchase nuclear reactor parts and fuel. On the part of the United States, negotiations are aimed at persuading India to agree to some nonproliferation measures that would enable it to import nuclear materials without becoming a full signatory to the NPT. The negotiations are suspended at present because of dissent among members of some of India's political parties, who do not trust the political, economic, and military relationships being developed as part of the strategic partnership between India and the United States. The talks are expected to resume in the near future.[d]

The NSG is awaiting the conclusion of the U.S.-India negotiations, as well as a safeguards agreement between India and the IAEA, before deciding whether to grant India an exception to nuclear import restrictions. Several countries, including France, Russia and Australia, are already discussing nuclear cooperation and contract deals with India in the event that an exception to the NSG guidelines is extended to India.

In the *IEO2008* reference case, India's nuclear power capacity grows rapidly, by an average of 8.2 percent per year, to 14 gigawatts in 2020 and 20 gigawatts in 2030. The projection still falls short, however, of the Indian Prime Minister's goal of achieving 20 gigawatts of operating nuclear generation capacity by 2020.

United States

The United States has the world's oldest commercial nuclear power program. The first electric power generation from nuclear energy occurred on December 20, 1951, in Arco, Idaho; and the world's first large-scale nuclear power plant, a 60-megawatt pressurized-water reactor, began operation on December 2, 1957, in Shippingport, Pennsylvania. The U.S. program expanded quickly in the 1960s and 1970s. Nuclear generation supplied 2.4 percent of U.S. electricity in 1971, 11 percent in 1979, and 20 percent at its height in 1992, when 111 U.S. nuclear generators were in operation. Today, 103 nuclear power plants supply nearly 800 billion kilowatthours of electricity in the United States—just under 20 percent of total U.S. generation.

In the mid- to late 1970s, U.S. public opinion started to turn against nuclear power. The rapidly escalating costs of building nuclear plants, including the costs of added safety measures, throughout the 1970s and 1980s contributed to large increases in electricity prices. Aside from the costs of building and maintaining nuclear plants, the potential dangers of plant malfunctions and the storage of hazardous radioactive wastes were major concerns. In 1978, an accident occurred at the Three Mile Island nuclear plant in central Pennsylvania, when a loss of coolant from the reactor core caused a partial meltdown and some release of radioactivity into the immediate vicinity. No new construction of a nuclear plant has been started since the Three Mile Island accident.

More recently, nuclear energy has increasingly come to be seen as a practical way for the United States to meet rising energy demands while releasing less carbon dioxide into the atmosphere and, simultaneously, increasing energy security. The Energy Policy Act of 2005 (EPACT2005) contained several provisions designed to encourage construction of new nuclear power plants, including a production tax credit of 1.8 cents per kilowatthour for up to 6 gigawatts of new nuclear capacity brought on line before 2021. The credit was authorized for the first 8 years of a plant's

(continued on page 66)

[b]"China's Nuclear Power Aspirations," *Energy Biz Insider* (December 12, 2007).
[c]World Nuclear Association, "Nuclear Power in India," Information Paper (July 2008), web site www.world-nuclear.org/info/inf53.html.
[d]"India's Nuclear Hopes Hit the Buffers," *Power In Asia*, No. 489 (October 25, 2007), pp. 8-9.

Mid-Term Prospects for Nuclear Electricity Generation in China, India, and the United States (Continued)

operation and up to $125 million for each 1,000-megawatt unit. EPACT2005 also authorized Federal risk insurance for companies building the next six nuclear power plants. In addition, EPACT2005 Title 17 included a provision enabling the Government to guarantee loans for the construction of new energy technologies "that reduce or avoid greenhouse gases," including nuclear power plants. The Secretary of Energy was given the authority, upon choosing a project, to guarantee a loan of up to 80 percent of the project's cost. Such loan guarantees could decrease the costs of nuclear power significantly, by reducing interest rates on the debt and allowing higher debt-to-equity ratios.

By 2010, 23 entities are expected to have submitted combined license applications for the construction of 34 new power plants in the United States.[e] It may, however, take many more years to get plants built in the United States than in either China or India, and any negative (or positive) experiences in those countries could have impacts on U.S. public opinion that would affect efforts to develop new nuclear plants.

In the *IEO2008* reference case, 17 gigawatts of new nuclear capacity is projected to come on line by 2030. The nuclear share of total U.S. electricity generation remains below 20 percent throughout most of the forecast, however, as older nuclear plants are retired and new generators of other types, especially coal-fired, are built.

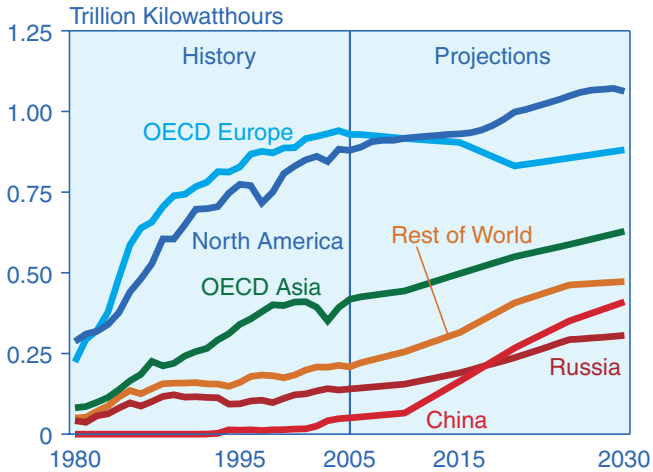
[e]U.S. Nuclear Regulatory Commission, "Expected New Nuclear Power Plant Applications," web site www.nrc.gov/reactors/new-licensing/new-licensing-files/expected-new-rx-applications.pdf (updated July 9, 2008).

Issues that could slow the expansion of nuclear power in the future include plant safety, radioactive waste disposal, and concerns that weapons-grade uranium may be produced from centrifuges installed to enrich uranium for civilian nuclear power programs. These issues continue to raise public concerns in many countries and may hinder the development of new nuclear power reactors. Nevertheless, the *IEO2008* reference case incorporates the improved prospects for world nuclear power. The *IEO2008* projection for nuclear electricity generation in 2025 is 31 percent higher than the projection published in *IEO2003* only 5 years ago.

On a regional basis, the *IEO2008* reference case projects the strongest growth in nuclear power for the countries of non-OECD Asia. For example, in China, electricity generation from nuclear power is projected to grow at an average annual rate of 8.8 percent from 2005 to 2030, and in India it is projected to increase by an average of 9.4 percent per year. Outside Asia, the largest increase in installed nuclear capacity among the non-OECD nations is projected for Russia, where nuclear power generation increases by an average of 3.2 percent per year. In contrast, OECD Europe is expected to see a decline in nuclear power generation as some national governments, including those of Germany and Belgium, still have plans in place to phase out nuclear programs entirely (Figure 55).

To address the uncertainty inherent in projections of nuclear power growth in the long term, a two-step approach was used to formulate the outlook for nuclear power in *IEO2008*. In the mid-term (through 2015), projections are based primarily on the current activities of the nuclear power industry and national governments. Because of the long permitting and construction lead times associated with nuclear power plants, there is general agreement among analysts about the nuclear projects that are likely to become operational in the mid-term. After 2015, the projections are based on a combination of announced plans or goals at the country and regional levels and consideration of other issues facing the development of nuclear power, including economics, geopolitical issues, technology advances, and environmental policies. The availability of potential uranium resources was also considered as part of the *IEO2008* modeling effort. Reserves appear to be more than sufficient to meet the expected growth in nuclear capacity worldwide (see box on page 67).

Figure 55. World Net Electricity Generation from Nuclear Power, 1980-2030



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **2030:** EIA, System for the Analysis of Global Energy Markets/Global Electricity Module (2008).

Hydroelectricity and Other Renewables

In the *IEO2008* reference case, electricity generation from hydroelectric and other renewable energy resources is projected to increase at an average annual rate of 1.8 percent from 2005 to 2030. High prices for oil and natural gas, which are expected to persist in the reference case, also encourage expanded use of renewable fuels. Renewable energy sources are attractive for environmental reasons, especially in countries where reducing greenhouse gas emissions is of particular concern. Government policies and incentives to increase the use of renewable energy sources for electricity generation are expected to encourage the development of renewable energy even when it cannot compete

Uranium Supplies Are Sufficient To Power Reactors Worldwide Through 2030

Current uranium reserves should be adequate to meet additional demand as worldwide installed nuclear capacity increases to the 498 gigawatts in 2030 projected in the *IEO2008* reference case. According to results from the demand model used by the OECD Nuclear Energy Agency and the International Atomic Energy Agency, annual uranium requirements are expected to grow from 68,000 metric tons per year in 2005 to 96,000 metric tons per year in 2030.[a] The cumulative demand for uranium to meet the projected increase in nuclear electricity generation from 2005 to 2030 would be 2.1 million metric tons.[b,c]

Uranium resources are divided into four groups, based on the confidence of supply estimation. *Reasonably assured resources* (RAR) are known uranium deposits that can be recovered with current mining technologies and methods. *Inferred resources* are uranium deposits that are believed to exist, based on direct geological evidence, but have not been studied as thoroughly as RAR. Resources could be expanded even further with *prognosticated resources*—uranium deposits expected to exist on the basis of indirect evidence—and *speculative resources* thought to exist on the basis of geological extrapolations.[d] The table below shows the two groups of worldwide uranium reserves estimated with the highest confidence, at various production cost levels.

Production Cost (Nominal U.S. Dollars per Kilogram of Uranium)	Metric Tons of Uranium Reserves as of January 1, 2005		
	Reasonably Assured	Inferred	Total
Less Than $40	1,947,000	799,000	**2,746,000**
Less Than $80	2,643,000	1,161,000	**3,804,000**
Less Than $130	3,297,000	1,446,000	**4,743,000**

Even in the lowest cost tier, less than $40 per kilogram, total uranium reserves should be sufficient to meet the requirements for projected nuclear capacity in 2030. In addition, with the spot price of uranium oxide having risen from $14.1 per kilogram in January 2001 to $163.1 per kilogram (equivalent to $192.4 per kilogram of uranium) during the week of March 7, 2008, and expected to remain high, it seems unlikely that production costs will hamper the future supply of uranium.[e]

Assuming that the available uranium resources will be adequate, more uranium production will be needed to ensure the annual delivery of 96,000 metric tons. In recent years, 40 to 50 percent of the world's uranium supply has come from secondary sources, including stockpiles of uranium, reprocessed spent fuel, and re-enriched depleted uranium tails.[f] Those secondary sources are expected to decline over the next 5 years, as the "Megatons to Megawatts" program, which converts decommissioned Russian warheads into commercial fuel, concludes in 2013. Primary production, which provided 40,263 metric tons of uranium in 2004, will have to be increased further to make up for diminishing secondary sources and increasing demand.[g]

The relatively high price of uranium already is leading to increased output. New mines in Australia, Canada, Kazakhstan, Brazil, and India are expected to add 30,000 metric tons of production capacity by 2010.[h] The reference case used by the World Nuclear Association projects the addition of 30,000 metric tons of supply by 2015, before uranium mining slowly decreases to 90 percent of its peak 2015 level in 2030.[i] Also, the uranium supply can be extended further by worldwide recycling of spent fuel and the use of breeder reactors.

[a]International Energy Agency, *World Energy Outlook 2006* (Paris, France, November 2006), p. 377, web site www.iea.org/textbase/nppdf/free/2006/weo2006.pdf.
[b]International Energy Agency, *World Energy Outlook 2006*, p. 379.
[c]Assuming that 4 metric tons of uranium is required to fuel 1 million watts of nuclear capacity.
[d]International Atomic Energy Agency, *Analysis of Uranium Supply to 2050* (Vienna, Austria, May 2001), pp. 2-3, web site www-pub.iaea.org/MTCD/publications/PDF/Pub1104_scr.pdf.
[e]TradeTech Uranium.Info Web Site, "Uranium Spot Price Indicator," web site www.uranium.info.
[f]International Energy Agency, *World Energy Outlook 2006*, p. 377.
[g]International Energy Agency, *World Energy Outlook 2006*, p. 380.
[h]Y. Sokolov, "Uranium Resources: Plenty To Sustain Growth of Nuclear Power," Statements of the Deputy Directors General (Vienna, Austria, June 1, 2006), web site www.iaea.org/NewsCenter/Statements/DDGs/2006/sokolov01062006.html.
[i]World Nuclear Association, *The Global Nuclear Fuel Market: Supply and Demand 2007-2030* (London, UK, 2007), p. 112, web site www.world-nuclear.org/reference/publications.html.

economically with fossil fuels. Nonetheless, the renewable share of world electricity generation falls slightly in the projection, from 18 percent in 2005 to 15 percent in 2030, as growth in the consumption of both coal and natural gas in the electricity generation sector worldwide exceeds the growth in renewable sources of generation. The capital costs of new power plants using renewable fuels remain relatively high in comparison with those for plants fired with coal or natural gas.

There is wide variation in the expectations for renewable energy use among the non-OECD countries. In the developing non-OECD nations of Asia and Central and South America, mid- to large-scale hydroelectric power plants are likely to dominate increases in renewable energy use over the projection period. China, India, and Brazil all have plans to expand hydroelectric capacity to help meet growing electricity demand. In contrast, hydroelectricity is not likely to expand strongly in the Middle East, where few countries have the natural resources needed to power hydroelectric facilities.

Among the OECD nations, hydroelectricity is fairly well established, and there are few plans to install major hydroelectric power projects in the future (with the exception of Canada and Turkey). Most of the growth in renewable electricity in the OECD countries is instead likely to come from nonhydroelectric renewable energy sources, especially wind and biomass. A number of OECD countries have incentives in place to increase the use of nonhydroelectric renewables for power generation, particularly to help stem the growth of greenhouse gas emissions produced by fossil fuel use and to promote energy independence. In the *IEO2008* reference case, OECD renewable generation grows by 1.6 percent per year from 2005 to 2030, second only to the growth rate for natural-gas-fired generation.

The *IEO2008* projections for hydroelectricity and other renewable energy resources include only marketed renewables. Non-marketed (noncommercial) biofuels from plant and animal sources are an important source of energy, particularly in non-OECD economies, and the International Energy Agency has estimated that some 2.5 billion people in developing countries depend on traditional biomass as their main fuel for cooking [3]. Non-marketed fuels and dispersed renewables (renewable energy consumed on the site of production, such as energy from solar panels used to heat water) are not included in the projections, however, because comprehensive data on their use are not available.

Regional Outlook

In the *IEO2008* reference case, the highest projected growth rates for electricity generation are for the non-OECD nations, where strong economic growth and rising personal incomes drive the projected growth in demand for electric power. In the OECD countries, where electric power infrastructures are relatively mature, national populations generally are expected to grow slowly or decline, and GDP growth is expected to be slower than in the developing nations, the increases in demand for electricity are projected to be much slower than those in the non-OECD countries. For example, electricity demand in China is projected to grow by an annual average of 5.4 percent from 2005 to 2030, which is more than five times the rate projected for the United States (Figure 56).

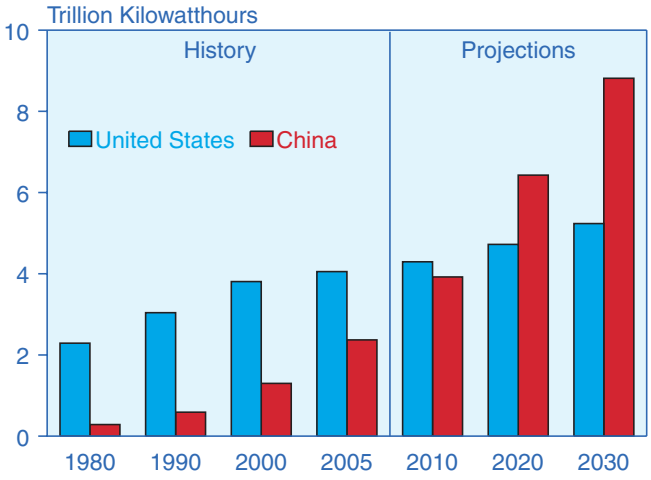
OECD Economies

North America

In 2005, electricity generation in North America totaled 4.9 trillion kilowatthours and accounted for 28 percent of the world's total generation. That share is projected to decline over the course of the projection period, as the non-OECD nations experience fast-paced growth in electric power demand. In 2030, North America accounts for only 20 percent of the world's electric power generation.

The United States is the largest consumer of electricity in North America and is projected to remain in that position through 2030 (Figure 57). U.S. electricity generation—including both generation by electric power producers and on-site generation—is projected to increase slowly, at an average annual rate of 1.0 percent. Canada, like the United States, has a mature electricity market, and its generation is projected to increase by 1.5 percent per year from 2005 to 2030. Mexico's electricity generation grows at a faster rate—averaging 3.3 percent per

Figure 56. Net Electricity Generation in the United States and China, 1980-2030



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, System for the Analysis of Global Energy Markets/Global Electricity Module (2008).

year through 2030—reflecting the relatively undeveloped state of the country's electric power infrastructure.

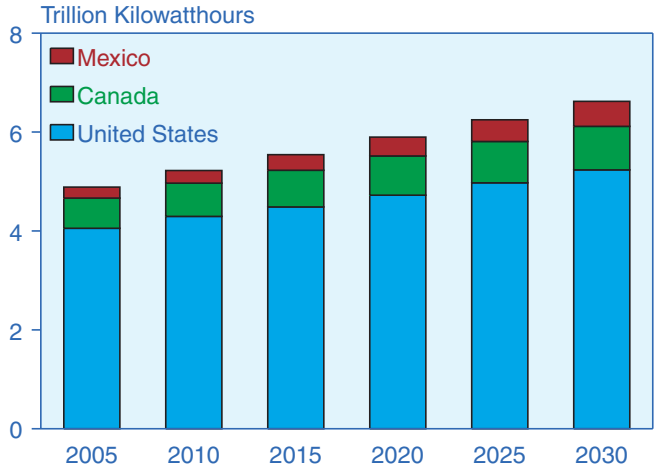
There are large differences in the mix of energy sources used to generate electricity in the three countries that make up OECD North America, and those differences are likely to become more pronounced in the future (Figure 58). In the United States, coal is the leading source of energy for power generation, accounting for 50 percent of the 2005 total; but in Canada, renewable energy sources (predominantly hydroelectricity) provided 60 percent of the nation's electricity generation in 2005. Most of Mexico's electricity generation currently is fueled by petroleum-based liquids and natural gas, which together accounted for 61 percent of its total electricity generation in 2005. In the reference case projections for 2030, U.S. reliance on coal is even greater than it is today; Canada's hydropower resources (along with some generation from wind capacity scheduled to be built) continue to provide nearly 60 percent of its electricity; and the natural gas share of Mexico's total electricity generation increases from 35 percent in 2005 to 71 percent in 2030.

In the United States, much of the growth in electricity generation is projected to be from coal-fired generation and renewables, rather than natural gas. The U.S. natural gas share of electricity generation (including generation in the end-use sectors) remains between 20 percent and 21 percent through 2017, then falls to 14 percent in 2030. The coal share of generation, in contrast, remains just below 50 percent until 2018, then increases to 54 percent in 2030. The rise in U.S. coal-fired generation in the *IEO2008* reference case is explained by a combination of coal prices that remain substantially lower than natural gas prices throughout the projection and the absence of legislation restricting the growth of carbon dioxide emissions. Recent EIA analysis suggests that the enactment of such legislation would lead to significant changes in the projected U.S. generation mix.[14]

Generation from renewable energy sources in the United States increases in the reference case from 0.4 trillion kilowatthours in 2005 to 0.7 trillion kilowatthours in 2030, with much of the growth attributable to nonhydroelectric renewable generation. The use of wind, solar, geothermal, and biomass increases largely as a result of State renewable portfolio standard (RPS) programs, which require that specific and generally increasing shares of electricity sales be supplied by renewable resources. Given that the consumer costs of the RPS programs would increase significantly if Federal production tax credits expired, past projections gave more weight to the probability that generators would exercise so-called "escape clauses" and opt out of the programs. *IEO2008* assumes that, in the absence of a clear indication to the contrary, State RPS goals will be met and result in substantial additional growth of generation from wind, biomass, and geothermal resources.

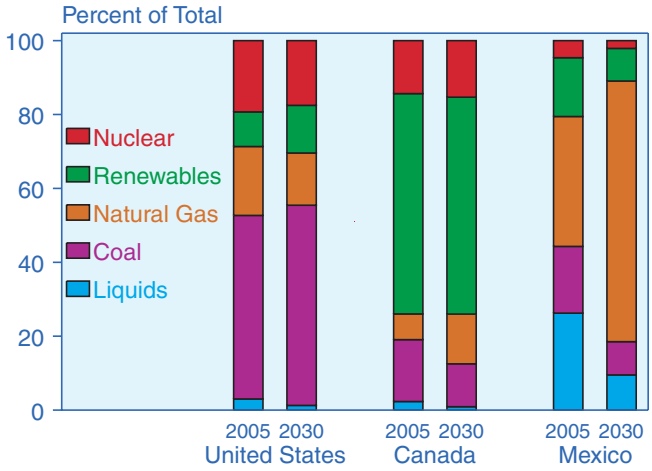
The United States is expected to add 14.6 gigawatts of net nuclear installed capacity between 2005 and 2030.

Figure 57. Net Electricity Generation in OECD North America, 2005-2030



Sources: **2005:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, System for the Analysis of Global Energy Markets/Global Electricity Module (2008).

Figure 58. Net Electricity Generation in OECD North America by Fuel, 2005 and 2030



Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **2030:** EIA, System for the Analysis of Global Energy Markets/Global Electricity Module (2008).

[14]See Energy Information Administration, *Energy Market and Economic Impacts of S. 2191, the Lieberman-Warner Climate Security Act of 2007*, SR-OIAF/2008- 01 (Washington, DC, April 2008); and *Energy Market and Economic Impacts of S. 1766, the Low Carbon Economy Act of 2007*, SR-OIAF/2007-06 (Washington, DC, January 2008), web site www.eia.doe.gov/ oiaf/service_rpts.htm.

The increase includes 16.6 gigawatts of newly built nuclear facilities and 2.7 gigawatts of uprates at existing nuclear power plants. The additional nuclear power capacity is offset, in part, by the retirement of 4.5 gigawatts of capacity at older nuclear power plants.

In Canada, generation from natural gas is projected to increase, while coal-fired generation remains flat and oil-fired generation declines. The Province of Ontario had announced plans to close all its coal-fired plants by the end of 2007 because of health and environmental concerns, but that date has since been pushed back to 2014. In 2007, the Ontario Power Authority—responsible for ensuring an adequate supply of electric power—filed a 20-year, $60 billion plan (U.S. dollars) for the Province's electricity system, including the phaseout of coal-fired capacity [***4***]. In the reference case, those retirements are offset by increases elsewhere in the country—notably, Alberta and Nova Scotia. As a result, Canada's coal-fired generation remains flat through 2030, at about 0.1 trillion kilowatthours. Increases in Canada's total electricity generation are fueled instead by natural gas (increasing by 4.2 percent per year), nuclear power (1.7 percent per year), and hydroelectricity and other renewables (1.4 percent per year).

Hydroelectricity remains a key source of electricity for Canada. In 2005, the hydroelectric share of total generation in Canada was 59 percent. In addition, several large- and small-scale hydroelectric facilities currently are either planned or under construction in Canada. Hydro-Québec has announced plans to construct a 768-megawatt powerhouse near Eastman and a smaller 120-megawatt facility at Sarcelle in Québec, both of which are expected to be fully commissioned by 2012 [***5***]. Other planned hydroelectric projects include the 2,260-megawatt Lower Churchill River project in Newfoundland and Labrador, the 1,550-megawatt Romaine River project in Québec, and the 200-megawatt Wuskwatim project in Manitoba [***6***]. The *IEO2008* reference case does not anticipate that all planned projects will be constructed, but given Canada's historical experience with hydropower and the commitments for construction, new hydroelectric capacity accounts for more than one-half of the 29,600 megawatts of additional renewable capacity projected to be added in Canada between 2005 and 2030.

Although hydropower plays a major role in Canada's renewable electricity generation, the country also has plans to expand wind-powered generating capacity in the future. In 2007, 386 megawatts of installed wind capacity was added, bringing the total to 1,846 megawatts and giving Canada the world's eleventh-largest national installed wind capacity [***7***]. In January 2007, Natural Resources Canada announced its new "ecoENERGY for Renewable Power" program as a follow-up to its Wind Power Production Incentive (WPPI).[15] The new program will allow an additional 3,000 megawatts of wind power to be installed by 2011 [***8***].

In addition to the incentive programs of Canada's federal government, several provincial governments have instituted their own incentives to support the construction of new wind capacity. Ontario's Renewable Energy Standard Offer Program has helped support robust growth in wind installations over the past several years, and installed wind capacity in the province has risen from 0.6 megawatts in 1995 to more than 490 megawatts in 2006 and hit the 500-megawatt milestone in January 2008 [***9***]. The Standard Offer Program pays all small renewable energy generators (with installed capacity less than 10 megawatts) 11.0 cents (Canadian) per kilowatthour of electricity delivered to local electricity distributors [***10***] and 42.0 cents per kilowatthour for electricity from solar photovoltaic projects. Contracts between Ontario Power Authority and the small renewable generators last for a term of 20 years, and beginning in 2007 a portion of the rate paid to generators was to be indexed annually for inflation. Support from Canada's federal and provincial governments—along with sustained higher world oil prices—is expected to support the projected increase in the country's use of wind power for electricity generation.

Most of the projected increase in Mexico's electricity generation is fueled by natural gas. At 0.4 trillion kilowatthours, natural-gas-fired generation in 2030 is 5 times the 2005 level. The resulting growth in Mexico's demand for natural gas strongly outpaces its production, leaving the country dependent on pipeline imports from the United States and LNG from other countries. Currently, Mexico has one LNG import terminal operating and a second under construction, in part to fuel the expected growth in electricity demand. Its first LNG facility, Altamira, became operational in 2006 and the second, Costa Azul, is under construction and expected to be on line by the end of 2008 [***11***].

Mexico's electricity generation is projected to increase by an average of 3.3 percent annually from 2005 to 2030—double the rate for Canada and triple the rate for the United States—and its government has recognized the need for electricity infrastructure to keep pace with growth in demand. In early 2008, the government announced plans to invest around $3.1 billion in electricity infrastructure in 2008 under the 2007-2012 National Infrastructure Programme [***12***]. As part of a major plan to increase power generation, the state-owned Comisión

[15]The WPPI supports the development of 4,000 megawatts of wind power by 2010, with qualifying wind producers eligible to receive an incentive of $0.01 per kilowatthour (Canadian dollars) for the first 10 years of production from new installations.

Federal de Electricidad (CFE) expects to begin construction in 2009 on a 652-megawatt natural-gas-fired combined-cycle power plant, Norte II in Chihuahua, with a completion target of 2011 [***13***]. The CFE has announced plans to add more than 26 gigawatts of new installed electric power capacity by 2017.

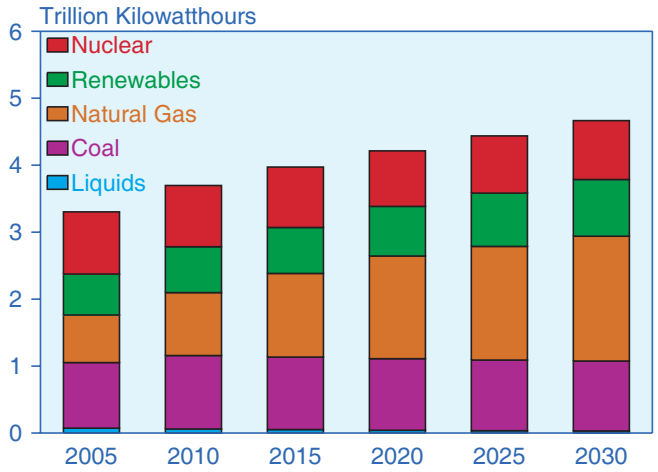
OECD Europe

Electricity generation in the nations of OECD Europe increases by an average of 1.4 percent per year in the *IEO2008* reference case, from 3.3 trillion kilowatthours in 2005 to 4.0 trillion kilowatthours in 2015 and 4.7 trillion kilowatthours in 2030. Because most of the OECD Europe countries have relatively stable populations and mature electricity markets, most of the growth in electricity demand is projected to come from those with more robust population growth (including Turkey, Ireland, and Spain) and from the newest OECD members (including the Czech Republic, Hungary, and Poland), whose economic growth rates exceed the OECD average through the projection period.

Natural gas is expected to be by far the fastest-growing fuel for electricity generation in OECD Europe, increasing at an average rate of 3.9 percent per year from 2005 to 2030. Use of liquids and other petroleum for generation is projected to decline steadily in the face of rising world oil prices (Figure 59).

OECD Europe's total nuclear capacity declines from 133 gigawatts in 2005 to 114 gigawatts in 2020 in the reference case, followed by a modest net increase to 118 gigawatts in 2030. Belgium and Germany, with substantial nuclear programs, have policies in effect to reduce their use of nuclear power in the future; however, it is unclear whether the planned nuclear plant closures will actually take place, given that nuclear power plants produce no carbon dioxide emissions. As a result, the reference case projects more license extensions and fewer retirements of operating nuclear power plants than were expected in earlier assessments, as well as some new builds (about 18 gigawatts of new nuclear capacity) in France, Finland, and possibly other countries of OECD Europe.

Figure 59. Net Electricity Generation in OECD Europe by Fuel, 2005-2030



Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, System for the Analysis of Global Energy Markets/Global Electricity Module (2008).

Coal accounts for nearly one-third of OECD Europe's net generation today, but concerns about carbon dioxide emissions and global warming could reduce that share in the future. On the other hand, in countries that rely heavily on coal for their electricity supplies (including Germany, where coal provides about 55 percent of total generation, and Poland, where it provides 95 percent) it will be difficult to reduce coal use substantially and, at the same time, carry out plans to dismantle nuclear power programs [***14***]. As a result, the *IEO2008* reference case projects that coal-fired electricity generation in OECD Europe will grow at the relatively slow average rate of 0.3 percent per year from 2005 to 2030.

Renewable energy is OECD Europe's second fastest-growing source for electricity generation in the reference case. The use of renewables (primarily nonhydropower) for electricity generation is projected to grow by 1.3 percent per year through 2030. Although most of the economically feasible hydroelectric resources in Europe already have been developed, the countries of OECD Europe have installed substantial amounts of alternative renewable energy capacity—consisting mainly of wind turbines—over the past several years. At present, 7 of the world's 10 largest markets for wind-powered electricity generation are in Europe,[16] and the 27-member European Union accounted for 60 percent of the world's total installed wind capacity at the end of 2007 [***15***]. With many European countries setting new goals to increase nonhydropower renewable electricity generation, the role of wind power in meeting OECD Europe's electricity demand is likely to grow in the future.

OECD Asia

Total electricity generation in OECD Asia is projected to increase by 1.2 percent per year on average, from 1.7 trillion kilowatthours in 2005 to 2.2 trillion kilowatthours in 2030. Japan accounts for the largest share of electricity generation in the region today and continues to do so in the mid-term projection, despite its having the slowest-growing electricity market in the region. Japan's electricity generation increases at a 0.6-percent average annual rate in the *IEO2008* reference case, as compared with

[16] According to the European Wind Energy Association, at the end of 2007 the 10 countries with the largest amounts of installed wind capacity were Germany, the United States, Spain, India, China, Denmark, Italy, France, the United Kingdom, and Portugal.

projected rates of 1.4 percent per year in Australia/New Zealand and 2.3 percent per year in South Korea (Figure 60). Japan's electricity markets are well established, and its aging population and relatively slow projected economic growth in the mid-term translate into slow growth in demand for electric power. In contrast, both Australia/New Zealand and South Korea are expected to have more robust income and population growth, leading to more rapid growth in demand for electricity.

The fuel mix for electricity generation varies widely among the three economies that make up the OECD Asia region. In Japan, natural gas, coal, and nuclear power make up the bulk of the current electric power mix, with natural gas and nuclear accounting for about 53 percent of total generation and coal another 30 percent. The remaining portion is split between renewables and petroleum-based liquids. In 2030, Japan is projected to rely on natural gas, nuclear power, and coal for nearly 90 percent of its electric power supply, with coal's share declining to 23 percent as both natural gas and nuclear power displace its use.

Australia and New Zealand, with their rich coal resources, rely on coal for nearly three-fourths of their combined electricity generation. The remainder is supplied by natural gas and renewable energy sources—largely hydroelectricity. The Australia/New Zealand region uses negligible amounts of oil for electricity generation and no nuclear power, and that is not expected to change over the projection period. Natural-gas-fired generation is expected to grow strongly in the region, at 3.1 percent per year between 2005 and 2030, and that growth will reduce the coal share to 68 percent at the end of the projection.

In South Korea, coal and nuclear power currently provide 41 percent and 38 percent of total electricity generation, respectively. Natural-gas-fired generation grows quickly in the reference case projection, helping to diversify the country's fuel mix. As a result, South Korea's natural gas share of generation reaches 22 percent in 2030, up from 15 percent in 2005. Coal and nuclear power continue to provide most of the country's electricity generation, however, with each providing between 36 and 37 percent of total electricity in 2030.

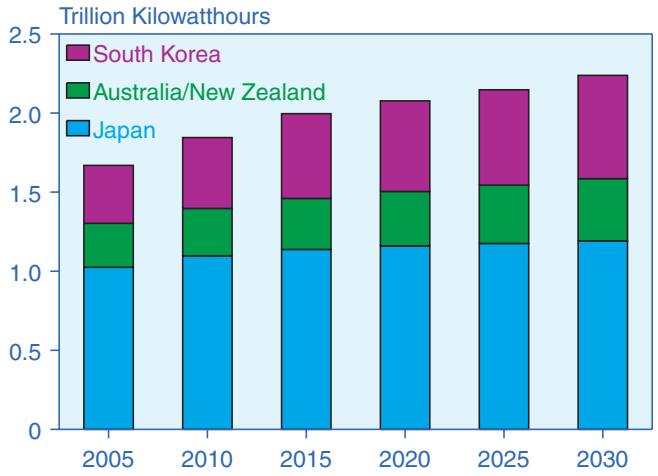
Non-OECD Economies

Non-OECD Europe and Eurasia

Total electricity generation in non-OECD Europe and Eurasia grows at an average rate of 2.6 percent per year in the *IEO2008* reference case, from 1.5 trillion kilowatthours in 2005 to 2.1 trillion kilowatthours in 2015 and 2.8 trillion kilowatthours in 2030. Russia, with the largest economy in non-OECD Europe and Eurasia, accounted for 60 percent of the region's total generation in 2005 and is expected to retain that share throughout the projection (Figure 61).

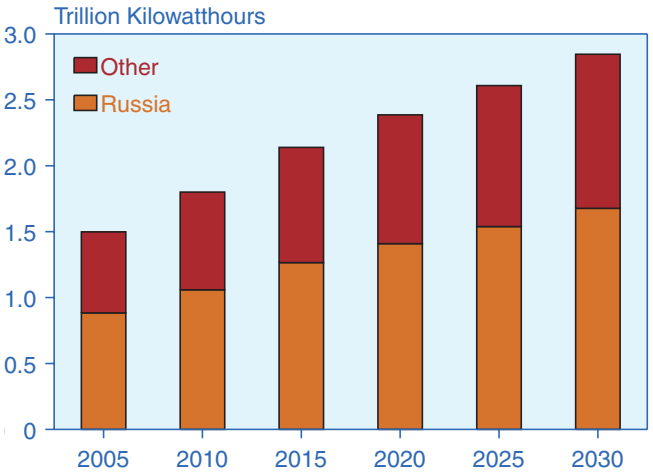
As a whole, non-OECD Europe and Eurasia has ample resources of natural gas. Consequently, much of its future electricity supply is expected to be provided from natural-gas-fired power plants. Natural gas is the region's fastest-growing source of electric power in the *IEO2008* reference case, increasing by 3.5 percent per year from 2005 to 2030. Coal-fired and nuclear power plants also are important regional sources of electricity generation, with projected annual increases averaging 2.7 percent and 2.5 percent, respectively, over the same period. Renewable generation, largely from

Figure 60. Net Electricity Generation in OECD Asia, 2005-2030



Sources: **2005:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, System for the Analysis of Global Energy Markets/Global Electricity Module (2008).

Figure 61. Net Electricity Generation in Non-OECD Europe and Eurasia, 2005-2030



Sources: **2005:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, System for the Analysis of Global Energy Markets/Global Electricity Module (2008).

hydropower facilities, increases more slowly, at an average rate of 1.1 percent per year, largely as a result of repairs and expansions at existing sites. Liquids play only a minor role in the electric power markets of non-OECD Europe and Eurasia, and given the expectation that world oil prices will remain relatively high, the role of liquids and other petroleum in the electricity sector remains small.

For Russia, the two fastest-growing energy sources for electric power in the mid-term projection are natural gas and nuclear power. Both are expected to grow by an average of 3.2 percent per year from 2005 to 2030. With its extensive natural gas reserves, Russia currently generates nearly 40 percent of its electricity from natural gas, and the share increases to 46 percent in 2030.

Russia's government also has announced ambitious plans to increase the country's nuclear power capacity in order to lessen the reliance of its power sector on natural gas and preserve what is becoming one of its most valuable export commodities. Although only 3 gigawatts of new nuclear generating capacity has become operational in Russia since 1991, there are plans in place to raise the nuclear share of total generation from about 15 percent currently to 25 percent by 2030 [***16***].

In 2007, Russia announced its intention to construct 26 new nuclear power facilities [***17***]. The government also is in the midst of liberalizing its electricity markets, with complete price liberalization to be phased in by 2011 [***18***]. Russia believes that it must attract private investment in the electric power sector, which could be facilitated by privatization of its generating business. In the short run, however, privatization may slow nuclear expansion plans, given the high capital costs associated with nuclear power plant construction.

The *IEO2008* reference case takes a more conservative view of the rate at which new nuclear power plants will come on line in Russia, and the outlook includes some delay in meeting the current construction schedule. A net total of 4 gigawatts of nuclear generating capacity is added to Russia's existing 23 gigawatts by 2015 and another 14 gigawatts by 2030.

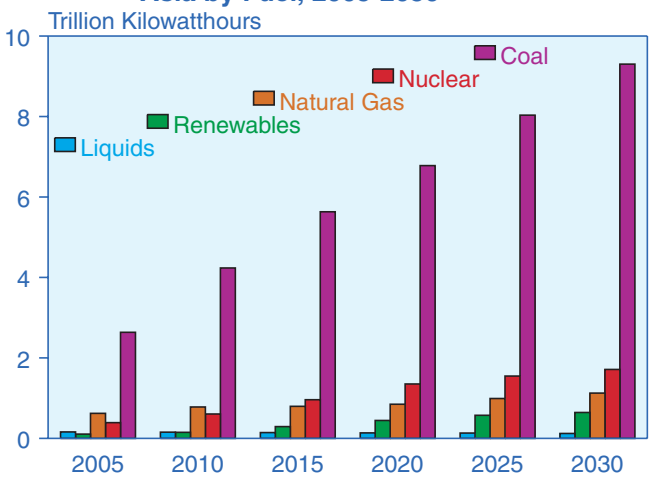
Non-OECD Asia

Non-OECD Asia—led by China and India—has the fastest projected growth in electric power generation worldwide, averaging 4.9 percent per year from 2005 to 2030 in the reference case. The nations of non-OECD Asia are expected to see continued robust economic growth, with corresponding increases in demand for electricity in the building sector, as well as for industrial sector uses. Total electricity generation in non-OECD Asia doubles over the first decade of the projection, from 3.9 trillion kilowatthours in 2005 to 7.8 trillion kilowatthours in 2015, with the region expected to see income growth averaging 7.4 percent per year. The rate of GDP expansion is expected to moderate in the later years of the projection, and the growth in electricity demand slows in concert with income growth. In 2030, total net generation in non-OECD Asia is 12.9 trillion kilowatthours in the reference case.

Coal accounts for two-thirds of the electricity generation in non-OECD Asia (Figure 62)—dominated by generation in China and India. Both countries already rely heavily on coal to produce electric power. In 2005, coal's share of generation was an estimated 77 percent in China and 74 percent in India. Despite efforts to diversify the fuel mix away from coal, it is likely that both countries will continue to use coal as the main fuel for electricity generation. In the *IEO2008* reference case, the coal share of electricity generation declines to 65 percent in 2030 in India but continues rising to 84 percent in China.

In both China and India, meeting future demand for electricity will present challenges. In China, a coal shortage and price spike that began in fall 2007 and continued into 2008 caused 6 gigawatts of coal-fired generating capacity to be taken out of service in southern China [***19***]. An additional 70 gigawatts of coal-fired capacity was idled in February 2008, when severe winter weather disrupted coal deliveries from China's northern mines to coastal demand centers, removing a substantial amount of the country's 440 gigawatts of capacity from service. India also faces supply issues. Coal inventories at the country's utilities have been so low in 2008 that the government has ordered a two-thirds increase in coal imports to assure adequate power supply. Moreover, the coal supply problems in China and India have been

Figure 62. Net Electricity Generation in Non-OECD Asia by Fuel, 2005-2030



Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, System for the Analysis of Global Energy Markets/Global Electricity Module (2008).

exacerbated by coal production problems in Australia and South Africa, cutting available imports [*20*].

Throughout non-OECD Asia, consumption of liquids and other petroleum for electricity generation is projected to decline, as relatively high world oil prices make other fuels more attractive economically. Although the liquids share of electricity generation in non-OECD Asia is projected to fall from 4 percent in 2005 to less than 1 percent in 2030, some oil-fired generation is expected to continue to be needed. Many rural areas currently do not have access to transmission lines, and until transmission infrastructure can be put in place, noncommercial energy sources are expected to be replaced with electricity from diesel-fired generators.

Non-OECD Asia leads the world in installing new nuclear capacity in the *IEO2008* reference case, accounting for 55 percent of the projected net increment in nuclear capacity worldwide. China is projected to add 45 gigawatts of nuclear capacity by 2030, India 17 gigawatts, and the other countries of non-OECD Asia a combined 6 gigawatts. Strong growth of nuclear capacity in China and India will have only a modest impact on fuel diversification in their electric power sectors, however, with thermal generation continuing to dominate in both countries. In China, the nuclear share of total electricity generation is projected to rise from 2 percent in 2005 to 5 percent in 2030, and in India it is projected to rise from 2 percent to 8 percent. Several other countries in the region are also expected to begin nuclear power programs. In the reference case, Vietnam, Indonesia, and Pakistan are projected to have some nuclear power capacity installed by 2030.

Although electricity generation from renewable energy sources in non-OECD Asia is projected to grow at an average annual rate of 2.4 percent, the renewable share of total generation declines—from 16 percent in 2005 to 9 percent in 2030—as the shares of fossil fuels and nuclear power increase more rapidly. Mid- to large-scale hydroelectric facilities provide much of the incremental growth in non-OECD Asia's renewable energy consumption. Several countries have hydropower facilities either planned or under construction: Vietnam is planning a number of hydropower projects on its Vu Gai-Thu Bon River, beginning with the 156-megawatt Song Bung 4 project, which is scheduled for completion by 2011 [*21*]. Malaysia expects to complete the 2,400-megawatt Bakun Dam project by 2011, although the project has had a number of delays and setbacks in the past [*22*].

In India, Himachal Pradesh has plans to commercialize a substantial portion of the state's reported 21,000 megawatts of hydroelectric power potential, adding 5,744 megawatts of hydroelectric capacity before 2015 to the existing 6,300 megawatts [*23*]. Also, the 2,000-megawatt lower Subansiri facility under construction in Arunachal Pradesh is expected to be completed by 2012 [*24*]. India's federal government is attempting to incentivize the development of hydropower across the nation. Legislation has been proposed to allow private hydroelectric power developers to be eligible over a 5-year period for a tariff that would guarantee a fixed return on investment, as well as allowing generators to improve their returns by selling up to 40 percent of their electricity on the spot market.

China also has a number of large-scale hydroelectric projects under construction, including the 18,200-megawatt Three Gorges Dam project slated for completion at the end of 2008. The China Yangtze River Three Gorges Project Development Corporation already has announced it plans to increase its total installed capacity to 22,400 megawatts. In addition, work continues on the 12,600-megawatt Xiluodu project on the Jisha River (scheduled for completion in 2020 as part of a 14-facility hydropower development plan) and the country's third-largest hydroelectric facility, the 6,300 megawatt Longtan project on the Hongshui River [*25*]. China also has the world's tallest dam (at nearly 985 feet) currently under construction, as part of the 3,600-megawatt Jinping I project on the Yalong River, which is scheduled for completion in 2014 as part of a plan by the Ertan Hydropower Development Company to construct 21 facilities with 34,620 megawatts of hydroelectric capacity on the Yalong [*26*]. The China Power Investment Corporation began construction on the first of a proposed 13-dam hydroelectric power system on the Yellow River in 2007, with an ultimate total installed capacity of 8,000 megawatts. The first part of the system, the 360-megawatt Banduo project, is scheduled to become operational by 2011 [*27*].

Although hydroelectric projects dominate the renewable energy mix in non-OECD Asia, there are also plans to increase the use of nonhydroelectric renewable energy sources, especially wind. In China, for example, the National Development and Reform Commission has announced its goal to install 10,000 megawatts of wind power capacity by 2010 [*28*]. The country is well on the way to meet the goal, having installed 3,400 megawatts of new wind capacity in 2007 alone, which brought total installed wind capacity to 6,000 megawatts [*29*]. India's wind capacity has increased steadily over the years, to 8,000 megawatts in 2007. Taiwan also added 100 megawatts of new wind capacity in 2007, bringing its total installed capacity to 282 megawatts.

Middle East

Electric power generation in the Middle East region is projected to grow by 2.6 percent per year, from 0.6 trillion kilowatthours in 2005 to 1.1 trillion kilowatthours in 2030. The region's young and fast-growing population

and a strong rise in projected national income are expected to result in a rapid increase in demand for electric power. In Iran, for instance, electricity demand has been increasing by about 7 percent annually in recent years, and the demand for energy to fuel the increase in electric power generation has pressured the country's supply infrastructure. At the beginning of 2008, unusually cold winter weather increased the demand for natural gas, both for power generation and for residential and commercial uses [***30***]. The sharp increase in natural gas demand has, since 2006, resulted in large natural gas shortages at Iran's power plants during the winter, and many have switched to burning fuel oil and diesel to meet the power demand.

Despite short-term supply issues in some Middle Eastern countries, natural gas is expected to remain the region's largest source of energy for electricity generation throughout the projection (Figure 63). In 2005, natural-gas-fired generation accounted for 56 percent of the Middle East region's total power supply. In 2030, the natural gas share is projected to be 65 percent, as the petroleum share of generation falls over the projection period. Petroleum is a valuable export commodity for many nations of the Middle East, and there is increasing interest in the use of domestic natural gas for electricity generation in order to make more oil assets available for export.

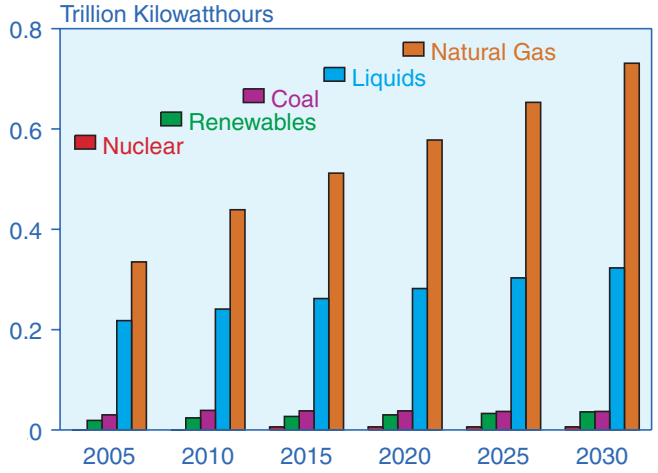
The Middle East is the only region in the world where petroleum liquids are expected to continue accounting for a sizable portion of the fuel mix for electricity generation. The Middle East region as a whole relied on oil-fired capacity to meet 36 percent of its total generation needs in 2005, and petroleum liquids are projected to continue providing 29 percent of the total in 2030. The rich petroleum resources in the Middle East are expected to allow nations of the region to continue using oil for electricity generation, even as high world oil prices result in the displacement of oil in other regions. Oil-fired generation in the Middle East is projected to increase by an average of 1.6 percent per year from 2005 to 2030.

Other energy sources make only minor contributions to the Middle East region's electricity supply. Israel is the only country in the region that uses significant amounts of coal to generate electric power [***31***], and Iran is the only one projected to add nuclear capacity, with the completion of its Bushehr 1 reactor expected by 2015. Finally, because there is little incentive for countries in the Middle East to increase their use of renewable energy sources, renewables are projected to account for a modest 3 percent of the region's total electricity generation throughout the 2005 to 2030 period.

Africa

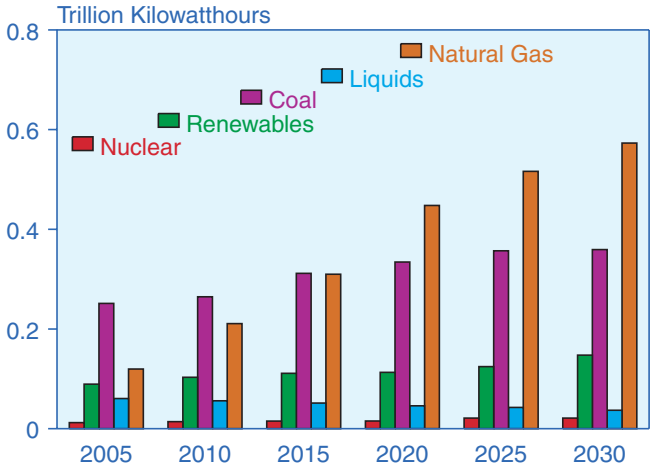
Demand for electricity in Africa grows at an average annual rate of 3.1 percent in the *IEO2008* reference case. Thermal generation accounted for most of the region's total electricity supply in 2005 and is expected to be in the same position through 2030. Coal-fired power plants, which were the region's largest source of electricity in 2005, accounting for 47 percent of total generation, are projected to provide a 32-percent share in 2030, as natural-gas-fired generation expands strongly from 22 percent of the total in 2005 to 50 percent in 2030 (Figure 64).

Figure 63. Net Electricity Generation in the Middle East by Fuel, 2005-2030



Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, System for the Analysis of Global Energy Markets/Global Electricity Module (2008).

Figure 64. Net Electricity Generation in Africa by Fuel, 2005-2030



Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, System for the Analysis of Global Energy Markets/Global Electricity Module (2008).

At present, South Africa's two nuclear reactors are the only ones operating in the region, accounting for about 2 percent of Africa's total electricity generation. Reports suggest that construction of a new Pebble Bed Modular Reactor may begin in South Africa in 2009, with an anticipated completion date of 2013; however, the project has had various setbacks since it was originally initiated in 1993, and it is uncertain whether the schedule will be met [*32*]. In addition, Egypt's government has announced plans to add a nuclear power project, with first tenders offered in early 2008 [*33*]. In the reference case, 1,000 megawatts of new nuclear capacity (net) is projected to become operational in Africa over the 2005 to 2030 period, and the nuclear share of the region's total generation remains at 2 percent through the end of the period.

South Africa is Africa's largest electricity generator, producing nearly 43 percent of the region's total electric power in 2005. The country has been an important regional supplier, exporting electricity to neighbors, including Zimbabwe and Swaziland [*34*]. Electricity demand in South Africa has increased strongly in recent years, and the state-owned public utility Eskom has been unable to expand installed capacity to keep up with increasing domestic demand [*35*]. As a result, South Africa experienced a number of power cuts in 2008 that even resulted in the closure of some mining operations, because companies could not guarantee the safety of workers without a secure power supply. Eskom has plans to increase capacity by adding 40,000 megawatts of new installed electric power capacity by 2025, but short-term supply problems are likely to continue to affect the country and other parts of southern Africa for the foreseeable future.

Generation from hydroelectric resources and other marketed renewable energy sources is expected to grow slowly in Africa. As they have in the past, nonmarketed renewables are expected to continue providing energy to Africa's rural areas; however, it is often difficult for African nations to find funding or international support for larger commercial projects. Still, plans for several hydroelectric projects in the region have been advanced recently, and they may help boost supplies of marketed renewable energy in the mid-term. Several (although not all) of the announced projects are expected to be completed by 2030, allowing the region's consumption of marketed renewable energy to grow by 2.0 percent per year from 2005 to 2030. Several small- to-mid-sized hydroelectric facilities are planned for the region, including a 60-megawatt power station on Tanzania's Kagera River, with construction scheduled to begin in 2009 after financing has been secured [*36*].

Central and South America

Electricity generation in Central and South America increases steadily in the *IEO2008* reference case, from 0.9 trillion kilowatthours in 2005 to 1.3 trillion kilowatthours in 2015 and 1.7 trillion kilowatthours in 2030. The nations of Central and South America are expected to experience strong economic growth through 2030, increasing the demand for electrification. The extent to which electricity consumption will be allowed to expand in the future depends on investment in the power sector and improvements in natural gas supply, including both pipeline and LNG supplies.

The electricity markets of some of the larger regional economies have become strained in recent years. With economic growth exceeding historical trends in Brazil and Argentina, among others, demand for electricity has grown sharply. For example, in Brazil, Central and South America's largest economy, GDP has been increasing on average by 4.3 percent per year since 2004, and at the same time electricity demand has risen by an annual average of 5.0 percent [*37*]. The robust increase in economic expansion has fueled strong demand for electricity in the region, testing the limits of the infrastructure. Brazil has had a difficult time securing natural gas supplies. Bolivia has suspended supplies to a 400-megawatt power plant in Cuiaba, and supplies from Argentina have been suspended as a result of Argentina's own natural gas production problems [*38*].

Brazil has made moves to relieve pressures on its electricity markets with plans to import LNG to reduce reliance on neighboring countries for natural gas supplies and to increase hydroelectric generating capacity [*39*]. Plans to increase Brazil's hydroelectric power generation include two plants on the Rio Madeira in Rondonia: the 3,150-megawatt Santo Antonio and the 3,326-megawatt Jirau hydroelectric facilities. The two plants, with completion dates scheduled for the 2012 to 2015 period, are expected to help Brazil meet electricity demand in the mid-term [*40*]. In the *IEO2008* reference case, renewable electricity supply grows by 2.8 percent per year from 2005 to 2030, led by hydroelectric generation as well as a modest increase in generation from other renewable energy sources; however, with natural-gas-fired generation expanding more rapidly, the renewable share of total generation falls from 86 percent in 2005 to 77 percent in 2030 (Figure 65). Natural-gas-fired generation is projected to grow by 7.3 percent per year in Brazil, with the expectation that infrastructure will be improved and supplies from both pipeline and LNG imports secured in the mid-term. The natural gas share of Brazil's total generation increases from 7 percent in 2005 to 17 percent in 2030.

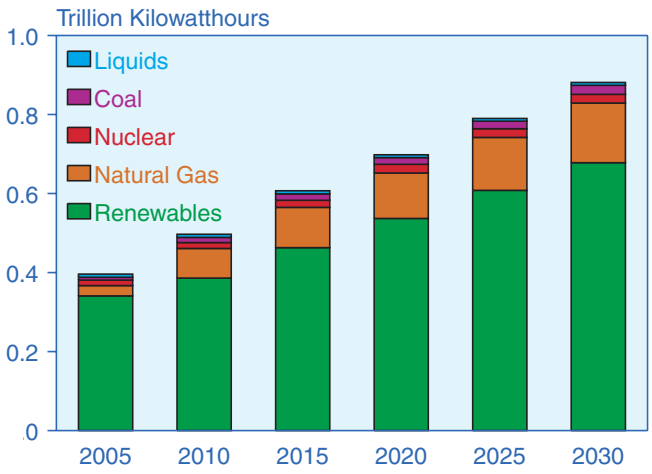
Until recently, Argentina was a major regional supplier of natural gas. In 2003, the government instituted price controls on natural gas to alleviate the impacts of an economic downturn. An unintended result of the price caps was a dramatic downturn in investment in new natural gas projects. Although the Argentine economy

has performed strongly over the past several years, natural gas production and natural-gas-fired generation have not kept pace with the growing demand for electricity. In 2007, Argentina reduced natural gas exports to Chile in the face of rising domestic demand and stagnant production [*41*]. Chile, in turn, has begun construction on an LNG regasification facility at Mejillones, which is scheduled for completion in 2010.

The problems with regional natural gas supplies have been exacerbated by drought conditions that have reduced the ability of nations in Central and South America to meet demand for electric power. Chile's electricity markets, in particular, have been hard-hit by Argentina's supply problems. In addition to coping with reduced supplies, Chile has had very low water levels at its hydroelectric facilities as a result of drought conditions. The Chilean government is pressing consumers to reduce power use by 5 percent but has also announced concerns that—even with such a reduction—electricity rationing may be necessary in the short run [*42*].

Several countries in the region are looking at near-term solutions to meeting electricity demand. Both Argentina and Brazil, for instance, are turning to coal, fuel oil, and diesel generation as emergency alternative sources of power [*43*]. The *IEO2008* projection includes the expectation that coal-fired generation will rise in Central and South America as a result of sustained high prices for oil and natural gas prices. Coal-fired generation increases in Central and South America by 2.6 percent per year on average from 2005 to 2030, but the coal share of generation remains at a modest 6 percent through the end of the projection period.

Figure 65. Net Electricity Generation in Brazil by Fuel, 2005-2030



Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, System for the Analysis of Global Energy Markets/Global Electricity Module (2008).

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Chapter 6

Transportation Sector Energy Consumption

In the IEO2008 reference case, transportation energy use in the non-OECD countries increases by an average of 3.0 percent per year from 2005 to 2030, as compared with an average of 0.7 percent per year for the OECD countries.

Over the next 25 years, world demand for liquids fuels and other petroleum is expected to increase more rapidly in the transportation sector than in any other end-use sector. In the *IEO2008* reference case, the transportation share of total liquids consumption increases from 52 percent in 2005 to 58 percent in 2030. Much of the growth in transportation energy use is projected for the non-OECD nations, where many rapidly expanding economies are expected to see strong growth in energy consumption as transportation systems are modernized and rising standards of living increase the demand for personal motor vehicle ownership. Non-OECD transportation energy use increases by an average of 3.0 percent per year from 2005 to 2030, as compared with an average of 0.7 percent per year for transportation energy consumption in the OECD countries, where transportation systems are generally well established (Table 11).

In the transportation sector, energy use provides mobility for people and goods. For people, mobility provides access to employment opportunities, friends and family, grocery and clothing stores, entertainment and leisure activities, and medical and financial services, to name a few. For businesses, mobility provides access to the means of production (raw materials, human resources, and the output of other businesses), as well as access to markets for their products. Understanding the reasons behind the demand for mobility is important for evaluating future transportation fuel consumption and policies, which may alter historical trends in transportation energy use.

Because access (rather than mobility *per se*) is the prime consideration for assessing demand growth in the transportation sector, factors that have nothing to do with transportation equipment can have a profound effect on the amount of energy consumed. For example, advances in communication technologies have made it possible for consumers to have unprecedented levels of access to financial services without traveling to a financial institution. Similarly, high-speed internet communication has increased the productivity of telecommuters, reducing traffic congestion, air pollution, and transportation energy demand.

The difference between mobility and access is particularly important for the analysis of transportation systems in today's rapidly developing economies. The levels and types of mobility and transportation fuel consumption required in the future will depend on infrastructure decisions evolving today. How far will people live from their places of employment and from friends

Table 11. World Energy Consumption for Transportation by Country Grouping, 2005-2030
(Quadrillion Btu)

Region	2005	2010	2015	2020	2025	2030	Average Annual Percent Change, 2005-2030
OECD	**58.5**	**60.5**	**63.8**	**65.6**	**67.0**	**68.8**	**0.7**
North America	32.2	33.7	35.6	36.8	37.9	39.4	0.8
Europe	18.7	19.1	19.8	20.1	20.2	20.3	0.3
Asia	7.7	7.8	8.4	8.7	8.9	9.1	0.7
Non-OECD	**31.7**	**39.9**	**46.7**	**53.1**	**59.4**	**66.6**	**3.0**
Europe and Eurasia	4.8	5.8	6.6	7.2	7.8	8.5	2.3
Asia	13.0	17.3	21.9	26.2	30.4	35.0	4.1
Middle East	4.9	5.8	6.2	6.8	7.3	8.0	1.9
Africa	3.1	3.7	4.1	4.5	4.9	5.3	2.2
Central and South America	5.9	7.2	7.8	8.4	9.0	9.9	2.0
Total World	**90.2**	**100.4**	**110.5**	**118.7**	**126.5**	**135.4**	**1.6**

Note: Totals may not equal sum of components due to independent rounding.
Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www. eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

and family? Will rapid urbanization in developing Asia follow the U.S. pattern of roads surrounding central cities, or will smaller cities, where people live and work, be increasingly more important? Such questions, which remain to be answered, indicate that projections of future transportation energy use in today's developing regions are far less certain than the projections for regions with mature transportation systems.

The *IEO2008* reference case assumes that, as personal income grows in the developing non-OECD nations, demand for personal motor vehicles will also grow but that major urban areas will address the accompanying congestion and strains on infrastructure with a variety of solutions, including development of mass transit (bus and/or rail), urban planning to reduce road congestion, and general improvements of the transportation network that will facilitate travel. In non-OECD Asia, for example, the reference case projects that energy use for personal motor vehicles (light-duty cars and trucks, as well as two- and three-wheel vehicles) will increase by 4.0 percent per year from 2005 to 2030, while energy use for passenger rail increases nearly as quickly, by 3.7 percent per year.

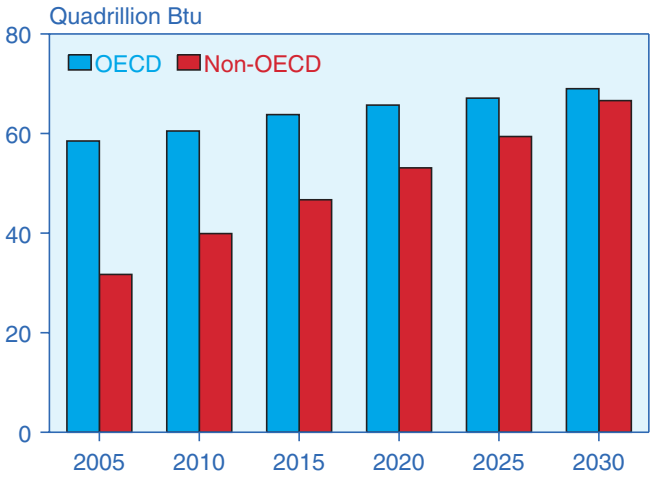
In the projections, the transportation sector continues to rely heavily on liquids to meet demand for travel. Total world liquids consumption increased by 35 percent from 2005 to 2030, and the transportation sector accounts for three-fourths of the increase. Given the world oil price environment projected in the *IEO2008* reference case, economic incentives will prompt consumers to find substitutes for liquids. In the OECD nations, liquids consumption in other sectors declines as electricity generation from liquid fuels is reduced. Transportation use accounts for virtually all the increase in liquids consumption in the OECD nations and 67 percent of the increase in the non-OECD nations. Liquids used for feedstocks in the chemical industry account for most of the rest. The non-OECD nations are expected to account for four-fifths of the global increase in transportation energy use (Figure 66).

Currently, the term "liquids" is largely synonymous with oil products. Liquids produced from renewable sources and from nonpetroleum fossil fuels are receiving a great deal of attention worldwide, given today's high oil prices and concerns over the political stability of some oil supply regions. The United States, for instance, has passed legislation to increase the amount of ethanol in the U.S. liquids mix and has increased funding for research on cellulosic biofuels. In OECD Europe, there has been a major push to increase the use of alternative fuels for transportation, including natural gas; however, barring any widespread increase in the penetration of new supply technologies, whether driven by policy changes or other factors, the world's use of alternative fuels in the transportation sector is expected to have only a modest impact on total liquids supply through 2030. In the *IEO2008* reference case, alternative fuels account for only 9 percent of total world liquids use in 2030, despite an average annual increase of 5.6 percent per year, from 2.5 million barrels per day in 2005 to 9.7 million barrels per day in 2030.

Projected world oil prices in the *IEO2008* reference case are 16 percent higher in 2015 and nearly 20 percent higher in 2030 than those projected in *IEO2007*. As a result, consumers in end-use sectors other than transportation (notably, the electric power and industrial sectors) are expected to switch to other fuels where possible. In the transportation sector, however, liquid fuels remain the most widely used energy source, and the impact of high prices on demand for liquid fuels is comparatively modest. World demand for liquid fuels in the transportation sector increases by 1.6 percent per year on average from 2005 to 2030—only 0.1 percentage point below the average increase in the *IEO2007* reference case.

Growing demand for transportation services in the non-OECD countries is the most important factor affecting the projections for world liquids consumption. In 2005, the OECD nations consumed 85 percent more transportation fuel than the non-OECD nations. The discrepancy narrows substantially over the projection period, however, and in 2030 total non-OECD energy consumption for transportation is less than 5 percent below the OECD total (Figure 67). For the OECD countries, the transportation share of total energy consumption increases from 58 percent in 2005 to 63 percent in 2030. For the non-OECD countries, the transportation share of total energy consumption increases from 43 percent in 2005 to 54 percent in 2030.

Figure 66. OECD and Non-OECD Transportation Sector Liquids Consumption, 2005-2030

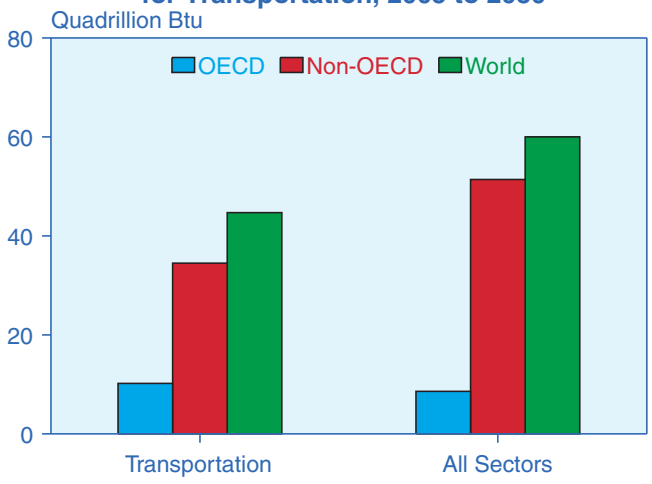


Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

High economic growth rates for the non-OECD nations as a whole in the *IEO2008* reference case are the most important reason for the projected strong growth in their demand for transportation (personal and freight). In addition, the governments of many emerging countries, like China and India, have been reluctant to relax price controls for motor vehicle fuels, for fear that such a move might raise inflation rates and slow their progress toward greater economic prosperity [*1*]. As a result, consumers in the non-OECD countries are not likely to reduce their consumption of motor fuels. Further, most of the world's largest net oil exporters are among the non-OECD nations, and they have the capacity to supply their own populations with transportation fuels at substantially lower prices than market-based economics would allow, funded with revenues from the oil they export.

The *IEO2008* projection for growth in demand for liquid fuels in the OECD nations is slightly lower than the corresponding projection in *IEO2007*. There is evidence that the sustained high world oil prices of the past several years have begun to affect consumers in the OECD. Recent legislation aimed at improving the efficiency of motor vehicles (such as the U.S. Government's move to raise motor vehicle efficiency standards) and consumers' choosing to drive less or purchase high-efficiency vehicles are expected to continue dampening the rate of demand growth in the future. In North America, for instance, transportation energy demand is expected to increase by an annual average of 0.8 percent in the reference case, substantially lower than the average of 1.3 percent per year in *IEO2007*.

Figure 67. Change in World Liquids Consumption for Transportation, 2005 to 2030



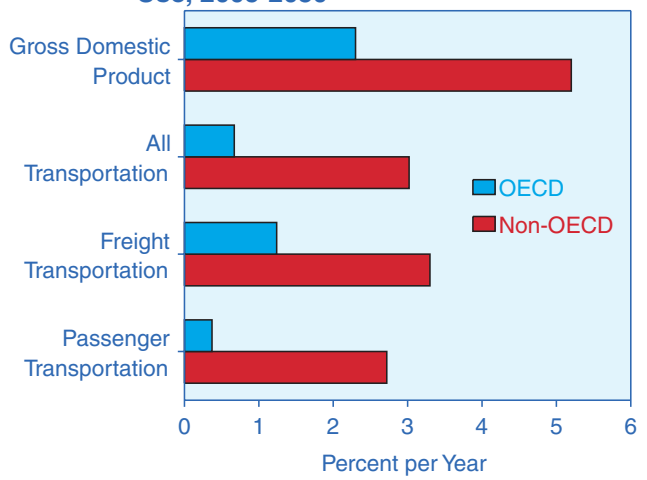
Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **2030:** EIA, World Energy Projections Plus (2008).

Economic growth (as measured by GDP) is associated with growth in fuel consumption to move both freight and people in the OECD and non-OECD countries. In the more service-oriented OECD economies, the link between economic growth and transportation energy use is weaker than in the developing non-OECD economies. From 2005 to 2030, the rate of increase in total OECD transportation energy consumption is 28 percent of the projected GDP growth rate, whereas the rate of increase in total non-OECD transportation energy consumption is about 58 percent of the GDP growth rate for the those countries (Figure 68).

In the non-OECD nations, sustained high rates of economic growth probably would be impossible without rapid modernization of national transportation systems to move raw materials and finished products. For much of the developing world animal power still is a prime means of freight transport, and walking is a prime means of personal transport. As a result, particularly in rural developing regions, growth in transportation services and energy use does not follow economic growth but, rather, enables it. Products and services are not produced if they cannot reach consumers, and without modern transportation systems economic growth may be severely limited.

Freight transportation energy use includes fuels used by large trucks, freight trains, and both domestic and international marine vessels.[17] Passenger transportation energy use includes fuels used in light-duty vehicles, buses, aircraft, and passenger trains. In 2005, about two-thirds of transportation energy use in the OECD

Figure 68. Average Annual Growth in OECD and Non-OECD Gross Domestic Product and Transportation Sector Delivered Energy Use, 2005-2030



Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

[17] In the *IEO2008* projections, fuel use in dedicated freight aircraft is included with fuel use in passenger aircraft.

countries was for passenger travel; that share declines slightly from 2005 to 2030. For the non-OECD nations, passenger travel accounted for less than one-half of total transportation energy use in 2005, and the share remains below 50 percent through 2030. Although energy consumption for passenger transportation grows more than 3 times faster in the non-OECD than in the OECD countries, passenger-related energy use in the developing world remains far below levels in the OECD on a per capita basis.

OECD Countries

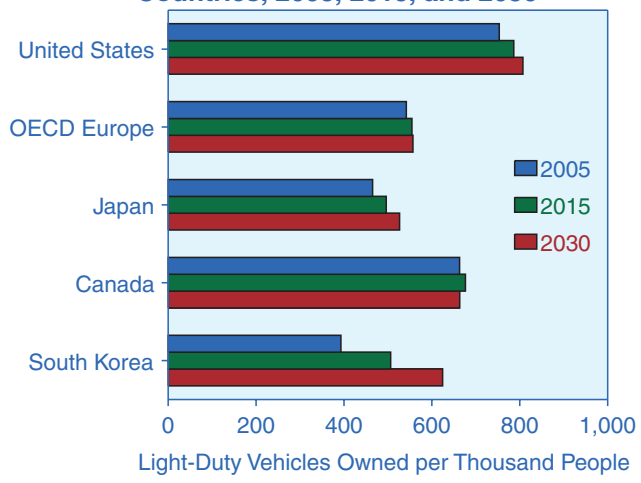
Transportation infrastructure in the OECD countries generally is well established. Roads and highways connect most population centers, and motorization levels (vehicles per 1,000 people), which already are fairly high, probably will reach saturation over the course of the projection period (Figure 69). As the OECD economies have become more service-oriented, the link between income and the transportation of goods has weakened. The established transportation sectors and relatively slow rates of GDP growth and population growth among the OECD economies lead to the expectation that transportation energy demand will increase only modestly from 2005 to 2030. It is projected to grow at an average annual rate of 0.7 percent in the *IEO2008* reference case, from 58.5 quadrillion Btu in 2005 to 63.8 quadrillion Btu in 2015 and 68.8 quadrillion Btu in 2030.

North America accounts for about one-half of the increase in OECD consumption of liquids and other petroleum for transportation in the reference case (Figure 70), and the United States accounts for about 70 percent of that increase (even though the rate of increase in U.S. transportation fuel use is less than one-third the corresponding rate for Mexico). Transportation energy demand in the United States grow from 27.9 quadrillion Btu in 2005 to 30.4 quadrillion Btu in 2015 and 33.0 quadrillion Btu in 2030, accounting for all the increase in U.S. liquids consumption over the period.

Transportation energy use, which accounted for 67 percent of total U.S. liquid fuels demand in 2005, increases to 73 percent of the total in 2030. Improvements in the efficiency of vehicles, aircraft, and ships in the projection period are more than offset by growth in travel. The Energy Independence and Security Act 2007 (EISA2007), enacted by the U.S. Government in December 2007, requires new light-duty vehicles (including both cars and light trucks) to reach an average fuel economy of 35 miles per gallon by 2020. EISA2007 significantly improves the fuel economy of the stock of more heavily used light-duty vehicles. In the reference case, the average in-use fuel economy for the stock of light-duty vehicles in 2030 increases to 28.0 miles per gallon, 41 percent above the 2005 level, resulting in a shift in the mix of transportation vehicle fuels [2].

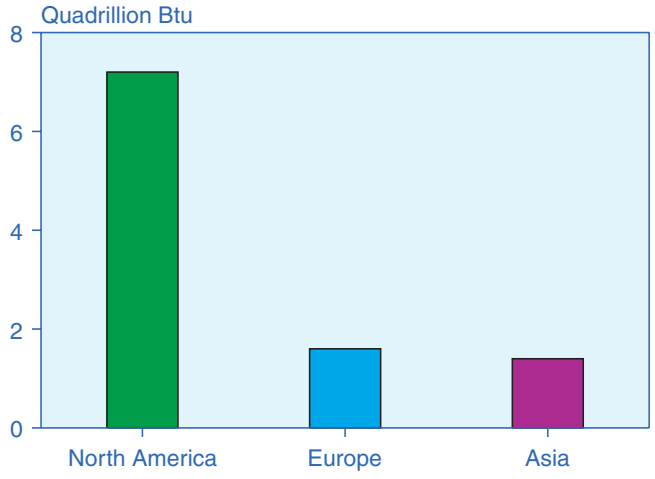
Another impact of EISA2007 on projected energy use in the U.S. transportation sector is a large increase in biofuel consumption. Total U.S. biofuel consumption rises from 0.3 quadrillion Btu (3.7 billion gallons) in 2005 to 2.8 quadrillion Btu (29.7 billion gallons) in 2030, when it represents about 11.3 percent of total U.S. motor vehicle fuel on a Btu basis. U.S. ethanol use grows from 4.0 billion gallons in 2005 to 24.3 billion gallons in 2030 (more than 16 percent of total gasoline consumption by volume). Biodiesel use reaches 1.3 billion gallons in 2030

Figure 69. Motor Vehicle Ownership in OECD Countries, 2005, 2015, and 2030



Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Figure 70. Change in Liquids Consumption for Transportation by OECD Region, 2005 to 2030



Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **2030:** EIA, World Energy Projections Plus (2008).

(about 1.6 percent of total diesel consumption by volume). Consumption of diesel liquids produced from biomass grows to 4.2 billion gallons, or 4.9 percent of total diesel consumption by volume, in 2030.

Canada's current mix of transportation energy use is similar to that in the United States (personal motor vehicles are fueled largely by motor gasoline rather than diesel or alternative fuels) and is expected to remain so in the *IEO2008* reference case. The markets of the two countries are largely interconnected, not only because of their proximity but also because of similar geography and demographics. As in the United States, the fastest growth in Canada's transportation fuel use is expected to be in the form of jet fuel and distillate fuel. For both countries, growth in total demand for transportation fuels averages less than 1.0 percent per year in the reference case from 2005 to 2030 [*3*].

Also similar to developments in the U.S. transportation sector is Canada's growing interest in increasing the role of biofuels in its domestic liquids supply. In 2006, Canada's federal government announced its intention to achieve a 5-percent share of renewable fuels blended into the national motor gasoline supply by 2010 and a 2-percent share of renewable fuels blended into diesel supplies by 2012 [*4*]. In addition, several provinces have enacted legislation or set goals to exceed the national goals.

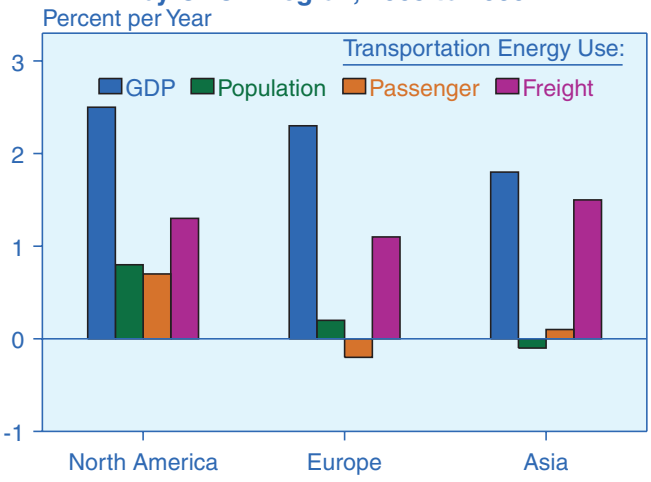
In November 2004, Ontario enacted the Regulation 535/05, "Renewable Fuel Standard," which required an average 5-percent ethanol blend share in the motor gasoline sold in the province, to be achieved by January 1, 2007 [*5*]. British Columbia has passed Bill 16 "The 2008 Greenhouse Gas Reduction (Renewable and Low Carbon Fuel Requirements) Act," which will require a 5-percent share of biodiesel blend in the diesel supply by 2010 [*6*]. In 2005, Saskatchewan set a goal to achieve a 7.5-percent ethanol share of motor gasoline 2005 [*7*]. Manitoba has passed legislation requiring that, as of January 1, 2008, fuel suppliers "replace at least 8.5 percent of their motor gasoline available for sale with ethanol" [*8*]. Finally, Quebec has set a goal to achieve a 5-percent share of ethanol blend in its gasoline supply by 2012, stipulating in addition that the target be met by cellulosic ethanol [*9*]. It is difficult to assess how effective these laws and initiatives may be in increasing domestic supplies of biofuels, but they demonstrate the considerable interest that biofuels have garnered in recent years, both as a result of high world oil prices and for environmental reasons.

In Mexico, strong GDP growth (3.9 percent per year) is projected to increase energy consumption in the transportation sector at an average rate of 2.4 percent per year, from 1.9 quadrillion Btu in 2005 to 2.5 quadrillion Btu in 2015 and 3.5 quadrillion Btu in 2030. The projected increase in transportation fuel use is based on expected growth in trade with the United States and overall improvement in the country's standard of living.

In OECD Europe, slow population growth, high transportation fuel costs, and environmental policies contribute to slow growth in transportation energy use in the *IEO2008* reference case. OECD Europe's population increases by 0.2 percent per year; the countries of OECD Europe already have mature transportation systems; and improvements in energy efficiency over the course of the projection dampen growth in passenger transportation energy use. Despite the slow growth projected for OECD Europe's population, national economic growth continues to expand, as does energy use for freight transportation. In total, however, OECD Europe's transportation energy consumption increases by only 0.3 percent per year on average, from 18.7 quadrillion Btu in 2005 to 19.8 quadrillion Btu in 2015 and 20.3 quadrillion Btu in 2030 (Figure 71). The transportation share of total energy use in OECD Europe remains essentially stable at 22 percent through 2030.

OECD Asia, like OECD Europe, generally has well-established transportation infrastructures; and with population in the region as a whole projected to contract (averaging -0.1 percent per year from 2005 to 2030), fairly slow growth in transportation energy demand is expected. Total demand for transportation fuels in OECD Asia increases by 0.7 percent per year, with the largest increases in South Korea, Australia, and New Zealand. For OECD Asia as a whole, energy use for passenger transportation grows by about 0.2 percent per year from 2005 to 2030.

Figure 71. Average Annual Change in Gross Domestic Product, Population, and Energy Consumption for Transportation by OECD Region, 2005 to 2030



Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

In Japan, transportation energy use declines by 0.1 percent per year on average, as the population declines by a total of 7.5 percent (10 million people) from 2005 to 2030. As a result, energy use in the country's passenger transportation sector in 2030 is projected to be 9 percent below the 2005 level, although with GDP growth averaging 1.1 percent per year, its energy use for freight transportation increases on average by 0.4 percent per year.

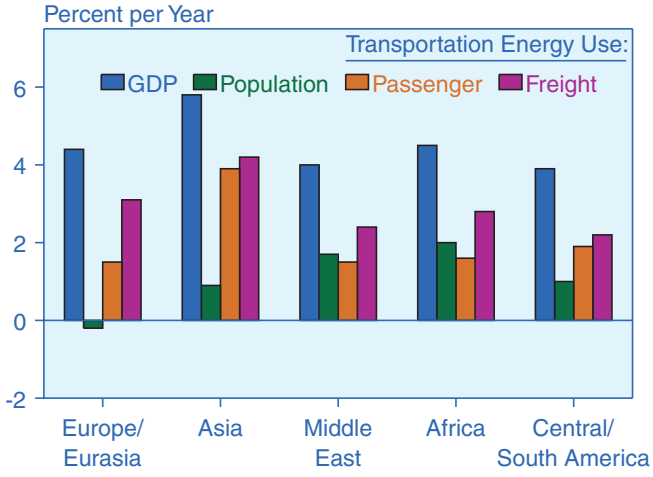
South Korea is the fastest-growing economy in the region, and its transportation energy use is projected to grow by 1.9 percent per year in the *IEO2008* reference case. The country has the region's strongest projected GDP growth, averaging 3.5 percent per year from 2005 to 2030, and its transportation infrastructure is still relatively young compared with those in Japan and Australia/New Zealand. South Korea accounts for about one-fourth of OECD Asia's total population, and its share of OECD Asia's transportation energy use is projected to increase from 24 percent in 2005 to 32 percent in 2030. Energy use for freight transportation in South Korea is projected to increase by an average of 2.5 percent per year, and its share of OECD Asia's total energy use for freight movement increases from 31 percent in 2005 to 40 percent in 2030, reflecting an increase in its share of OECD Asia's total GDP from 15 percent to 22 percent.

In Australia/New Zealand, transportation energy use is projected to grow by average of 1.1 percent per year, based on modest population growth and average annual GDP growth of 3.0 percent. As in South Korea, freight transportation is the key factor behind the projected increase in transportation fuel demand for Australia/New Zealand in the *IEO2008* reference case, rising from 0.4 quadrillion Btu in 2005 to 0.7 quadrillion Btu in 2030, at an average annual rate of 2.3 percent. Air travel is also expected to count for a substantial part of the growth in Australia/New Zealand's transportation fuel demand, as income growth raises standards of living and the demand for business and vacation travel. Passenger air travel in Australia/New Zealand nearly doubles in the reference case, from 0.2 quadrillion Btu in 2005 to 0.4 quadrillion Btu in 2030.

Non-OECD Countries

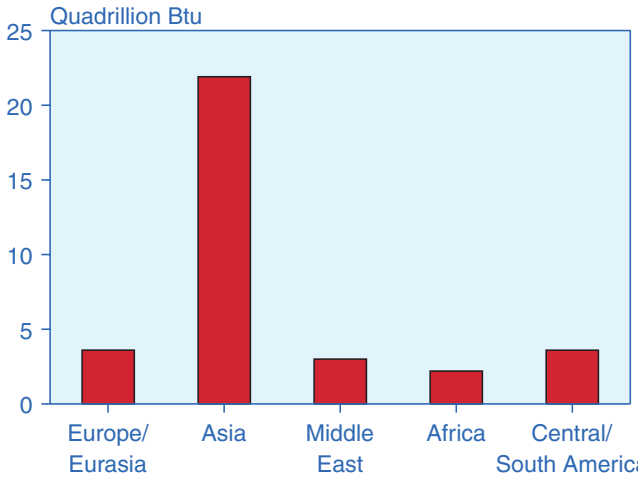
The projected average growth rate of transportation energy use in the non-OECD countries from 2005 to 2030, at 3.0 percent per year, is more than quadruple the projected rate for OECD countries, and their use of liquids in the transportation sector is expected to double over the period. Transportation energy consumption for both passenger and freight transportation in non-OECD Asia is projected to increase at a much greater rate than in the other non-OECD countries (Figure 72). Combined, China, India, and other developing countries in Asia (non-OECD Asia) are expected to sustain high rates of economic growth over the forecast, accounting for 54 percent of the increase in world GDP between 2005 and 2030. In 2030 they represent 45 percent of the world economy, up from 29 percent in 2005. Over the same period, non-OECD Asia's share of world transportation liquids consumption increases from 12.6 percent to 34.5 percent (Figure 73).

Figure 72. Average Annual Change in Gross Domestic Product, Population, and Energy Consumption for Transportation by Non-OECD Region, 2005 to 2030



Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Figure 73. Change in Liquids Consumption for Transportation by Non-OECD Region, 2005 to 2030



Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **2030:** EIA, World Energy Projections Plus (2008).

The high rate of economic growth projected for the non-OECD countries will be realized only if their transportation infrastructures keep pace with economic growth. China has been, and is projected to continue to be, the fastest growing economy among non-OECD countries. From 2005 to 2030, China's GDP is projected to increase by an average of 6.4 percent per year, and its use of liquid fuels for passenger and freight transportation increases by 5.0 and 5.5 percent, respectively. Between 1995 and 2005, growth in the combined length of China's highways averaged 5.3 percent per year [***10***]. Over the same period, highway passenger travel (measured in passenger-miles) and highway freight travel (measured in ton-miles) increased at annual rates of 7.3 and 6.4 percent, respectively. India, similarly, has been expanding its road infrastructure to keep pace with economic growth.

The *IEO2008* projections assume that the pace of infrastructure expansion will not significantly hinder economic growth in the rapidly expanding economies of non-OECD Asia. They also assume that the type of infrastructure developed largely will mirror the transportation infrastructure of today's developed economies. Given the increasing scale of needed infrastructure and the very different fuel price regimes in the economies of non-OECD Asia, these assumptions are a source of considerable uncertainty in the projections.

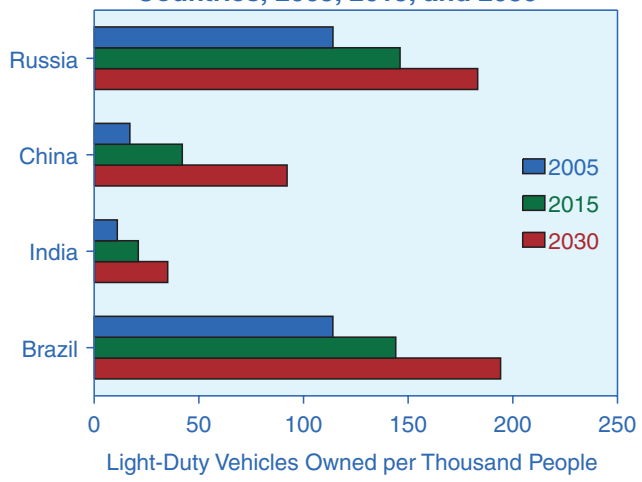
Both China and India have become major vehicle manufacturers. In 2006, China produced nearly 7.2 million motor vehicles, the third-highest production level in the world after Japan and the United States and more than one-tenth of the world's total production [***11***]. In 2007, motor vehicle production in China grew by another 22 percent, to 8.9 million vehicles [***12***]. Within the next several years, China's production of motor vehicles may reach 10 million vehicles. Domestic demand for motor vehicles has advanced strongly since the accession of China into the World Trade Organization in December 2001, which has promoted increased economic activity. Between 2005 and 2006, for instance, personal vehicle ownership increased by nearly 24 percent, making China the world's second-largest consumer of automobiles (the United States is the largest).

India produces a much smaller number of motor vehicles than China does, but the number has grown substantially over the past several years. In 2000, India produced 0.8 million motor vehicles; in 2007, production had increased to 2.3 million vehicles [***13***], and India had become the world's tenth-largest motor vehicle producer and Asia's fourth largest (after Japan, China, and South Korea). India's motor vehicle manufacturers aspire to improve their penetration of the world's automotive sector. In 2008, Tata Motors—India's largest manufacturer of passenger and commercial vehicles—has launched the world's cheapest mass-produced car (the $3,116 Nano) and agreed to purchase Land Rover and Jaguar from U.S. Ford Motor Company [***14***]. India's government has estimated that the country's production of passenger cars—largely supported by anticipated robust economic growth—will increase from 1.7 million vehicles in 2007 to 3.0 million vehicles in 2015 [***15***].

Small and relatively inexpensive vehicles are being produced in China and India to meet the personal transportation needs of an expanding middle class. Motorization in both countries more than triples over the projection period, although their motorization levels remain far below those in most OECD nations in 2030 (Figure 74). The personal transportation service provided by motor vehicles, along with an expanding road infrastructure, greatly increases the mobility of the labor force and helps support continued high rates of economic growth. Although the new vehicles are expected to achieve high levels of fuel efficiency per mile, the growing fleet of automobiles will replace even more fuel-efficient motorcycles.

As an alternative to light-duty automobiles and trucks, public transport may play an increasingly important role in China, India, and the other rapidly developing economies of non-OECD Asia. This is especially true for large, densely populated urban areas, where traffic congestion will require a government response to ensure that goods and people can be transported effectively. The *IEO2008* reference case projection assumes robust growth in both personal motorization and public transportation—namely, buses and light rail—for China and India. In China, for instance, while transportation energy use by light-duty vehicles (including automobiles, light-duty trucks, and two- and three-wheel vehicles) increases by 5.4 percent per year from 2005 to 2030,

Figure 74. Motor Vehicle Ownership in Non-OECD Countries, 2005, 2015, and 2030



Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

energy consumption for passenger rail also grows strongly, by a projected 4.4 percent per year, and energy use for passenger bus increases by 2.7 percent per year. In India, transportation energy use increases by an average of 4.4 percent per year for light-duty vehicles, 2.9 percent per year for passenger rail, and 3.4 percent per year for buses.

In Russia, energy consumption for passenger transportation increases at an average rate of 0.6 percent per year from 2005 to 2030 in the reference case, even as the Russian population declines by an average of 0.6 percent per year (for a total population reduction of 20 million). Russia's automobile market has been particularly strong in the past several years, with 1.5 million vehicles sold in 2005 and expectations by some analysts that sales may expand by 7.0 percent per year until 2010 [***16***]. Thus, passenger energy use per capita is projected to increase by an average of 1.2 percent per year. Strong economic growth, fueled by sustained high prices for Russia's exports of oil and natural gas, increases the demand for personal motorization.

The population in the rest of non-OECD Europe and Eurasia is expected to be virtually unchanged between 2005 and 2030, and energy consumption for passenger transportation per capita is projected to increase at a yearly rate of 2.8 percent, compared with 4.8-percent annual growth in income per capita. Based on economic growth averaging 4.4 percent per year in non-OECD Europe and Eurasia, energy use for freight transportation is projected to grow by an average of 3.2 percent per year, reflecting improvements in standards of living among countries that have continued to prosper since the fall of the Soviet Union. Rising standards of living fuel the demand for merchandise and appliances and the need to ship those goods to market.

The Middle East has a relatively small population and is not a major energy-consuming region but rather an exporter; however, rapid population growth in the region is expected to result in increased demand for transportation. Transportation energy use has been expanding quickly in several key nations of the Middle East, at a rate greatly exceeding the world average.

From 2000 to 2005, transportation energy use increased by 4.2 percent per year in Saudi Arabia; by 6.8 percent per year in Iran; by 7.0 percent per year in Kuwait; and by an impressive 15.5 percent per year in Qatar. In comparison, the world average was 2.3 percent per year [***17***]. Saudi Arabia, Kuwait, and Iran, among other Middle Eastern nations, subsidize transportation fuels for their citizens, discouraging conservation or efficiency of use [***18***]. Further, personal motor vehicle sales in many countries of the region have posted double-digit growth rates in recent years, as the economies of oil-exporting countries have prospered in the current high price environment [***19***]. In the *IEO2008* reference case, energy consumption for transportation in the Middle East grows by an average of 1.9 percent per year from 2005 to 2030, to a total of 8.0 quadrillion Btu in 2030.

Transportation energy use in Central and South America is projected to increase by 2.0 percent per year from 2005 to 2030. Brazil, the region's largest economy, is experiencing particularly strong growth in its transportation sector following its success in achieving economic stability, which has bolstered consumer confidence and improved consumer access to credit, allowing vehicle sales to increase strongly [***20***]. Total vehicle sales in Brazil (including light-duty vehicles, heavy-duty trucks, and buses) rose by 28 percent in 2007, following a 12-percent increase in 2006. Indications are that robust domestic sales will continue [***21***]. In the *IEO2008* reference case, energy use by light-duty vehicles in Brazil increases by an average of 2.6 percent per year from 2005 to 2015, before slowing substantially to 1.6 percent per year from 2015 to 2030.

In 1975, the Brazilian government launched its National Alcohol Program to increase the penetration of ethanol in the transportation fuel mix [***22***]. Subsequently, ethanol production in Brazil rose from 0.1 billion gallons in 1975 to 2.5 billion gallons per year in the early 1980s; and in 2005, ethanol accounted for about 40 percent of total fuel consumption in the country's passenger vehicles. Its reliance on biofuels (and ethanol in particular) to fuel its transportation sector has focused attention on Brazil, as other nations of the world have begun to increase the penetration of alternative fuels in the face of sustained high world oil prices over recent years.

With a sharp upswing in sales of flexible-fuel vehicles (FFVs),[18] coupled with ethanol prices that are currently about one-half the price of gasoline, the ethanol share of Brazil's transportation fuel market is poised to increase even further [***23***]. FFV production in Brazil began in March 2003, when 49,000 vehicles were sold. By March 2007 sales of FFVs had risen to 3 million, and in 2008 more than 5 million have been sold [***24***]. FFVs now account for more than 80 percent of new automobile sales in Brazil. The country also is intent on increasing biodiesel supplies. Beginning in January 2008, Brazilian distributors are required to blend 2 percent biodiesel into their regular diesel supplies [***25***]. Further, national legislation requires an increase in the biodiesel share to 5 percent of the diesel mix by 2013.

[18]Flexible-fuel vehicles can operate using 100 percent ethanol, 100 percent motor gasoline, or any combination of the two fuels.

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Chapter 7

Energy-Related Carbon Dioxide Emissions

In 2005, non-OECD emissions of carbon dioxide exceeded OECD emissions by 7 percent. In 2030, carbon dioxide emissions from the non-OECD countries are projected to exceed those from the OECD countries by 72 percent.

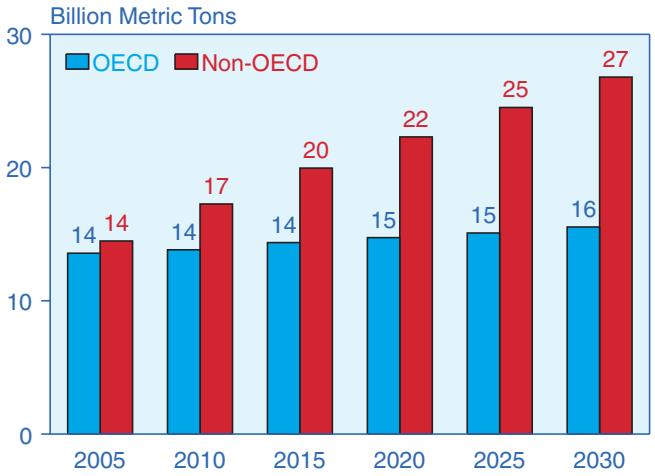
Carbon dioxide is the most abundant anthropogenic (human-caused) greenhouse gas in the atmosphere. Atmospheric concentrations of carbon dioxide have been rising at a rate of about 0.6 percent annually in recent years, and that growth rate is likely to increase. As a result, by the middle of the 21st century, carbon dioxide concentrations in the atmosphere could be double their pre-industrialization level (see box on page 90).

Because anthropogenic emissions of carbon dioxide result primarily from the combustion of fossil fuels for energy, world energy use has emerged at the center of the climate change debate. In the *IEO2008* reference case, world carbon dioxide emissions are projected to rise from 28.1 billion metric tons in 2005 to 34.3 billion metric tons in 2015 and 42.3 billion metric tons in 2030.[19]

From 2004 to 2005, total energy-related carbon dioxide emissions from the non-OECD countries grew by 6.6 percent, while emissions from the OECD countries grew by less than 1 percent. Consequently, annual emissions from the non-OECD countries currently exceed total annual emissions from the OECD countries, and the difference is growing (Figure 75). In addition, the projected average annual increase in non-OECD emissions from 2005 to 2030 (2.5 percent) is five times the increase projected for the OECD countries (0.5 percent). In 2030, non-OECD emissions, projected at 26.8 billion metric tons, exceed the projection for OECD emissions by 72 percent. The *IEO2008* reference case projections are, to the extent possible, based on existing laws and policies. The projections for carbon dioxide emissions could change significantly if existing laws and policies aimed at reducing the use of fossil fuels, and thus greenhouse gas emissions, changed.

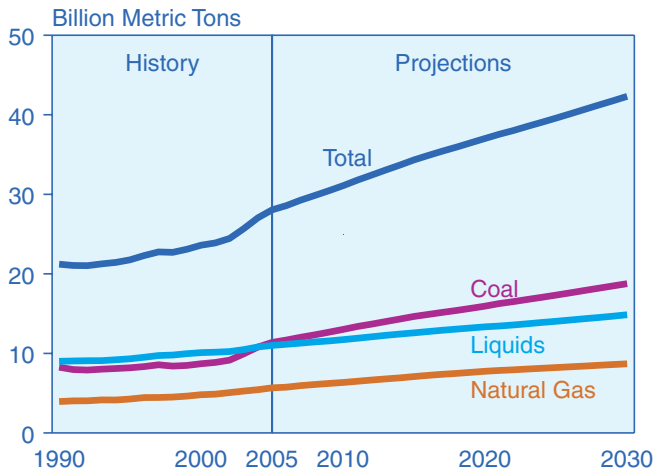
The relative contributions of different fossil fuels to total energy-related carbon dioxide emissions have changed over time. In 1990, emissions from the combustion of liquids and other petroleum made up an estimated 42 percent of the world total; in 2005 their share was 39 percent; and in 2030 it is projected to be 35 percent (Figure 76). Carbon dioxide emissions from natural gas combustion, which accounted for 19 percent of the total in 1990, increased to 20 percent of the 2005 total. That share is projected to stabilize at between 20 and 21 percent from 2005 to 2030.

Figure 75. World Energy-Related Carbon Dioxide Emissions, 2005-2030



Sources: **2005:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Figure 76. World Energy-Related Carbon Dioxide Emissions by Fuel Type, 1990-2030



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

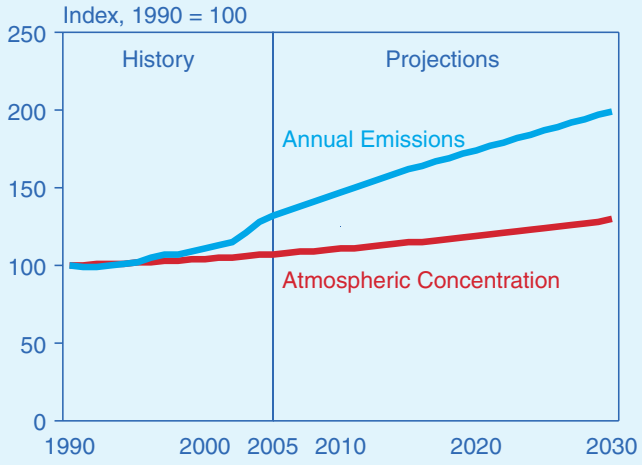
[19]In keeping with current international practice, *IEO2008* presents data on greenhouse gas emissions in billion metric tons carbon dioxide equivalent. The figures can be converted to carbon equivalent units by multiplying by 12/44.

What Will It Take To Stabilize Carbon Dioxide Concentrations?

Currently, world energy-related carbon dioxide emissions are increasing at a rate of about 2.1 percent per year. Carbon dioxide concentrations, on the other hand, are rising by only about 0.6 percent per year (see figure below). There are two major reasons for the difference:

- First, the base from which growth in the atmospheric carbon dioxide concentration is calculated is much larger than the base from which increases in annual emissions are calculated. Before the industrial revolution, the weight of carbon dioxide in the atmosphere was about 2,163 billion metric tons,[a] and in the early stages of industrialization the concentration increased slowly—at a rate of about 0.04 percent per year.
- Second, the Earth's oceans and soils absorb carbon dioxide. Over time, about 42 percent (at current emission rates, between 11 and 12 billion metric tons) of the net carbon dioxide emitted through the burning of fossil fuels and deforestation has been absorbed by the planet and has not accumulated in the atmosphere. The other 58 percent has been added to the atmospheric balance. One of the uncertainties in projecting future concentrations is whether the same absorption ratio will hold for future emissions.

Growth in Carbon Dioxide Emissions and Atmospheric Concentration, 1990-2030



Sources: **History:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

In pre-industrial times, the concentration of carbon dioxide in the atmosphere was about 280 parts per million (ppm). The atmospheric concentration of carbon dioxide at present is about 380 ppm, and according to the *IEO2008* reference case projections, by 2030 it would be about 450 ppm.[b] If the growth of world carbon dioxide emissions continues unabated, the concentration of carbon dioxide in the Earth's atmosphere could reach 560 ppm by the middle of the 21st century.

Many possible actions beyond those currently projected in the business-as-usual baseline would be needed to stabilize the atmospheric concentration of carbon dioxide at a level below 560 ppm (still double the pre-industrial level). There is no unique path for achieving any stabilization goal. In addition, a number of "wild cards" could alter the relationship between emissions rates and atmospheric concentrations—such as the Earth's capacity to absorb carbon, which some scientists believe could be diminished by global warming. Each of the options outlined below could be expected to mitigate 1 billion metric tons or more annually by 2030, relative to the *IEO2008* reference case projection. It is beyond the scope of this analysis to project either the upper bound or the economic cost of each option.

- *Reductions in energy demand growth*. Reducing the growth of energy demand in residential and commercial buildings would require adoption of more energy-efficient lighting systems (such as compact fluorescent bulbs and, eventually, light-emitting diodes) and of more efficient heating, cooling, and refrigeration systems, as well as energy-efficient building shell retrofits and new construction. In the transportation sector, it would require more fuel-efficient vehicles and more use of public transit and telecommuting. In the industrial sector, more combined heat and power and more efficient processes would be needed to lower energy demand per unit of industrial output.
- *Increases in nuclear electricity generation*. According to the World Nuclear Association, the achievement of 740 gigawatts of installed nuclear electricity capacity by 2030—36 percent more than projected in the *IEO2008* reference case—is possible. If additional nuclear power displaced only coal, such an increase would achieve a reduction of about 1 billion metric tons annually by 2030.

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[a]Scientists typically measure carbon dioxide concentrations by the weight of the carbon only, because some carbon exchanges (fluxes) do not involve carbon dioxide. For this analysis, however, the weight of carbon dioxide is used for consistency with the rest of the chapter.

[b]The concentration levels calculated here are based only on energy-related carbon dioxide. Taking into account other sources of carbon dioxide and concentrations of other heat-trapping gases, total greenhouse gas concentrations will be somewhat higher.

What Will It Take To Stabilize Carbon Dioxide Concentrations? (Continued)

- *Increased use of nonhydropower renewables for electricity generation in the OECD economies*. For nonhydropower renewables to provide 20 percent of the electricity consumed in the OECD economies in 2030, the use of renewables would have to increase by an average of 7.4 percent annually from 2010 to 2030, as compared with the 2.5-percent average increase in the *IEO2008* reference case. The increase would yield 1 billion metric tons of abatement annually by 2030.
- *Increased use of hydropower and nonhydropower renewables for electricity generation in the non-OECD economies*. Assuming that there are more opportunities for hydropower expansion in the non-OECD economies than in the OECD economies, if the combined use of hydropower and nonhydropower renewables in non-OECD countries grew by 3.5 percent per year from 2020 to 2030, as compared with 1.3 percent in the *IEO2008* reference case, 1 billion metric tons of carbon dioxide emissions would be avoided annually by 2030.
- *Increased use of renewable fuels for transportation.* If new technologies were employed to minimize carbon dioxide emissions from input fuels and indirect emissions of other greenhouse gases, so that an additional 20 quadrillion Btu of biofuels was consumed in the transportation sector, assuming a life-cycle savings of 80 percent in carbon dioxide emissions compared to conventional petroleum, 1 billion metric tons of carbon dioxide emissions could be avoided by 2030.
- *Carbon capture and storage.* It is unlikely that significant amounts of carbon capture and storage will be implemented before 2020. When the technology does become available commercially, its application to about 250 gigawatts of coal-fired generation capacity with a 90-percent removal rate would result in the mitigation of 1 billion metric tons of carbon dioxide emissions annually. The *IEO2008* reference case does not include carbon capture and storage. Although there are some small projects in pilot phases around the world, the assumption is that without binding constraints on carbon dioxide emissions throughout the projection period there would be no economic incentive to engage in carbon capture and storage.
- *Anthropogenic sequestration.* The latest assessment by the Intergovernmental Panel on Climate Change estimates that about 3.7 billion tons carbon dioxide equivalent per year is sequestered by anthropogenic activity, including projects such as reforestation and other land-use programs. A 27-percent increase in such activity by 2030 would represent an emissions reduction of 1 billion metric tons.

For many of the options listed above, the magnitude of the required changes relative to the reference case projections points to the difficulty of achieving stabilization at an atmospheric concentration that is at or below twice preindustrial levels. The effectiveness of reductions in electricity demand as a way to decrease carbon dioxide emissions depends on the fuel mix, the efficiency of generation, and the resultant carbon intensity of electricity supply (carbon dioxide emitted per kilowatthour of generation). For example, because coal-fired generation is more carbon-intensive than natural-gas-fired generation, achieving a given level of reduction in carbon dioxide emissions would require a smaller cut in coal use than the cut in natural gas use that would be required for the same reduction in emissions. Similarly, as the overall carbon intensity of electric power production declines, larger reductions in electricity demand will be needed to achieve a given level of emission abatement (see figure below).

Over time, increases in the efficiencies of generation technologies, such as new natural gas combined-cycle generation, will mean that demand reductions avoid smaller amounts of carbon dioxide emissions. With the average efficiency of electricity generation improving over time, the 2030 reference case intensity of 0.48 metric tons carbon dioxide per megawatthour of electricity supplied is lower than the 2005 historical carbon intensity of 0.56 metric tons per megawatthour supplied. As a result, if more non-carbon-emitting electricity supply is added, such as nuclear and renewables, the demand reduction requirement for the same amount of carbon dioxide emissions savings increases over time.

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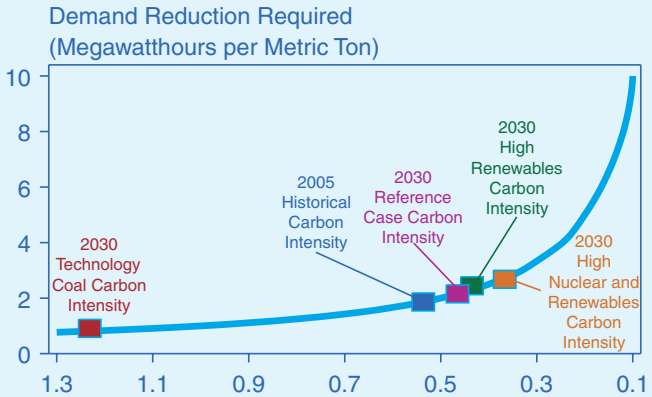
Impact of Carbon Dioxide Intensity of Electricity Supply on Effectiveness of Demand Reduction



Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** Estimated by EIA, Office of Integrated Analysis and Forecasting.

What Will It Take To Stabilize Carbon Dioxide Concentrations? (Continued)

There are wide ranges of estimates both for the marginal cost levels required to achieve various reduction levels and for the corresponding impacts on GDP. Policies to achieve emission abatements can have a large effect on the cost estimates, as can the rate of development of low- or non-carbon technologies. Specific questions that would have to be answered in order to estimate costs include:

- Are all greenhouse gases included in the analysis? Are emissions credits freely traded?
- Is nuclear power allowed to grow at a rapid pace?
- Are biomass and other renewable technologies allowed to penetrate rapidly?
- What discount rates are used for future costs and benefits?
- Do new technologies, such as carbon capture and storage, enter the technology base early enough to be employed in the abatement strategy?

If, by 2030, world GDP were 1 percent lower as a result of mitigation efforts, it would mean an annual cost of about $1.5 trillion (in constant 2000 dollars). The costs must of course be weighed against future benefits in the form of avoiding human-caused climate disruptions.

Coal's share of world carbon dioxide emissions grew from 39 percent in 1990 to 41 percent in 2005 and is projected to increase to 44 percent in 2030. Coal is the most carbon-intensive of the fossil fuels, and it is the fastest-growing energy source in the *IEO2008* reference case projection, reflecting its important role in the energy mix of non-OECD countries—especially China and India. In 1990, China and India together accounted for 13 percent of world carbon dioxide emissions; in 2005 their combined share had risen to 23 percent, largely because of strong economic growth and increasing use of coal to provide energy for that growth. In 2030, carbon dioxide emissions from China and India combined are projected to account for 34 percent of total world emissions, with China alone responsible for 28 percent of the world total.

The Kyoto Protocol, which requires participating "Annex I" countries to reduce their greenhouse gas emissions collectively to an annual average of about 5 percent below their 1990 level over the 2008-2012 period, entered into force on February 16, 2005. Annex I countries include the 24 original OECD countries, the European Union, and 14 countries that are considered "economies in transition."[20] As of December 3, 2007, 174 countries and the European Commission had ratified the Kyoto Protocol; however, only the Annex I countries that have ratified the Protocol are obligated to reduce or limit their carbon dioxide emissions. The United States has not ratified the Protocol; and although both China and India have ratified it, neither is subject to emissions limits under the terms of the treaty.

Although the Protocol is technically "in force," it would have an effect on only one year of the *IEO2008* forecast, namely, 2010. The *IEO2008* projections do not explicitly include the impacts of the Kyoto Protocol, because the treaty does not indicate the methods by which ratifying parties will implement their obligations.

Further, although some countries have passed laws intended to implement the goals of the Kyoto Protocol, it is difficult to interpret those laws in the *IEO2008* reference case. Many of the Kyoto goals are being met by "Kyoto mechanisms," such as reforestation, which are not reflected in the projections. Additionally, greenhouse gases other than carbon dioxide often are the least expensive to reduce, and those reductions may account for a larger proportion of some countries' Kyoto goals. In the *IEO2008* projections only energy-related carbon dioxide emissions are calculated; estimates of other greenhouse gas emissions are not included.

Finally, the participants have been unable to agree on a second commitment period or on any actions that might occur after 2012. Until those issues are resolved, it will be difficult to project the effects of the Kyoto Protocol through 2030.[21]

There are signs that concerns about global climate change are beginning to affect the world fuel mix. In recent years, many countries have begun to express new interest in expanding their use of non-carbon-emitting nuclear power, in part to stem the growth of greenhouse gas emissions. The *IEO2008* reference case projection for electricity generation from nuclear power in 2030 is almost 4 percent higher than the *IEO2007* projection, which in turn is 10 percent higher than the *IEO2006* projection. The changes reflect a generally more favorable

[20] Turkey is an Annex I country that has not ratified the Framework Convention on Climate Change and did not commit to quantifiable emissions targets under the Kyoto Protocol.

[21] For a modeling analysis of the effects of the Kyoto Protocol, see Energy Information Administration, *International Energy Outlook 2006*, DOE/EIA-0484(2006) (Washington, DC, June 2006), "Kyoto Protocol Case," pp. 75-79, web site www.eia.doe.gov/oiaf/ieo.

perception of nuclear power as an alternative to carbon-producing fossil fuels for electricity generation.

Reference Case

Carbon Dioxide Emissions

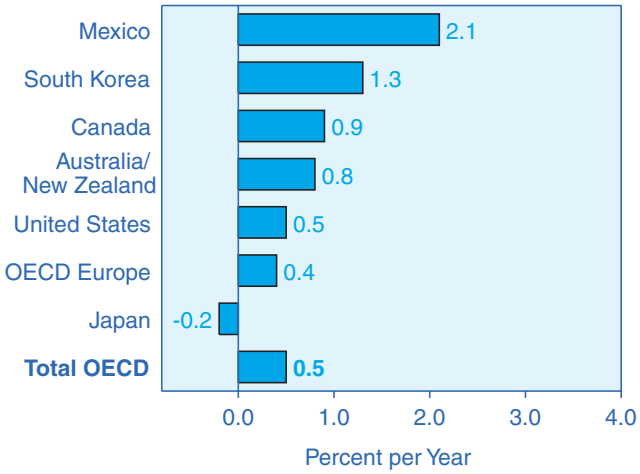
In the *IEO2008* reference case, world energy-related carbon dioxide emissions are projected to grow by an average of 1.7 percent per year from 2005 to 2030 (Table 12). For the OECD, annual increases in carbon dioxide emissions are projected to average 0.5 percent, from 13.6 billion metric tons in 2005 to 14.4 billion metric tons in 2015 and 15.5 billion metric tons in 2030.

The highest rate of increase in annual emissions of carbon dioxide among the OECD countries is projected for Mexico, at 2.1 percent per year (Figure 77). Mexico is projected to have the highest GDP growth rate among the OECD countries, and much of its growth is expected to come from energy-intensive industries. For all the other OECD countries, annual increases in carbon dioxide emissions are projected to average less than 1.5 percent. South Korea, which still is industrializing, is the only OECD country other than Mexico for which the average is projected to be greater than 1 percent. Japan's emissions are projected to *decrease* by an average of 0.2 percent per year from 2005 to 2030, and for OECD Europe an average annual increase of 0.4 percent per year is projected.

Although the United States has not ratified binding emissions constraints, recent changes in U.S. environmental laws and regulations (in addition to other factors) have lowered the projections for carbon dioxide emissions relative to earlier estimates.[22] In the *IEO2007* reference case, U.S. emissions were projected to grow by an average of 1.1 percent per year from 2005 to 2030. In the *IEO2008* reference case, in contrast, the projected annual growth rate is 0.5 percent over the same period, leading to a 14-percent lower projection for energy-related carbon dioxide emissions in 2030 in *IEO2008* compared with *IEO2007* (Figure 78).

For the non-OECD countries, total carbon dioxide emissions are projected to average 2.5-percent annual growth

Figure 77. Average Annual Growth in Energy-Related Carbon Dioxide Emissions in the OECD Economies, 2005-2030



Sources: **2005:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **2030:** EIA, World Energy Projections Plus (2008).

Table 12. World Energy-Related Carbon Dioxide Emissions by Region, 1990-2030
(Billion Metric Tons)

Region	History		Projections					Average Annual Percent Change	
	1990	2005	2010	2015	2020	2025	2030	1990-2005	2005-2030
OECD	**11.4**	**13.6**	**13.8**	**14.4**	**14.7**	**15.1**	**15.5**	**1.2%**	**0.5%**
North America	5.8	7.0	7.1	7.4	7.7	7.9	8.3	1.3%	0.7%
Europe	4.1	4.4	4.5	4.7	4.8	4.8	4.8	0.4%	0.4%
Asia	1.5	2.2	2.2	2.3	2.3	2.4	2.4	2.3%	0.4%
Non-OECD	**9.8**	**14.5**	**17.3**	**20.0**	**22.3**	**24.5**	**26.8**	**2.6%**	**2.5%**
Europe and Eurasia	4.2	2.9	3.1	3.3	3.5	3.6	3.8	-2.5%	1.1%
Asia	3.6	8.2	10.2	12.2	13.9	15.7	17.5	5.6%	3.1%
Middle East	0.7	1.4	1.6	1.8	2.0	2.1	2.3	4.7%	1.9%
Africa	0.6	1.0	1.1	1.2	1.4	1.4	1.5	2.7%	1.8%
Central and South America	0.7	1.1	1.3	1.4	1.5	1.6	1.7	3.2%	1.9%
Total World	**21.2**	**28.1**	**31.1**	**34.3**	**37.0**	**39.6**	**42.3**	**1.9%**	**1.7%**

Sources: **1990 and 2005:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **2010-2030:** EIA, World Energy Projections Plus (2008).

[22]For example, the Energy Independence and Security Act of 2007, which was signed into law in December 2007 (Public Law 110-140), includes a number of provisions aimed at reducing greenhouse gas emissions. Other factors that contribute to the lower projections for carbon dioxide emissions include higher energy prices and lower projected economic growth rates in comparison with previous outlooks.

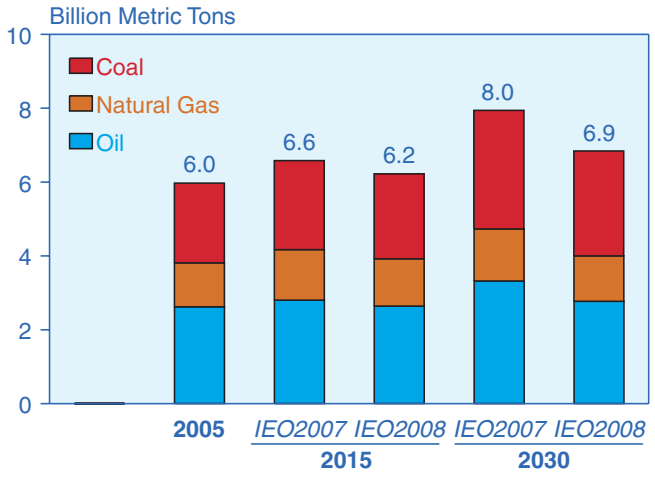
(Figure 79). The highest growth rate among the non-OECD countries is projected for China, at 3.3 percent annually from 2005 to 2030, reflecting the country's continued heavy reliance on fossil fuels, especially coal, over the projection period. China's energy-related emissions of carbon dioxide are projected to exceed U.S. emissions by almost 15 percent in 2010 and by 75 percent in 2030. The lowest growth rate among the non-OECD countries is projected for Russia, at 0.9 percent per year. Over the projection period, Russia is expected to expand its reliance on indigenous natural gas resources and nuclear power to fuel electricity generation, and a decline in its population is expected to slow the overall rate of increase in energy demand.

By fuel, world carbon dioxide emissions from the consumption of liquid fuels and other petroleum are projected to grow at an average annual rate of 1.2 percent from 2005 to 2030. The average growth rates for the OECD and non-OECD countries are projected to be 0.3 percent and 2.2 percent per year, respectively (Figure 80). The highest rate of growth in petroleum-related carbon dioxide emissions is projected for China, at 3.5 percent per year, as its demand for liquid fuels increases to meet growing demand in the transportation and industrial sectors. The United States is expected to remain the largest source of petroleum-related carbon dioxide emissions throughout the period, with projected emissions of 2.8 billion metric tons in 2030—still 34 percent above the corresponding projection for China.

Carbon dioxide emissions from natural gas combustion worldwide are projected to increase on average by 1.7 percent per year, to 8.7 billion metric tons in 2030, with the OECD countries averaging 1.0 percent and the non-OECD countries 2.4 percent (Figure 81). Again, China is projected to have the most rapid growth in emissions, averaging 5.5 percent annually; however, China's emissions from natural gas combustion amounted to only 0.1 billion metric tons in 2005, and in 2030 they are projected to total only 0.4 billion metric tons, or less than 5 percent of the world total. The growth in U.S. emissions from natural gas use is projected to average 0.1 percent per year, but the projected level of 1.2 billion metric tons in 2030 is triple the projection for China.

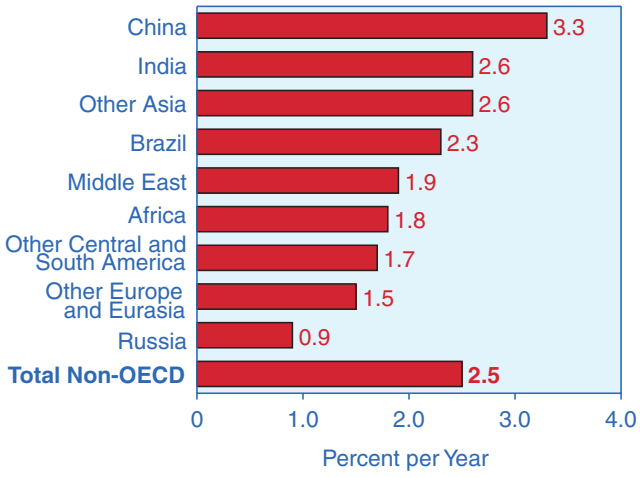
Total carbon dioxide emissions from the combustion of coal throughout the world are projected to increase by 2.0 percent per year on average, from 11.4 billion metric tons in 2005 to 18.8 billion metric tons in 2030. Total coal-related emissions from the non-OECD countries have been greater than those from the OECD countries since 1987, and in 2030 they are projected to be more than 2.5 times the OECD total (Figure 82), in large part because of the increase in coal use projected for China and India. Together, China and India account for 79 percent of the projected increase in the world's coal-related carbon dioxide emissions from 2005 to 2030. For China alone, coal-related emissions are projected to grow by an average of 3.2 percent annually, from 4.3 billion metric tons in 2005 to 9.6 billion metric tons (51 percent of the world total) in 2030. India's carbon dioxide emissions from coal combustion are projected to total 1.4 billion metric tons in 2030, accounting for more than 7 percent of the world total.

Figure 78. U.S. Energy-Related Carbon Dioxide Emissions in *IEO2007* and *IEO2008*, 2005-2030



Sources: Energy Information Administration, *Annual Energy Outlook 2007*, DOE/EIA-0383(2007) (Washington, DC, January 2007), and *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, April 2008).

Figure 79. Average Annual Growth in Energy-Related Carbon Dioxide Emissions in the Non-OECD Economies, 2005-2030



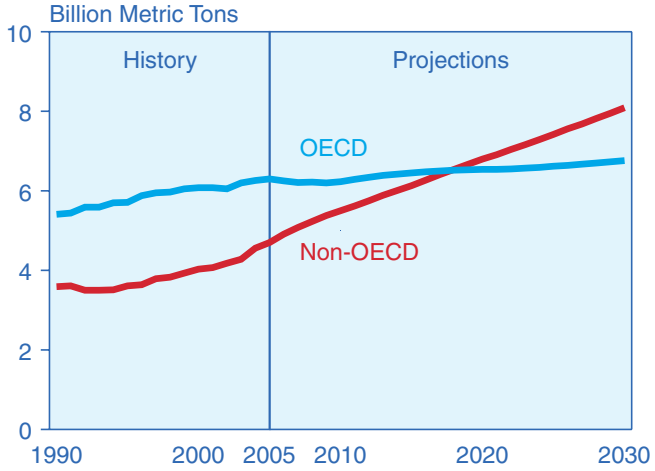
Sources: **2005:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **2030:** EIA, World Energy Projections Plus (2008).

Carbon Dioxide Intensity Measures

Emissions per Dollar of GDP

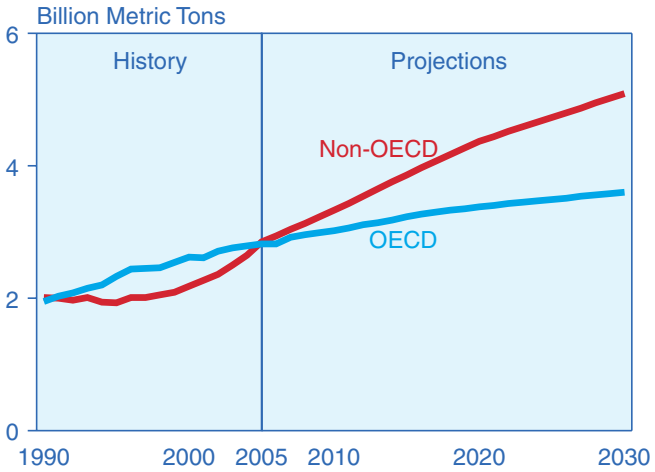
In all countries and regions, energy-related carbon dioxide intensities—expressed in emissions per unit of economic output—are projected to improve (decline) over the projection period as all world economies continue to use energy more efficiently. In 2005, estimated carbon dioxide intensities were 461 metric tons per million dollars of GDP in the OECD countries and 529 metric tons in the non-OECD countries (Table 13).[23]

Figure 80. World Carbon Dioxide Emissions from Liquids Combustion, 1990-2030



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Figure 81. World Carbon Dioxide Emissions from Natural Gas Combustion, 1990-2030

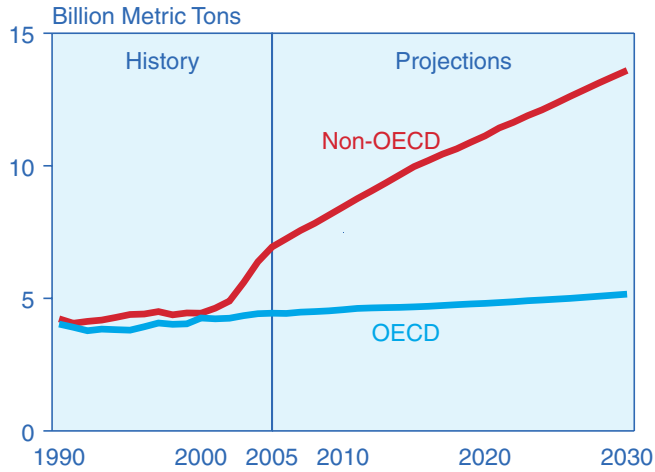


Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Fossil fuel use in the non-OECD countries is projected to increase strongly over the projection period; however, their economic growth is expected to be even stronger. As a result, non-OECD carbon dioxide intensity is projected to decline by an average of 2.6 percent per year, from 529 metric tons per million dollars of GDP in 2005 to 274 metric tons per million dollars of GDP in 2030. In particular, China, with a relatively high projected rate of growth in emissions (3.3 percent per year), has an even higher projected growth rate for GDP (6.4 percent). As a result, its emissions intensity falls from 693 metric tons per million dollars in 2005 to 334 metric tons in 2030.

For all the OECD countries, average carbon dioxide intensity in 2030 is projected to be 296 metric tons per million dollars. OECD Europe is projected to have the lowest carbon dioxide intensity among the OECD economies in 2030, at 241 metric tons per million dollars, followed by Mexico at 247 metric tons and Japan at 262 metric tons. (Mexico's relatively low carbon dioxide intensity results in large part from its projected 3.9-percent annual GDP growth rate, the highest among the OECD countries.) Without carbon dioxide constraints, Canada is projected to have the highest carbon dioxide intensity of the OECD countries in 2030, at 422 metric tons per million dollars, followed by South Korea at 396 metric tons and Australia/New Zealand at 365 metric tons. U.S. carbon dioxide intensity in 2030 is projected to be 339 metric tons per million dollars of GDP. The average for the entire world is projected to fall from 494 metric tons per million dollars of GDP in 2005 to 282 metric tons in 2030.

Figure 82. World Carbon Dioxide Emissions from Coal Combustion, 1990-2030



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

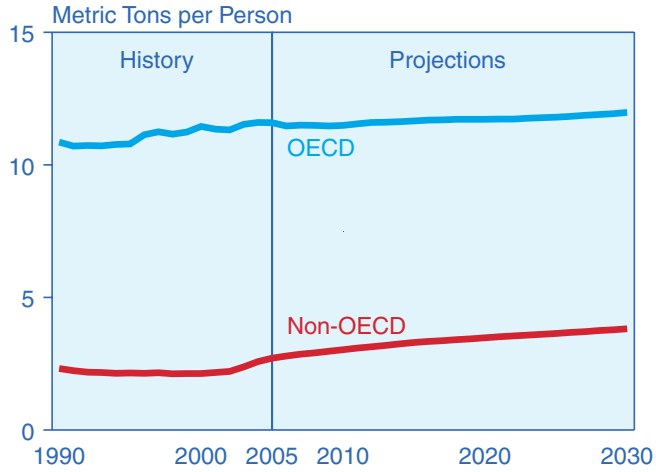
[23]GDP is measured in chain-weighted 2000 dollars converted to the currency of the relevant country or region, based on purchasing power parity.

Emissions per Capita

Another measure of carbon dioxide intensity is emissions per person. Carbon dioxide emissions per capita in the OECD economies are significantly higher (about fourfold in 2005) than in the non-OECD economies (Figure 83). If non-OECD countries consumed as much energy per capita as the OECD countries, the projection for world carbon dioxide emissions in 2030 would be much larger, because the non-OECD countries would consume almost four times more energy than the current reference case estimate of 409 quadrillion Btu. Further, given the expectation that non-OECD countries will rely heavily on fossil fuels to meet their energy needs, the increase in carbon dioxide emissions would be even greater.

Among the non-OECD countries, Russia has the highest projected increase in carbon dioxide emissions per capita in the *IEO2008* reference case, from 12 metric tons per person in 2005 to 17 metric tons in 2030 (Figure 84 and Table 14). A projected decline in Russia's population, averaging 0.6 percent per year from 2005 to 2030,

Figure 83. World Carbon Dioxide Emissions per Capita, 1990-2030



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Table 13. Carbon Dioxide Intensity by Region and Country, 1980-2030
(Metric Tons per Million 2000 U.S. Dollars of Gross Domestic Product)

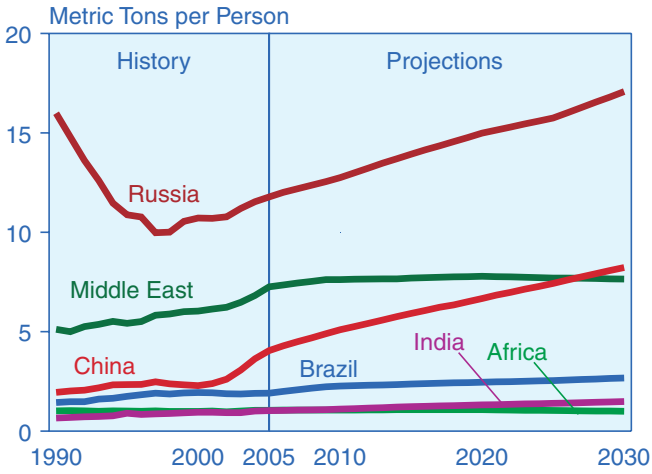
Region	History			Projections					Average Annual Percent Change	
	1980	1990	2005	2010	2015	2020	2025	2030	1990-2005	2005-2030
OECD	**732**	**565**	**461**	**411**	**379**	**347**	**319**	**296**	**-1.3%**	**-1.8%**
United States	916	701	544	483	439	399	366	339	-1.7%	-1.9%
Canada	867	679	607	563	521	486	453	422	-0.7%	-1.4%
Mexico	394	441	381	337	312	288	266	247	-1.0%	-1.7%
Europe	674	508	383	343	318	290	264	241	-1.9%	-1.8%
Japan	482	353	358	316	297	284	273	262	0.1%	-1.2%
South Korea	942	729	670	580	521	464	424	396	-0.6%	-2.1%
Australia/New Zealand	694	679	633	558	500	449	404	365	-0.5%	-2.2%
Non-OECD	**694**	**711**	**529**	**440**	**388**	**344**	**306**	**274**	**-2.0%**	**-2.6%**
Europe/Eurasia	1,019	1,166	804	615	531	469	410	368	-2.4%	-3.1%
Russia	900	1,060	836	649	554	494	432	392	-1.6%	-3.0%
Other	1,215	1,339	762	573	504	440	385	342	-3.7%	-3.2%
Asia	755	624	498	411	363	322	289	261	-1.5%	-2.5%
China	1,959	1,242	693	552	478	421	373	334	-3.8%	-2.9%
India	295	333	287	221	189	165	148	135	-1.0%	-3.0%
Other	400	352	360	313	299	270	246	224	0.1%	-1.9%
Middle East	450	854	903	827	747	679	605	539	0.4%	-2.0%
Africa	398	448	421	362	327	292	255	220	-0.4%	-2.6%
Central and South America	317	310	305	290	262	234	209	187	-0.1%	-1.9%
Brazil	212	211	219	224	208	192	175	162	0.2%	-1.2%
Other	403	398	379	342	303	267	234	205	-0.3%	-2.4%
Total World	**716**	**624**	**494**	**427**	**384**	**345**	**311**	**282**	**-1.6%**	**-2.2%**

Note: GDP is expressed in terms of purchasing power parity.
Sources: **1980-2005:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **2010-2030:** EIA, World Energy Projections Plus (2008).

slows the growth in its total carbon dioxide emissions to an average annual rate of 0.9 percent, but the population decline leads to a higher rate of increase in emissions per capita. The lowest levels of per capita emissions in the world are in India and Africa. For India, emissions per capita are projected to increase by about 50 percent, from 1.0 metric tons per person in 2005 to 1.5 in 2030. For Africa, emissions per capita are projected to remain at about 1 metric ton per person through 2030.

The OECD countries have higher levels of carbon dioxide emissions per capita, in part because of their higher levels of income and fossil fuel use per capita. In the United States, emissions per capita are projected to fall slightly, from 20 metric tons per person in 2005 to 19 metric tons in 2030 (Figure 85). Canada's emissions per capita are projected to rise slightly, from 19 metric tons per person in 2005 to 20 metric tons in 2030, in the absence of binding constraints on carbon dioxide emissions. In Mexico, with the lowest level of per capita emissions among the OECD countries, an increase from 4 metric tons in 2005 to 5 metric tons in 2030 is projected.

Figure 84. Non-OECD Carbon Dioxide Emissions per Capita by Country and Region, 1990-2030



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

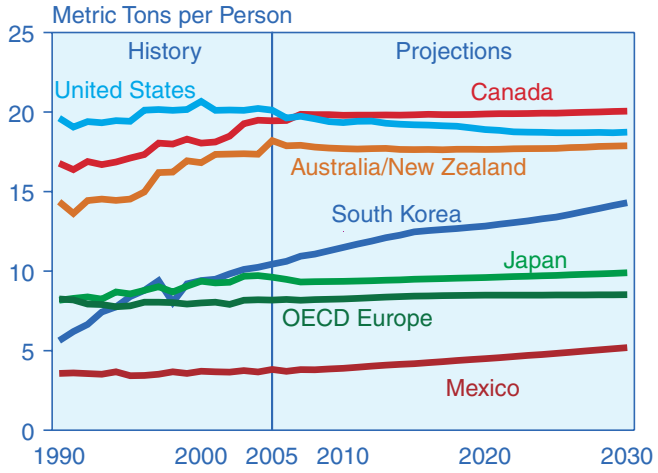
Table 14. Energy-Related Carbon Dioxide Emissions per Capita, 1980-2030
(Metric Tons per Person)

Region	History			Projections					Average Annual Percent Change	
	1980	1990	2005	2010	2015	2020	2025	2030	1990-2005	2005-2030
OECD	**11.3**	**10.9**	**11.6**	**11.5**	**11.7**	**11.7**	**11.8**	**12.0**	**0.4**	**0.1**
United States	20.6	19.6	20.1	19.3	19.2	18.9	18.7	18.7	0.2	-0.3
Canada	18.3	16.8	19.5	19.8	19.8	19.9	19.9	20.1	1.0	0.1
Mexico	3.2	3.6	3.8	3.9	4.2	4.5	4.8	5.2	0.4	1.2
Europe	9.1	8.3	8.2	8.3	8.4	8.5	8.5	8.5	-0.1	0.2
Japan	8.0	8.2	9.6	9.4	9.5	9.6	9.7	9.9	1.1	0.1
South Korea	3.5	5.6	10.4	11.5	12.5	12.8	13.4	14.3	4.2	1.3
Australia/New Zealand	12.3	14.4	18.2	17.7	17.6	17.6	17.7	17.9	1.6	-0.1
Non-OECD	**2.0**	**2.3**	**2.7**	**3.0**	**3.3**	**3.5**	**3.6**	**3.8**	**1.1**	**1.4**
Europe/Eurasia	10.6	12.1	8.4	9.0	9.9	10.5	11.0	11.8	-2.4	1.4
Russia	13.5	16.0	11.8	12.7	13.9	15.0	15.8	17.1	-2.0	1.5
Other	8.4	9.1	5.9	6.4	7.1	7.6	8.0	8.5	-2.9	1.5
Asia	1.0	1.3	2.4	2.8	3.2	3.5	3.8	4.1	4.1	2.2
China	1.5	2.0	4.1	5.1	5.9	6.7	7.4	8.2	5.0	2.9
India	0.4	0.7	1.0	1.1	1.2	1.3	1.4	1.5	3.0	1.5
Other	0.8	1.1	1.7	1.8	2.1	2.2	2.3	2.4	3.2	1.4
Middle East	3.9	5.1	7.3	7.6	7.7	7.8	7.7	7.7	2.4	0.2
Africa	1.0	1.0	1.0	1.1	1.1	1.1	1.0	1.0	0.2	-0.2
Central and South America	2.1	1.9	2.4	2.7	2.8	2.8	2.9	3.0	1.7	0.9
Brazil	1.5	1.4	1.9	2.3	2.4	2.5	2.5	2.7	1.9	1.4
Other	2.5	2.2	2.7	3.0	3.1	3.1	3.1	3.1	1.5	0.6
Total World	**4.1**	**4.0**	**4.3**	**4.5**	**4.7**	**4.8**	**4.9**	**5.1**	**0.5**	**0.7**

Sources: **1980-2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **2010-2030:** EIA, World Energy Projections Plus (2008).

Other factors that can affect carbon dioxide emissions per capita include climate (in general, more energy is used per capita for heating in colder climates than is used for cooling in warmer climates) and population density (densely populated countries use less energy per capita for transportation). For example, Canada has a relatively cold climate with a low population density, and its carbon dioxide emissions in 2005 are estimated at 19.5 metric tons per capita, whereas Japan has a more temperate climate and a much higher population density, and its emissions in 2005 are estimated at 9.6 metric tons per capita—about half the rate for Canada.

Figure 85. OECD Carbon Dioxide Emissions per Capita by Country and Region, 1990-2030



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Alternative Macroeconomic Growth Cases

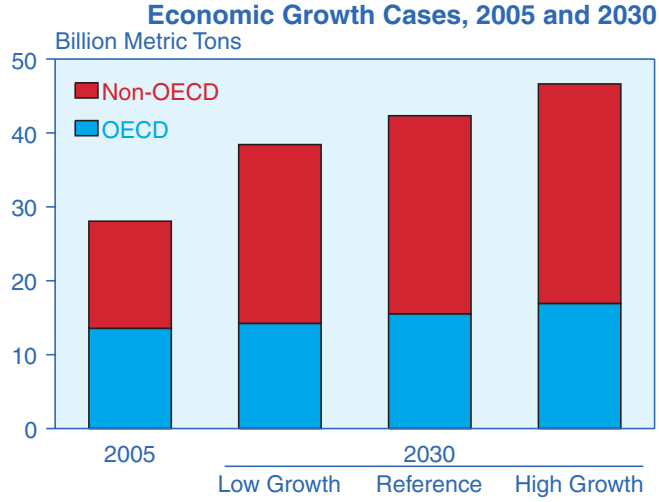
Economic growth is the most significant factor underlying the projections for growth in energy-related carbon dioxide emissions in the mid-term, as the world continues to rely on fossil fuels for most of its energy use. Accordingly, projections of world carbon dioxide emissions are lower in the *IEO2008* low economic growth case and higher in the high economic growth case.

In the high growth case, world carbon dioxide emissions are projected to increase at an average rate of 2.1 percent annually from 2005 to 2030, as compared with 1.7 percent in the reference case. For the OECD countries, the projected average increase is 0.9 percent per year; for the non-OECD countries, the average is 2.9 percent per year. In the low growth case, world carbon dioxide emissions are projected to increase by 1.3 percent per year, with averages of 0.2 percent per year in the OECD countries and 2.1 percent per year in the non-OECD countries (compared with 0.5 percent and 2.5 percent, respectively, in the reference case). Total emissions worldwide are projected to be 38.4 billion metric tons in 2030 in the low growth case and 46.6 billion metric tons in the high growth case—21 percent higher than projected in the low growth case (Figure 86). The projections for emissions by fuel show similar variations across the cases.

Alternative Price Cases

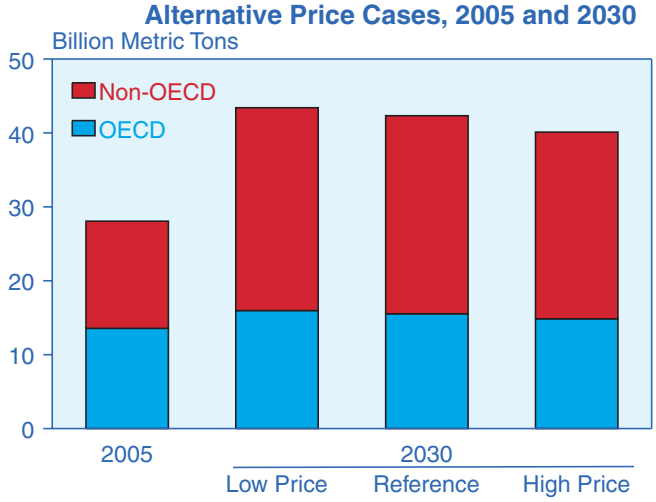
The projections for carbon dioxide emissions in the *IEO2008* low and high price cases (Figure 87) show smaller variations from the reference case than do those in the alternative macroeconomic growth cases. In 2030,

Figure 86. Carbon Dioxide Emissions in Three Economic Growth Cases, 2005 and 2030



Sources: **2005:** Energy Information Administration, *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **2030:** Energy Information Administration, World Energy Projections Plus (2008).

Figure 87. Carbon Dioxide Emissions in Three Alternative Price Cases, 2005 and 2030



Sources: **2005:** Energy Information Administration, *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **2030:** Energy Information Administration, World Energy Projections Plus (2008).

as compared with the reference case projection (42.3 billion metric tons), total carbon dioxide emissions are projected to be higher in the low price case (43.4 billion metric tons) and lower in the high price case (40.1 billion metric tons). Thus, there is an 8-percent difference between the projections in the two alternative world oil price cases, as compared with a 21-percent difference between the alternative macroeconomic growth cases.

In the alternative price cases, world oil and natural gas prices are affected more strongly than coal prices. As a result (and in the absence of policies to limit the use of coal), in the high price case both liquids and natural gas lose global market share to coal relative to the reference case projection. In the *IEO2008* reference case, coal's share of total energy use is projected to increase to 29 percent in 2030; in the high price case, its share increases to 30 percent; and in the low price case, its share drops to 27 percent in 2030.

Prices have the greatest impact on world liquids consumption and the associated carbon dioxide emissions. In the high price case, where nominal world oil prices reach $186 per barrel in 2030, nations choose alternative fuels over liquids wherever possible, so that liquids-related emissions total 13.1 billion metric tons in 2030, down from 14.9 billion metric tons in the reference case. In the low price case, world oil prices decline to $69 per barrel in 2030, substantially lower than the $113 per barrel projected in the reference case and providing little economic incentive for nations to turn to other forms of energy. Consequently, liquids-related emissions in 2030 in the low price case, at 16.2 billion metric tons, are 1.3 billion metric tons higher than projected in the reference case.

The impact of high prices on natural gas use is smaller than the impact on liquids consumption, but a similar trend away from natural gas to other fuels, particularly coal, is projected. In the high price case, world carbon dioxide emissions from natural gas combustion in 2030 total 8.3 billion metric tons, down from 8.7 billion metric tons in the reference case. In the low price case, natural-gas-related emissions in 2030 are projected to total 9.2 billion metric tons.

Appendix A

Reference Case Projections:

- World Energy Consumption
- Gross Domestic Product
- Carbon Dioxide Emissions
- World Population

Table A1. World Total Primary Energy Consumption by Region, Reference Case, 1990-2030
(Quadrillion Btu)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**100.7**	**120.6**	**121.3**	**126.4**	**132.3**	**137.8**	**143.4**	**148.9**	**0.8**
United States[a]	84.7	100.1	100.1	103.3	107.3	110.8	114.5	118.0	0.7
Canada	11.0	14.0	14.3	15.7	16.7	17.6	18.4	19.3	1.2
Mexico	5.0	6.5	6.9	7.4	8.4	9.4	10.4	11.6	2.1
OECD Europe	**70.0**	**81.0**	**81.4**	**83.9**	**86.8**	**88.5**	**90.4**	**92.0**	**0.5**
OECD Asia	**26.8**	**37.8**	**38.2**	**39.3**	**41.4**	**42.7**	**43.7**	**44.9**	**0.7**
Japan	18.5	22.7	22.6	22.4	22.9	23.1	23.3	23.4	0.1
South Korea	3.8	9.0	9.3	10.3	11.6	12.4	13.0	13.7	1.6
Australia/New Zealand	4.5	6.1	6.3	6.6	6.9	7.2	7.5	7.8	0.8
Total OECD	**197.5**	**239.4**	**240.9**	**249.7**	**260.5**	**269.0**	**277.6**	**285.9**	**0.7**
Non-OECD									
Non-OECD Europe and Eurasia	**67.3**	**49.5**	**50.7**	**55.1**	**59.5**	**63.3**	**66.0**	**69.1**	**1.2**
Russia	39.4	29.9	30.3	32.7	34.9	36.7	38.0	39.6	1.1
Other	28.0	19.6	20.4	22.4	24.5	26.5	28.0	29.4	1.5
Non-OECD Asia	**47.4**	**101.0**	**109.9**	**137.1**	**164.2**	**189.4**	**215.3**	**240.8**	**3.2**
China	27.0	59.9	67.1	87.3	104.0	120.6	138.0	155.2	3.4
India	7.9	15.5	16.2	19.4	23.2	26.6	29.9	33.2	2.9
Other Non-OECD Asia	12.5	25.6	26.6	30.5	37.0	42.2	47.3	52.4	2.7
Middle East	**11.2**	**20.9**	**22.9**	**26.4**	**29.5**	**32.6**	**34.7**	**36.8**	**1.9**
Africa	**9.5**	**14.0**	**14.4**	**16.5**	**18.9**	**20.9**	**22.5**	**23.9**	**2.0**
Central and South America	**14.5**	**22.5**	**23.4**	**27.7**	**30.5**	**33.2**	**35.7**	**38.3**	**2.0**
Brazil	5.7	9.0	9.3	11.1	12.6	14.1	15.5	17.0	2.4
Other Central and South America	8.8	13.5	14.1	16.6	17.9	19.1	20.3	21.3	1.7
Total Non-OECD	**149.9**	**207.9**	**221.3**	**262.8**	**302.5**	**339.4**	**374.2**	**408.8**	**2.5**
Total World	**347.4**	**447.3**	**462.2**	**512.5**	**563.0**	**608.4**	**651.8**	**694.7**	**1.6**

[a]Includes the 50 States and the District of Columbia.

Notes: Energy totals include net imports of coal coke and electricity generated from biomass in the United States. Totals may not equal sum of components due to independent rounding. The electricity portion of the national fuel consumption values consists of generation for domestic use plus an adjustment for electricity trade based on a fuel's share of total generation in the exporting country.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run AEO2008.D030208F, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table A2. World Total Energy Consumption by Region and Fuel, Reference Case, 1990-2030
(Quadrillion Btu)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America									
Liquids	40.5	48.9	49.1	49.4	51.4	52.3	53.4	55.2	0.5
Natural Gas	23.2	28.1	28.0	29.8	31.0	31.6	32.1	32.8	0.6
Coal	20.6	24.5	24.8	25.3	26.5	28.3	30.2	32.4	1.1
Nuclear	6.9	9.3	9.3	9.7	9.8	10.5	11.0	11.2	0.8
Other	9.5	9.8	10.2	12.2	13.6	15.2	16.7	17.3	2.1
Total	**100.7**	**120.6**	**121.3**	**126.4**	**132.3**	**137.8**	**143.4**	**148.9**	**0.8**
OECD Europe									
Liquids	28.4	32.0	32.1	31.9	32.8	33.0	33.1	33.2	0.1
Natural Gas	11.2	19.4	19.9	21.3	23.5	25.5	26.7	28.0	1.4
Coal	17.7	13.3	13.2	13.8	13.7	13.3	13.0	12.6	-0.2
Nuclear	7.9	9.9	9.8	9.6	9.5	8.7	9.0	9.3	-0.2
Other	4.8	6.3	6.5	7.2	7.3	7.9	8.6	9.0	1.3
Total	**70.0**	**81.0**	**81.4**	**83.9**	**86.8**	**88.5**	**90.4**	**92.0**	**0.5**
OECD Asia									
Liquids	14.7	17.3	17.5	17.2	17.9	18.3	18.5	18.8	0.3
Natural Gas	2.9	5.6	5.6	6.2	6.8	7.1	7.3	7.5	1.2
Coal	5.2	9.2	9.3	9.6	9.6	9.6	9.7	10.0	0.3
Nuclear	2.5	4.0	4.2	4.5	5.0	5.5	5.9	6.3	1.6
Other	1.6	1.8	1.6	1.9	2.0	2.1	2.2	2.4	1.7
Total	**26.8**	**37.8**	**38.2**	**39.3**	**41.4**	**42.7**	**43.7**	**44.9**	**0.7**
Total OECD									
Liquids	83.6	98.2	98.7	98.5	102.1	103.7	105.1	107.2	0.3
Natural Gas	37.2	53.1	53.4	57.3	61.2	64.1	66.1	68.3	1.0
Coal	43.5	47.0	47.3	48.7	49.9	51.2	52.9	55.0	0.6
Nuclear	17.3	23.1	23.2	23.8	24.3	24.8	26.0	26.8	0.6
Other	15.9	17.9	18.2	21.3	22.9	25.2	27.5	28.7	1.8
Total	**197.5**	**239.4**	**240.9**	**249.7**	**260.5**	**269.0**	**277.6**	**285.9**	**0.7**
Non-OECD									
Non-OECD Europe and Eurasia									
Liquids	19.6	9.8	10.0	11.3	12.1	12.9	13.6	14.2	1.4
Natural Gas	27.5	25.1	26.0	28.1	30.0	31.8	32.8	34.4	1.1
Coal	15.1	8.7	8.8	8.9	10.0	10.4	10.5	11.2	0.9
Nuclear	2.5	2.9	2.8	3.1	3.5	4.4	5.1	5.2	2.5
Other	2.8	3.0	3.1	3.7	3.8	3.8	4.0	4.1	1.1
Total	**67.3**	**49.5**	**50.7**	**55.1**	**59.5**	**63.3**	**66.0**	**69.1**	**1.2**
Non-OECD Asia									
Liquids	14.0	30.5	31.5	37.5	43.9	50.2	56.5	63.6	2.8
Natural Gas	3.0	8.9	9.8	13.3	17.7	22.3	25.8	28.9	4.4
Coal	27.0	54.9	60.9	76.4	90.7	102.6	115.4	128.2	3.0
Nuclear	0.4	1.1	1.1	1.6	3.1	4.7	6.0	6.8	7.5
Other	3.0	5.6	6.6	8.4	8.8	9.6	11.5	13.3	2.8
Total	**47.4**	**101.0**	**109.9**	**137.1**	**164.2**	**189.4**	**215.3**	**240.8**	**3.2**

See notes at end of table.

Table A2. World Total Energy Consumption by Region and Fuel, Reference Case, 1990-2030 (Continued)
(Quadrillion Btu)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
Non-OECD (Continued)									
Middle East									
Liquids	7.2	11.3	12.0	14.0	15.3	16.9	18.2	19.5	2.0
Natural Gas	3.8	9.0	10.2	11.7	13.4	14.9	15.7	16.4	1.9
Coal	0.1	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.7
Nuclear	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	—
Other	0.1	0.2	0.2	0.3	0.3	0.3	0.3	0.4	2.4
Total	**11.2**	**20.9**	**22.9**	**26.4**	**29.5**	**32.6**	**34.7**	**36.8**	**1.9**
Africa									
Liquids	4.3	5.8	6.0	7.0	7.5	8.1	8.5	8.8	1.6
Natural Gas	1.5	2.8	3.2	3.8	4.9	6.0	6.7	7.5	3.5
Coal	3.0	4.3	4.2	4.4	5.1	5.3	5.6	5.6	1.1
Nuclear	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	2.2
Other	0.6	0.9	0.9	1.1	1.2	1.3	1.5	1.8	2.7
Total	**9.5**	**14.0**	**14.4**	**16.5**	**18.9**	**20.9**	**22.5**	**23.9**	**2.0**
Central and South America									
Liquids	7.8	11.0	11.2	12.9	13.5	14.3	15.1	16.0	1.4
Natural Gas	2.2	4.4	4.7	6.0	7.1	7.9	8.6	9.3	2.7
Coal	0.6	0.8	0.9	1.3	1.6	1.7	1.8	1.9	3.1
Nuclear	0.1	0.2	0.2	0.2	0.3	0.4	0.4	0.4	2.9
Other	3.9	6.1	6.4	7.1	7.9	9.0	9.9	10.8	2.1
Total	**14.5**	**22.5**	**23.4**	**27.7**	**30.5**	**33.2**	**35.7**	**38.3**	**2.0**
Total Non-OECD									
Liquids	52.9	68.4	70.8	82.6	92.3	102.4	111.9	122.1	2.2
Natural Gas	38.0	50.2	53.9	63.0	73.1	82.8	89.6	96.4	2.4
Coal	45.7	69.1	75.2	91.5	107.9	120.5	133.8	147.3	2.7
Nuclear	3.1	4.3	4.2	5.1	7.1	9.7	11.8	12.6	4.5
Other	10.3	15.9	17.2	20.7	22.1	24.0	27.2	30.3	2.3
Total	**149.9**	**207.9**	**221.3**	**262.8**	**302.5**	**339.4**	**374.2**	**408.8**	**2.5**
Total World									
Liquids	136.4	166.6	169.4	181.1	194.4	206.1	216.9	229.3	1.2
Natural Gas	75.2	103.3	107.4	120.3	134.4	146.9	155.8	164.7	1.7
Coal	89.2	116.1	122.5	140.2	157.8	171.7	186.7	202.2	2.0
Nuclear	20.4	27.4	27.5	28.8	31.4	34.5	37.7	39.4	1.5
Other	26.2	33.8	35.5	42.0	45.0	49.3	54.7	59.0	2.1
Total	**347.4**	**447.3**	**462.2**	**512.5**	**563.0**	**608.4**	**651.8**	**694.7**	**1.6**

Notes: Energy totals include net imports of coal coke and electricity generated from biomass in the United States. Totals may not equal sum of components due to independent rounding. The electricity portion of the national fuel consumption values consists of generation for domestic use plus an adjustment for electricity trade based on a fuel's share of total generation in the exporting country.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run AEO2008.D030208F, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table A3. World Gross Domestic Product (GDP) by Region Expressed in Purchasing Power Parity, Reference Case, 1990-2030
(Billion 2000 Dollars)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**8,477**	**12,696**	**13,083**	**14,913**	**17,088**	**19,366**	**21,886**	**24,772**	**2.6**
United States[a]	7,113	10,676	11,004	12,453	14,199	15,984	17,951	20,219	2.5
Canada	684	1,004	1,034	1,187	1,339	1,498	1,668	1,858	2.4
Mexico	680	1,016	1,045	1,273	1,550	1,884	2,266	2,695	3.9
OECD Europe	**8,067**	**11,197**	**11,445**	**13,150**	**14,710**	**16,395**	**18,184**	**20,076**	**2.3**
OECD Asia	**3,621**	**4,775**	**4,887**	**5,565**	**6,168**	**6,674**	**7,166**	**7,694**	**1.8**
Japan	2,862	3,377	3,440	3,788	4,045	4,212	4,338	4,467	1.1
South Korea	331	715	745	963	1,175	1,360	1,550	1,749	3.5
Australia/New Zealand	429	683	702	814	948	1,102	1,278	1,477	3.0
Total OECD	**20,165**	**28,667**	**29,415**	**33,627**	**37,965**	**42,436**	**47,236**	**52,542**	**2.3**
Non-OECD									
Non-OECD Europe and Eurasia	**3,601**	**3,340**	**3,563**	**4,985**	**6,268**	**7,488**	**8,840**	**10,362**	**4.4**
Russia	2,241	1,907	2,029	2,754	3,433	4,020	4,671	5,404	4.0
Other	1,360	1,433	1,534	2,231	2,835	3,468	4,169	4,957	4.8
Non-OECD Asia	**5,792**	**15,102**	**16,436**	**24,780**	**33,468**	**43,245**	**54,322**	**66,955**	**5.8**
China	1,805	6,961	7,685	12,502	17,183	22,532	28,811	35,973	6.4
India	1,697	3,714	4,056	6,092	8,476	11,036	13,647	16,524	5.8
Other Non-OECD Asia	2,291	4,428	4,695	6,186	7,809	9,677	11,863	14,458	4.6
Middle East	**820**	**1,466**	**1,550**	**1,961**	**2,414**	**2,926**	**3,504**	**4,174**	**4.0**
Africa	**1,450**	**2,182**	**2,295**	**3,014**	**3,798**	**4,672**	**5,690**	**6,891**	**4.5**
Central and South America	**2,162**	**3,372**	**3,535**	**4,515**	**5,464**	**6,533**	**7,784**	**9,259**	**3.9**
Brazil	1,022	1,581	1,627	2,012	2,393	2,823	3,320	3,896	3.6
Other Central and South America	1,140	1,791	1,908	2,503	3,071	3,710	4,464	5,362	4.2
Total Non-OECD	**13,824**	**25,462**	**27,378**	**39,255**	**51,413**	**64,864**	**80,141**	**97,640**	**5.2**
Total World	**33,989**	**54,129**	**56,793**	**72,882**	**89,378**	**107,299**	**127,377**	**150,182**	**4.0**

[a]Includes the 50 States and the District of Columbia.

Notes: Totals may not equal sum of components due to independent rounding. GDP growth rates for China and India were adjusted, based on the analyst's judgment.

Sources: **History:** Global Insight, Inc., *World Overview* (Lexington, MA, various issues). **Projections:** Global Insight, Inc., *World Overview*, Fourth Quarter 2007 (Lexington, MA, January 2008); and EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run AEO2008.D030208F, web site www.eia.doe.gov/oiaf/aeo.

Table A4. World Gross Domestic Product (GDP) by Region Expressed in Market Exchange Rates, Reference Case, 1990-2030
(Billion 2000 Dollars)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**8,070**	**12,091**	**12,460**	**14,170**	**16,205**	**18,320**	**20,655**	**23,334**	**2.5**
United States[a]	7,113	10,676	11,004	12,453	14,199	15,984	17,951	20,219	2.5
Canada	543	797	822	943	1,064	1,190	1,325	1,476	2.4
Mexico	414	618	635	774	942	1,146	1,378	1,639	3.9
OECD Europe	**6,878**	**9,436**	**9,620**	**10,943**	**12,135**	**13,412**	**14,754**	**16,160**	**2.1**
OECD Asia	**4,743**	**6,002**	**6,133**	**6,906**	**7,559**	**8,072**	**8,547**	**9,052**	**1.6**
Japan	4,144	4,887	4,978	5,481	5,854	6,095	6,278	6,465	1.1
South Korea	284	614	639	826	1,008	1,167	1,330	1,500	3.5
Australia/New Zealand	316	502	515	598	697	810	939	1,086	3.0
Total OECD	**19,690**	**27,529**	**28,214**	**32,019**	**35,898**	**39,804**	**43,955**	**48,546**	**2.2**
Non-OECD									
Non-OECD Europe and Eurasia	**700**	**656**	**699**	**971**	**1,217**	**1,452**	**1,713**	**2,006**	**4.3**
Russia	386	329	350	474	591	693	805	931	4.0
Other	314	327	349	497	625	760	908	1,075	4.6
Non-OECD Asia	**1,478**	**3,784**	**4,100**	**6,088**	**8,134**	**10,432**	**13,045**	**16,022**	**5.6**
China	445	1,715	1,893	3,080	4,233	5,551	7,098	8,863	6.4
India	274	599	655	983	1,368	1,781	2,203	2,667	5.8
Other Non-OECD Asia	760	1,469	1,552	2,025	2,533	3,099	3,744	4,492	4.3
Middle East	**397**	**723**	**769**	**988**	**1,223**	**1,485**	**1,783**	**2,121**	**4.1**
Africa	**488**	**707**	**745**	**981**	**1,234**	**1,513**	**1,839**	**2,222**	**4.5**
Central and South America	**1,112**	**1,675**	**1,760**	**2,257**	**2,742**	**3,286**	**3,924**	**4,681**	**4.0**
Brazil	500	717	738	913	1,085	1,280	1,506	1,767	3.6
Other Central and South America	612	958	1,022	1,345	1,657	2,005	2,419	2,914	4.3
Total Non-OECD	**4,176**	**7,544**	**8,072**	**11,286**	**14,550**	**18,168**	**22,303**	**27,053**	**5.0**
Total World	**23,866**	**35,073**	**36,286**	**43,305**	**50,448**	**57,972**	**66,258**	**75,598**	**3.0**

[a]Includes the 50 States and the District of Columbia.

Note: Totals may not equal sum of components due to independent rounding. GDP growth rates for China and India were adjusted, based on the analyst's judgment.

Sources: **History:** Global Insight, Inc., *World Overview* (Lexington, MA, various issues). **Projections:** Global Insight, Inc., *World Overview*, Fourth Quarter 2007 (Lexington, MA, January 2008); and EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), Table A19.

Table A5. World Liquids Consumption by Region, Reference Case, 1990-2030
(Million Barrels Oil Equivalent per Day)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**20.5**	**25.0**	**25.2**	**25.3**	**26.2**	**26.7**	**27.2**	**28.0**	**0.4**
United States[a]	17.0	20.7	20.8	20.7	21.4	21.6	21.8	22.3	0.3
Canada	1.7	2.3	2.3	2.4	2.5	2.5	2.6	2.6	0.6
Mexico	1.8	2.0	2.1	2.2	2.4	2.6	2.8	3.1	1.6
OECD Europe	**13.7**	**15.5**	**15.5**	**15.4**	**15.9**	**16.0**	**16.0**	**16.0**	**0.1**
OECD Asia	**7.2**	**8.5**	**8.6**	**8.4**	**8.8**	**9.0**	**9.1**	**9.2**	**0.3**
Japan	5.3	5.3	5.4	5.0	5.0	5.0	5.0	4.9	-0.4
South Korea	1.0	2.2	2.2	2.4	2.6	2.7	2.9	3.0	1.3
Australia/New Zealand	0.8	1.0	1.1	1.1	1.2	1.2	1.3	1.3	0.9
Total OECD	**41.4**	**49.0**	**49.3**	**49.1**	**50.9**	**51.6**	**52.2**	**53.3**	**0.3**
Non-OECD									
Non-OECD Europe and Eurasia	**9.4**	**4.8**	**4.8**	**5.5**	**5.9**	**6.3**	**6.6**	**6.9**	**1.4**
Russia	5.4	2.8	2.8	3.0	3.2	3.3	3.4	3.5	0.9
Other	3.9	2.0	2.1	2.5	2.7	2.9	3.2	3.4	2.0
Non-OECD Asia	**6.6**	**14.8**	**15.3**	**18.1**	**21.2**	**24.3**	**27.4**	**30.8**	**2.9**
China	2.3	6.4	6.7	8.8	10.0	11.7	13.6	15.7	3.4
India	1.2	2.4	2.4	2.7	3.3	3.8	4.3	4.9	2.8
Other Non-OECD Asia	3.1	6.0	6.1	6.6	7.9	8.7	9.5	10.3	2.1
Middle East	**3.5**	**5.5**	**5.9**	**6.8**	**7.5**	**8.2**	**8.9**	**9.5**	**2.0**
Africa	**2.1**	**2.8**	**2.9**	**3.4**	**3.7**	**4.0**	**4.1**	**4.3**	**1.6**
Central and South America	**3.8**	**5.4**	**5.5**	**6.3**	**6.6**	**7.0**	**7.3**	**7.8**	**1.4**
Brazil	1.5	2.1	2.2	2.5	2.6	2.8	3.0	3.3	1.7
Other Central and South America	2.3	3.2	3.3	3.8	3.9	4.1	4.3	4.5	1.3
Total Non-OECD	**25.3**	**33.3**	**34.3**	**40.1**	**44.8**	**49.7**	**54.3**	**59.3**	**2.2**
Total World	**66.6**	**82.3**	**83.6**	**89.2**	**95.7**	**101.3**	**106.5**	**112.5**	**1.2**

[a]Includes the 50 States and the District of Columbia.

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

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run AEO2008.D030208F, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table A6. World Natural Gas Consumption by Region, Reference Case, 1990-2030
(Trillion Cubic Feet)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**22.5**	**27.4**	**27.4**	**28.9**	**30.0**	**30.6**	**31.1**	**31.7**	**0.6**
United States[a]	19.2	22.4	22.2	23.2	23.7	23.3	23.0	22.7	0.1
Canada	2.4	3.3	3.4	3.7	4.0	4.3	4.6	5.0	1.5
Mexico	0.9	1.7	1.7	2.0	2.4	2.9	3.4	4.0	3.4
OECD Europe	**11.6**	**18.9**	**19.3**	**20.7**	**22.8**	**24.7**	**26.0**	**27.2**	**1.4**
OECD Asia	**2.8**	**5.2**	**5.2**	**5.8**	**6.4**	**6.6**	**6.9**	**7.0**	**1.2**
Japan	1.9	3.1	3.1	3.3	3.5	3.6	3.7	3.7	0.7
South Korea	0.1	1.0	1.1	1.3	1.6	1.7	1.8	1.8	2.2
Australia/New Zealand	0.8	1.1	1.1	1.2	1.2	1.3	1.4	1.5	1.3
Total OECD	**36.8**	**51.6**	**51.9**	**55.4**	**59.2**	**61.9**	**63.9**	**65.9**	**1.0**
Non-OECD									
Non-OECD Europe and Eurasia	**26.7**	**24.4**	**25.3**	**27.3**	**29.2**	**30.9**	**31.9**	**33.4**	**1.1**
Russia	17.3	16.0	16.2	17.3	18.4	19.1	19.7	20.5	1.0
Other	9.5	8.4	9.1	10.0	10.8	11.7	12.2	12.9	1.4
Non-OECD Asia	**2.9**	**8.5**	**9.3**	**12.6**	**16.8**	**21.2**	**24.4**	**27.4**	**4.4**
China	0.5	1.4	1.7	2.7	3.9	5.0	5.7	6.4	5.5
India	0.4	1.1	1.3	1.8	2.4	2.9	3.5	3.9	4.6
Other Non-OECD Asia	2.0	6.1	6.4	8.1	10.5	13.3	15.2	17.1	4.0
Middle East	**3.6**	**8.6**	**9.8**	**11.2**	**12.8**	**14.2**	**14.9**	**15.7**	**1.9**
Africa	**1.4**	**2.6**	**3.0**	**3.6**	**4.5**	**5.6**	**6.3**	**7.0**	**3.5**
Central and South America	**2.0**	**4.1**	**4.4**	**5.6**	**6.7**	**7.4**	**8.1**	**8.7**	**2.8**
Brazil	0.1	0.6	0.7	1.0	1.2	1.4	1.6	1.8	4.2
Other Central and South America	1.9	3.5	3.7	4.6	5.4	6.0	6.5	6.9	2.4
Total Non-OECD	**36.5**	**48.2**	**51.8**	**60.3**	**70.0**	**79.1**	**85.6**	**92.1**	**2.3**
Total World	**73.4**	**99.8**	**103.7**	**115.7**	**129.2**	**141.1**	**149.5**	**158.0**	**1.7**

[a]Includes the 50 States and the District of Columbia.

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

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run AEO2008.D030208F, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table A7. World Coal Consumption by Region, Reference Case, 1990-2030
(Quadrillion Btu)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**20.6**	**24.5**	**24.8**	**25.3**	**26.5**	**28.3**	**30.2**	**32.4**	**1.1**
United States[a]	19.2	22.6	22.8	23.0	24.2	25.9	27.7	29.9	1.1
Canada	1.2	1.6	1.7	1.8	1.9	1.9	2.0	2.0	0.7
Mexico	0.2	0.3	0.4	0.4	0.5	0.5	0.5	0.5	1.3
OECD Europe	**17.7**	**13.3**	**13.2**	**13.8**	**13.7**	**13.3**	**13.0**	**12.6**	**-0.2**
OECD Asia	**5.2**	**9.2**	**9.3**	**9.6**	**9.6**	**9.6**	**9.7**	**10.0**	**0.3**
Japan	2.7	4.8	4.6	4.5	4.4	4.3	4.2	4.2	-0.4
South Korea	1.0	2.1	2.1	2.4	2.6	2.6	2.6	2.8	1.1
Australia/New Zealand	1.5	2.4	2.6	2.6	2.7	2.8	2.9	3.0	0.6
Total OECD	**43.5**	**47.0**	**47.3**	**48.7**	**49.9**	**51.2**	**52.9**	**55.0**	**0.6**
Non-OECD									
Non-OECD Europe and Eurasia	**15.1**	**8.7**	**8.8**	**8.9**	**10.0**	**10.4**	**10.5**	**11.2**	**0.9**
Russia	7.2	4.6	4.8	4.8	5.0	5.3	5.2	5.7	0.7
Other	7.9	4.1	4.0	4.1	5.0	5.0	5.3	5.5	1.2
Non-OECD Asia	**27.0**	**54.9**	**60.9**	**76.4**	**90.7**	**102.6**	**115.4**	**128.2**	**3.0**
China	20.3	41.4	46.9	60.3	72.1	82.5	93.2	103.4	3.2
India	4.2	8.4	8.6	9.9	11.6	12.9	14.1	15.5	2.4
Other Non-OECD Asia	2.6	5.1	5.3	6.1	7.0	7.2	8.2	9.3	2.3
Middle East	**0.1**	**0.4**	**0.4**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.7**
Africa	**3.0**	**4.3**	**4.2**	**4.4**	**5.1**	**5.3**	**5.6**	**5.6**	**1.1**
Central and South America	**0.6**	**0.8**	**0.9**	**1.3**	**1.6**	**1.7**	**1.8**	**1.9**	**3.1**
Brazil	0.3	0.5	0.4	0.8	1.0	1.1	1.1	1.2	4.1
Other Central and South America	0.2	0.4	0.4	0.5	0.7	0.7	0.7	0.7	1.8
Total Non-OECD	**45.7**	**69.1**	**75.2**	**91.5**	**107.9**	**120.5**	**133.8**	**147.3**	**2.7**
Total World	**89.2**	**116.1**	**122.5**	**140.2**	**157.8**	**171.7**	**186.7**	**202.2**	**2.0**

[a]Includes the 50 States and the District of Columbia.

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

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run AEO2008.D030208F, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table A8. World Nuclear Energy Consumption by Region, Reference Case, 1990-2030
(Billion Kilowatthours)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**649**	**883**	**880**	**917**	**931**	**998**	**1,048**	**1,063**	**0.8**
United States[a]	577	789	782	797	807	868	911	917	0.6
Canada	69	86	87	110	113	120	127	135	1.7
Mexico	3	9	10	11	11	11	11	11	0.1
OECD Europe	**743**	**941**	**929**	**914**	**902**	**829**	**854**	**879**	**-0.2**
OECD Asia	**242**	**392**	**418**	**440**	**494**	**546**	**583**	**624**	**1.6**
Japan	192	268	278	299	319	336	358	381	1.3
South Korea	50	124	139	142	175	210	225	243	2.2
Australia/New Zealand	0	0	0	0	0	0	0	0	—
Total OECD	**1,635**	**2,216**	**2,227**	**2,271**	**2,326**	**2,373**	**2,485**	**2,565**	**0.6**
Non-OECD									
Non-OECD Europe and Eurasia	**219**	**263**	**264**	**289**	**327**	**409**	**472**	**485**	**2.5**
Russia	115	137	140	155	190	236	293	305	3.2
Other	104	125	124	134	136	172	180	180	1.5
Non-OECD Asia	**38**	**103**	**106**	**150**	**293**	**446**	**573**	**643**	**7.5**
China	0	48	50	65	164	267	351	410	8.8
India	6	15	16	37	66	104	134	149	9.4
Other Non-OECD Asia	32	40	40	47	64	75	88	84	3.0
Middle East	**0**	**0**	**0**	**0**	**6**	**6**	**6**	**6**	**—**
Africa	**8**	**14**	**12**	**14**	**15**	**15**	**21**	**21**	**2.2**
Central and South America	**9**	**19**	**16**	**23**	**28**	**34**	**34**	**34**	**2.0**
Brazil	2	12	10	15	18	22	22	22	1.8
Other Central and South America	7	7	6	8	10	12	11	11	2.4
Total Non-OECD	**274**	**399**	**399**	**476**	**669**	**910**	**1,106**	**1,189**	**4.4**
Total World	**1,909**	**2,615**	**2,626**	**2,747**	**2,996**	**3,283**	**3,591**	**3,754**	**1.4**

[a]Includes the 50 States and the District of Columbia.

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

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run AEO2008.D030208F, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table A9. World Consumption of Hydroelectricity and Other Renewable Energy by Region, Reference Case, 1990-2030
(Quadrillion Btu)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**9.5**	**9.8**	**10.2**	**12.2**	**13.6**	**15.2**	**16.7**	**17.3**	**2.1**
United States[a]	6.1	6.0	6.0	7.6	8.5	9.7	10.9	11.2	2.5
Canada	3.1	3.5	3.7	4.1	4.6	4.9	5.2	5.5	1.6
Mexico	0.3	0.4	0.4	0.5	0.6	0.6	0.6	0.6	1.5
OECD Europe	**4.8**	**6.3**	**6.5**	**7.2**	**7.3**	**7.9**	**8.6**	**9.0**	**1.3**
OECD Asia	**1.6**	**1.8**	**1.6**	**1.9**	**2.0**	**2.1**	**2.2**	**2.4**	**1.7**
Japan	1.1	1.2	1.0	1.2	1.3	1.4	1.4	1.5	1.5
South Korea	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.3	7.7
Australia/New Zealand	0.4	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.8
Total OECD	**15.9**	**17.9**	**18.2**	**21.3**	**22.9**	**25.2**	**27.5**	**28.7**	**1.8**
Non-OECD									
Non-OECD Europe and Eurasia	**2.8**	**3.0**	**3.1**	**3.7**	**3.8**	**3.8**	**4.0**	**4.1**	**1.1**
Russia	1.8	1.8	1.8	2.3	2.3	2.3	2.3	2.3	1.1
Other	1.0	1.3	1.3	1.4	1.5	1.5	1.7	1.7	1.1
Non-OECD Asia	**3.0**	**5.6**	**6.6**	**8.4**	**8.8**	**9.6**	**11.5**	**13.3**	**2.8**
China	1.3	3.3	4.0	5.1	5.3	5.5	6.8	8.1	2.8
India	0.7	0.9	1.1	1.5	1.5	1.6	1.8	1.9	2.4
Other Non-OECD Asia	0.9	1.4	1.6	1.8	2.0	2.5	2.9	3.3	3.1
Middle East	**0.1**	**0.2**	**0.2**	**0.3**	**0.3**	**0.3**	**0.3**	**0.4**	**2.4**
Africa	**0.6**	**0.9**	**0.9**	**1.1**	**1.2**	**1.3**	**1.5**	**1.8**	**2.7**
Central and South America	**3.9**	**6.1**	**6.4**	**7.1**	**7.9**	**9.0**	**9.9**	**10.8**	**2.1**
Brazil	2.2	3.4	3.5	4.0	4.8	5.5	6.3	7.0	2.8
Other Central and South America	1.7	2.8	2.9	3.1	3.2	3.4	3.6	3.8	1.1
Total Non-OECD	**10.3**	**15.9**	**17.2**	**20.7**	**22.1**	**24.0**	**27.2**	**30.3**	**2.3**
Total World	**26.2**	**33.8**	**35.5**	**42.0**	**45.0**	**49.3**	**54.7**	**59.0**	**2.1**

[a]Includes the 50 States and the District of Columbia.

Notes: Totals may not equal sum of components due to independent rounding. U.S. totals include net electricity imports, methanol, and liquid hydrogen.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run AEO2008.D030208F, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table A10. World Carbon Dioxide Emissions by Region, Reference Case, 1990-2030
(Million Metric Tons Carbon Dioxide)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**5,754**	**6,959**	**7,008**	**7,109**	**7,408**	**7,653**	**7,928**	**8,300**	**0.7**
United States[a]	4,989	5,957	5,982	6,011	6,226	6,384	6,571	6,851	0.5
Canada	465	623	628	669	698	727	756	784	0.9
Mexico	300	379	398	430	484	542	601	665	2.1
OECD Europe	**4,101**	**4,373**	**4,383**	**4,512**	**4,678**	**4,760**	**4,800**	**4,834**	**0.4**
OECD Asia	**1,541**	**2,148**	**2,174**	**2,208**	**2,287**	**2,322**	**2,357**	**2,403**	**0.4**
Japan	1,009	1,242	1,230	1,196	1,201	1,195	1,184	1,170	-0.2
South Korea	241	488	500	559	612	632	656	693	1.3
Australia/New Zealand	291	418	444	454	474	495	517	540	0.8
Total OECD	**11,396**	**13,480**	**13,565**	**13,829**	**14,373**	**14,736**	**15,085**	**15,538**	**0.5**
Non-OECD									
Non-OECD Europe and Eurasia	**4,198**	**2,797**	**2,865**	**3,066**	**3,330**	**3,508**	**3,625**	**3,811**	**1.1**
Russia	2,376	1,669	1,696	1,789	1,902	1,984	2,020	2,117	0.9
Other	1,822	1,128	1,169	1,278	1,428	1,524	1,606	1,694	1.5
Non-OECD Asia	**3,613**	**7,517**	**8,177**	**10,185**	**12,157**	**13,907**	**15,683**	**17,482**	**3.1**
China	2,241	4,753	5,323	6,898	8,214	9,475	10,747	12,007	3.3
India	565	1,127	1,164	1,349	1,604	1,818	2,019	2,238	2.6
Other Non-OECD Asia	807	1,637	1,690	1,938	2,338	2,614	2,917	3,237	2.6
Middle East	**700**	**1,290**	**1,400**	**1,622**	**1,802**	**1,988**	**2,120**	**2,250**	**1.9**
Africa	**649**	**943**	**966**	**1,090**	**1,244**	**1,366**	**1,450**	**1,515**	**1.8**
Central and South America	**669**	**1,042**	**1,078**	**1,308**	**1,429**	**1,531**	**1,628**	**1,729**	**1.9**
Brazil	216	350	356	451	498	541	582	633	2.3
Other Central and South America	453	692	722	857	931	990	1,046	1,097	1.7
Total Non-OECD	**9,830**	**13,589**	**14,486**	**17,271**	**19,962**	**22,299**	**24,506**	**26,787**	**2.5**
Total World	**21,226**	**27,070**	**28,051**	**31,100**	**34,335**	**37,035**	**39,591**	**42,325**	**1.7**

[a]Includes the 50 States and the District of Columbia.

Note: The U.S. numbers include carbon dioxide emissions attributable to renewable energy sources.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run AEO2008.D030208F, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table A11. World Carbon Dioxide Emissions from Liquids Use by Region, Reference Case, 1990-2030
(Million Metric Tons Carbon Dioxide)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**2,633**	**3,142**	**3,169**	**3,134**	**3,254**	**3,302**	**3,361**	**3,492**	**0.4**
United States[a]	2,178	2,597	2,615	2,555	2,636	2,650	2,676	2,767	0.2
Canada	224	291	290	304	311	319	326	333	0.6
Mexico	231	254	264	275	307	332	359	391	1.6
OECD Europe	**1,867**	**2,097**	**2,103**	**2,093**	**2,151**	**2,165**	**2,171**	**2,174**	**0.1**
OECD Asia	**914**	**1,016**	**1,028**	**1,005**	**1,049**	**1,070**	**1,084**	**1,097**	**0.3**
Japan	661	636	643	599	605	602	596	589	-0.4
South Korea	144	238	240	260	285	301	315	328	1.3
Australia/New Zealand	110	142	144	146	159	166	173	180	0.9
Total OECD	**5,414**	**6,255**	**6,300**	**6,232**	**6,455**	**6,537**	**6,616**	**6,763**	**0.3**
Non-OECD									
Non-OECD Europe and Eurasia	**1,355**	**666**	**673**	**764**	**821**	**875**	**921**	**965**	**1.5**
Russia	783	379	379	416	441	461	473	482	1.0
Other	572	287	294	348	379	414	448	483	2.0
Non-OECD Asia	**950**	**1,979**	**2,037**	**2,425**	**2,839**	**3,248**	**3,655**	**4,110**	**2.8**
China	325	843	880	1,156	1,312	1,544	1,785	2,062	3.5
India	160	302	303	342	415	481	541	608	2.8
Other Non-OECD Asia	464	833	854	928	1,112	1,223	1,329	1,440	2.1
Middle East	**488**	**780**	**824**	**960**	**1,052**	**1,159**	**1,250**	**1,340**	**2.0**
Africa	**298**	**400**	**413**	**482**	**520**	**563**	**586**	**611**	**1.6**
Central and South America	**503**	**734**	**749**	**866**	**902**	**954**	**1,007**	**1,067**	**1.4**
Brazil	180	274	279	320	340	366	391	422	1.7
Other Central and South America	323	460	470	546	562	588	616	645	1.3
Total Non-OECD	**3,594**	**4,558**	**4,697**	**5,497**	**6,134**	**6,800**	**7,420**	**8,092**	**2.2**
Total World	**9,009**	**10,813**	**10,996**	**11,729**	**12,588**	**13,337**	**14,036**	**14,855**	**1.2**

[a]Includes the 50 States and the District of Columbia.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run AEO2008.D030208F, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table A12. World Carbon Dioxide Emissions from Natural Gas Use by Region, Reference Case, 1990-2030
(Million Metric Tons Carbon Dioxide)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**1,207**	**1,471**	**1,476**	**1,567**	**1,629**	**1,660**	**1,690**	**1,726**	**0.6**
United States[a]	1,026	1,194	1,193	1,256	1,279	1,262	1,245	1,231	0.1
Canada	127	181	185	198	217	234	251	270	1.5
Mexico	54	97	99	113	133	164	194	225	3.4
OECD Europe	**590**	**1,027**	**1,048**	**1,124**	**1,239**	**1,344**	**1,411**	**1,479**	**1.4**
OECD Asia	**152**	**293**	**294**	**327**	**358**	**373**	**386**	**395**	**1.2**
Japan	102	173	170	184	195	201	203	203	0.7
South Korea	6	60	63	78	94	98	104	108	2.2
Australia/New Zealand	44	60	61	65	69	73	79	84	1.3
Total OECD	**1,949**	**2,791**	**2,819**	**3,018**	**3,226**	**3,378**	**3,487**	**3,600**	**1.0**
Non-OECD									
Non-OECD Europe and Eurasia	**1,450**	**1,328**	**1,375**	**1,484**	**1,586**	**1,677**	**1,733**	**1,814**	**1.1**
Russia	928	868	875	936	998	1,037	1,066	1,111	1.0
Other	521	460	500	548	588	640	668	702	1.4
Non-OECD Asia	**160**	**469**	**516**	**700**	**935**	**1,179**	**1,360**	**1,524**	**4.4**
China	30	83	101	167	237	305	350	391	5.5
India	24	59	69	99	131	160	192	213	4.6
Other Non-OECD Asia	106	327	345	434	567	713	818	920	4.0
Middle East	**199**	**476**	**541**	**619**	**707**	**785**	**827**	**867**	**1.9**
Africa	**80**	**149**	**167**	**203**	**257**	**315**	**356**	**395**	**3.5**
Central and South America	**116**	**231**	**249**	**318**	**376**	**416**	**455**	**489**	**2.7**
Brazil	6	33	36	55	68	76	87	100	4.2
Other Central and South America	110	197	213	263	308	340	368	390	2.4
Total Non-OECD	**2,005**	**2,651**	**2,847**	**3,325**	**3,861**	**4,372**	**4,731**	**5,090**	**2.4**
Total World	**3,954**	**5,443**	**5,666**	**6,342**	**7,088**	**7,750**	**8,218**	**8,689**	**1.7**

[a]Includes the 50 States and the District of Columbia.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run AEO2008.D030208F, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table A13. World Carbon Dioxide Emissions from Coal Use by Region, Reference Case, 1990-2030
(Million Metric Tons Carbon Dioxide)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**1,913**	**2,333**	**2,351**	**2,396**	**2,513**	**2,679**	**2,865**	**3,071**	**1.1**
United States[a]	1,784	2,155	2,162	2,188	2,299	2,459	2,638	2,841	1.1
Canada	114	151	153	166	170	174	179	181	0.7
Mexico	15	28	35	42	44	45	48	49	1.3
OECD Europe	**1,644**	**1,250**	**1,232**	**1,296**	**1,287**	**1,251**	**1,218**	**1,181**	**-0.2**
OECD Asia	**475**	**840**	**853**	**876**	**880**	**879**	**887**	**911**	**0.3**
Japan	246	433	417	412	401	392	385	378	-0.4
South Korea	91	190	196	221	233	232	237	257	1.1
Australia/New Zealand	138	217	239	243	246	255	265	276	0.6
Total OECD	**4,032**	**4,423**	**4,435**	**4,568**	**4,680**	**4,809**	**4,970**	**5,163**	**0.6**
Non-OECD									
Non-OECD Europe and Eurasia	**1,393**	**804**	**817**	**818**	**924**	**956**	**971**	**1,032**	**0.9**
Russia	665	422	442	437	462	487	481	523	0.7
Other	729	381	376	381	461	469	490	509	1.2
Non-OECD Asia	**2,503**	**5,070**	**5,624**	**7,059**	**8,383**	**9,480**	**10,667**	**11,848**	**3.0**
China	1,886	3,827	4,341	5,575	6,665	7,626	8,611	9,555	3.2
India	380	765	791	908	1,058	1,177	1,286	1,417	2.4
Other Non-OECD Asia	237	477	492	576	660	677	770	876	2.3
Middle East	**13**	**35**	**35**	**43**	**43**	**44**	**43**	**43**	**0.8**
Africa	**271**	**394**	**386**	**405**	**466**	**487**	**508**	**510**	**1.1**
Central and South America	**50**	**78**	**81**	**124**	**151**	**161**	**166**	**173**	**3.1**
Brazil	30	43	41	76	89	99	104	111	4.1
Other Central and South America	20	35	40	48	62	62	62	62	1.8
Total Non-OECD	**4,231**	**6,380**	**6,943**	**8,449**	**9,967**	**11,127**	**12,355**	**13,605**	**2.7**
Total World	**8,263**	**10,803**	**11,378**	**13,017**	**14,647**	**15,937**	**17,324**	**18,768**	**2.0**

[a]Includes the 50 States and the District of Columbia.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run AEO2008.D030208F, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table A14. World Population by Region, Reference Case, 1990-2030
(Millions)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**366**	**430**	**434**	**455**	**475**	**495**	**514**	**533**	**0.8**
United States[a]	254	294	297	311	324	338	351	366	0.8
Canada	28	32	32	34	35	37	38	39	0.8
Mexico	84	103	104	110	116	121	125	128	0.8
OECD Europe	**497**	**533**	**536**	**547**	**555**	**561**	**565**	**568**	**0.2**
OECD Asia	**187**	**200**	**200**	**202**	**203**	**202**	**200**	**197**	**-0.1**
Japan	124	128	128	128	127	124	122	118	-0.3
South Korea	43	48	48	49	49	49	49	48	0.0
Australia/New Zealand	20	24	24	26	27	28	29	30	0.9
Total OECD	**1,050**	**1,162**	**1,170**	**1,204**	**1,233**	**1,257**	**1,279**	**1,297**	**0.4**
Non-OECD									
Non-OECD Europe and Eurasia	**348**	**343**	**342**	**340**	**337**	**333**	**328**	**322**	**-0.2**
Russia	149	145	144	140	136	132	128	124	-0.6
Other	200	198	198	199	200	201	200	198	0.0
Non-OECD Asia	**2,760**	**3,390**	**3,431**	**3,631**	**3,826**	**4,007**	**4,167**	**4,300**	**0.9**
China	1,149	1,304	1,313	1,352	1,389	1,421	1,446	1,458	0.4
India	860	1,117	1,134	1,220	1,303	1,379	1,447	1,506	1.1
Other Non-OECD Asia	751	969	984	1,060	1,135	1,206	1,274	1,336	1.2
Middle East	**137**	**189**	**193**	**213**	**234**	**255**	**275**	**294**	**1.7**
Africa	**637**	**902**	**922**	**1,032**	**1,149**	**1,271**	**1,394**	**1,518**	**2.0**
Central and South America	**360**	**448**	**454**	**483**	**512**	**539**	**563**	**585**	**1.0**
Brazil	150	184	187	199	210	220	229	236	0.9
Other Central and South America	211	263	267	284	302	319	335	348	1.1
Total Non-OECD	**4,243**	**5,272**	**5,342**	**5,699**	**6,058**	**6,405**	**6,728**	**7,020**	**1.1**
Total World	**5,293**	**6,434**	**6,512**	**6,903**	**7,290**	**7,662**	**8,007**	**8,317**	**1.0**

[a]Includes the 50 States and the District of Columbia.

Sources: **United States:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run AEO2008.D030208F, web site www.eia.doe.gov/oiaf/aeo. **Other Countries:** United Nations, Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects: The 2005 Revision and World Urbanization Prospects (February 25, 2005), web site http://esa.un.org/unpp.

Appendix B

High Economic Growth Case Projections:

- World Energy Consumption
- Gross Domestic Product
- Carbon Dioxide Emissions

Table B1. World Total Primary Energy Consumption by Region, High Economic Growth Case, 1990-2030
(Quadrillion Btu)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**100.7**	**120.6**	**121.3**	**127.7**	**136.0**	**144.5**	**153.3**	**162.6**	**1.2**
United States[a]	84.7	100.1	100.1	104.5	110.2	116.0	122.1	128.4	1.0
Canada	11.0	14.0	14.3	15.8	17.1	18.4	19.7	21.2	1.6
Mexico	5.0	6.5	6.9	7.5	8.7	10.0	11.5	13.1	2.6
OECD Europe	**70.0**	**81.0**	**81.4**	**84.5**	**89.1**	**92.3**	**95.8**	**99.3**	**0.8**
OECD Asia	**26.8**	**37.8**	**38.2**	**39.6**	**42.6**	**44.8**	**46.9**	**49.3**	**1.0**
Japan	18.5	22.7	22.6	22.6	23.5	24.1	24.7	25.3	0.5
South Korea	3.8	9.0	9.3	10.4	12.0	13.1	14.1	15.4	2.0
Australia/New Zealand	4.5	6.1	6.3	6.6	7.1	7.5	8.1	8.6	1.2
Total OECD	**197.5**	**239.4**	**240.9**	**251.9**	**267.7**	**281.5**	**296.0**	**311.2**	**1.0**
Non-OECD									
Non-OECD Europe and Eurasia	**67.3**	**49.5**	**50.7**	**55.6**	**61.4**	**66.8**	**71.4**	**76.7**	**1.7**
Russia	39.4	29.9	30.3	33.0	36.0	38.7	40.9	43.6	1.5
Other	28.0	19.6	20.4	22.6	25.4	28.1	30.5	33.0	2.0
Non-OECD Asia	**47.4**	**101.0**	**109.9**	**139.4**	**171.0**	**201.2**	**233.2**	**265.8**	**3.6**
China	27.0	59.9	67.1	89.0	108.6	128.2	149.3	170.4	3.8
India	7.9	15.5	16.2	19.7	24.1	28.2	32.3	36.4	3.3
Other Non-OECD Asia	12.5	25.6	26.6	30.7	38.3	44.8	51.6	59.0	3.2
Middle East	**11.2**	**20.9**	**22.9**	**26.6**	**30.6**	**34.6**	**37.9**	**41.4**	**2.4**
Africa	**9.5**	**14.0**	**14.4**	**16.6**	**19.6**	**22.2**	**24.5**	**26.8**	**2.5**
Central and South America	**14.5**	**22.5**	**23.4**	**27.9**	**31.6**	**35.3**	**39.0**	**43.0**	**2.5**
Brazil	5.7	9.0	9.3	11.2	13.1	15.0	16.9	19.1	2.9
Other Central and South America	8.8	13.5	14.1	16.7	18.5	20.3	22.1	23.9	2.1
Total Non-OECD	**149.9**	**207.9**	**221.3**	**266.1**	**314.0**	**360.1**	**406.0**	**453.7**	**2.9**
Total World	**347.4**	**447.3**	**462.2**	**518.0**	**581.7**	**641.5**	**701.9**	**764.9**	**2.0**

[a]Includes the 50 States and the District of Columbia.

Notes: Energy totals include net imports of coal coke and electricity generated from biomass in the United States. Totals may not equal sum of components due to independent rounding. The electricity portion of the national fuel consumption values consists of generation for domestic use plus an adjustment for electricity trade based on a fuel's share of total generation in the exporting country.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run HM2008.D031608A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table B2. World Total Energy Consumption by Region and Fuel, High Economic Growth Case, 1990-2030
(Quadrillion Btu)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America									
Liquids	40.5	48.9	49.1	50.2	53.2	55.2	57.5	60.6	0.8
Natural Gas	23.2	28.1	28.0	30.3	32.1	32.6	33.8	35.1	0.9
Coal	20.6	24.5	24.8	25.3	27.1	30.2	32.8	35.7	1.5
Nuclear	6.9	9.3	9.3	9.7	9.8	10.8	11.7	12.7	1.3
Other	9.5	9.8	10.2	12.3	13.9	15.7	17.5	18.5	2.4
Total	**100.7**	**120.6**	**121.3**	**127.7**	**136.0**	**144.5**	**153.3**	**162.6**	**1.2**
OECD Europe									
Liquids	28.4	32.0	32.1	32.1	33.8	34.6	35.3	36.1	0.5
Natural Gas	11.2	19.4	19.9	21.5	24.0	26.5	28.2	30.1	1.7
Coal	17.7	13.3	13.2	13.9	14.1	13.9	13.7	13.5	0.1
Nuclear	7.9	9.9	9.8	9.8	9.8	9.1	9.5	9.9	0.1
Other	4.8	6.3	6.5	7.3	7.5	8.3	9.1	9.6	1.6
Total	**70.0**	**81.0**	**81.4**	**84.5**	**89.1**	**92.3**	**95.8**	**99.3**	**0.8**
OECD Asia									
Liquids	14.7	17.3	17.5	17.2	18.5	19.3	20.1	20.9	0.7
Natural Gas	2.9	5.6	5.6	6.2	6.9	7.4	7.7	8.1	1.5
Coal	5.2	9.2	9.3	9.7	9.9	10.1	10.4	10.9	0.6
Nuclear	2.5	4.0	4.2	4.5	5.2	5.8	6.3	6.9	2.0
Other	1.6	1.8	1.6	1.9	2.1	2.2	2.4	2.5	2.0
Total	**26.8**	**37.8**	**38.2**	**39.6**	**42.6**	**44.8**	**46.9**	**49.3**	**1.0**
Total OECD									
Liquids	83.6	98.2	98.7	99.5	105.4	109.1	112.9	117.5	0.7
Natural Gas	37.2	53.1	53.4	57.9	63.0	66.4	69.8	73.4	1.3
Coal	43.5	47.0	47.3	49.0	51.1	54.2	56.9	60.1	1.0
Nuclear	17.3	23.1	23.2	24.0	24.8	25.7	27.5	29.5	1.0
Other	15.9	17.9	18.2	21.5	23.4	26.1	28.9	30.6	2.1
Total	**197.5**	**239.4**	**240.9**	**251.9**	**267.7**	**281.5**	**296.0**	**311.2**	**1.0**
Non-OECD									
Non-OECD Europe and Eurasia									
Liquids	19.6	9.8	10.0	11.3	12.6	13.7	14.8	15.9	1.9
Natural Gas	27.5	25.1	26.0	28.4	31.0	33.5	35.5	38.2	1.5
Coal	15.1	8.7	8.8	9.0	10.3	10.9	11.3	12.3	1.3
Nuclear	2.5	2.9	2.8	3.1	3.6	4.6	5.5	5.7	2.9
Other	2.8	3.0	3.1	3.8	3.9	4.0	4.3	4.5	1.5
Total	**67.3**	**49.5**	**50.7**	**55.6**	**61.4**	**66.8**	**71.4**	**76.7**	**1.7**
Non-OECD Asia									
Liquids	14.0	30.5	31.5	37.7	45.7	53.6	61.8	71.1	3.3
Natural Gas	3.0	8.9	9.8	13.4	18.3	23.6	27.9	32.1	4.9
Coal	27.0	54.9	60.9	78.1	94.7	109.0	124.8	140.6	3.4
Nuclear	0.4	1.1	1.1	1.6	3.2	4.9	6.5	7.4	7.9
Other	3.0	5.6	6.6	8.6	9.1	10.1	12.4	14.6	3.2
Total	**47.4**	**101.0**	**109.9**	**139.4**	**171.0**	**201.2**	**233.2**	**265.8**	**3.6**

See notes at end of table.

Table B2. World Total Energy Consumption by Region and Fuel, High Economic Growth Case, 1990-2030 (Continued)
(Quadrillion Btu)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
Non-OECD (Continued)									
Middle East									
Liquids	7.2	11.3	12.0	14.0	15.9	18.0	20.0	22.1	2.5
Natural Gas	3.8	9.0	10.2	11.9	13.8	15.7	17.0	18.4	2.4
Coal	0.1	0.4	0.4	0.5	0.5	0.5	0.5	0.5	1.1
Nuclear	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	—
Other	0.1	0.2	0.2	0.3	0.3	0.3	0.4	0.4	2.8
Total	**11.2**	**20.9**	**22.9**	**26.6**	**30.6**	**34.6**	**37.9**	**41.4**	**2.4**
Africa									
Liquids	4.3	5.8	6.0	7.0	7.8	8.7	9.3	9.9	2.0
Natural Gas	1.5	2.8	3.2	3.9	5.0	6.3	7.4	8.4	4.0
Coal	3.0	4.3	4.2	4.5	5.3	5.6	6.0	6.2	1.6
Nuclear	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	2.7
Other	0.6	0.9	0.9	1.1	1.3	1.4	1.6	2.0	3.2
Total	**9.5**	**14.0**	**14.4**	**16.7**	**19.6**	**22.2**	**24.5**	**26.8**	**2.5**
Central and South America									
Liquids	7.8	11.0	11.2	13.0	14.1	15.3	16.6	18.1	1.9
Natural Gas	2.2	4.4	4.7	6.1	7.4	8.3	9.4	10.4	3.2
Coal	0.6	0.8	0.9	1.4	1.7	1.8	1.9	2.1	3.5
Nuclear	0.1	0.2	0.2	0.3	0.3	0.4	0.4	0.4	3.4
Other	3.9	6.1	6.4	7.2	8.2	9.4	10.7	12.0	2.5
Total	**14.5**	**22.5**	**23.4**	**27.9**	**31.6**	**35.3**	**39.0**	**43.0**	**2.5**
Total Non-OECD									
Liquids	52.9	68.4	70.8	83.1	96.1	109.3	122.5	137.1	2.7
Natural Gas	38.0	50.2	53.9	63.7	75.4	87.4	97.1	107.5	2.8
Coal	45.7	69.1	75.2	93.3	112.4	127.9	144.5	161.8	3.1
Nuclear	3.1	4.3	4.2	5.1	7.3	10.2	12.6	13.9	4.9
Other	10.3	15.9	17.2	20.9	22.8	25.3	29.3	33.5	2.7
Total	**149.9**	**207.9**	**221.3**	**266.2**	**314.0**	**360.1**	**406.0**	**453.6**	**2.9**
Total World									
Liquids	136.4	166.6	169.4	182.6	201.5	218.4	235.3	254.6	1.6
Natural Gas	75.2	103.3	107.4	121.6	138.4	153.8	166.8	180.9	2.1
Coal	89.2	116.1	122.5	142.3	163.5	182.0	201.4	221.9	2.4
Nuclear	20.4	27.4	27.5	29.1	32.1	35.9	40.2	43.3	1.8
Other	26.2	33.8	35.5	42.5	46.2	51.4	58.2	64.1	2.4
Total	**347.4**	**447.3**	**462.2**	**518.0**	**581.7**	**641.6**	**702.0**	**764.8**	**2.0**

Notes: Energy totals include net imports of coal coke and electricity generated from biomass in the United States. Totals may not equal sum of components due to independent rounding. The electricity portion of the national fuel consumption values consists of generation for domestic use plus an adjustment for electricity trade based on a fuel's share of total generation in the exporting country.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run HM2008.D031608A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table B3. World Gross Domestic Product (GDP) by Region Expressed in Purchasing Power Parity, High Economic Growth Case, 1990-2030
(Billion 2000 Dollars)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**8,477**	**12,696**	**13,083**	**15,289**	**18,061**	**20,845**	**24,180**	**28,098**	**3.1**
United States[a]	7,113	10,676	11,004	12,793	15,058	17,244	19,888	23,009	3.0
Canada	684	1,004	1,034	1,204	1,392	1,596	1,821	2,079	2.8
Mexico	680	1,016	1,045	1,291	1,610	2,005	2,471	3,010	4.3
OECD Europe	**8,067**	**11,197**	**11,445**	**13,343**	**15,294**	**17,468**	**19,853**	**22,461**	**2.7**
OECD Asia	**3,621**	**4,775**	**4,887**	**5,647**	**6,413**	**7,112**	**7,826**	**8,611**	**2.3**
Japan	2,862	3,377	3,440	3,844	4,207	4,490	4,741	5,005	1.5
South Korea	331	715	745	977	1,221	1,448	1,691	1,955	3.9
Australia/New Zealand	429	683	702	826	985	1,174	1,394	1,651	3.5
Total OECD	**20,165**	**28,667**	**29,415**	**34,278**	**39,769**	**45,425**	**51,859**	**59,169**	**2.8**
Non-OECD									
Non-OECD Europe and Eurasia	**3,601**	**3,340**	**3,563**	**5,055**	**6,510**	**7,967**	**9,635**	**11,569**	**4.8**
Russia	2,241	1,907	2,029	2,793	3,566	4,278	5,092	6,036	4.5
Other	1,360	1,433	1,534	2,263	2,944	3,689	4,543	5,533	5.3
Non-OECD Asia	**5,792**	**15,102**	**16,436**	**25,125**	**34,740**	**45,965**	**59,131**	**74,646**	**6.2**
China	1,805	6,961	7,685	12,674	17,832	23,942	31,350	40,087	6.8
India	1,697	3,714	4,056	6,177	8,797	11,728	14,855	18,423	6.2
Other Non-OECD Asia	2,291	4,428	4,695	6,275	8,111	10,295	12,926	16,136	5.1
Middle East	**820**	**1,466**	**1,550**	**1,989**	**2,508**	**3,113**	**3,820**	**4,661**	**4.5**
Africa	**1,450**	**2,182**	**2,295**	**3,057**	**3,945**	**4,970**	**6,200**	**7,692**	**5.0**
Central and South America	**2,162**	**3,372**	**3,535**	**4,580**	**5,678**	**6,953**	**8,487**	**10,340**	**4.4**
Brazil	1,022	1,581	1,627	2,041	2,487	3,006	3,621	4,353	4.0
Other Central and South America	1,140	1,791	1,908	2,539	3,191	3,948	4,866	5,988	4.7
Total Non-OECD	**13,824**	**25,462**	**27,378**	**39,807**	**53,382**	**68,969**	**87,273**	**108,909**	**5.7**
Total World	**33,989**	**54,129**	**56,793**	**74,085**	**93,151**	**114,394**	**139,132**	**168,078**	**4.4**

[a]Includes the 50 States and the District of Columbia.

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

Sources: **History:** Global Insight, Inc., *World Overview* (Lexington, MA, various issues). **Projections:** Derived from Global Insight, Inc., *World Overview*, Fourth Quarter 2007 (Lexington, MA, January 2008); and Energy Information Administration, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), Table B4.

Table B4. World Liquids Consumption by Region, High Economic Growth Case, 1990-2030
(Million Barrels Oil Equivalent per Day)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**20.5**	**25.0**	**25.2**	**25.7**	**27.2**	**28.2**	**29.2**	**30.8**	**0.8**
United States[a]	17.0	20.7	20.8	21.1	22.1	22.7	23.4	24.4	0.6
Canada	1.7	2.3	2.3	2.4	2.5	2.7	2.8	2.9	1.0
Mexico	1.8	2.0	2.1	2.2	2.5	2.8	3.1	3.5	2.1
OECD Europe	**13.7**	**15.5**	**15.5**	**15.5**	**16.3**	**16.7**	**17.1**	**17.4**	**0.5**
OECD Asia	**7.2**	**8.5**	**8.6**	**8.5**	**9.1**	**9.5**	**9.8**	**10.2**	**0.7**
Japan	5.3	5.3	5.4	5.0	5.2	5.3	5.3	5.4	0.0
South Korea	1.0	2.2	2.2	2.4	2.7	2.9	3.1	3.4	1.7
Australia/New Zealand	0.8	1.0	1.1	1.1	1.2	1.3	1.4	1.5	1.3
Total OECD	**41.4**	**49.0**	**49.3**	**49.6**	**52.5**	**54.4**	**56.2**	**58.5**	**0.7**
Non-OECD									
Non-OECD Europe and Eurasia	**9.4**	**4.8**	**4.8**	**5.5**	**6.1**	**6.7**	**7.2**	**7.7**	**1.9**
Russia	5.4	2.8	2.8	3.0	3.3	3.5	3.7	3.9	1.4
Other	3.9	2.0	2.1	2.5	2.8	3.1	3.5	3.8	2.5
Non-OECD Asia	**6.6**	**14.8**	**15.3**	**18.3**	**22.1**	**25.9**	**29.9**	**34.4**	**3.3**
China	2.3	6.4	6.7	8.9	10.4	12.5	14.8	17.4	3.9
India	1.2	2.4	2.4	2.8	3.5	4.1	4.7	5.4	3.2
Other Non-OECD Asia	3.1	6.0	6.1	6.6	8.3	9.3	10.4	11.6	2.6
Middle East	**3.5**	**5.5**	**5.9**	**6.8**	**7.8**	**8.8**	**9.7**	**10.7**	**2.5**
Africa	**2.1**	**2.8**	**2.9**	**3.4**	**3.8**	**4.2**	**4.5**	**4.8**	**2.0**
Central and South America	**3.8**	**5.4**	**5.5**	**6.3**	**6.9**	**7.5**	**8.1**	**8.8**	**1.9**
Brazil	1.5	2.1	2.2	2.5	2.8	3.0	3.3	3.7	2.2
Other Central and South America	2.3	3.2	3.3	3.9	4.1	4.4	4.7	5.1	1.8
Total Non-OECD	**25.3**	**33.3**	**34.3**	**40.4**	**46.6**	**53.1**	**59.4**	**66.5**	**2.7**
Total World	**66.6**	**82.3**	**83.6**	**90.0**	**99.2**	**107.4**	**115.6**	**125.0**	**1.6**

[a]Includes the 50 States and the District of Columbia.

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

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run HM2008.D031608A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table B5. World Natural Gas Consumption by Region, High Economic Growth Case, 1990-2030
(Trillion Cubic Feet)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**22.5**	**27.4**	**27.4**	**29.3**	**31.1**	**31.6**	**32.7**	**34.0**	**0.9**
United States[a]	19.2	22.4	22.2	23.6	24.5	24.0	24.0	24.0	0.3
Canada	2.4	3.3	3.4	3.7	4.1	4.5	5.0	5.5	1.9
Mexico	0.9	1.7	1.7	2.0	2.4	3.1	3.8	4.5	3.9
OECD Europe	**11.6**	**18.9**	**19.3**	**20.8**	**23.3**	**25.7**	**27.4**	**29.3**	**1.7**
OECD Asia	**2.8**	**5.2**	**5.2**	**5.9**	**6.5**	**6.9**	**7.3**	**7.6**	**1.5**
Japan	1.9	3.1	3.1	3.4	3.6	3.8	3.8	3.9	1.0
South Korea	0.1	1.0	1.1	1.3	1.6	1.8	1.9	2.0	2.6
Australia/New Zealand	0.8	1.1	1.1	1.2	1.3	1.4	1.5	1.7	1.7
Total OECD	**36.8**	**51.6**	**51.9**	**56.0**	**60.9**	**64.2**	**67.4**	**70.9**	**1.3**
Non-OECD									
Non-OECD Europe and Eurasia	**26.7**	**24.4**	**25.3**	**27.6**	**30.1**	**32.5**	**34.5**	**37.1**	**1.5**
Russia	17.3	16.0	16.2	17.4	19.0	20.1	21.2	22.7	1.4
Other	9.5	8.4	9.1	10.1	11.1	12.4	13.3	14.4	1.8
Non-OECD Asia	**2.9**	**8.5**	**9.3**	**12.8**	**17.4**	**22.4**	**26.4**	**30.5**	**4.8**
China	0.5	1.4	1.7	2.8	4.0	5.2	6.1	6.9	5.9
India	0.4	1.1	1.3	1.9	2.5	3.1	3.8	4.3	5.0
Other Non-OECD Asia	2.0	6.1	6.4	8.2	10.9	14.0	16.6	19.3	4.5
Middle East	**3.6**	**8.6**	**9.8**	**11.3**	**13.1**	**15.0**	**16.2**	**17.5**	**2.4**
Africa	**1.4**	**2.6**	**3.0**	**3.6**	**4.7**	**5.9**	**6.9**	**7.9**	**4.0**
Central and South America	**2.0**	**4.1**	**4.4**	**5.7**	**6.9**	**7.8**	**8.7**	**9.7**	**3.2**
Brazil	0.1	0.6	0.7	1.0	1.3	1.5	1.7	2.0	4.6
Other Central and South America	1.9	3.5	3.7	4.7	5.6	6.3	7.0	7.7	2.9
Total Non-OECD	**36.5**	**48.2**	**51.8**	**61.0**	**72.1**	**83.5**	**92.7**	**102.7**	**2.8**
Total World	**73.4**	**99.8**	**103.7**	**117.0**	**133.0**	**147.7**	**160.1**	**173.6**	**2.1**

[a]Includes the 50 States and the District of Columbia.

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

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run HM2008.D031608A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table B6. World Coal Consumption by Region, High Economic Growth Case, 1990-2030
(Quadrillion Btu)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**20.6**	**24.5**	**24.8**	**25.3**	**27.1**	**30.2**	**32.8**	**35.7**	**1.5**
United States[a]	19.2	22.6	22.8	23.1	24.7	27.7	30.2	33.0	1.5
Canada	1.2	1.6	1.7	1.8	1.9	2.0	2.1	2.2	1.0
Mexico	0.2	0.3	0.4	0.5	0.5	0.5	0.6	0.6	1.7
OECD Europe	**17.7**	**13.3**	**13.2**	**13.9**	**14.1**	**13.9**	**13.7**	**13.5**	**0.1**
OECD Asia	**5.2**	**9.2**	**9.3**	**9.7**	**9.9**	**10.1**	**10.4**	**10.9**	**0.6**
Japan	2.7	4.8	4.6	4.6	4.5	4.5	4.5	4.5	-0.1
South Korea	1.0	2.1	2.1	2.5	2.6	2.7	2.8	3.2	1.6
Australia/New Zealand	1.5	2.4	2.6	2.7	2.7	2.9	3.1	3.3	0.9
Total OECD	**43.5**	**47.0**	**47.3**	**49.0**	**51.1**	**54.2**	**56.9**	**60.1**	**1.0**
Non-OECD									
Non-OECD Europe and Eurasia	**15.1**	**8.7**	**8.8**	**8.9**	**10.3**	**10.9**	**11.3**	**12.3**	**1.3**
Russia	7.2	4.6	4.8	4.8	5.2	5.6	5.6	6.2	1.0
Other	7.9	4.1	4.0	4.1	5.1	5.3	5.7	6.1	1.7
Non-OECD Asia	**27.0**	**54.9**	**60.9**	**78.1**	**94.7**	**109.0**	**124.8**	**140.6**	**3.4**
China	20.3	41.4	46.9	61.8	75.5	87.9	100.8	113.4	3.6
India	4.2	8.4	8.6	10.1	12.0	13.6	15.1	16.9	2.7
Other Non-OECD Asia	2.6	5.1	5.3	6.2	7.2	7.6	8.9	10.4	2.7
Middle East	**0.1**	**0.4**	**0.4**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**1.1**
Africa	**3.0**	**4.3**	**4.2**	**4.5**	**5.3**	**5.6**	**6.0**	**6.2**	**1.6**
Central and South America	**0.6**	**0.8**	**0.9**	**1.4**	**1.7**	**1.8**	**1.9**	**2.1**	**3.5**
Brazil	0.3	0.5	0.4	0.8	1.0	1.1	1.2	1.3	4.5
Other Central and South America	0.2	0.4	0.4	0.5	0.7	0.7	0.7	0.7	2.2
Total Non-OECD	**45.7**	**69.1**	**75.2**	**93.3**	**112.4**	**127.9**	**144.5**	**161.8**	**3.1**
Total World	**89.2**	**116.1**	**122.5**	**142.3**	**163.5**	**182.0**	**201.4**	**221.9**	**2.4**

[a]Includes the 50 States and the District of Columbia.

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

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run HM2008.D031608A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table B7. World Nuclear Energy Consumption by Region, High Economic Growth Case, 1990-2030
(Billion Kilowatthours)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**649**	**883**	**880**	**918**	**934**	**1,024**	**1,113**	**1,206**	**1.3**
United States[a]	577	789	782	797	807	888	966	1,047	1.2
Canada	69	86	87	110	116	125	135	147	2.1
Mexico	3	9	10	11	11	11	12	12	0.6
OECD Europe	**743**	**941**	**929**	**927**	**930**	**867**	**904**	**943**	**0.1**
OECD Asia	**242**	**392**	**418**	**449**	**511**	**575**	**626**	**683**	**2.0**
Japan	192	268	278	304	329	351	379	408	1.5
South Korea	50	124	139	144	182	224	247	275	2.8
Australia/New Zealand	0	0	0	0	0	0	0	0	—
Total OECD	**1,635**	**2,216**	**2,227**	**2,294**	**2,375**	**2,466**	**2,643**	**2,832**	**1.0**
Non-OECD									
Non-OECD Europe and Eurasia	**219**	**263**	**264**	**292**	**337**	**431**	**507**	**532**	**2.8**
Russia	115	137	140	157	196	248	311	329	3.5
Other	104	125	124	136	141	183	196	203	2.0
Non-OECD Asia	**38**	**103**	**106**	**152**	**303**	**470**	**615**	**702**	**7.8**
China	0	48	50	66	170	281	377	447	9.1
India	6	15	16	38	68	109	143	162	9.8
Other Non-OECD Asia	32	40	40	48	65	79	95	93	3.4
Middle East	**0**	**0**	**0**	**0**	**6**	**6**	**6**	**6**	**—**
Africa	**8**	**14**	**12**	**14**	**16**	**16**	**23**	**24**	**2.7**
Central and South America	**9**	**19**	**16**	**23**	**29**	**36**	**37**	**38**	**3.4**
Brazil	2	12	10	15	19	23	24	25	3.8
Other Central and South America	7	7	6	8	10	13	12	13	2.8
Total Non-OECD	**274**	**399**	**399**	**481**	**691**	**959**	**1,188**	**1,302**	**4.8**
Total World	**1,909**	**2,615**	**2,626**	**2,775**	**3,066**	**3,424**	**3,831**	**4,133**	**1.8**

[a]Includes the 50 States and the District of Columbia.

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

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run HM2008.D031608A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table B8. World Consumption of Hydroelectricity and Other Renewable Energy by Region, High Economic Growth Case, 1990-2030
(Quadrillion Btu)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**9.5**	**9.8**	**10.2**	**12.3**	**13.9**	**15.7**	**17.5**	**18.5**	**2.4**
United States[a]	6.1	6.0	6.0	7.7	8.6	9.9	11.3	11.7	2.7
Canada	3.1	3.5	3.7	4.1	4.7	5.1	5.5	6.0	2.0
Mexico	0.3	0.4	0.4	0.5	0.6	0.6	0.7	0.7	2.0
OECD Europe	**4.8**	**6.3**	**6.5**	**7.3**	**7.5**	**8.2**	**9.1**	**9.6**	**1.6**
OECD Asia	**1.6**	**1.8**	**1.6**	**1.9**	**2.1**	**2.2**	**2.4**	**2.5**	**1.9**
Japan	1.1	1.2	1.0	1.2	1.3	1.4	1.5	1.6	1.8
South Korea	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.3	8.2
Australia/New Zealand	0.4	0.5	0.5	0.6	0.6	0.6	0.6	0.6	1.1
Total OECD	**15.9**	**17.9**	**18.2**	**21.5**	**23.4**	**26.1**	**28.9**	**30.6**	**2.1**
Non-OECD									
Non-OECD Europe and Eurasia	**2.8**	**3.0**	**3.1**	**3.8**	**3.9**	**4.0**	**4.3**	**4.5**	**1.5**
Russia	1.8	1.8	1.8	2.4	2.4	2.4	2.5	2.5	1.4
Other	1.0	1.3	1.3	1.4	1.5	1.6	1.8	2.0	1.6
Non-OECD Asia	**3.0**	**5.6**	**6.6**	**8.6**	**9.1**	**10.1**	**12.4**	**14.6**	**3.2**
China	1.3	3.3	4.0	5.2	5.4	5.9	7.3	8.8	3.2
India	0.7	0.9	1.1	1.5	1.6	1.7	1.9	2.1	2.7
Other Non-OECD Asia	0.9	1.4	1.6	1.8	2.1	2.6	3.1	3.7	3.5
Middle East	**0.1**	**0.2**	**0.2**	**0.3**	**0.3**	**0.3**	**0.4**	**0.4**	**2.8**
Africa	**0.6**	**0.9**	**0.9**	**1.1**	**1.3**	**1.4**	**1.6**	**2.0**	**3.2**
Central and South America	**3.9**	**6.1**	**6.4**	**7.2**	**8.2**	**9.4**	**10.7**	**12.0**	**2.5**
Brazil	2.2	3.4	3.5	4.0	4.9	5.8	6.8	7.8	3.2
Other Central and South America	1.7	2.8	2.9	3.2	3.2	3.6	3.9	4.2	1.5
Total Non-OECD	**10.3**	**15.9**	**17.2**	**20.9**	**22.8**	**25.3**	**29.3**	**33.5**	**2.7**
Total World	**26.2**	**33.8**	**35.5**	**42.5**	**46.2**	**51.4**	**58.2**	**64.1**	**2.4**

[a]Includes the 50 States and the District of Columbia.

Notes: Totals may not equal sum of components due to independent rounding. U.S. totals include net electricity imports, methanol, and liquid hydrogen.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run HM2008.D031608A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table B9. World Carbon Dioxide Emissions by Region, High Economic Growth Case, 1990-2030
(Million Metric Tons Carbon Dioxide)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**5,754**	**6,959**	**7,008**	**7,175**	**7,623**	**8,063**	**8,503**	**9,067**	**1.0**
United States[a]	4,989	5,957	5,982	6,069	6,401	6,721	7,032	7,452	0.9
Canada	465	623	628	672	718	763	811	861	1.3
Mexico	300	379	398	433	504	579	660	753	2.6
OECD Europe	**4,101**	**4,373**	**4,383**	**4,543**	**4,800**	**4,966**	**5,093**	**5,223**	**0.7**
OECD Asia	**1,541**	**2,148**	**2,174**	**2,225**	**2,353**	**2,437**	**2,531**	**2,644**	**0.8**
Japan	1,009	1,242	1,230	1,204	1,231	1,248	1,260	1,272	0.1
South Korea	241	488	500	564	634	669	715	777	1.8
Australia/New Zealand	291	418	444	457	487	520	556	595	1.2
Total OECD	**11,396**	**13,480**	**13,565**	**13,942**	**14,776**	**15,465**	**16,126**	**16,933**	**0.9**
Non-OECD									
Non-OECD Europe and Eurasia	**4,198**	**2,797**	**2,865**	**3,093**	**3,438**	**3,703**	**3,924**	**4,236**	**1.6**
Russia	2,376	1,669	1,696	1,803	1,962	2,090	2,177	2,337	1.3
Other	1,822	1,128	1,169	1,290	1,476	1,613	1,747	1,899	2.0
Non-OECD Asia	**3,613**	**7,517**	**8,177**	**10,365**	**12,675**	**14,785**	**16,992**	**19,286**	**3.5**
China	2,241	4,753	5,323	7,042	8,585	10,082	11,630	13,193	3.7
India	565	1,127	1,164	1,369	1,667	1,924	2,177	2,453	3.0
Other Non-OECD Asia	807	1,637	1,690	1,954	2,423	2,779	3,186	3,640	3.1
Middle East	**700**	**1,290**	**1,400**	**1,634**	**1,868**	**2,114**	**2,319**	**2,535**	**2.4**
Africa	**649**	**943**	**966**	**1,099**	**1,286**	**1,448**	**1,578**	**1,697**	**2.3**
Central and South America	**669**	**1,042**	**1,078**	**1,319**	**1,484**	**1,631**	**1,784**	**1,950**	**2.4**
Brazil	216	350	356	456	518	579	640	716	2.8
Other Central and South America	453	692	722	863	966	1,053	1,143	1,234	2.2
Total Non-OECD	**9,830**	**13,589**	**14,486**	**17,510**	**20,752**	**23,681**	**26,597**	**29,704**	**2.9**
Total World	**21,226**	**27,070**	**28,051**	**31,453**	**35,527**	**39,146**	**42,723**	**46,637**	**2.1**

[a]Includes the 50 States and the District of Columbia.

Note: The U.S. numbers include carbon dioxide emissions attributable to renewable energy sources.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run HM2008.D031608A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table B10. World Carbon Dioxide Emissions from Liquids Use by Region, High Economic Growth Case, 1990-2030
(Million Metric Tons Carbon Dioxide)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**2,633**	**3,142**	**3,169**	**3,173**	**3,358**	**3,470**	**3,606**	**3,820**	**0.8**
United States[a]	2,178	2,597	2,615	2,591	2,716	2,777	2,858	3,008	0.6
Canada	224	291	290	305	321	337	352	369	1.0
Mexico	231	254	264	277	321	356	396	443	2.1
OECD Europe	**1,867**	**2,097**	**2,103**	**2,101**	**2,211**	**2,266**	**2,315**	**2,365**	**0.5**
OECD Asia	**914**	**1,016**	**1,028**	**1,010**	**1,083**	**1,130**	**1,175**	**1,219**	**0.7**
Japan	661	636	643	602	622	632	641	649	0.0
South Korea	144	238	240	261	297	321	345	370	1.7
Australia/New Zealand	110	142	144	147	164	177	188	200	1.3
Total OECD	**5,414**	**6,255**	**6,300**	**6,284**	**6,652**	**6,867**	**7,096**	**7,404**	**0.6**
Non-OECD									
Non-OECD Europe and Eurasia	**1,355**	**666**	**673**	**768**	**852**	**931**	**1,005**	**1,080**	**1.9**
Russia	783	379	379	418	458	490	515	538	1.4
Other	572	287	294	350	394	441	491	542	2.5
Non-OECD Asia	**950**	**1,979**	**2,037**	**2,441**	**2,959**	**3,466**	**3,993**	**4,593**	**3.3**
China	325	843	880	1,164	1,367	1,644	1,942	2,291	3.9
India	160	302	303	345	433	512	589	675	3.2
Other Non-OECD Asia	464	833	854	933	1,159	1,310	1,462	1,627	2.6
Middle East	**488**	**780**	**824**	**966**	**1,096**	**1,240**	**1,376**	**1,517**	**2.5**
Africa	**298**	**400**	**413**	**485**	**541**	**601**	**641**	**685**	**2.0**
Central and South America	**503**	**734**	**749**	**872**	**941**	**1,023**	**1,110**	**1,209**	**1.9**
Brazil	180	274	279	322	356	394	433	480	2.2
Other Central and South America	323	460	470	549	585	629	677	729	1.8
Total Non-OECD	**3,594**	**4,558**	**4,697**	**5,531**	**6,388**	**7,261**	**8,125**	**9,084**	**2.7**
Total World	**9,009**	**10,813**	**10,996**	**11,815**	**13,040**	**14,128**	**15,221**	**16,488**	**1.6**

[a]Includes the 50 States and the District of Columbia.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run HM2008.D031608A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table B11. World Carbon Dioxide Emissions from Natural Gas Use by Region, High Economic Growth Case, 1990-2030
(Million Metric Tons Carbon Dioxide)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**1,207**	**1,471**	**1,476**	**1,590**	**1,685**	**1,715**	**1,777**	**1,850**	**0.9**
United States[a]	1,026	1,194	1,193	1,276	1,325	1,296	1,297	1,299	0.3
Canada	127	181	185	200	222	244	268	296	1.9
Mexico	54	97	99	115	138	175	212	255	3.9
OECD Europe	**590**	**1,027**	**1,048**	**1,132**	**1,267**	**1,396**	**1,491**	**1,591**	**1.7**
OECD Asia	**152**	**293**	**294**	**329**	**366**	**388**	**409**	**428**	**1.5**
Japan	102	173	170	185	198	208	212	216	1.0
South Korea	6	60	63	79	97	103	111	119	2.6
Australia/New Zealand	44	60	61	65	71	77	85	93	1.7
Total OECD	**1,949**	**2,791**	**2,819**	**3,051**	**3,318**	**3,499**	**3,677**	**3,869**	**1.3**
Non-OECD									
Non-OECD Europe and Eurasia	**1,450**	**1,328**	**1,375**	**1,498**	**1,634**	**1,767**	**1,874**	**2,018**	**1.5**
Russia	928	868	875	944	1,028	1,091	1,150	1,231	1.4
Other	521	460	500	554	606	676	724	787	1.8
Non-OECD Asia	**160**	**469**	**516**	**710**	**965**	**1,244**	**1,470**	**1,694**	**4.9**
China	30	83	101	169	243	318	372	422	5.9
India	24	59	69	101	137	170	207	234	5.0
Other Non-OECD Asia	106	327	345	439	585	755	892	1,038	4.5
Middle East	**199**	**476**	**541**	**626**	**727**	**828**	**896**	**971**	**2.4**
Africa	**80**	**149**	**167**	**205**	**266**	**334**	**389**	**446**	**4.0**
Central and South America	**116**	**231**	**249**	**321**	**388**	**439**	**494**	**548**	**3.2**
Brazil	6	33	36	56	70	80	94	112	4.6
Other Central and South America	110	197	213	266	318	358	400	436	2.9
Total Non-OECD	**2,005**	**2,651**	**2,847**	**3,360**	**3,980**	**4,611**	**5,123**	**5,676**	**2.8**
Total World	**3,954**	**5,443**	**5,666**	**6,411**	**7,299**	**8,110**	**8,800**	**9,545**	**2.1**

[a]Includes the 50 States and the District of Columbia.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run HM2008.D031608A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table B12. World Carbon Dioxide Emissions from Coal Use by Region, High Economic Growth Case, 1990-2030
(Million Metric Tons Carbon Dioxide)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**1,913**	**2,333**	**2,351**	**2,400**	**2,568**	**2,866**	**3,108**	**3,384**	**1.5**
United States[a]	1,784	2,155	2,162	2,190	2,348	2,636	2,865	3,133	1.5
Canada	114	151	153	168	174	181	191	197	1.0
Mexico	15	28	35	42	46	48	52	55	1.8
OECD Europe	**1,644**	**1,250**	**1,232**	**1,309**	**1,322**	**1,303**	**1,287**	**1,267**	**0.1**
OECD Asia	**475**	**840**	**853**	**886**	**904**	**919**	**947**	**997**	**0.6**
Japan	246	433	417	417	411	408	407	407	-0.1
South Korea	91	190	196	224	240	245	258	288	1.5
Australia/New Zealand	138	217	239	245	252	266	283	302	0.9
Total OECD	**4,032**	**4,423**	**4,435**	**4,595**	**4,794**	**5,087**	**5,342**	**5,648**	**1.0**
Non-OECD									
Non-OECD Europe and Eurasia	**1,393**	**804**	**817**	**826**	**951**	**1,005**	**1,045**	**1,138**	**1.3**
Russia	665	422	442	440	475	509	513	568	1.0
Other	729	381	376	386	476	496	532	570	1.7
Non-OECD Asia	**2,503**	**5,070**	**5,624**	**7,215**	**8,751**	**10,075**	**11,529**	**12,999**	**3.4**
China	1,886	3,827	4,341	5,709	6,975	8,120	9,316	10,479	3.6
India	380	765	791	923	1,097	1,242	1,381	1,544	2.7
Other Non-OECD Asia	237	477	492	582	680	713	833	975	2.8
Middle East	**13**	**35**	**35**	**43**	**45**	**46**	**47**	**48**	**1.2**
Africa	**271**	**394**	**386**	**409**	**480**	**513**	**548**	**567**	**1.6**
Central and South America	**50**	**78**	**81**	**126**	**155**	**169**	**180**	**193**	**3.5**
Brazil	30	43	41	77	92	104	113	124	4.5
Other Central and South America	20	35	40	49	63	65	67	69	2.2
Total Non-OECD	**4,231**	**6,380**	**6,943**	**8,619**	**10,383**	**11,808**	**13,348**	**14,944**	**3.1**
Total World	**8,263**	**10,803**	**11,378**	**13,214**	**15,176**	**16,896**	**18,690**	**20,592**	**2.4**

[a]Includes the 50 States and the District of Columbia.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run HM2008.D031608A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Appendix C

Low Economic Growth Case Projections:

- World Energy Consumption
- Gross Domestic Product
- Carbon Dioxide Emissions

Table C1. World Total Energy Consumption by Region, Low Economic Growth Case, 1990-2030
(Quadrillion Btu)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**100.7**	**120.6**	**121.3**	**125.1**	**128.4**	**131.4**	**134.2**	**136.1**	**0.5**
United States[a]	84.7	100.1	100.1	102.2	104.2	105.8	107.4	108.2	0.3
Canada	11.0	14.0	14.3	15.6	16.2	16.8	17.3	17.6	0.8
Mexico	5.0	6.5	6.9	7.4	8.0	8.8	9.5	10.2	1.6
OECD Europe	**70.0**	**81.0**	**81.4**	**83.2**	**84.6**	**84.9**	**85.4**	**85.4**	**0.2**
OECD Asia	**26.8**	**37.8**	**38.2**	**39.1**	**40.3**	**40.7**	**40.8**	**41.0**	**0.3**
Japan	18.5	22.7	22.6	22.3	22.3	22.2	21.9	21.7	-0.2
South Korea	3.8	9.0	9.3	10.2	11.2	11.7	11.9	12.3	1.1
Australia/New Zealand	4.5	6.1	6.3	6.6	6.7	6.8	7.0	7.1	0.5
Total OECD	**197.5**	**239.4**	**240.9**	**247.4**	**253.3**	**257.0**	**260.3**	**262.5**	**0.3**
Non-OECD									
Non-OECD Europe and Eurasia	**67.3**	**49.5**	**50.7**	**54.6**	**57.6**	**60.0**	**61.1**	**62.3**	**0.8**
Russia	39.4	29.9	30.3	32.4	33.9	34.9	35.4	36.0	0.7
Other	28.0	19.6	20.4	22.2	23.8	25.1	25.7	26.3	1.0
Non-OECD Asia	**47.4**	**101.0**	**109.9**	**135.0**	**157.8**	**178.5**	**198.9**	**218.2**	**2.8**
China	27.0	59.9	67.1	85.7	99.7	113.6	127.7	141.3	3.0
India	7.9	15.5	16.2	19.1	22.3	25.2	27.8	30.3	2.5
Other Non-OECD Asia	12.5	25.6	26.6	30.2	35.7	39.7	43.3	46.7	2.3
Middle East	**11.2**	**20.9**	**22.9**	**26.2**	**28.5**	**30.7**	**31.8**	**32.7**	**1.4**
Africa	**9.5**	**14.0**	**14.4**	**16.4**	**18.3**	**19.7**	**20.6**	**21.3**	**1.6**
Central and South America	**14.5**	**22.5**	**23.4**	**27.4**	**29.5**	**31.3**	**32.8**	**34.2**	**1.5**
Brazil	5.7	9.0	9.3	11.0	12.2	13.3	14.2	15.1	2.0
Other Central and South America	8.8	13.5	14.1	16.4	17.3	18.0	18.6	19.0	1.2
Total Non-OECD	**149.9**	**207.9**	**221.3**	**259.7**	**291.6**	**320.2**	**345.2**	**368.7**	**2.1**
Total World	**347.4**	**447.3**	**462.2**	**507.1**	**544.9**	**577.2**	**605.6**	**631.3**	**1.3**

[a]Includes the 50 States and the District of Columbia.

Notes: Energy totals include net imports of coal coke and electricity generated from biomass in the United States. Totals may not equal sum of components due to independent rounding. The electricity portion of the national fuel consumption values consists of generation for domestic use plus an adjustment for electricity trade based on a fuel's share of total generation in the exporting country.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run LM2008.D031608A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table C2. World Total Energy Consumption by Region and Fuel, Low Economic Growth Case, 1990-2030
(Quadrillion Btu)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America									
Liquids	40.5	48.9	49.1	48.8	49.6	49.6	49.6	50.1	0.1
Natural Gas	23.2	28.1	28.0	29.4	29.8	30.2	30.5	30.3	0.3
Coal	20.6	24.5	24.8	25.2	26.0	26.8	27.9	29.3	0.7
Nuclear	6.9	9.3	9.3	9.6	9.8	10.3	10.4	10.2	0.4
Other	9.5	9.8	10.2	12.1	13.3	14.6	15.8	16.1	1.9
Total	**100.7**	**120.6**	**121.3**	**125.1**	**128.4**	**131.4**	**134.1**	**136.1**	**0.5**
OECD Europe									
Liquids	28.4	32.0	32.1	31.8	32.0	31.6	31.1	30.6	-0.2
Natural Gas	11.2	19.4	19.9	21.1	23.0	24.5	25.3	26.1	1.1
Coal	17.7	13.3	13.2	13.7	13.4	12.8	12.3	11.7	-0.5
Nuclear	7.9	9.9	9.8	9.5	9.3	8.4	8.5	8.7	-0.5
Other	4.8	6.3	6.5	7.1	7.1	7.6	8.1	8.4	1.1
Total	**70.0**	**81.0**	**81.4**	**83.2**	**84.6**	**84.9**	**85.4**	**85.5**	**0.2**
OECD Asia									
Liquids	14.7	17.3	17.5	17.1	17.4	17.3	17.1	16.9	-0.1
Natural Gas	2.9	5.6	5.6	6.1	6.6	6.8	6.9	6.9	0.9
Coal	5.2	9.2	9.3	9.5	9.4	9.2	9.1	9.1	-0.1
Nuclear	2.5	4.0	4.2	4.4	4.9	5.3	5.6	5.8	1.3
Other	1.6	1.8	1.6	1.9	2.0	2.1	2.1	2.2	1.4
Total	**26.8**	**37.8**	**38.2**	**39.1**	**40.3**	**40.7**	**40.8**	**41.0**	**0.3**
Total OECD									
Liquids	83.6	98.2	98.7	97.7	98.9	98.5	97.8	97.6	0.0
Natural Gas	37.2	53.1	53.4	56.6	59.4	61.5	62.7	63.3	0.7
Coal	43.5	47.0	47.3	48.4	48.7	48.8	49.3	50.1	0.2
Nuclear	17.3	23.1	23.2	23.6	23.9	24.0	24.5	24.7	0.2
Other	15.9	17.9	18.2	21.1	22.4	24.2	26.0	26.8	1.5
Total	**197.5**	**239.4**	**240.9**	**247.4**	**253.3**	**257.0**	**260.3**	**262.5**	**0.3**
Non-OECD									
Non-OECD Europe and Eurasia									
Liquids	19.6	9.8	10.0	11.2	11.7	12.1	12.5	12.7	1.0
Natural Gas	27.5	25.1	26.0	27.8	29.2	30.2	30.4	30.9	0.7
Coal	15.1	8.7	8.8	8.8	9.7	9.8	9.8	10.1	0.5
Nuclear	2.5	2.9	2.8	3.1	3.4	4.2	4.8	4.8	2.1
Other	2.8	3.0	3.1	3.7	3.7	3.7	3.7	3.7	0.8
Total	**67.3**	**49.5**	**50.7**	**54.6**	**57.7**	**60.0**	**61.1**	**62.3**	**0.8**
Non-OECD Asia									
Liquids	14.0	30.5	31.5	37.2	42.1	47.1	51.8	57.0	2.4
Natural Gas	3.0	8.9	9.8	13.1	17.2	21.2	23.9	26.0	4.0
Coal	27.0	54.9	60.9	74.8	87.0	96.6	106.9	116.9	2.6
Nuclear	0.4	1.1	1.1	1.6	3.0	4.5	5.6	6.2	7.2
Other	3.0	5.6	6.6	8.3	8.5	9.1	10.7	12.2	2.5
Total	**47.4**	**101.0**	**109.9**	**135.0**	**157.8**	**178.5**	**198.9**	**218.2**	**2.8**

See notes at end of table.

Table C2. World Total Energy Consumption by Region and Fuel, Low Economic Growth Case, 1990-2030 (Continued)
(Quadrillion Btu)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
Non-OECD (Continued)									
Middle East									
Liquids	7.2	11.3	12.0	13.9	14.7	15.8	16.5	17.2	1.5
Natural Gas	3.8	9.0	10.2	11.6	13.0	14.1	14.5	14.7	1.5
Coal	0.1	0.4	0.4	0.5	0.5	0.5	0.4	0.4	0.4
Nuclear	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	—
Other	0.1	0.2	0.2	0.3	0.3	0.3	0.3	0.4	2.1
Total	**11.2**	**20.9**	**22.9**	**26.2**	**28.5**	**30.7**	**31.8**	**32.8**	**1.4**
Africa									
Liquids	4.3	5.8	6.0	6.9	7.2	7.6	7.7	7.9	1.1
Natural Gas	1.5	2.8	3.2	3.8	4.7	5.6	6.2	6.6	3.0
Coal	3.0	4.3	4.2	4.4	5.0	5.1	5.2	5.0	0.7
Nuclear	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	1.8
Other	0.6	0.9	0.9	1.1	1.2	1.2	1.4	1.6	2.2
Total	**9.5**	**14.0**	**14.4**	**16.4**	**18.3**	**19.8**	**20.7**	**21.3**	**1.6**
Central and South America									
Liquids	7.8	11.0	11.2	12.9	12.9	13.3	13.7	14.1	0.9
Natural Gas	2.2	4.4	4.7	6.0	6.9	7.5	7.9	8.3	2.3
Coal	0.6	0.8	0.9	1.3	1.6	1.6	1.7	1.7	2.6
Nuclear	0.1	0.2	0.2	0.2	0.3	0.4	0.3	0.3	2.5
Other	3.9	6.1	6.4	7.1	7.7	8.5	9.2	9.7	1.7
Total	**14.5**	**22.5**	**23.4**	**27.4**	**29.5**	**31.3**	**32.8**	**34.2**	**1.5**
Total Non-OECD									
Liquids	52.9	68.4	70.8	82.1	88.6	96.0	102.3	108.9	1.7
Natural Gas	38.0	50.2	53.9	62.3	71.0	78.5	82.8	86.5	1.9
Coal	45.7	69.1	75.2	89.8	103.7	113.6	123.9	134.2	2.3
Nuclear	3.1	4.3	4.2	5.0	6.9	9.2	11.0	11.6	4.1
Other	10.3	15.9	17.2	20.5	21.4	22.8	25.3	27.5	1.9
Total	**149.9**	**207.9**	**221.3**	**259.7**	**291.6**	**320.2**	**345.3**	**368.7**	**2.1**
Total World									
Liquids	136.4	166.6	169.4	179.8	187.5	194.5	200.1	206.5	0.8
Natural Gas	75.2	103.3	107.4	118.9	130.3	140.0	145.5	149.9	1.3
Coal	89.2	116.1	122.5	138.2	152.4	162.4	173.2	184.3	1.6
Nuclear	20.4	27.4	27.5	28.6	30.8	33.2	35.5	36.3	1.1
Other	26.2	33.8	35.5	41.6	43.8	47.1	51.3	54.3	1.7
Total	**347.4**	**447.3**	**462.2**	**507.1**	**544.9**	**577.2**	**605.6**	**631.3**	**1.3**

Notes: Energy totals include net imports of coal coke and electricity generated from biomass in the United States. Totals may not equal sum of components due to independent rounding. The electricity portion of the national fuel consumption values consists of generation for domestic use plus an adjustment for electricity trade based on a fuel's share of total generation in the exporting country.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run LM2008.D031608A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table C3. World Gross Domestic Product (GDP) by Region Expressed in Purchasing Power Parity, Low Economic Growth Case, 1990-2030
(Billion 2000 Dollars)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**8,477**	**12,696**	**13,083**	**14,530**	**16,129**	**17,922**	**19,644**	**21,505**	**2.0**
United States[a]	7,113	10,676	11,004	12,106	13,350	14,747	16,039	17,432	1.9
Canada	684	1,004	1,034	1,170	1,288	1,405	1,528	1,660	1.9
Mexico	680	1,016	1,045	1,255	1,491	1,770	2,078	2,412	3.4
OECD Europe	**8,067**	**11,197**	**11,445**	**12,958**	**14,145**	**15,383**	**16,648**	**17,934**	**1.8**
OECD Asia	**3,621**	**4,775**	**4,887**	**5,484**	**5,931**	**6,262**	**6,559**	**6,871**	**1.4**
Japan	2,862	3,377	3,440	3,732	3,889	3,949	3,967	3,985	0.6
South Korea	331	715	745	950	1,131	1,278	1,421	1,565	3.0
Australia/New Zealand	429	683	702	802	912	1,035	1,171	1,321	2.6
Total OECD	**20,165**	**28,667**	**29,415**	**32,972**	**36,205**	**39,567**	**42,852**	**46,310**	**1.8**
Non-OECD									
Non-OECD Europe and Eurasia	**3,601**	**3,340**	**3,563**	**4,915**	**6,034**	**7,036**	**8,107**	**9,275**	**3.9**
Russia	2,241	1,907	2,029	2,715	3,304	3,777	4,282	4,836	3.5
Other	1,360	1,433	1,534	2,200	2,730	3,259	3,825	4,439	4.3
Non-OECD Asia	**5,792**	**15,102**	**16,436**	**24,438**	**32,236**	**40,674**	**49,884**	**60,025**	**5.3**
China	1,805	6,961	7,685	12,332	16,554	21,199	26,468	32,264	5.9
India	1,697	3,714	4,056	6,008	8,165	10,381	12,533	14,814	5.3
Other Non-OECD Asia	2,291	4,428	4,695	6,099	7,516	9,094	10,883	12,947	4.1
Middle East	**820**	**1,466**	**1,550**	**1,933**	**2,323**	**2,748**	**3,213**	**3,736**	**3.6**
Africa	**1,450**	**2,182**	**2,295**	**2,971**	**3,656**	**4,390**	**5,219**	**6,171**	**4.0**
Central and South America	**2,162**	**3,372**	**3,535**	**4,451**	**5,258**	**6,136**	**7,137**	**8,285**	**3.5**
Brazil	1,022	1,581	1,627	1,984	2,302	2,651	3,043	3,486	3.1
Other Central and South America	1,140	1,791	1,908	2,467	2,956	3,485	4,094	4,800	3.8
Total Non-OECD	**13,824**	**25,462**	**27,378**	**38,708**	**49,508**	**60,985**	**73,561**	**87,493**	**4.8**
Total World	**33,989**	**54,129**	**56,793**	**71,680**	**85,713**	**100,552**	**116,413**	**133,802**	**3.5**

[a]Includes the 50 States and the District of Columbia.

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

Sources: **History:** Global Insight, Inc., *World Overview* (Lexington, MA, various issues). **Projections:** Derived from Global Insight, Inc., *World Overview*, Fourth Quarter 2007 (Lexington, MA, January 2008); and Energy Information Administration, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), Table B4.

Table C4. World Liquids Consumption by Region, Low Economic Growth Case, 1990-2030
(Million Barrels Oil Equivalent per Day)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**20.5**	**25.0**	**25.2**	**25.0**	**25.3**	**25.3**	**25.2**	**25.4**	**0.0**
United States[a]	17.0	20.7	20.8	20.4	20.6	20.5	20.3	20.3	-0.1
Canada	1.7	2.3	2.3	2.4	2.4	2.4	2.4	2.4	0.2
Mexico	1.8	2.0	2.1	2.1	2.3	2.4	2.6	2.7	1.1
OECD Europe	**13.7**	**15.5**	**15.5**	**15.4**	**15.4**	**15.3**	**15.0**	**14.8**	**-0.2**
OECD Asia	**7.2**	**8.5**	**8.6**	**8.4**	**8.5**	**8.5**	**8.4**	**8.3**	**-0.1**
Japan	5.3	5.3	5.4	5.0	4.9	4.8	4.6	4.5	-0.7
South Korea	1.0	2.2	2.2	2.3	2.5	2.6	2.6	2.6	0.8
Australia/New Zealand	0.8	1.0	1.1	1.1	1.1	1.2	1.2	1.2	0.5
Total OECD	**41.4**	**49.0**	**49.3**	**48.7**	**49.3**	**49.1**	**48.6**	**48.5**	**-0.1**
Non-OECD									
Non-OECD Europe and Eurasia	**9.4**	**4.8**	**4.8**	**5.4**	**5.6**	**5.9**	**6.0**	**6.2**	**1.0**
Russia	5.4	2.8	2.8	3.0	3.1	3.1	3.2	3.1	0.5
Other	3.9	2.0	2.1	2.4	2.6	2.7	2.9	3.0	1.5
Non-OECD Asia	**6.6**	**14.8**	**15.3**	**18.0**	**20.4**	**22.8**	**25.1**	**27.6**	**2.4**
China	2.3	6.4	6.7	8.7	9.6	11.0	12.5	14.1	3.0
India	1.2	2.4	2.4	2.7	3.2	3.6	4.0	4.4	2.4
Other Non-OECD Asia	3.1	6.0	6.1	6.6	7.6	8.1	8.6	9.1	1.6
Middle East	**3.5**	**5.5**	**5.9**	**6.8**	**7.2**	**7.7**	**8.1**	**8.4**	**1.5**
Africa	**2.1**	**2.8**	**2.9**	**3.4**	**3.5**	**3.7**	**3.8**	**3.8**	**1.1**
Central and South America	**3.8**	**5.4**	**5.5**	**6.3**	**6.3**	**6.5**	**6.7**	**6.9**	**0.9**
Brazil	1.5	2.1	2.2	2.5	2.5	2.6	2.7	2.9	1.1
Other Central and South America	2.3	3.2	3.3	3.8	3.8	3.9	3.9	4.0	0.8
Total Non-OECD	**25.3**	**33.3**	**34.3**	**39.8**	**43.0**	**46.6**	**49.6**	**52.9**	**1.7**
Total World	**66.6**	**82.3**	**83.6**	**88.6**	**92.3**	**95.6**	**98.3**	**101.3**	**0.8**

[a]Includes the 50 States and the District of Columbia.

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

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run LM2008.D031608A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table C5. World Natural Gas Consumption by Region, Low Economic Growth Case, 1990-2030
(Trillion Cubic Feet)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**22.5**	**27.4**	**27.4**	**28.5**	**28.9**	**29.2**	**29.5**	**29.4**	**0.3**
United States[a]	19.2	22.4	22.2	22.8	22.7	22.3	22.0	21.3	-0.2
Canada	2.4	3.3	3.4	3.6	3.9	4.1	4.4	4.6	1.2
Mexico	0.9	1.7	1.7	2.0	2.3	2.7	3.1	3.5	2.8
OECD Europe	**11.6**	**18.9**	**19.3**	**20.5**	**22.3**	**23.8**	**24.6**	**25.3**	**1.1**
OECD Asia	**2.8**	**5.2**	**5.2**	**5.8**	**6.2**	**6.4**	**6.5**	**6.5**	**0.9**
Japan	1.9	3.1	3.1	3.3	3.5	3.5	3.5	3.5	0.5
South Korea	0.1	1.0	1.1	1.3	1.6	1.6	1.7	1.7	1.8
Australia/New Zealand	0.8	1.1	1.1	1.2	1.2	1.3	1.3	1.4	1.0
Total OECD	**36.8**	**51.6**	**51.9**	**54.7**	**57.4**	**59.4**	**60.6**	**61.2**	**0.7**
Non-OECD									
Non-OECD Europe and Eurasia	**26.7**	**24.4**	**25.3**	**27.0**	**28.3**	**29.3**	**29.5**	**30.0**	**0.7**
Russia	17.3	16.0	16.2	17.1	17.9	18.2	18.3	18.5	0.6
Other	9.5	8.4	9.1	9.9	10.4	11.1	11.3	11.5	0.9
Non-OECD Asia	**2.9**	**8.5**	**9.3**	**12.5**	**16.3**	**20.1**	**22.6**	**24.7**	**4.0**
China	0.5	1.4	1.7	2.7	3.8	4.8	5.4	5.9	5.2
India	0.4	1.1	1.3	1.8	2.3	2.8	3.3	3.6	4.2
Other Non-OECD Asia	2.0	6.1	6.4	8.0	10.2	12.5	14.0	15.2	3.5
Middle East	**3.6**	**8.6**	**9.8**	**11.1**	**12.4**	**13.5**	**13.8**	**14.0**	**1.5**
Africa	**1.4**	**2.6**	**3.0**	**3.5**	**4.4**	**5.3**	**5.8**	**6.2**	**3.0**
Central and South America	**2.0**	**4.1**	**4.4**	**5.6**	**6.5**	**7.0**	**7.4**	**7.8**	**2.3**
Brazil	0.1	0.6	0.7	1.0	1.2	1.3	1.5	1.6	3.7
Other Central and South America	1.9	3.5	3.7	4.6	5.3	5.7	6.0	6.1	2.0
Total Non-OECD	**36.5**	**48.2**	**51.8**	**59.7**	**67.9**	**75.0**	**79.1**	**82.6**	**1.9**
Total World	**73.4**	**99.8**	**103.7**	**114.4**	**125.3**	**134.5**	**139.7**	**143.8**	**1.3**

[a]Includes the 50 States and the District of Columbia.

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

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run LM2008.D031608A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table C6. World Coal Consumption by Region, Low Economic Growth Case, 1990-2030
(Quadrillion Btu)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**20.6**	**24.5**	**24.8**	**25.2**	**26.0**	**26.8**	**27.9**	**29.3**	**0.7**
United States[a]	19.2	22.6	22.8	23.0	23.7	24.5	25.6	27.0	0.7
Canada	1.2	1.6	1.7	1.8	1.8	1.8	1.8	1.8	0.3
Mexico	0.2	0.3	0.4	0.4	0.5	0.5	0.5	0.5	0.8
OECD Europe	**17.7**	**13.3**	**13.2**	**13.6**	**13.3**	**12.8**	**12.3**	**11.7**	**-0.5**
OECD Asia	**5.2**	**9.2**	**9.3**	**9.5**	**9.4**	**9.2**	**9.1**	**9.1**	**-0.1**
Japan	2.7	4.8	4.6	4.5	4.3	4.1	4.0	3.9	-0.7
South Korea	1.0	2.1	2.1	2.4	2.5	2.4	2.4	2.5	0.7
Australia/New Zealand	1.5	2.4	2.6	2.6	2.6	2.7	2.7	2.7	0.2
Total OECD	**43.5**	**47.0**	**47.3**	**48.4**	**48.7**	**48.8**	**49.3**	**50.1**	**0.2**
Non-OECD									
Non-OECD Europe and Eurasia	**15.1**	**8.7**	**8.8**	**8.8**	**9.7**	**9.8**	**9.8**	**10.1**	**0.5**
Russia	7.2	4.6	4.8	4.7	4.9	5.1	4.9	5.3	0.4
Other	7.9	4.1	4.0	4.1	4.8	4.8	4.9	4.9	0.8
Non-OECD Asia	**27.0**	**54.9**	**60.9**	**74.8**	**87.0**	**96.6**	**106.9**	**116.9**	**2.6**
China	20.3	41.4	46.9	59.0	69.0	77.6	86.2	94.3	2.8
India	4.2	8.4	8.6	9.8	11.2	12.2	13.1	14.2	2.0
Other Non-OECD Asia	2.6	5.1	5.3	6.1	6.8	6.9	7.6	8.4	1.8
Middle East	**0.1**	**0.4**	**0.4**	**0.5**	**0.5**	**0.5**	**0.4**	**0.4**	**0.4**
Africa	**3.0**	**4.3**	**4.2**	**4.4**	**5.0**	**5.1**	**5.2**	**5.0**	**0.7**
Central and South America	**0.6**	**0.8**	**0.9**	**1.3**	**1.6**	**1.6**	**1.7**	**1.7**	**2.6**
Brazil	0.3	0.5	0.4	0.8	0.9	1.0	1.0	1.1	3.6
Other Central and South America	0.2	0.4	0.4	0.5	0.7	0.6	0.6	0.6	1.4
Total Non-OECD	**45.7**	**69.1**	**75.2**	**89.8**	**103.7**	**113.6**	**123.9**	**134.2**	**2.3**
Total World	**89.2**	**116.1**	**122.5**	**138.2**	**152.4**	**162.4**	**173.2**	**184.3**	**1.6**

[a]Includes the 50 States and the District of Columbia.

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

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run LM2008.D031608A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table C7. World Nuclear Energy Consumption by Region, Low Economic Growth Case, 1990-2030
(Billion Kilowatthours)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**649**	**883**	**880**	**916**	**928**	**978**	**989**	**970**	**0.4**
United States[a]	577	789	782	797	807	854	860	837	0.3
Canada	69	86	87	109	111	115	120	124	1.4
Mexico	3	9	10	11	10	10	10	9	-0.3
OECD Europe	**743**	**941**	**929**	**905**	**879**	**797**	**811**	**824**	**-0.5**
OECD Asia	**242**	**392**	**418**	**439**	**485**	**526**	**553**	**580**	**1.3**
Japan	192	268	278	298	313	326	344	361	1.0
South Korea	50	124	139	141	171	200	209	218	1.8
Australia/New Zealand	0	0	0	0	0	0	0	0	—
Total OECD	**1,635**	**2,216**	**2,227**	**2,261**	**2,292**	**2,302**	**2,352**	**2,373**	**0.3**
Non-OECD									
Non-OECD Europe and Eurasia	**219**	**263**	**264**	**286**	**317**	**389**	**440**	**443**	**2.1**
Russia	115	137	140	154	185	226	276	284	2.9
Other	104	125	124	132	132	162	164	159	1.0
Non-OECD Asia	**38**	**103**	**106**	**148**	**284**	**423**	**534**	**589**	**7.1**
China	0	48	50	65	158	253	327	377	8.4
India	6	15	16	37	64	99	126	137	9.1
Other Non-OECD Asia	32	40	40	47	62	71	81	75	2.5
Middle East	**0**	**0**	**0**	**0**	**6**	**6**	**5**	**5**	**—**
Africa	**8**	**14**	**12**	**14**	**15**	**15**	**20**	**19**	**1.8**
Central and South America	**9**	**19**	**16**	**23**	**28**	**33**	**31**	**31**	**2.5**
Brazil	2	12	10	15	18	21	21	20	2.9
Other Central and South America	7	7	6	8	10	12	11	10	2.0
Total Non-OECD	**274**	**399**	**399**	**471**	**648**	**865**	**1,031**	**1,087**	**4.1**
Total World	**1,909**	**2,615**	**2,626**	**2,731**	**2,940**	**3,167**	**3,383**	**3,460**	**1.1**

[a]Includes the 50 States and the District of Columbia.

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

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run LM2008.D031608A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table C8. World Consumption of Hydroelectricity and Other Renewable Energy by Region, Low Economic Growth Case, 1990-2030
(Quadrillion Btu)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**9.5**	**9.8**	**10.2**	**12.1**	**13.3**	**14.6**	**15.8**	**16.1**	**1.9**
United States[a]	6.1	6.0	6.0	7.5	8.3	9.3	10.3	10.5	2.2
Canada	3.1	3.5	3.7	4.1	4.5	4.7	4.9	5.1	1.3
Mexico	0.3	0.4	0.4	0.5	0.5	0.6	0.6	0.6	1.0
OECD Europe	**4.8**	**6.3**	**6.5**	**7.1**	**7.1**	**7.6**	**8.1**	**8.4**	**1.1**
OECD Asia	**1.6**	**1.8**	**1.6**	**1.9**	**2.0**	**2.1**	**2.1**	**2.2**	**1.4**
Japan	1.1	1.2	1.0	1.2	1.3	1.3	1.4	1.4	1.3
South Korea	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.2	7.2
Australia/New Zealand	0.4	0.5	0.5	0.6	0.6	0.6	0.6	0.5	0.5
Total OECD	**15.9**	**17.9**	**18.2**	**21.1**	**22.4**	**24.2**	**26.0**	**26.8**	**1.5**
Non-OECD									
Non-OECD Europe and Eurasia	**2.8**	**3.0**	**3.1**	**3.7**	**3.7**	**3.7**	**3.7**	**3.7**	**0.8**
Russia	1.8	1.8	1.8	2.3	2.3	2.2	2.2	2.2	0.9
Other	1.0	1.3	1.3	1.4	1.4	1.4	1.5	1.5	0.6
Non-OECD Asia	**3.0**	**5.6**	**6.6**	**8.3**	**8.5**	**9.1**	**10.7**	**12.2**	**2.5**
China	1.3	3.3	4.0	5.0	5.1	5.3	6.4	7.4	2.5
India	0.7	0.9	1.1	1.5	1.5	1.5	1.7	1.8	2.1
Other Non-OECD Asia	0.9	1.4	1.6	1.8	2.0	2.3	2.7	3.0	2.7
Middle East	**0.1**	**0.2**	**0.2**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**2.1**
Africa	**0.6**	**0.9**	**0.9**	**1.1**	**1.2**	**1.2**	**1.4**	**1.6**	**2.2**
Central and South America	**3.9**	**6.1**	**6.4**	**7.1**	**7.7**	**8.5**	**9.2**	**9.7**	**1.7**
Brazil	2.2	3.4	3.5	4.0	4.7	5.3	5.8	6.3	2.3
Other Central and South America	1.7	2.8	2.9	3.1	3.1	3.3	3.4	3.5	0.7
Total Non-OECD	**10.3**	**15.9**	**17.2**	**20.4**	**21.4**	**22.9**	**25.3**	**27.6**	**1.9**
Total World	**26.2**	**33.8**	**35.5**	**41.6**	**43.8**	**47.1**	**51.4**	**54.3**	**1.7**

[a]Includes the 50 States and the District of Columbia.

Notes: Totals may not equal sum of components due to independent rounding. U.S. totals include net electricity imports, methanol, and liquid hydrogen.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run LM2008.D031608A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table C9. World Carbon Dioxide Emissions by Region, Low Economic Growth Case, 1990-2030
(Million Metric Tons Carbon Dioxide)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**5,754**	**6,959**	**7,008**	**7,043**	**7,190**	**7,278**	**7,394**	**7,566**	**0.3**
United States[a]	4,989	5,957	5,982	5,953	6,046	6,077	6,141	6,264	0.2
Canada	465	623	628	665	679	694	705	714	0.5
Mexico	300	379	398	425	465	507	548	588	1.6
OECD Europe	**4,101**	**4,373**	**4,383**	**4,481**	**4,559**	**4,566**	**4,528**	**4,479**	**0.1**
OECD Asia	**1,541**	**2,148**	**2,174**	**2,193**	**2,224**	**2,213**	**2,198**	**2,190**	**0.0**
Japan	1,009	1,242	1,230	1,188	1,172	1,145	1,113	1,079	-0.5
South Korea	241	488	500	555	592	596	604	619	0.9
Australia/New Zealand	291	418	444	450	460	471	481	492	0.4
Total OECD	**11,396**	**13,480**	**13,565**	**13,718**	**13,973**	**14,057**	**14,120**	**14,235**	**0.2**
Non-OECD									
Non-OECD Europe and Eurasia	**4,198**	**2,797**	**2,865**	**3,040**	**3,227**	**3,323**	**3,352**	**3,432**	**0.7**
Russia	2,376	1,669	1,696	1,774	1,844	1,884	1,875	1,920	0.5
Other	1,822	1,128	1,169	1,267	1,383	1,439	1,477	1,512	1.0
Non-OECD Asia	**3,613**	**7,517**	**8,177**	**10,016**	**11,671**	**13,094**	**14,484**	**15,855**	**2.7**
China	2,241	4,753	5,323	6,763	7,869	8,915	9,938	10,931	2.9
India	565	1,127	1,164	1,329	1,546	1,719	1,875	2,043	2.3
Other Non-OECD Asia	807	1,637	1,690	1,923	2,256	2,460	2,672	2,881	2.2
Middle East	**700**	**1,290**	**1,400**	**1,610**	**1,739**	**1,870**	**1,940**	**1,999**	**1.4**
Africa	**649**	**943**	**966**	**1,082**	**1,202**	**1,289**	**1,333**	**1,354**	**1.4**
Central and South America	**669**	**1,042**	**1,078**	**1,299**	**1,376**	**1,436**	**1,488**	**1,535**	**1.4**
Brazil	216	350	356	448	478	505	529	559	1.8
Other Central and South America	453	692	722	851	898	930	958	976	1.2
Total Non-OECD	**9,830**	**13,589**	**14,486**	**17,045**	**19,215**	**21,011**	**22,597**	**24,176**	**2.1**
Total World	**21,226**	**27,070**	**28,051**	**30,764**	**33,188**	**35,068**	**36,717**	**38,411**	**1.3**

[a]Includes the 50 States and the District of Columbia.

Note: The U.S. numbers include carbon dioxide emissions attributable to renewable energy sources.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run LM2008.D031608A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table C10. World Carbon Dioxide Emissions from Liquids Use by Region, Low Economic Growth Case, 1990-2030
(Million Metric Tons Carbon Dioxide)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**2,633**	**3,142**	**3,169**	**3,098**	**3,149**	**3,141**	**3,133**	**3,177**	**0.0**
United States[a]	2,178	2,597	2,615	2,523	2,555	2,529	2,505	2,530	-0.1
Canada	224	291	290	303	301	302	301	302	0.2
Mexico	231	254	264	272	294	310	326	345	1.1
OECD Europe	**1,867**	**2,097**	**2,103**	**2,084**	**2,093**	**2,070**	**2,038**	**2,003**	**-0.2**
OECD Asia	**914**	**1,016**	**1,028**	**1,001**	**1,017**	**1,013**	**1,002**	**990**	**-0.2**
Japan	661	636	643	597	590	574	555	536	-0.7
South Korea	144	238	240	258	274	282	287	292	0.8
Australia/New Zealand	110	142	144	146	153	157	159	162	0.5
Total OECD	**5,414**	**6,255**	**6,300**	**6,183**	**6,260**	**6,224**	**6,173**	**6,170**	**-0.1**
Non-OECD									
Non-OECD Europe and Eurasia	**1,355**	**666**	**673**	**760**	**791**	**823**	**845**	**864**	**1.0**
Russia	783	379	379	414	426	434	435	433	0.5
Other	572	287	294	346	365	388	410	430	1.5
Non-OECD Asia	**950**	**1,979**	**2,037**	**2,410**	**2,725**	**3,047**	**3,349**	**3,680**	**2.4**
China	325	843	880	1,148	1,260	1,453	1,642	1,856	3.0
India	160	302	303	338	399	452	498	547	2.4
Other Non-OECD Asia	464	833	854	923	1,066	1,143	1,209	1,277	1.6
Middle East	**488**	**780**	**824**	**954**	**1,010**	**1,083**	**1,137**	**1,184**	**1.5**
Africa	**298**	**400**	**413**	**480**	**501**	**528**	**536**	**545**	**1.1**
Central and South America	**503**	**734**	**749**	**861**	**865**	**890**	**915**	**942**	**0.9**
Brazil	180	274	279	318	326	341	354	370	1.1
Other Central and South America	323	460	470	543	539	550	561	572	0.8
Total Non-OECD	**3,594**	**4,558**	**4,697**	**5,464**	**5,891**	**6,372**	**6,782**	**7,215**	**1.7**
Total World	**9,009**	**10,813**	**10,996**	**11,648**	**12,151**	**12,596**	**12,955**	**13,385**	**0.8**

[a]Includes the 50 States and the District of Columbia.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run LM2008.D031608A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table C11. World Carbon Dioxide Emissions from Natural Gas Use by Region, Low Economic Growth Case, 1990-2030
(Million Metric Tons Carbon Dioxide)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**1,207**	**1,471**	**1,476**	**1,543**	**1,567**	**1,588**	**1,605**	**1,600**	**0.3**
United States[a]	1,026	1,194	1,193	1,234	1,226	1,209	1,191	1,155	-0.1
Canada	127	181	185	197	212	224	236	247	1.2
Mexico	54	97	99	112	128	155	177	199	2.8
OECD Europe	**590**	**1,027**	**1,048**	**1,115**	**1,212**	**1,295**	**1,337**	**1,375**	**1.1**
OECD Asia	**152**	**293**	**294**	**324**	**350**	**359**	**365**	**366**	**0.9**
Japan	102	173	170	182	191	195	194	191	0.5
South Korea	6	60	63	78	92	94	97	98	1.8
Australia/New Zealand	44	60	61	64	68	70	74	77	1.0
Total OECD	**1,949**	**2,791**	**2,819**	**2,981**	**3,129**	**3,242**	**3,306**	**3,341**	**0.7**
Non-OECD									
Non-OECD Europe and Eurasia	**1,450**	**1,328**	**1,375**	**1,470**	**1,540**	**1,592**	**1,604**	**1,632**	**0.7**
Russia	928	868	875	926	969	985	989	1,004	0.6
Other	521	460	500	543	571	607	616	628	0.9
Non-OECD Asia	**160**	**469**	**516**	**692**	**906**	**1,118**	**1,259**	**1,373**	**4.0**
China	30	83	101	165	231	293	331	362	5.2
India	24	59	69	98	126	151	178	195	4.2
Other Non-OECD Asia	106	327	345	429	549	674	750	816	3.5
Middle East	**199**	**476**	**541**	**613**	**686**	**744**	**763**	**776**	**1.5**
Africa	**80**	**149**	**167**	**201**	**249**	**298**	**327**	**350**	**3.0**
Central and South America	**116**	**231**	**249**	**315**	**365**	**393**	**419**	**438**	**2.3**
Brazil	6	33	36	54	66	72	80	89	3.7
Other Central and South America	110	197	213	260	299	321	339	348	2.0
Total Non-OECD	**2,005**	**2,651**	**2,847**	**3,290**	**3,746**	**4,145**	**4,372**	**4,568**	**1.9**
Total World	**3,954**	**5,443**	**5,666**	**6,271**	**6,875**	**7,387**	**7,678**	**7,909**	**1.3**

[a]Includes the 50 States and the District of Columbia.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run LM2008.D031608A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table C12. World Carbon Dioxide Emissions from Coal Use by Region, Low Economic Growth Case, 1990-2030
(Million Metric Tons Carbon Dioxide)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**1,913**	**2,333**	**2,351**	**2,391**	**2,462**	**2,537**	**2,645**	**2,776**	**0.7**
United States[a]	1,784	2,155	2,162	2,185	2,253	2,327	2,433	2,567	0.7
Canada	114	151	153	165	166	168	168	166	0.3
Mexico	15	28	35	41	43	43	45	44	0.9
OECD Europe	**1,644**	**1,250**	**1,232**	**1,282**	**1,254**	**1,201**	**1,153**	**1,101**	**-0.4**
OECD Asia	**475**	**840**	**853**	**868**	**857**	**841**	**831**	**834**	**-0.1**
Japan	246	433	417	409	391	377	364	352	-0.7
South Korea	91	190	196	219	226	220	219	230	0.6
Australia/New Zealand	138	217	239	240	239	244	248	252	0.2
Total OECD	**4,032**	**4,423**	**4,435**	**4,541**	**4,573**	**4,579**	**4,629**	**4,711**	**0.2**
Non-OECD									
Non-OECD Europe and Eurasia	**1,393**	**804**	**817**	**811**	**897**	**909**	**902**	**936**	**0.5**
Russia	665	422	442	433	449	465	451	483	0.4
Other	729	381	376	378	447	444	451	454	0.8
Non-OECD Asia	**2,503**	**5,070**	**5,624**	**6,914**	**8,040**	**8,928**	**9,876**	**10,802**	**2.6**
China	1,886	3,827	4,341	5,450	6,378	7,170	7,965	8,713	2.8
India	380	765	791	893	1,021	1,116	1,199	1,300	2.0
Other Non-OECD Asia	237	477	492	571	641	643	712	788	1.9
Middle East	**13**	**35**	**35**	**42**	**42**	**42**	**40**	**39**	**0.4**
Africa	**271**	**394**	**386**	**401**	**452**	**463**	**470**	**460**	**0.7**
Central and South America	**50**	**78**	**81**	**123**	**146**	**152**	**154**	**156**	**2.7**
Brazil	30	43	41	75	87	93	96	100	3.6
Other Central and South America	20	35	40	48	60	59	58	56	1.4
Total Non-OECD	**4,231**	**6,380**	**6,943**	**8,291**	**9,577**	**10,494**	**11,443**	**12,393**	**2.3**
Total World	**8,263**	**10,803**	**11,378**	**12,833**	**14,150**	**15,073**	**16,071**	**17,104**	**1.6**

[a]Includes the 50 States and the District of Columbia.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run LM2008.D031608A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Appendix D

High Price Case Projections:

- World Energy Consumption
- Gross Domestic Product
- Carbon Dioxide Emissions

Table D1. World Total Primary Energy Consumption by Region, High Price Case, 1990-2030
(Quadrillion Btu)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**100.7**	**120.6**	**121.3**	**125.8**	**129.7**	**134.7**	**140.6**	**147.1**	**0.8**
United States[a]	84.7	100.1	100.1	102.9	105.4	108.8	112.8	117.5	0.6
Canada	11.0	14.0	14.3	15.6	16.3	17.0	17.9	18.8	1.1
Mexico	5.0	6.5	6.9	7.4	8.0	8.9	9.8	10.8	1.8
OECD Europe	**70.0**	**81.0**	**81.4**	**83.6**	**84.4**	**85.2**	**87.2**	**88.9**	**0.4**
OECD Asia	**26.8**	**37.8**	**38.2**	**39.2**	**39.9**	**40.5**	**41.5**	**42.6**	**0.4**
Japan	18.5	22.7	22.6	22.3	22.1	21.9	22.1	22.2	-0.1
South Korea	3.8	9.0	9.3	10.3	11.1	11.7	12.2	12.8	1.3
Australia/New Zealand	4.5	6.1	6.3	6.6	6.7	6.9	7.2	7.6	0.7
Total OECD	**197.5**	**239.4**	**240.9**	**248.6**	**254.1**	**260.4**	**269.3**	**278.6**	**0.6**
Non-OECD									
Non-OECD Europe and Eurasia	**67.3**	**49.5**	**50.7**	**54.7**	**58.1**	**61.5**	**64.2**	**67.0**	**1.1**
Russia	39.4	29.9	30.3	32.5	34.2	35.8	37.1	38.5	1.0
Other	28.0	19.6	20.4	22.3	23.9	25.7	27.2	28.5	1.4
Non-OECD Asia	**47.4**	**101.0**	**109.9**	**136.7**	**159.4**	**181.3**	**205.3**	**227.9**	**3.0**
China	27.0	59.9	67.1	87.1	101.7	116.4	132.7	147.8	3.2
India	7.9	15.5	16.2	19.2	22.5	25.2	28.3	30.9	2.6
Other Non-OECD Asia	12.5	25.6	26.6	30.4	35.2	39.6	44.4	49.3	2.5
Middle East	**11.2**	**20.9**	**22.9**	**26.3**	**29.2**	**31.5**	**33.2**	**34.9**	**1.7**
Africa	**9.5**	**14.0**	**14.4**	**16.4**	**18.3**	**20.0**	**21.5**	**22.9**	**1.9**
Central and South America	**14.5**	**22.5**	**23.4**	**27.4**	**29.4**	**31.6**	**33.9**	**36.3**	**1.8**
Brazil	5.7	9.0	9.3	11.1	12.3	13.5	14.7	16.0	2.2
Other Central and South America	8.8	13.5	14.1	16.4	17.1	18.1	19.2	20.2	1.5
Total Non-OECD	**149.9**	**207.9**	**221.3**	**261.5**	**294.5**	**325.8**	**358.2**	**389.1**	**2.3**
Total World	**347.4**	**447.3**	**462.2**	**510.2**	**548.5**	**586.3**	**627.5**	**667.6**	**1.5**

[a]Includes the 50 States and the District of Columbia.

Notes: Energy totals include net imports of coal coke and electricity generated from biomass in the United States. Totals may not equal sum of components due to independent rounding. The electricity portion of the national fuel consumption values consists of generation for domestic use plus an adjustment for electricity trade based on a fuel's share of total generation in the exporting country.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run HP2008.D031808A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table D2. World Total Energy Consumption by Region and Fuel, High Price Case, 1990-2030
(Quadrillion Btu)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America									
Liquids	40.5	48.9	49.1	49.1	49.2	49.3	49.9	51.4	0.2
Natural Gas	23.2	28.1	28.0	29.5	29.8	29.9	30.9	31.1	0.4
Coal	20.6	24.5	24.8	25.3	26.9	29.2	31.3	34.6	1.3
Nuclear	6.9	9.3	9.3	9.7	9.9	10.8	11.7	12.5	1.2
Other	9.5	9.8	10.2	12.3	13.9	15.4	16.8	17.5	2.2
Total	**100.7**	**120.6**	**121.3**	**125.8**	**129.7**	**134.7**	**140.6**	**147.1**	**0.8**
OECD Europe									
Liquids	28.4	32.0	32.1	31.7	30.6	29.8	29.7	29.7	-0.3
Natural Gas	11.2	19.4	19.9	20.8	22.5	24.2	25.2	26.1	1.1
Coal	17.7	13.3	13.2	13.8	13.6	13.2	12.8	12.4	-0.2
Nuclear	7.9	9.9	9.8	10.0	10.3	9.9	10.5	11.2	0.5
Other	4.8	6.3	6.5	7.3	7.4	8.1	8.9	9.5	1.5
Total	**70.0**	**81.0**	**81.4**	**83.6**	**84.4**	**85.2**	**87.2**	**88.9**	**0.4**
OECD Asia									
Liquids	14.7	17.3	17.5	17.1	16.5	16.2	16.3	16.3	-0.3
Natural Gas	2.9	5.6	5.6	6.1	6.5	6.7	6.9	6.9	0.9
Coal	5.2	9.2	9.3	9.6	9.6	9.5	9.6	9.9	0.2
Nuclear	2.5	4.0	4.2	4.6	5.2	5.9	6.4	7.0	2.0
Other	1.6	1.8	1.6	1.9	2.1	2.2	2.3	2.5	1.8
Total	**26.8**	**37.8**	**38.2**	**39.2**	**39.9**	**40.5**	**41.5**	**42.6**	**0.4**
Total OECD									
Liquids	83.6	98.2	98.7	97.8	96.3	95.3	95.9	97.4	-0.1
Natural Gas	37.2	53.1	53.4	56.4	58.8	60.8	63.0	64.2	0.7
Coal	43.5	47.0	47.3	48.7	50.1	51.9	53.8	56.9	0.7
Nuclear	17.3	23.1	23.2	24.3	25.4	26.6	28.7	30.7	1.1
Other	15.9	17.9	18.2	21.5	23.4	25.8	28.0	29.4	1.9
Total	**197.5**	**239.4**	**240.9**	**248.6**	**254.1**	**260.4**	**269.3**	**278.6**	**0.6**
Non-OECD									
Non-OECD Europe and Eurasia									
Liquids	19.6	9.8	10.0	11.2	11.4	11.7	12.3	12.8	1.0
Natural Gas	27.5	25.1	26.0	27.7	29.3	30.8	31.8	33.1	1.0
Coal	15.1	8.7	8.8	8.9	10.0	10.3	10.4	11.1	0.9
Nuclear	2.5	2.9	2.8	3.2	3.7	4.7	5.5	5.8	2.9
Other	2.8	3.0	3.1	3.8	3.9	4.0	4.2	4.3	1.3
Total	**67.3**	**49.5**	**50.7**	**54.7**	**58.1**	**61.5**	**64.2**	**67.0**	**1.1**
Non-OECD Asia									
Liquids	14.0	30.5	31.5	37.1	40.0	43.4	47.7	52.0	2.0
Natural Gas	3.0	8.9	9.8	13.0	17.1	21.4	24.7	27.6	4.2
Coal	27.0	54.9	60.9	76.2	89.8	101.2	114.0	126.4	3.0
Nuclear	0.4	1.1	1.1	1.8	3.5	5.4	7.0	7.9	8.2
Other	3.0	5.6	6.6	8.5	9.0	9.9	12.0	14.0	3.0
Total	**47.4**	**101.0**	**109.9**	**136.7**	**159.4**	**181.3**	**205.3**	**227.9**	**3.0**

See notes at end of table.

Table D2. World Total Energy Consumption by Region and Fuel, High Price Case, 1990-2030 (Continued)
(Quadrillion Btu)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
Non-OECD (Continued)									
Middle East									
Liquids	7.2	11.3	12.0	13.9	15.0	15.9	16.9	17.9	1.6
Natural Gas	3.8	9.0	10.2	11.6	13.3	14.7	15.4	16.0	1.8
Coal	0.1	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.7
Nuclear	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	—
Other	0.1	0.2	0.2	0.3	0.3	0.3	0.4	0.4	2.6
Total	**11.2**	**20.9**	**22.9**	**26.3**	**29.2**	**31.5**	**33.2**	**34.9**	**1.7**
Africa									
Liquids	4.3	5.8	6.0	6.9	7.0	7.3	7.6	7.9	1.1
Natural Gas	1.5	2.8	3.2	3.8	4.7	5.8	6.5	7.2	3.3
Coal	3.0	4.3	4.2	4.4	5.1	5.3	5.5	5.5	1.1
Nuclear	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.4	4.5
Other	0.6	0.9	0.9	1.1	1.3	1.4	1.5	1.9	2.9
Total	**9.5**	**14.0**	**14.4**	**16.4**	**18.3**	**20.0**	**21.5**	**22.9**	**1.9**
Central and South America									
Liquids	7.8	11.0	11.2	12.7	12.5	12.8	13.3	14.0	0.9
Natural Gas	2.2	4.4	4.7	5.9	6.8	7.5	8.2	8.7	2.5
Coal	0.6	0.8	0.9	1.3	1.6	1.7	1.8	1.8	3.0
Nuclear	0.1	0.2	0.2	0.3	0.3	0.4	0.4	0.4	3.3
Other	3.9	6.1	6.4	7.2	8.1	9.2	10.3	11.3	2.3
Total	**14.5**	**22.5**	**23.4**	**27.4**	**29.4**	**31.6**	**33.9**	**36.3**	**1.8**
Total Non-OECD									
Liquids	52.9	68.4	70.8	81.9	85.9	91.2	97.8	104.7	1.6
Natural Gas	38.0	50.2	53.9	62.1	71.3	80.1	86.6	92.7	2.2
Coal	45.7	69.1	75.2	91.3	106.9	119.0	132.2	145.3	2.7
Nuclear	3.1	4.3	4.2	5.4	7.8	10.8	13.3	14.6	5.1
Other	10.3	15.9	17.2	20.9	22.5	24.8	28.3	31.8	2.5
Total	**149.9**	**207.9**	**221.3**	**261.5**	**294.5**	**325.8**	**358.2**	**389.1**	**2.3**
Total World									
Liquids	136.4	166.6	169.4	179.7	182.2	186.4	193.7	202.1	0.7
Natural Gas	75.2	103.3	107.4	118.5	130.1	141.0	149.6	156.8	1.5
Coal	89.2	116.1	122.5	139.9	157.1	170.9	185.9	202.2	2.0
Nuclear	20.4	27.4	27.5	29.7	33.2	37.4	42.0	45.2	2.0
Other	26.2	33.8	35.5	42.4	45.9	50.6	56.3	61.3	2.2
Total	**347.4**	**447.3**	**462.2**	**510.2**	**548.5**	**586.3**	**627.5**	**667.6**	**1.5**

Notes: Energy totals include net imports of coal coke and electricity generated from biomass in the United States. Totals may not equal sum of components due to independent rounding. The electricity portion of the national fuel consumption values consists of generation for domestic use plus an adjustment for electricity trade based on a fuel's share of total generation in the exporting country.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run HP2008.D031808A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table D3. World Gross Domestic Product (GDP) by Region Expressed in Purchasing Power Parity, High Price Case, 1990-2030
(Billion 2000 Dollars)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**8,477**	**12,696**	**13,083**	**14,885**	**16,942**	**19,317**	**21,977**	**24,835**	**2.6**
United States[a]	7,113	10,676	11,004	12,426	14,060	15,947	18,047	20,284	2.5
Canada	684	1,004	1,034	1,187	1,341	1,497	1,669	1,858	2.4
Mexico	680	1,016	1,045	1,272	1,541	1,873	2,261	2,693	3.9
OECD Europe	**8,067**	**11,197**	**11,445**	**13,140**	**14,626**	**16,240**	**18,031**	**20,007**	**2.3**
OECD Asia	**3,621**	**4,775**	**4,887**	**5,559**	**6,113**	**6,589**	**7,117**	**7,666**	**1.8**
Japan	2,862	3,377	3,440	3,783	4,009	4,158	4,306	4,448	1.0
South Korea	331	715	745	962	1,157	1,332	1,536	1,742	3.5
Australia/New Zealand	429	683	702	814	947	1,099	1,276	1,476	3.0
Total OECD	**20,165**	**28,667**	**29,415**	**33,584**	**37,681**	**42,146**	**47,125**	**52,508**	**2.3**
Non-OECD									
Non-OECD Europe and Eurasia	**3,601**	**3,340**	**3,563**	**4,986**	**6,280**	**7,496**	**8,849**	**10,378**	**4.4**
Russia	2,241	1,907	2,029	2,757	3,460	4,050	4,695	5,420	4.0
Other	1,360	1,433	1,534	2,229	2,820	3,446	4,154	4,959	4.8
Non-OECD Asia	**5,792**	**15,102**	**16,436**	**24,750**	**33,027**	**42,474**	**53,741**	**66,773**	**5.8**
China	1,805	6,961	7,685	12,488	16,940	22,206	28,625	35,869	6.4
India	1,697	3,714	4,056	6,084	8,345	10,697	13,369	16,465	5.8
Other Non-OECD Asia	2,291	4,428	4,695	6,179	7,742	9,571	11,747	14,440	4.6
Middle East	**820**	**1,466**	**1,550**	**1,968**	**2,501**	**2,987**	**3,527**	**4,182**	**4.1**
Africa	**1,450**	**2,182**	**2,295**	**3,012**	**3,777**	**4,625**	**5,644**	**6,874**	**4.5**
Central and South America	**2,162**	**3,372**	**3,535**	**4,510**	**5,399**	**6,432**	**7,717**	**9,213**	**3.9**
Brazil	1,022	1,581	1,627	2,011	2,382	2,807	3,309	3,888	3.5
Other Central and South America	1,140	1,791	1,908	2,499	3,017	3,625	4,408	5,325	4.2
Total Non-OECD	**13,824**	**25,462**	**27,378**	**39,226**	**50,983**	**64,014**	**79,478**	**97,420**	**5.2**
Total World	**33,989**	**54,129**	**56,793**	**72,810**	**88,664**	**106,160**	**126,603**	**149,928**	**4.0**

[a]Includes the 50 States and the District of Columbia.

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

Sources: **History:** Global Insight, Inc., *World Overview* (Lexington, MA, various issues). **Projections:** Derived from Global Insight, Inc., *World Overview*, Fourth Quarter 2007 (Lexington, MA, January 2008); and Energy Information Administration, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), Table B4.

Table D4. World Liquids Consumption by Region, High Price Case, 1990-2030
(Million Barrels Oil Equivalent per Day)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**20.5**	**25.0**	**25.2**	**25.1**	**25.1**	**25.1**	**25.4**	**26.1**	**0.1**
United States[a]	17.0	20.7	20.8	20.6	20.6	20.5	20.6	21.1	0.1
Canada	1.7	2.3	2.3	2.4	2.3	2.3	2.3	2.3	0.1
Mexico	1.8	2.0	2.1	2.1	2.2	2.4	2.5	2.7	1.0
OECD Europe	**13.7**	**15.5**	**15.5**	**15.3**	**14.8**	**14.4**	**14.4**	**14.4**	**-0.3**
OECD Asia	**7.2**	**8.5**	**8.6**	**8.4**	**8.1**	**7.9**	**8.0**	**8.0**	**-0.3**
Japan	5.3	5.3	5.4	4.9	4.6	4.4	4.3	4.3	-0.9
South Korea	1.0	2.2	2.2	2.4	2.4	2.4	2.5	2.5	0.6
Australia/New Zealand	0.8	1.0	1.1	1.1	1.1	1.1	1.2	1.2	0.5
Total OECD	**41.4**	**49.0**	**49.3**	**48.8**	**48.0**	**47.5**	**47.8**	**48.5**	**-0.1**
Non-OECD									
Non-OECD Europe and Eurasia	**9.4**	**4.8**	**4.8**	**5.4**	**5.5**	**5.7**	**6.0**	**6.2**	**1.0**
Russia	5.4	2.8	2.8	3.0	3.0	3.0	3.1	3.1	0.5
Other	3.9	2.0	2.1	2.4	2.5	2.6	2.9	3.1	1.6
Non-OECD Asia	**6.6**	**14.8**	**15.3**	**18.0**	**19.4**	**21.0**	**23.1**	**25.2**	**2.0**
China	2.3	6.4	6.7	8.7	9.2	10.1	11.3	12.5	2.5
India	1.2	2.4	2.4	2.7	3.0	3.2	3.5	3.7	1.7
Other Non-OECD Asia	3.1	6.0	6.1	6.6	7.2	7.6	8.2	8.9	1.5
Middle East	**3.5**	**5.5**	**5.9**	**6.8**	**7.3**	**7.8**	**8.2**	**8.7**	**1.6**
Africa	**2.1**	**2.8**	**2.9**	**3.4**	**3.4**	**3.6**	**3.7**	**3.9**	**1.1**
Central and South America	**3.8**	**5.4**	**5.5**	**6.2**	**6.1**	**6.2**	**6.5**	**6.8**	**0.9**
Brazil	1.5	2.1	2.2	2.5	2.4	2.5	2.6	2.8	1.0
Other Central and South America	2.3	3.2	3.3	3.7	3.6	3.7	3.9	4.1	0.8
Total Non-OECD	**25.3**	**33.3**	**34.3**	**39.7**	**41.7**	**44.2**	**47.5**	**50.8**	**1.6**
Total World	**66.6**	**82.3**	**83.6**	**88.6**	**89.7**	**91.7**	**95.2**	**99.3**	**0.7**

[a]Includes the 50 States and the District of Columbia.

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

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run HP2008.D031808A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table D5. World Natural Gas Consumption by Region, High Price Case, 1990-2030
(Trillion Cubic Feet)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**22.5**	**27.4**	**27.4**	**28.6**	**29.1**	**29.3**	**30.2**	**30.4**	**0.4**
United States[a]	19.2	22.4	22.2	23.0	23.0	22.3	22.4	21.9	-0.1
Canada	2.4	3.3	3.4	3.6	3.8	4.1	4.4	4.6	1.2
Mexico	0.9	1.7	1.7	2.0	2.3	2.8	3.4	3.9	3.2
OECD Europe	**11.6**	**18.9**	**19.3**	**20.2**	**21.9**	**23.5**	**24.5**	**25.4**	**1.1**
OECD Asia	**2.8**	**5.2**	**5.2**	**5.7**	**6.1**	**6.3**	**6.5**	**6.5**	**0.9**
Japan	1.9	3.1	3.1	3.3	3.4	3.5	3.4	3.4	0.4
South Korea	0.1	1.0	1.1	1.3	1.5	1.6	1.6	1.7	1.8
Australia/New Zealand	0.8	1.1	1.1	1.1	1.2	1.3	1.4	1.5	1.2
Total OECD	**36.8**	**51.6**	**51.9**	**54.5**	**57.1**	**59.0**	**61.1**	**62.3**	**0.7**
Non-OECD									
Non-OECD Europe and Eurasia	**26.7**	**24.4**	**25.3**	**27.0**	**28.4**	**29.9**	**30.9**	**32.1**	**1.0**
Russia	17.3	16.0	16.2	17.1	18.0	18.6	19.1	19.7	0.8
Other	9.5	8.4	9.1	9.9	10.4	11.3	11.8	12.4	1.2
Non-OECD Asia	**2.9**	**8.5**	**9.3**	**12.4**	**16.2**	**20.3**	**23.5**	**26.3**	**4.2**
China	0.5	1.4	1.7	2.6	3.7	4.7	5.4	6.0	5.3
India	0.4	1.1	1.3	1.8	2.3	2.7	3.3	3.6	4.3
Other Non-OECD Asia	2.0	6.1	6.4	8.0	10.3	12.9	14.8	16.6	3.9
Middle East	**3.6**	**8.6**	**9.8**	**11.1**	**12.7**	**14.0**	**14.7**	**15.3**	**1.8**
Africa	**1.4**	**2.6**	**3.0**	**3.5**	**4.4**	**5.4**	**6.1**	**6.7**	**3.3**
Central and South America	**2.0**	**4.1**	**4.4**	**5.5**	**6.4**	**7.0**	**7.6**	**8.1**	**2.5**
Brazil	0.1	0.6	0.7	1.0	1.2	1.3	1.4	1.6	3.5
Other Central and South America	1.9	3.5	3.7	4.6	5.2	5.7	6.2	6.6	2.3
Total Non-OECD	**36.5**	**48.2**	**51.8**	**59.5**	**68.2**	**76.6**	**82.8**	**88.5**	**2.2**
Total World	**73.4**	**99.8**	**103.7**	**114.0**	**125.3**	**135.7**	**143.9**	**150.8**	**1.5**

[a]Includes the 50 States and the District of Columbia.

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

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run HP2008.D031808A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table D6. World Coal Consumption by Region, High Price Case, 1990-2030
(Quadrillion Btu)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**20.6**	**24.5**	**24.8**	**25.3**	**26.9**	**29.2**	**31.3**	**34.6**	**1.3**
United States[a]	19.2	22.6	22.8	23.0	24.6	26.8	28.8	32.1	1.4
Canada	1.2	1.6	1.7	1.8	1.8	1.9	1.9	1.9	0.6
Mexico	0.2	0.3	0.4	0.4	0.5	0.5	0.5	0.5	1.3
OECD Europe	**17.7**	**13.3**	**13.2**	**13.8**	**13.6**	**13.2**	**12.8**	**12.4**	**-0.2**
OECD Asia	**5.2**	**9.2**	**9.3**	**9.6**	**9.6**	**9.5**	**9.6**	**9.9**	**0.2**
Japan	2.7	4.8	4.6	4.5	4.4	4.3	4.2	4.1	-0.5
South Korea	1.0	2.1	2.1	2.4	2.5	2.5	2.6	2.8	1.1
Australia/New Zealand	1.5	2.4	2.6	2.6	2.7	2.8	2.9	3.0	0.5
Total OECD	**43.5**	**47.0**	**47.3**	**48.7**	**50.1**	**51.9**	**53.8**	**56.9**	**0.7**
Non-OECD									
Non-OECD Europe and Eurasia	**15.1**	**8.7**	**8.8**	**8.9**	**10.0**	**10.3**	**10.4**	**11.1**	**0.9**
Russia	7.2	4.6	4.8	4.8	5.0	5.3	5.2	5.7	0.7
Other	7.9	4.1	4.0	4.1	4.9	5.0	5.2	5.4	1.2
Non-OECD Asia	**27.0**	**54.9**	**60.9**	**76.2**	**89.8**	**101.2**	**114.0**	**126.4**	**3.0**
China	20.3	41.4	46.9	60.2	71.3	81.4	92.0	101.8	3.1
India	4.2	8.4	8.6	9.9	11.5	12.7	13.9	15.3	2.3
Other Non-OECD Asia	2.6	5.1	5.3	6.1	7.0	7.1	8.1	9.2	2.2
Middle East	**0.1**	**0.4**	**0.4**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.7**
Africa	**3.0**	**4.3**	**4.2**	**4.4**	**5.1**	**5.3**	**5.5**	**5.5**	**1.1**
Central and South America	**0.6**	**0.8**	**0.9**	**1.3**	**1.6**	**1.7**	**1.8**	**1.8**	**3.0**
Brazil	0.3	0.5	0.4	0.8	1.0	1.0	1.1	1.2	4.0
Other Central and South America	0.2	0.4	0.4	0.5	0.7	0.7	0.7	0.7	1.8
Total Non-OECD	**45.7**	**69.1**	**75.2**	**91.3**	**106.9**	**119.0**	**132.2**	**145.3**	**2.7**
Total World	**89.2**	**116.1**	**122.5**	**139.9**	**157.1**	**170.9**	**185.9**	**202.2**	**2.0**

[a]Includes the 50 States and the District of Columbia.

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

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run HP2008.D031808A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table D7. World Nuclear Energy Consumption by Region, High Price Case, 1990-2030
(Billion Kilowatthours)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**649**	**883**	**880**	**921**	**938**	**1,030**	**1,114**	**1,188**	**1.2**
United States[a]	577	789	782	797	807	888	960	1,022	1.1
Canada	69	86	87	112	118	127	137	148	2.1
Mexico	3	9	10	12	14	15	17	18	2.3
OECD Europe	**743**	**941**	**929**	**953**	**977**	**940**	**1,001**	**1,062**	**0.5**
OECD Asia	**242**	**392**	**418**	**453**	**518**	**583**	**635**	**692**	**2.0**
Japan	192	268	278	307	334	359	389	422	1.7
South Korea	50	124	139	146	184	225	245	269	2.7
Australia/New Zealand	0	0	0	0	0	0	0	0	—
Total OECD	**1,635**	**2,216**	**2,227**	**2,326**	**2,432**	**2,553**	**2,750**	**2,942**	**1.1**
Non-OECD									
Non-OECD Europe and Eurasia	**219**	**263**	**264**	**295**	**340**	**434**	**510**	**534**	**2.9**
Russia	115	137	140	158	198	251	316	336	3.6
Other	104	125	124	137	142	183	194	198	1.9
Non-OECD Asia	**38**	**103**	**106**	**171**	**336**	**511**	**660**	**751**	**8.1**
China	0	48	50	80	193	311	409	483	9.5
India	6	15	16	43	76	121	156	176	10.1
Other Non-OECD Asia	32	40	40	48	66	79	95	92	3.3
Middle East	**0**	**0**	**0**	**0**	**8**	**10**	**11**	**12**	**—**
Africa	**8**	**14**	**12**	**17**	**22**	**25**	**34**	**37**	**4.5**
Central and South America	**9**	**19**	**16**	**23**	**30**	**36**	**37**	**37**	**3.4**
Brazil	2	12	10	15	19	23	24	25	3.7
Other Central and South America	7	7	6	8	11	13	12	13	2.8
Total Non-OECD	**274**	**399**	**399**	**506**	**735**	**1,015**	**1,252**	**1,372**	**5.1**
Total World	**1,909**	**2,615**	**2,626**	**2,832**	**3,167**	**3,568**	**4,002**	**4,313**	**2.0**

[a]Includes the 50 States and the District of Columbia.

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

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run HP2008.D031808A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table D8. World Consumption of Hydroelectricity and Other Renewable Energy by Region, High Price Case, 1990-2030
(Quadrillion Btu)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**9.5**	**9.8**	**10.2**	**12.3**	**13.9**	**15.4**	**16.8**	**17.5**	**2.2**
United States[a]	6.1	6.0	6.0	7.6	8.7	9.8	10.7	11.1	2.4
Canada	3.1	3.5	3.7	4.1	4.6	5.1	5.4	5.8	1.8
Mexico	0.3	0.4	0.4	0.5	0.6	0.6	0.6	0.7	1.7
OECD Europe	**4.8**	**6.3**	**6.5**	**7.3**	**7.4**	**8.1**	**8.9**	**9.5**	**1.5**
OECD Asia	**1.6**	**1.8**	**1.6**	**1.9**	**2.1**	**2.2**	**2.3**	**2.5**	**1.8**
Japan	1.1	1.2	1.0	1.2	1.3	1.4	1.5	1.6	1.7
South Korea	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.3	7.9
Australia/New Zealand	0.4	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.9
Total OECD	**15.9**	**17.9**	**18.2**	**21.5**	**23.4**	**25.8**	**28.0**	**29.4**	**1.9**
Non-OECD									
Non-OECD Europe and Eurasia	**2.8**	**3.0**	**3.1**	**3.8**	**3.9**	**4.0**	**4.2**	**4.3**	**1.3**
Russia	1.8	1.8	1.8	2.4	2.4	2.4	2.4	2.4	1.3
Other	1.0	1.3	1.3	1.4	1.5	1.6	1.7	1.8	1.3
Non-OECD Asia	**3.0**	**5.6**	**6.6**	**8.5**	**9.0**	**9.9**	**12.0**	**14.0**	**3.0**
China	1.3	3.3	4.0	5.2	5.4	5.7	7.1	8.5	3.0
India	0.7	0.9	1.1	1.5	1.6	1.6	1.8	2.0	2.6
Other Non-OECD Asia	0.9	1.4	1.6	1.8	2.1	2.5	3.0	3.5	3.3
Middle East	**0.1**	**0.2**	**0.2**	**0.3**	**0.3**	**0.3**	**0.4**	**0.4**	**2.6**
Africa	**0.6**	**0.9**	**0.9**	**1.1**	**1.3**	**1.4**	**1.5**	**1.9**	**2.9**
Central and South America	**3.9**	**6.1**	**6.4**	**7.2**	**8.1**	**9.2**	**10.3**	**11.3**	**2.3**
Brazil	2.2	3.4	3.5	4.0	4.9	5.7	6.5	7.3	3.0
Other Central and South America	1.7	2.8	2.9	3.2	3.2	3.5	3.8	4.0	1.3
Total Non-OECD	**10.3**	**15.9**	**17.2**	**20.9**	**22.5**	**24.8**	**28.3**	**31.8**	**2.5**
Total World	**26.2**	**33.8**	**35.5**	**42.4**	**45.9**	**50.6**	**56.3**	**61.3**	**2.2**

[a]Includes the 50 States and the District of Columbia.

Notes: Totals may not equal sum of components due to independent rounding. U.S. totals include net electricity imports, methanol, and liquid hydrogen.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run HP2008.D031808A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table D9. World Carbon Dioxide Emissions by Region, High Price Case, 1990-2030
(Million Metric Tons Carbon Dioxide)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**5,754**	**6,959**	**7,008**	**7,067**	**7,228**	**7,447**	**7,714**	**8,133**	**0.6**
United States[a]	4,989	5,957	5,982	5,983	6,102	6,259	6,451	6,799	0.5
Canada	465	623	628	660	666	681	705	725	0.6
Mexico	300	379	398	423	461	507	558	609	1.7
OECD Europe	**4,101**	**4,373**	**4,383**	**4,469**	**4,474**	**4,468**	**4,485**	**4,496**	**0.1**
OECD Asia	**1,541**	**2,148**	**2,174**	**2,195**	**2,186**	**2,172**	**2,195**	**2,223**	**0.1**
Japan	1,009	1,242	1,230	1,186	1,142	1,109	1,093	1,072	-0.6
South Korea	241	488	500	558	582	586	604	631	0.9
Australia/New Zealand	291	418	444	451	462	477	498	520	0.6
Total OECD	**11,396**	**13,480**	**13,565**	**13,731**	**13,887**	**14,088**	**14,394**	**14,852**	**0.4**
Non-OECD									
Non-OECD Europe and Eurasia	**4,198**	**2,797**	**2,865**	**3,041**	**3,236**	**3,373**	**3,478**	**3,641**	**1.0**
Russia	2,376	1,669	1,696	1,773	1,853	1,913	1,940	2,022	0.7
Other	1,822	1,128	1,169	1,268	1,383	1,460	1,538	1,619	1.3
Non-OECD Asia	**3,613**	**7,517**	**8,177**	**10,134**	**11,791**	**13,290**	**14,924**	**16,504**	**2.8**
China	2,241	4,753	5,323	6,868	8,024	9,138	10,319	11,424	3.1
India	565	1,127	1,164	1,336	1,550	1,714	1,893	2,068	2.3
Other Non-OECD Asia	807	1,637	1,690	1,930	2,217	2,437	2,712	3,012	2.3
Middle East	**700**	**1,290**	**1,400**	**1,615**	**1,783**	**1,915**	**2,015**	**2,119**	**1.7**
Africa	**649**	**943**	**966**	**1,083**	**1,199**	**1,296**	**1,375**	**1,436**	**1.6**
Central and South America	**669**	**1,042**	**1,078**	**1,286**	**1,345**	**1,406**	**1,486**	**1,564**	**1.5**
Brazil	216	350	356	446	467	494	520	551	1.8
Other Central and South America	453	692	722	840	877	913	966	1,012	1.4
Total Non-OECD	**9,830**	**13,589**	**14,486**	**17,158**	**19,354**	**21,280**	**23,277**	**25,264**	**2.2**
Total World	**21,226**	**27,070**	**28,051**	**30,890**	**33,241**	**35,368**	**37,671**	**40,116**	**1.4**

[a]Includes the 50 States and the District of Columbia.

Note: The U.S. numbers include carbon dioxide emissions attributable to renewable energy sources.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run HP2008.D031808A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table D10. World Carbon Dioxide Emissions from Liquids Use by Region, High Price Case, 1990-2030
(Million Metric Tons Carbon Dioxide)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**2,633**	**3,142**	**3,169**	**3,110**	**3,111**	**3,105**	**3,123**	**3,220**	**0.1**
United States[a]	2,178	2,597	2,615	2,538	2,534	2,516	2,510	2,582	-0.1
Canada	224	291	290	302	289	287	291	297	0.1
Mexico	231	254	264	270	287	302	321	341	1.0
OECD Europe	**1,867**	**2,097**	**2,103**	**2,078**	**2,005**	**1,952**	**1,948**	**1,949**	**-0.3**
OECD Asia	**914**	**1,016**	**1,028**	**999**	**966**	**947**	**952**	**956**	**-0.3**
Japan	661	636	643	594	556	531	522	512	-0.9
South Korea	144	238	240	260	261	265	273	280	0.6
Australia/New Zealand	110	142	144	145	149	151	157	164	0.5
Total OECD	**5,414**	**6,255**	**6,300**	**6,187**	**6,082**	**6,004**	**6,023**	**6,125**	**-0.1**
Non-OECD									
Non-OECD Europe and Eurasia	**1,355**	**666**	**673**	**759**	**770**	**797**	**835**	**872**	**1.0**
Russia	783	379	379	413	416	421	428	433	0.5
Other	572	287	294	346	354	376	407	438	1.6
Non-OECD Asia	**950**	**1,979**	**2,037**	**2,404**	**2,589**	**2,806**	**3,085**	**3,363**	**2.0**
China	325	843	880	1,145	1,204	1,329	1,487	1,647	2.5
India	160	302	303	334	376	403	442	467	1.7
Other Non-OECD Asia	464	833	854	926	1,009	1,074	1,155	1,250	1.5
Middle East	**488**	**780**	**824**	**959**	**1,035**	**1,097**	**1,160**	**1,232**	**1.6**
Africa	**298**	**400**	**413**	**478**	**485**	**507**	**526**	**549**	**1.1**
Central and South America	**503**	**734**	**749**	**850**	**834**	**854**	**891**	**934**	**0.9**
Brazil	180	274	279	317	316	328	341	357	1.0
Other Central and South America	323	460	470	533	519	526	550	578	0.8
Total Non-OECD	**3,594**	**4,558**	**4,697**	**5,449**	**5,713**	**6,060**	**6,497**	**6,950**	**1.6**
Total World	**9,009**	**10,813**	**10,996**	**11,637**	**11,795**	**12,064**	**12,520**	**13,075**	**0.7**

[a]Includes the 50 States and the District of Columbia.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run HP2008.D031808A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table D11. World Carbon Dioxide Emissions from Natural Gas Use by Region, High Price Case, 1990-2030
(Million Metric Tons Carbon Dioxide)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**1,207**	**1,471**	**1,476**	**1,550**	**1,556**	**1,565**	**1,616**	**1,629**	**0.4**
United States[a]	1,026	1,194	1,193	1,245	1,219	1,183	1,189	1,160	-0.1
Canada	127	181	185	193	207	222	237	250	1.2
Mexico	54	97	99	112	130	160	189	219	3.2
OECD Europe	**590**	**1,027**	**1,048**	**1,098**	**1,188**	**1,276**	**1,330**	**1,379**	**1.1**
OECD Asia	**152**	**293**	**294**	**321**	**345**	**355**	**363**	**366**	**0.9**
Japan	102	173	170	180	188	191	190	186	0.4
South Korea	6	60	63	77	90	92	96	98	1.8
Australia/New Zealand	44	60	61	64	67	71	77	82	1.2
Total OECD	**1,949**	**2,791**	**2,819**	**2,968**	**3,089**	**3,195**	**3,309**	**3,375**	**0.7**
Non-OECD									
Non-OECD Europe and Eurasia	**1,450**	**1,328**	**1,375**	**1,464**	**1,546**	**1,626**	**1,681**	**1,747**	**1.0**
Russia	928	868	875	924	975	1,008	1,034	1,070	0.8
Other	521	460	500	541	570	619	646	677	1.2
Non-OECD Asia	**160**	**469**	**516**	**688**	**902**	**1,130**	**1,305**	**1,460**	**4.2**
China	30	83	101	162	225	287	330	366	5.3
India	24	59	69	97	124	149	179	199	4.3
Other Non-OECD Asia	106	327	345	429	553	694	795	895	3.9
Middle East	**199**	**476**	**541**	**614**	**704**	**775**	**811**	**845**	**1.8**
Africa	**80**	**149**	**167**	**200**	**250**	**306**	**345**	**381**	**3.3**
Central and South America	**116**	**231**	**249**	**313**	**361**	**394**	**431**	**459**	**2.5**
Brazil	6	33	36	53	64	69	77	86	3.5
Other Central and South America	110	197	213	259	297	325	354	373	2.3
Total Non-OECD	**2,005**	**2,651**	**2,847**	**3,278**	**3,763**	**4,231**	**4,572**	**4,891**	**2.2**
Total World	**3,954**	**5,443**	**5,666**	**6,247**	**6,852**	**7,426**	**7,882**	**8,266**	**1.5**

[a]Includes the 50 States and the District of Columbia.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run HP2008.D031808A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table D12. World Carbon Dioxide Emissions from Coal Use by Region, High Price Case, 1990-2030
(Million Metric Tons Carbon Dioxide)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**1,913**	**2,333**	**2,351**	**2,395**	**2,549**	**2,765**	**2,964**	**3,272**	**1.3**
United States[a]	1,784	2,155	2,162	2,188	2,337	2,548	2,739	3,045	1.4
Canada	114	151	153	166	169	172	176	178	0.6
Mexico	15	28	35	42	44	45	48	48	1.3
OECD Europe	**1,644**	**1,250**	**1,232**	**1,293**	**1,280**	**1,240**	**1,207**	**1,168**	**-0.2**
OECD Asia	**475**	**840**	**853**	**876**	**875**	**871**	**879**	**901**	**0.2**
Japan	246	433	417	412	398	387	381	373	-0.4
South Korea	91	190	196	221	231	229	235	253	1.0
Australia/New Zealand	138	217	239	243	246	254	264	275	0.6
Total OECD	**4,032**	**4,423**	**4,435**	**4,564**	**4,704**	**4,877**	**5,049**	**5,341**	**0.7**
Non-OECD									
Non-OECD Europe and Eurasia	**1,393**	**804**	**817**	**818**	**920**	**950**	**963**	**1,022**	**0.9**
Russia	665	422	442	437	462	485	478	519	0.6
Other	729	381	376	381	459	465	485	503	1.2
Non-OECD Asia	**2,503**	**5,070**	**5,624**	**7,041**	**8,300**	**9,353**	**10,534**	**11,681**	**3.0**
China	1,886	3,827	4,341	5,560	6,594	7,522	8,502	9,412	3.1
India	380	765	791	906	1,050	1,162	1,271	1,402	2.3
Other Non-OECD Asia	237	477	492	575	655	670	761	867	2.3
Middle East	**13**	**35**	**35**	**43**	**44**	**44**	**43**	**43**	**0.8**
Africa	**271**	**394**	**386**	**405**	**464**	**484**	**504**	**506**	**1.1**
Central and South America	**50**	**78**	**81**	**124**	**150**	**159**	**164**	**170**	**3.0**
Brazil	30	43	41	76	88	97	102	109	4.0
Other Central and South America	20	35	40	48	61	62	62	61	1.8
Total Non-OECD	**4,231**	**6,380**	**6,943**	**8,431**	**9,877**	**10,989**	**12,208**	**13,422**	**2.7**
Total World	**8,263**	**10,803**	**11,378**	**12,995**	**14,582**	**15,866**	**17,257**	**18,763**	**2.0**

[a]Includes the 50 States and the District of Columbia.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run HP2008.D031808A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Appendix E

Low Price Case Projections:

- **World Energy Consumption**
- **Gross Domestic Product**
- **Carbon Dioxide Emissions**

Table E1. World Total Energy Consumption by Region, Low Price Case, 1990-2030
(Quadrillion Btu)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**100.7**	**120.6**	**121.3**	**126.7**	**133.9**	**140.1**	**145.8**	**151.4**	**0.9**
United States[a]	84.7	100.1	100.1	103.6	108.5	112.4	116.0	119.4	0.7
Canada	11.0	14.0	14.3	15.7	16.9	17.9	18.9	19.9	1.3
Mexico	5.0	6.5	6.9	7.4	8.6	9.7	10.9	12.1	2.3
OECD Europe	**70.0**	**81.0**	**81.4**	**84.1**	**88.3**	**90.8**	**93.2**	**95.2**	**0.6**
OECD Asia	**26.8**	**37.8**	**38.2**	**39.4**	**42.1**	**43.9**	**45.2**	**46.6**	**0.8**
Japan	18.5	22.7	22.6	22.4	23.3	23.8	24.1	24.3	0.3
South Korea	3.8	9.0	9.3	10.4	11.8	12.8	13.4	14.3	1.7
Australia/New Zealand	4.5	6.1	6.3	6.6	7.0	7.3	7.7	8.0	1.0
Total OECD	**197.5**	**239.4**	**240.9**	**250.2**	**264.4**	**274.8**	**284.2**	**293.2**	**0.8**
Non-OECD									
Non-OECD Europe and Eurasia	**67.3**	**49.5**	**50.7**	**55.3**	**60.5**	**64.7**	**67.8**	**71.3**	**1.4**
Russia	39.4	29.9	30.3	32.8	35.5	37.5	38.9	40.9	1.2
Other	28.0	19.6	20.4	22.5	25.0	27.2	28.8	30.5	1.6
Non-OECD Asia	**47.4**	**101.0**	**109.9**	**137.1**	**166.5**	**194.0**	**220.5**	**247.0**	**3.3**
China	27.0	59.9	67.1	87.3	105.2	123.1	140.9	158.5	3.5
India	7.9	15.5	16.2	19.3	23.5	27.3	30.6	34.0	3.0
Other Non-OECD Asia	12.5	25.6	26.6	30.6	37.8	43.6	49.0	54.5	2.9
Middle East	**11.2**	**20.9**	**22.9**	**26.5**	**29.6**	**33.2**	**35.8**	**38.3**	**2.1**
Africa	**9.5**	**14.0**	**14.4**	**16.5**	**19.2**	**21.5**	**23.2**	**24.7**	**2.2**
Central and South America	**14.5**	**22.5**	**23.4**	**27.7**	**31.2**	**34.4**	**37.0**	**39.8**	**2.1**
Brazil	5.7	9.0	9.3	11.1	12.8	14.5	15.9	17.6	2.6
Other Central and South America	8.8	13.5	14.1	16.6	18.4	19.9	21.1	22.3	1.8
Total Non-OECD	**149.9**	**207.9**	**221.3**	**263.1**	**307.0**	**347.8**	**384.2**	**421.1**	**2.6**
Total World	**347.4**	**447.3**	**462.2**	**513.3**	**571.4**	**622.6**	**668.4**	**714.3**	**1.8**

[a]Includes the 50 States and the District of Columbia.

Notes: Energy totals include net imports of coal coke and electricity generated from biomass in the United States. Totals may not equal sum of components due to independent rounding. The electricity portion of the national fuel consumption values consists of generation for domestic use plus an adjustment for electricity trade based on a fuel's share of total generation in the exporting country.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run LP2008.D031608A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table E2. World Total Energy Consumption by Region and Fuel, Low Price Case, 1990-2030
(Quadrillion Btu)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America									
Liquids	40.5	48.9	49.1	49.5	53.0	55.2	56.8	59.3	0.8
Natural Gas	23.2	28.1	28.0	30.2	32.0	33.5	34.8	35.3	0.9
Coal	20.6	24.5	24.8	25.2	25.9	26.4	27.6	29.6	0.7
Nuclear	6.9	9.3	9.3	9.7	9.8	10.4	10.5	10.3	0.5
Other	9.5	9.8	10.2	12.1	13.4	15.0	16.4	17.0	2.1
Total	**100.7**	**120.6**	**121.3**	**126.7**	**134.2**	**140.4**	**146.1**	**151.7**	**0.9**
OECD Europe									
Liquids	28.4	32.0	32.1	32.0	34.0	35.0	35.6	36.0	0.5
Natural Gas	11.2	19.4	19.9	21.5	24.0	26.2	27.5	29.0	1.5
Coal	17.7	13.3	13.2	13.6	13.4	12.9	12.4	11.9	-0.4
Nuclear	7.9	9.9	9.8	9.6	9.5	8.7	9.0	9.3	-0.2
Other	4.8	6.3	6.5	7.2	7.3	7.9	8.6	9.0	1.3
Total	**70.0**	**81.0**	**81.4**	**84.1**	**88.3**	**90.8**	**93.2**	**95.2**	**0.6**
OECD Asia									
Liquids	14.7	17.3	17.5	17.3	18.7	19.6	20.2	20.7	0.7
Natural Gas	2.9	5.6	5.6	6.3	7.0	7.4	7.7	7.9	1.4
Coal	5.2	9.2	9.3	9.5	9.4	9.2	9.2	9.3	0.0
Nuclear	2.5	4.0	4.2	4.5	5.0	5.5	5.9	6.3	1.6
Other	1.6	1.8	1.6	1.9	2.0	2.1	2.2	2.4	1.7
Total	**26.8**	**37.8**	**38.2**	**39.4**	**42.1**	**43.9**	**45.2**	**46.6**	**0.8**
Total OECD									
Liquids	83.6	98.2	98.7	98.8	105.8	109.9	112.6	116.0	0.6
Natural Gas	37.2	53.1	53.4	58.0	63.1	67.1	70.0	72.3	1.2
Coal	43.5	47.0	47.3	48.3	48.7	48.5	49.2	50.9	0.3
Nuclear	17.3	23.1	23.2	23.8	24.3	24.6	25.4	26.0	0.4
Other	15.9	17.9	18.2	21.2	22.7	25.0	27.2	28.4	1.8
Total	**197.5**	**239.4**	**240.9**	**250.2**	**264.4**	**274.8**	**284.2**	**293.2**	**0.8**
Non-OECD									
Non-OECD Europe and Eurasia									
Liquids	19.6	9.8	10.0	11.3	12.6	13.7	14.7	15.6	1.8
Natural Gas	27.5	25.1	26.0	28.4	30.8	32.8	34.0	35.8	1.3
Coal	15.1	8.7	8.8	8.7	9.7	9.9	10.0	10.6	0.7
Nuclear	2.5	2.9	2.8	3.1	3.5	4.4	5.1	5.2	2.5
Other	2.8	3.0	3.1	3.7	3.8	3.8	4.0	4.1	1.1
Total	**67.3**	**49.5**	**50.7**	**55.3**	**60.5**	**64.7**	**67.8**	**71.3**	**1.4**
Non-OECD Asia									
Liquids	14.0	30.5	31.5	37.7	46.0	54.1	61.2	69.3	3.2
Natural Gas	3.0	8.9	9.8	13.7	18.8	23.9	27.7	31.3	4.8
Coal	27.0	54.9	60.9	75.7	89.9	101.7	114.1	126.3	3.0
Nuclear	0.4	1.1	1.1	1.6	3.1	4.7	6.0	6.8	7.5
Other	3.0	5.6	6.6	8.4	8.8	9.6	11.5	13.3	2.8
Total	**47.4**	**101.0**	**109.9**	**137.1**	**166.5**	**194.0**	**220.5**	**247.0**	**3.3**

See notes at end of table.

Table E2. World Total Energy Consumption by Region and Fuel, Low Price Case, 1990-2030 (Continued)
(Quadrillion Btu)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
Non-OECD (Continued)									
Middle East									
Liquids	7.2	11.3	12.0	13.9	15.3	17.3	19.0	20.6	2.2
Natural Gas	3.8	9.0	10.2	11.8	13.5	15.2	16.1	17.0	2.1
Coal	0.1	0.4	0.4	0.4	0.4	0.4	0.3	0.3	-1.3
Nuclear	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	—
Other	0.1	0.2	0.2	0.3	0.3	0.3	0.3	0.4	2.4
Total	**11.2**	**20.9**	**22.9**	**26.5**	**29.6**	**33.2**	**35.8**	**38.3**	**2.1**
Africa									
Liquids	4.3	5.8	6.0	7.0	7.9	8.8	9.3	9.9	2.0
Natural Gas	1.5	2.8	3.2	3.9	5.0	6.2	7.0	7.8	3.7
Coal	3.0	4.3	4.2	4.3	4.9	5.0	5.1	5.0	0.7
Nuclear	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	2.2
Other	0.6	0.9	0.9	1.1	1.2	1.3	1.5	1.8	2.7
Total	**9.5**	**14.0**	**14.4**	**16.5**	**19.2**	**21.5**	**23.2**	**24.7**	**2.2**
Central and South America									
Liquids	7.8	11.0	11.2	13.0	14.2	15.4	16.4	17.6	1.8
Natural Gas	2.2	4.4	4.7	6.1	7.3	8.1	8.9	9.6	2.9
Coal	0.6	0.8	0.9	1.3	1.5	1.5	1.5	1.5	2.2
Nuclear	0.1	0.2	0.2	0.2	0.3	0.4	0.4	0.4	2.9
Other	3.9	6.1	6.4	7.1	7.9	9.0	9.9	10.8	2.1
Total	**14.5**	**22.5**	**23.4**	**27.7**	**31.2**	**34.4**	**37.0**	**39.8**	**2.1**
Total Non-OECD									
Liquids	52.9	68.4	70.8	83.0	96.0	109.3	120.6	132.9	2.6
Natural Gas	38.0	50.2	53.9	64.0	75.5	86.2	93.5	101.5	2.6
Coal	45.7	69.1	75.2	90.4	106.3	118.6	131.1	143.7	2.6
Nuclear	3.1	4.3	4.2	5.1	7.1	9.7	11.8	12.6	4.5
Other	10.3	15.9	17.2	20.7	22.1	24.0	27.2	30.3	2.3
Total	**149.9**	**207.9**	**221.3**	**263.1**	**307.0**	**347.8**	**384.2**	**421.1**	**2.6**
Total World									
Liquids	136.4	166.6	169.4	181.8	201.8	219.2	233.2	248.9	1.6
Natural Gas	75.2	103.3	107.4	122.0	138.5	153.3	163.6	173.8	1.9
Coal	89.2	116.1	122.5	138.7	155.0	167.1	180.3	194.6	1.9
Nuclear	20.4	27.4	27.5	28.8	31.4	34.3	37.2	38.6	1.4
Other	26.2	33.8	35.5	41.9	44.8	49.1	54.4	58.7	2.0
Total	**347.4**	**447.3**	**462.2**	**513.3**	**571.4**	**622.6**	**668.4**	**714.3**	**1.8**

Notes: Energy totals include net imports of coal coke and electricity generated from biomass in the United States. Totals may not equal sum of components due to independent rounding. The electricity portion of the national fuel consumption values consists of generation for domestic use plus an adjustment for electricity trade based on a fuel's share of total generation in the exporting country.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run LP2008.D031608A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table E3. World Gross Domestic Product (GDP) by Region Expressed in Purchasing Power Parity, Low Price Case, 1990-2030
(Billion 2000 Dollars)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**8,477**	**12,696**	**13,083**	**14,925**	**17,183**	**19,415**	**21,906**	**24,786**	**2.6**
United States[a]	7,113	10,676	11,004	12,465	14,292	16,030	17,966	20,228	2.5
Canada	684	1,004	1,034	1,187	1,337	1,493	1,667	1,858	2.4
Mexico	680	1,016	1,045	1,273	1,555	1,892	2,272	2,700	3.9
OECD Europe	**8,067**	**11,197**	**11,445**	**13,154**	**14,754**	**16,483**	**18,283**	**20,122**	**2.3**
OECD Asia	**3,621**	**4,775**	**4,887**	**5,567**	**6,196**	**6,731**	**7,202**	**7,712**	**1.8**
Japan	2,862	3,377	3,440	3,790	4,064	4,246	4,360	4,479	1.1
South Korea	331	715	745	964	1,184	1,380	1,562	1,754	3.5
Australia/New Zealand	429	683	702	814	947	1,104	1,280	1,479	3.0
Total OECD	**20,165**	**28,667**	**29,415**	**33,646**	**38,134**	**42,629**	**47,391**	**52,619**	**2.4**
Non-OECD									
Non-OECD Europe and Eurasia	**3,601**	**3,340**	**3,563**	**4,985**	**6,259**	**7,477**	**8,837**	**10,363**	**4.4**
Russia	2,241	1,907	2,029	2,752	3,414	3,996	4,653	5,399	4.0
Other	1,360	1,433	1,534	2,233	2,844	3,480	4,183	4,964	4.8
Non-OECD Asia	**5,792**	**15,102**	**16,436**	**24,791**	**33,776**	**43,882**	**54,667**	**67,103**	**5.8**
China	1,805	6,961	7,685	12,507	17,352	22,864	29,010	36,067	6.4
India	1,697	3,714	4,056	6,094	8,564	11,254	13,743	16,554	5.8
Other Non-OECD Asia	2,291	4,428	4,695	6,190	7,860	9,764	11,913	14,481	4.6
Middle East	**820**	**1,466**	**1,550**	**1,959**	**2,362**	**2,888**	**3,487**	**4,170**	**4.0**
Africa	**1,450**	**2,182**	**2,295**	**3,014**	**3,810**	**4,703**	**5,714**	**6,898**	**4.5**
Central and South America	**2,162**	**3,372**	**3,535**	**4,517**	**5,505**	**6,600**	**7,815**	**9,268**	**3.9**
Brazil	1,022	1,581	1,627	2,013	2,401	2,842	3,328	3,901	3.6
Other Central and South America	1,140	1,791	1,908	2,504	3,104	3,758	4,487	5,368	4.2
Total Non-OECD	**13,824**	**25,462**	**27,378**	**39,266**	**51,712**	**65,550**	**80,520**	**97,802**	**5.2**
Total World	**33,989**	**54,129**	**56,793**	**72,912**	**89,845**	**108,179**	**127,910**	**150,421**	**4.0**

[a]Includes the 50 States and the District of Columbia.

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

Sources: **History:** Global Insight, Inc., *World Overview* (Lexington, MA, various issues). **Projections:** Derived from Global Insight, Inc., *World Overview*, Fourth Quarter 2007 (Lexington, MA, January 2008); and Energy Information Administration, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), Table B4.

Table E4. World Liquids Consumption by Region, Low Price Case, 1990-2030
(Million Barrels Oil Equivalent per Day)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**20.5**	**25.0**	**25.2**	**25.4**	**26.9**	**28.1**	**28.9**	**30.0**	**0.7**
United States[a]	17.0	20.7	20.8	20.8	21.9	22.6	23.1	23.7	0.5
Canada	1.7	2.3	2.3	2.4	2.5	2.7	2.8	2.9	0.9
Mexico	1.8	2.0	2.1	2.2	2.5	2.8	3.1	3.4	2.0
OECD Europe	**13.7**	**15.5**	**15.5**	**15.5**	**16.4**	**16.9**	**17.2**	**17.4**	**0.5**
OECD Asia	**7.2**	**8.5**	**8.6**	**8.5**	**9.2**	**9.6**	**9.9**	**10.1**	**0.7**
Japan	5.3	5.3	5.4	5.0	5.3	5.4	5.4	5.5	0.1
South Korea	1.0	2.2	2.2	2.4	2.7	2.9	3.1	3.2	1.6
Australia/New Zealand	0.8	1.0	1.1	1.1	1.2	1.3	1.4	1.4	1.2
Total OECD	**41.4**	**49.0**	**49.3**	**49.3**	**52.6**	**54.6**	**56.0**	**57.6**	**0.6**
Non-OECD									
Non-OECD Europe and Eurasia	**9.4**	**4.8**	**4.8**	**5.5**	**6.1**	**6.7**	**7.1**	**7.6**	**1.8**
Russia	5.4	2.8	2.8	3.0	3.3	3.5	3.7	3.8	1.3
Other	3.9	2.0	2.1	2.5	2.8	3.1	3.5	3.8	2.4
Non-OECD Asia	**6.6**	**14.8**	**15.3**	**18.2**	**22.3**	**26.2**	**29.6**	**33.5**	**3.2**
China	2.3	6.4	6.7	8.8	10.4	12.6	14.6	16.9	3.8
India	1.2	2.4	2.4	2.7	3.5	4.2	4.7	5.3	3.2
Other Non-OECD Asia	3.1	6.0	6.1	6.7	8.3	9.4	10.3	11.3	2.5
Middle East	**3.5**	**5.5**	**5.9**	**6.8**	**7.5**	**8.4**	**9.2**	**10.0**	**2.2**
Africa	**2.1**	**2.8**	**2.9**	**3.4**	**3.8**	**4.3**	**4.5**	**4.8**	**2.0**
Central and South America	**3.8**	**5.4**	**5.5**	**6.3**	**6.9**	**7.5**	**8.0**	**8.6**	**1.8**
Brazil	1.5	2.1	2.2	2.5	2.7	3.0	3.3	3.5	2.0
Other Central and South America	2.3	3.2	3.3	3.9	4.2	4.5	4.7	5.0	1.7
Total Non-OECD	**25.3**	**33.3**	**34.3**	**40.3**	**46.6**	**53.0**	**58.5**	**64.5**	**2.6**
Total World	**66.6**	**82.3**	**83.6**	**89.6**	**99.2**	**107.7**	**114.6**	**122.0**	**1.5**

[a]Includes the 50 States and the District of Columbia.

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

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run LP2008.D031608A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table E5. World Natural Gas Consumption by Region, Low Price Case, 1990-2030
(Trillion Cubic Feet)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**22.5**	**27.4**	**27.4**	**29.2**	**31.0**	**32.2**	**33.2**	**34.0**	**0.9**
United States[a]	19.2	22.4	22.2	23.4	24.5	24.8	24.9	24.8	0.4
Canada	2.4	3.3	3.4	3.7	4.1	4.5	4.8	5.2	1.7
Mexico	0.9	1.7	1.7	2.0	2.4	3.0	3.5	4.1	3.4
OECD Europe	**11.6**	**18.9**	**19.3**	**20.9**	**23.4**	**25.5**	**26.8**	**28.2**	**1.5**
OECD Asia	**2.8**	**5.2**	**5.2**	**5.9**	**6.6**	**6.9**	**7.2**	**7.4**	**1.4**
Japan	1.9	3.1	3.1	3.4	3.6	3.7	3.8	3.8	0.9
South Korea	0.1	1.0	1.1	1.4	1.7	1.8	1.9	1.9	2.4
Australia/New Zealand	0.8	1.1	1.1	1.2	1.3	1.4	1.5	1.7	1.7
Total OECD	**36.8**	**51.6**	**51.9**	**56.0**	**60.9**	**64.6**	**67.2**	**69.6**	**1.2**
Non-OECD									
Non-OECD Europe and Eurasia	**26.7**	**24.4**	**25.3**	**27.6**	**30.0**	**31.9**	**33.0**	**34.8**	**1.3**
Russia	17.3	16.0	16.2	17.5	18.9	19.7	20.3	21.4	1.1
Other	9.5	8.4	9.1	10.2	11.1	12.2	12.7	13.4	1.6
Non-OECD Asia	**2.9**	**8.5**	**9.3**	**13.0**	**17.8**	**22.6**	**26.2**	**29.6**	**4.7**
China	0.5	1.4	1.7	2.9	4.3	5.6	6.5	7.4	6.2
India	0.4	1.1	1.3	1.9	2.6	3.3	3.9	4.4	5.1
Other Non-OECD Asia	2.0	6.1	6.4	8.2	10.9	13.8	15.8	17.9	4.2
Middle East	**3.6**	**8.6**	**9.8**	**11.3**	**12.9**	**14.5**	**15.3**	**16.3**	**2.1**
Africa	**1.4**	**2.6**	**3.0**	**3.6**	**4.7**	**5.7**	**6.5**	**7.2**	**3.7**
Central and South America	**2.0**	**4.1**	**4.4**	**5.7**	**6.8**	**7.6**	**8.3**	**9.0**	**2.9**
Brazil	0.1	0.6	0.7	1.0	1.3	1.4	1.6	1.9	4.3
Other Central and South America	1.9	3.5	3.7	4.7	5.6	6.2	6.7	7.1	2.6
Total Non-OECD	**36.5**	**48.2**	**51.8**	**61.3**	**72.2**	**82.4**	**89.3**	**96.9**	**2.5**
Total World	**73.4**	**99.8**	**103.7**	**117.3**	**133.0**	**147.0**	**156.5**	**166.5**	**1.9**

[a]Includes the 50 States and the District of Columbia.

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

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run LP2008.D031608A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table E6. World Coal Consumption by Region, Low Price Case, 1990-2030
(Quadrillion Btu)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**20.6**	**24.5**	**24.8**	**25.2**	**25.9**	**26.4**	**27.6**	**29.6**	**0.7**
United States[a]	19.2	22.6	22.8	23.0	23.7	24.2	25.4	27.4	0.7
Canada	1.2	1.6	1.7	1.8	1.8	1.8	1.8	1.8	0.4
Mexico	0.2	0.3	0.4	0.4	0.4	0.4	0.4	0.4	-0.3
OECD Europe	**17.7**	**13.3**	**13.2**	**13.6**	**13.4**	**12.9**	**12.4**	**11.9**	**-0.4**
OECD Asia	**5.2**	**9.2**	**9.3**	**9.5**	**9.4**	**9.2**	**9.2**	**9.3**	**0.0**
Japan	2.7	4.8	4.6	4.5	4.3	4.1	4.0	3.8	-0.8
South Korea	1.0	2.1	2.1	2.4	2.5	2.5	2.5	2.7	0.9
Australia/New Zealand	1.5	2.4	2.6	2.6	2.6	2.7	2.8	2.9	0.4
Total OECD	**43.5**	**47.0**	**47.3**	**48.3**	**48.7**	**48.5**	**49.2**	**50.8**	**0.3**
Non-OECD									
Non-OECD Europe and Eurasia	**15.1**	**8.7**	**8.8**	**8.7**	**9.7**	**9.9**	**10.0**	**10.6**	**0.7**
Russia	7.2	4.6	4.8	4.7	4.9	5.1	5.0	5.4	0.5
Other	7.9	4.1	4.0	4.0	4.8	4.8	5.0	5.1	1.0
Non-OECD Asia	**27.0**	**54.9**	**60.9**	**75.7**	**89.9**	**101.7**	**114.1**	**126.3**	**3.0**
China	20.3	41.4	46.9	60.0	71.9	82.5	93.0	102.9	3.2
India	4.2	8.4	8.6	9.7	11.3	12.5	13.5	14.8	2.2
Other Non-OECD Asia	2.6	5.1	5.3	6.0	6.7	6.8	7.6	8.6	1.9
Middle East	**0.1**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.3**	**0.3**	**-1.3**
Africa	**3.0**	**4.3**	**4.2**	**4.3**	**4.9**	**5.0**	**5.1**	**5.0**	**0.7**
Central and South America	**0.6**	**0.8**	**0.9**	**1.3**	**1.5**	**1.5**	**1.5**	**1.5**	**2.2**
Brazil	0.3	0.5	0.4	0.8	0.9	1.0	1.1	1.1	3.8
Other Central and South America	0.2	0.4	0.4	0.5	0.6	0.5	0.4	0.4	-0.5
Total Non-OECD	**45.7**	**69.1**	**75.2**	**90.4**	**106.3**	**118.6**	**131.1**	**143.7**	**2.6**
Total World	**89.2**	**116.1**	**122.5**	**138.7**	**155.1**	**167.1**	**180.3**	**194.5**	**1.9**

[a]Includes the 50 States and the District of Columbia.

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

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run LP2008.D031608A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table E7. World Nuclear Energy Consumption by Region, Low Price Case, 1990-2030
(Billion Kilowatthours)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**649**	**883**	**880**	**917**	**931**	**984**	**997**	**982**	**0.4**
United States[a]	577	789	782	797	807	854	860	837	0.3
Canada	69	86	87	110	113	120	127	135	1.7
Mexico	3	9	10	11	11	11	11	11	0.1
OECD Europe	**743**	**941**	**929**	**916**	**904**	**831**	**856**	**881**	**-0.2**
OECD Asia	**242**	**392**	**418**	**444**	**498**	**550**	**588**	**629**	**1.6**
Japan	192	268	278	301	321	338	361	384	1.3
South Korea	50	124	139	143	177	212	227	245	2.3
Australia/New Zealand	0	0	0	0	0	0	0	0	—
Total OECD	**1,635**	**2,216**	**2,227**	**2,277**	**2,333**	**2,365**	**2,441**	**2,492**	**0.5**
Non-OECD									
Non-OECD Europe and Eurasia	**219**	**263**	**264**	**289**	**327**	**409**	**472**	**485**	**2.5**
Russia	115	137	140	155	190	237	293	306	3.2
Other	104	125	124	134	136	172	180	180	1.5
Non-OECD Asia	**38**	**103**	**106**	**150**	**293**	**446**	**573**	**643**	**7.5**
China	0	48	50	65	164	267	351	410	8.8
India	6	15	16	37	66	104	134	149	9.4
Other Non-OECD Asia	32	40	40	47	64	75	88	84	3.0
Middle East	**0**	**0**	**0**	**0**	**6**	**6**	**6**	**6**	**—**
Africa	**8**	**14**	**12**	**14**	**15**	**15**	**21**	**21**	**2.2**
Central and South America	**9**	**19**	**16**	**23**	**28**	**34**	**34**	**34**	**3.0**
Brazil	2	12	10	15	18	22	22	22	3.3
Other Central and South America	7	7	6	8	10	12	11	11	2.4
Total Non-OECD	**274**	**399**	**399**	**476**	**669**	**910**	**1,106**	**1,189**	**4.5**
Total World	**1,909**	**2,615**	**2,626**	**2,753**	**3,002**	**3,275**	**3,548**	**3,680**	**1.4**

[a]Includes the 50 States and the District of Columbia.

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

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run LP2008.D031608A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table E8. World Consumption of Hydroelectricity and Other Renewable Energy by Region, Low Price Case, 1990-2030
(Quadrillion Btu)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**9.5**	**9.8**	**10.2**	**12.1**	**13.5**	**15.0**	**16.4**	**17.1**	**2.1**
United States[a]	6.1	6.0	6.0	7.5	8.4	9.5	10.6	10.9	2.4
Canada	3.1	3.5	3.7	4.1	4.6	4.9	5.2	5.5	1.6
Mexico	0.3	0.4	0.4	0.5	0.6	0.6	0.6	0.6	1.5
OECD Europe	**4.8**	**6.3**	**6.5**	**7.2**	**7.3**	**7.9**	**8.6**	**9.0**	**1.3**
OECD Asia	**1.6**	**1.8**	**1.6**	**1.9**	**2.0**	**2.1**	**2.2**	**2.4**	**1.7**
Japan	1.1	1.2	1.0	1.2	1.3	1.4	1.4	1.5	1.5
South Korea	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.3	7.7
Australia/New Zealand	0.4	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.8
Total OECD	**15.9**	**17.9**	**18.2**	**21.3**	**22.8**	**25.0**	**27.2**	**28.4**	**1.8**
Non-OECD									
Non-OECD Europe and Eurasia	**2.8**	**3.0**	**3.1**	**3.7**	**3.8**	**3.8**	**4.0**	**4.1**	**1.1**
Russia	1.8	1.8	1.8	2.3	2.3	2.3	2.3	2.3	1.1
Other	1.0	1.3	1.3	1.4	1.5	1.5	1.7	1.7	1.1
Non-OECD Asia	**3.0**	**5.6**	**6.6**	**8.4**	**8.8**	**9.6**	**11.5**	**13.3**	**2.8**
China	1.3	3.3	4.0	5.1	5.3	5.5	6.8	8.1	2.8
India	0.7	0.9	1.1	1.5	1.5	1.6	1.8	1.9	2.4
Other Non-OECD Asia	0.9	1.4	1.6	1.8	2.0	2.5	2.9	3.3	3.1
Middle East	**0.1**	**0.2**	**0.2**	**0.3**	**0.3**	**0.3**	**0.3**	**0.4**	**2.4**
Africa	**0.6**	**0.9**	**0.9**	**1.1**	**1.2**	**1.3**	**1.5**	**1.8**	**2.7**
Central and South America	**3.9**	**6.1**	**6.4**	**7.1**	**7.9**	**9.0**	**9.9**	**10.8**	**2.1**
Brazil	2.2	3.4	3.5	4.0	4.8	5.5	6.3	7.0	2.8
Other Central and South America	1.7	2.8	2.9	3.1	3.2	3.4	3.6	3.8	1.1
Total Non-OECD	**10.3**	**15.9**	**17.2**	**20.7**	**22.1**	**24.0**	**27.2**	**30.3**	**2.3**
Total World	**26.2**	**33.8**	**35.5**	**41.9**	**44.9**	**49.1**	**54.5**	**58.8**	**2.0**

[a]Includes the 50 States and the District of Columbia.

Notes: Totals may not equal sum of components due to independent rounding. U.S. totals include net electricity imports, methanol, and liquid hydrogen.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run LP2008.D031608A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table E9. World Carbon Dioxide Emissions by Region, Low Price Case, 1990-2030
(Million Metric Tons Carbon Dioxide)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**5,754**	**6,959**	**7,008**	**7,128**	**7,516**	**7,777**	**8,059**	**8,486**	**0.8**
United States[a]	4,989	5,957	5,982	6,032	6,312	6,471	6,654	6,976	0.6
Canada	465	623	628	670	710	746	780	814	1.0
Mexico	300	379	398	427	495	560	625	695	2.3
OECD Europe	**4,101**	**4,373**	**4,383**	**4,518**	**4,761**	**4,893**	**4,956**	**5,009**	**0.5**
OECD Asia	**1,541**	**2,148**	**2,174**	**2,205**	**2,319**	**2,382**	**2,424**	**2,478**	**0.5**
Japan	1,009	1,242	1,230	1,193	1,220	1,229	1,223	1,214	-0.1
South Korea	241	488	500	561	623	651	677	715	1.4
Australia/New Zealand	291	418	444	452	477	501	524	549	0.8
Total OECD	**11,396**	**13,480**	**13,565**	**13,851**	**14,597**	**15,052**	**15,439**	**15,973**	**0.7**
Non-OECD									
Non-OECD Europe and Eurasia	**4,198**	**2,797**	**2,865**	**3,071**	**3,378**	**3,582**	**3,714**	**3,926**	**1.3**
Russia	2,376	1,669	1,696	1,791	1,926	2,022	2,065	2,180	1.0
Other	1,822	1,128	1,169	1,280	1,451	1,559	1,649	1,746	1.6
Non-OECD Asia	**3,613**	**7,517**	**8,177**	**10,161**	**12,276**	**14,158**	**15,960**	**17,804**	**3.2**
China	2,241	4,753	5,323	6,887	8,282	9,624	10,912	12,193	3.4
India	565	1,127	1,164	1,336	1,612	1,843	2,042	2,263	2.7
Other Non-OECD Asia	807	1,637	1,690	1,938	2,382	2,691	3,007	3,348	2.8
Middle East	**700**	**1,290**	**1,400**	**1,623**	**1,806**	**2,024**	**2,183**	**2,340**	**2.1**
Africa	**649**	**943**	**966**	**1,087**	**1,258**	**1,395**	**1,484**	**1,553**	**1.9**
Central and South America	**669**	**1,042**	**1,078**	**1,309**	**1,470**	**1,599**	**1,702**	**1,818**	**2.1**
Brazil	216	350	356	451	510	564	609	666	2.5
Other Central and South America	453	692	722	858	960	1,035	1,093	1,152	1.9
Total Non-OECD	**9,830**	**13,589**	**14,486**	**17,251**	**20,188**	**22,758**	**25,043**	**27,441**	**2.6**
Total World	**21,226**	**27,070**	**28,051**	**31,102**	**34,784**	**37,810**	**40,482**	**43,414**	**1.8**

[a]Includes the 50 States and the District of Columbia.

Note: The U.S. numbers include carbon dioxide emissions attributable to renewable energy sources.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run LP2008.D031608A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table E10. World Carbon Dioxide Emissions from Liquids Use by Region, Low Price Case, 1990-2030
(Million Metric Tons Carbon Dioxide)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**2,633**	**3,142**	**3,169**	**3,140**	**3,367**	**3,500**	**3,598**	**3,799**	**0.7**
United States[a]	2,178	2,597	2,615	2,560	2,723	2,804	2,853	3,002	0.6
Canada	224	291	290	305	322	339	352	365	0.9
Mexico	231	254	264	275	322	357	393	433	2.0
OECD Europe	**1,867**	**2,097**	**2,103**	**2,099**	**2,230**	**2,296**	**2,334**	**2,360**	**0.5**
OECD Asia	**914**	**1,016**	**1,028**	**1,010**	**1,095**	**1,149**	**1,180**	**1,209**	**0.7**
Japan	661	636	643	602	633	649	654	657	0.1
South Korea	144	238	240	263	298	324	341	358	1.6
Australia/New Zealand	110	142	144	146	164	175	185	194	1.2
Total OECD	**5,414**	**6,255**	**6,300**	**6,249**	**6,692**	**6,945**	**7,112**	**7,368**	**0.6**
Non-OECD									
Non-OECD Europe and Eurasia	**1,355**	**666**	**673**	**768**	**855**	**932**	**998**	**1,060**	**1.8**
Russia	783	379	379	416	456	487	508	526	1.3
Other	572	287	294	352	398	445	490	534	2.4
Non-OECD Asia	**950**	**1,979**	**2,037**	**2,437**	**2,979**	**3,496**	**3,954**	**4,474**	**3.2**
China	325	843	880	1,160	1,373	1,656	1,919	2,226	3.8
India	160	302	303	339	438	523	589	666	3.2
Other Non-OECD Asia	464	833	854	939	1,168	1,317	1,446	1,582	2.5
Middle East	**488**	**780**	**824**	**959**	**1,055**	**1,189**	**1,305**	**1,414**	**2.2**
Africa	**298**	**400**	**413**	**487**	**548**	**612**	**647**	**683**	**2.0**
Central and South America	**503**	**734**	**749**	**871**	**947**	**1,028**	**1,095**	**1,173**	**1.8**
Brazil	180	274	279	321	354	391	421	458	2.0
Other Central and South America	323	460	470	550	593	638	674	714	1.7
Total Non-OECD	**3,594**	**4,558**	**4,697**	**5,522**	**6,383**	**7,258**	**7,999**	**8,804**	**2.5**
Total World	**9,009**	**10,813**	**10,996**	**11,771**	**13,075**	**14,202**	**15,111**	**16,172**	**1.6**

[a]Includes the 50 States and the District of Columbia.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run LP2008.D031608A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table E11. World Carbon Dioxide Emissions from Natural Gas Use by Region, Low Price Case, 1990-2030
(Million Metric Tons Carbon Dioxide)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**1,207**	**1,471**	**1,476**	**1,587**	**1,684**	**1,764**	**1,833**	**1,863**	**0.9**
United States[a]	1,026	1,194	1,193	1,272	1,326	1,356	1,376	1,352	0.5
Canada	127	181	185	201	223	241	260	281	1.7
Mexico	54	97	99	114	135	167	197	230	3.4
OECD Europe	**590**	**1,027**	**1,048**	**1,137**	**1,270**	**1,384**	**1,454**	**1,530**	**1.5**
OECD Asia	**152**	**293**	**294**	**332**	**369**	**389**	**405**	**418**	**1.4**
Japan	102	173	170	186	199	207	210	212	0.9
South Korea	6	60	63	80	97	103	109	114	2.4
Australia/New Zealand	44	60	61	66	73	79	86	92	1.7
Total OECD	**1,949**	**2,791**	**2,819**	**3,056**	**3,322**	**3,537**	**3,692**	**3,811**	**1.2**
Non-OECD									
Non-OECD Europe and Eurasia	**1,450**	**1,328**	**1,375**	**1,502**	**1,628**	**1,732**	**1,793**	**1,892**	**1.3**
Russia	928	868	875	946	1,022	1,068	1,100	1,158	1.1
Other	521	460	500	556	605	664	693	734	1.5
Non-OECD Asia	**160**	**469**	**516**	**725**	**991**	**1,263**	**1,461**	**1,653**	**4.8**
China	30	83	101	180	263	345	400	453	6.2
India	24	59	69	105	144	178	214	240	5.1
Other Non-OECD Asia	106	327	345	440	584	740	848	960	4.2
Middle East	**199**	**476**	**541**	**625**	**715**	**802**	**849**	**899**	**2.1**
Africa	**80**	**149**	**167**	**206**	**265**	**326**	**368**	**411**	**3.7**
Central and South America	**116**	**231**	**249**	**321**	**386**	**429**	**468**	**505**	**2.9**
Brazil	6	33	36	56	69	78	89	103	4.3
Other Central and South America	110	197	213	266	317	351	379	403	2.6
Total Non-OECD	**2,005**	**2,651**	**2,847**	**3,379**	**3,984**	**4,552**	**4,938**	**5,360**	**2.6**
Total World	**3,954**	**5,443**	**5,666**	**6,435**	**7,306**	**8,089**	**8,630**	**9,171**	**1.9**

[a]Includes the 50 States and the District of Columbia.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run LP2008.D031608A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table E12. World Carbon Dioxide Emissions from Coal Use by Region, Low Price Case, 1990-2030
(Million Metric Tons Carbon Dioxide)

Region/Country	History			Projections					Average Annual Percent Change, 2005-2030
	1990	2004	2005	2010	2015	2020	2025	2030	
OECD									
OECD North America	**1,913**	**2,333**	**2,351**	**2,390**	**2,454**	**2,501**	**2,616**	**2,812**	**0.7**
United States[a]	1,784	2,155	2,162	2,188	2,252	2,299	2,412	2,611	0.8
Canada	114	151	153	163	165	166	168	168	0.4
Mexico	15	28	35	38	37	36	35	33	-0.3
OECD Europe	**1,644**	**1,250**	**1,232**	**1,282**	**1,261**	**1,214**	**1,168**	**1,119**	**-0.4**
OECD Asia	**475**	**840**	**853**	**863**	**855**	**844**	**839**	**851**	**0.0**
Japan	246	433	417	405	388	373	359	345	-0.8
South Korea	91	190	196	218	227	224	226	242	0.8
Australia/New Zealand	138	217	239	240	240	247	254	263	0.4
Total OECD	**4,032**	**4,423**	**4,435**	**4,535**	**4,570**	**4,558**	**4,624**	**4,781**	**0.3**
Non-OECD									
Non-OECD Europe and Eurasia	**1,393**	**804**	**817**	**801**	**895**	**918**	**923**	**975**	**0.7**
Russia	665	422	442	429	448	468	457	496	0.5
Other	729	381	376	372	447	450	466	478	1.0
Non-OECD Asia	**2,503**	**5,070**	**5,624**	**6,998**	**8,307**	**9,399**	**10,544**	**11,676**	**3.0**
China	1,886	3,827	4,341	5,548	6,646	7,624	8,593	9,513	3.2
India	380	765	791	891	1,031	1,142	1,239	1,357	2.2
Other Non-OECD Asia	237	477	492	559	630	634	713	806	2.0
Middle East	**13**	**35**	**35**	**39**	**36**	**33**	**30**	**26**	**-1.2**
Africa	**271**	**394**	**386**	**394**	**445**	**457**	**469**	**460**	**0.7**
Central and South America	**50**	**78**	**81**	**117**	**138**	**141**	**140**	**140**	**2.2**
Brazil	30	43	41	75	87	95	99	105	3.8
Other Central and South America	20	35	40	42	51	46	40	35	-0.5
Total Non-OECD	**4,231**	**6,380**	**6,943**	**8,350**	**9,821**	**10,949**	**12,105**	**13,277**	**2.6**
Total World	**8,263**	**10,803**	**11,378**	**12,884**	**14,391**	**15,507**	**16,729**	**18,058**	**1.9**

[a]Includes the 50 States and the District of Columbia.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run LP2008.D031608A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Appendix F

Reference Case Projections by End-Use Sector and Country Grouping

Table F1. Total World Delivered Energy Consumption by End-Use Sector and Fuel, 2005-2030
(Quadrillion Btu)

Sector/Fuel	2005	Projections					Average Annual Percent Change, 2005-2030
		2010	2015	2020	2025	2030	
Residential							
Liquids	10.4	10.3	10.5	10.8	11.0	11.1	0.3
Natural Gas	19.1	20.5	22.1	23.2	24.1	25.2	1.1
Coal	3.2	3.3	3.5	3.6	3.5	3.3	0.2
Electricity	15.1	18.1	20.7	23.1	25.2	27.4	2.4
Renewables	0.7	0.7	0.6	0.6	0.6	0.6	-0.4
Total	**48.5**	**52.8**	**57.5**	**61.3**	**64.4**	**67.6**	**1.3**
Commercial							
Liquids	5.1	4.9	5.1	5.1	5.2	5.3	0.2
Natural Gas	7.3	7.6	8.2	8.7	9.2	9.6	1.1
Coal	0.8	0.8	1.0	1.0	1.0	1.0	0.9
Electricity	12.3	14.6	17.1	19.2	21.3	23.4	2.6
Renewables	0.2	0.2	0.2	0.2	0.2	0.2	0.0
Total	**25.6**	**28.2**	**31.5**	**34.2**	**36.9**	**39.5**	**1.7**
Industrial							
Liquids	55.4	58.6	61.8	65.3	68.3	72.0	1.1
Natural Gas	45.2	51.4	57.6	62.6	66.5	70.2	1.8
Coal	41.2	46.0	51.0	55.3	59.9	64.2	1.8
Electricity	26.2	32.7	38.4	43.2	47.9	52.2	2.8
Renewables	2.0	2.5	2.9	3.5	4.4	4.5	3.2
Total	**170.0**	**191.2**	**211.8**	**230.0**	**247.0**	**263.1**	**1.8**
Transportation							
Liquids	88.2	98.2	108.1	116.2	123.9	132.8	1.6
Natural Gas	1.0	1.1	1.3	1.4	1.5	1.6	1.9
Coal	0.2	0.2	0.2	0.1	0.0	0.0	-100.0
Electricity	0.8	0.9	0.9	1.0	1.0	1.1	1.2
Total	**90.2**	**100.4**	**110.5**	**118.7**	**126.5**	**135.4**	**1.6**
All End-Use Sectors							
Liquids	159.0	172.0	185.5	197.5	208.5	221.2	1.3
Natural Gas	72.6	80.7	89.1	95.9	101.3	106.5	1.5
Coal	45.3	50.4	55.7	60.0	64.4	68.5	1.7
Electricity	54.4	66.3	77.1	86.4	95.4	104.1	2.6
Renewables	2.9	3.4	3.8	4.3	5.2	5.3	2.4
Delivered Energy	**334.3**	**372.6**	**411.2**	**444.2**	**474.8**	**505.7**	**1.7**
Electricity-Related Losses[a]	128.0	139.8	151.8	164.2	177.0	189.0	1.6
Total	**462.2**	**512.5**	**563.0**	**608.4**	**651.8**	**694.7**	**1.6**
Electric Power[b]							
Liquids	10.4	9.2	8.9	8.6	8.4	8.1	-1.0
Natural Gas	34.7	39.6	45.2	51.0	54.5	58.2	2.1
Coal	77.2	89.8	102.0	111.7	122.3	133.7	2.2
Nuclear	27.5	28.8	31.4	34.5	37.7	39.4	1.5
Renewables	32.4	38.5	41.1	44.8	49.4	53.6	2.0
Total	**182.4**	**206.1**	**228.8**	**250.6**	**272.4**	**293.1**	**1.9**
Total Energy Consumption							
Liquids	169.4	181.1	194.4	206.1	216.9	229.3	1.2
Natural Gas	107.4	120.3	134.4	146.9	155.8	164.7	1.7
Coal	122.5	140.2	157.8	171.7	186.7	202.2	2.0
Nuclear	27.5	28.8	31.4	34.5	37.7	39.4	1.5
Renewables	35.5	42.0	45.0	49.3	54.7	59.0	2.1
Total	**462.2**	**512.5**	**563.0**	**608.4**	**651.8**	**694.7**	**1.6**

[a]Electricity losses incurred in the transmission and distribution of electric power. May include some heat production.
[b]Fuel inputs used in the production of electricity and heat at central-station generators.

Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run AEO2008.D031608A, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table F2. Total OECD Delivered Energy Consumption by End-Use Sector and Fuel, 2005-2030
(Quadrillion Btu)

Sector/Fuel	2005	Projections					Average Annual Percent Change, 2005-2030
		2010	2015	2020	2025	2030	
Residential							
Liquids	5.3	5.0	5.1	5.1	5.1	5.1	-0.2
Natural Gas	12.2	12.3	12.6	12.9	13.0	13.1	0.3
Coal	0.5	0.4	0.4	0.4	0.4	0.4	-1.3
Electricity	10.0	11.0	11.5	12.2	12.8	13.5	1.2
Renewables	0.6	0.6	0.5	0.5	0.5	0.5	-0.5
Total	**28.6**	**29.3**	**30.2**	**31.0**	**31.8**	**32.6**	**0.5**
Commercial							
Liquids	3.5	3.2	3.3	3.3	3.4	3.4	-0.1
Natural Gas	6.3	6.3	6.7	7.0	7.2	7.4	0.7
Coal	0.2	0.2	0.2	0.2	0.2	0.2	-0.6
Electricity	9.1	10.3	11.4	12.3	13.3	14.2	1.8
Renewables	0.1	0.1	0.1	0.1	0.1	0.1	0.0
Total	**19.2**	**20.2**	**21.7**	**23.0**	**24.2**	**25.3**	**1.1**
Industrial							
Liquids	28.5	28.0	28.5	28.4	28.6	29.1	0.1
Natural Gas	17.9	19.3	20.2	20.8	21.5	22.0	0.8
Coal	9.2	9.3	9.4	9.4	9.4	9.5	0.1
Electricity	11.3	12.0	12.7	13.2	13.6	14.1	0.9
Renewables	2.0	2.4	2.8	3.4	4.3	4.4	3.3
Total	**68.8**	**71.0**	**73.6**	**75.2**	**77.3**	**79.1**	**0.6**
Transportation							
Liquids	57.5	59.4	62.6	64.4	65.8	67.6	0.7
Natural Gas	0.7	0.7	0.8	0.8	0.9	0.9	1.1
Coal	0.0	0.0	0.0	0.0	0.0	0.0	-100.0
Electricity	0.4	0.4	0.4	0.4	0.4	0.4	0.3
Total	**58.5**	**60.5**	**63.8**	**65.6**	**67.0**	**68.8**	**0.7**
All End-Use Sectors							
Liquids	94.7	95.7	99.5	101.3	102.8	105.1	0.4
Natural Gas	37.1	38.8	40.3	41.5	42.6	43.4	0.6
Coal	9.9	9.9	9.9	10.0	9.9	10.0	0.1
Electricity	30.8	33.6	36.0	38.1	40.0	42.2	1.3
Renewables	2.7	3.1	3.5	4.1	5.0	5.1	2.6
Delivered Energy	**175.2**	**181.0**	**189.3**	**194.9**	**200.3**	**205.8**	**0.6**
Electricity-Related Losses[a]	65.8	68.6	71.2	74.1	77.2	80.1	0.8
Total	**240.9**	**249.7**	**260.5**	**269.0**	**277.6**	**285.9**	**0.7**
Electric Power[b]							
Liquids	3.9	2.9	2.6	2.4	2.2	2.0	-2.6
Natural Gas	16.4	18.5	20.9	22.6	23.6	24.9	1.7
Coal	37.5	38.8	39.9	41.3	43.0	44.9	0.7
Nuclear	23.2	23.8	24.3	24.8	26.0	26.8	0.6
Renewables	15.4	18.1	19.3	21.0	22.4	23.5	1.7
Total	**96.6**	**102.2**	**107.2**	**112.2**	**117.3**	**122.3**	**0.9**
Total Energy Consumption							
Liquids	98.7	98.5	102.1	103.7	105.1	107.2	0.3
Natural Gas	53.4	57.3	61.2	64.1	66.1	68.3	1.0
Coal	47.3	48.7	49.9	51.2	52.9	55.0	0.6
Nuclear	23.2	23.8	24.3	24.8	26.0	26.8	0.6
Renewables	18.2	21.3	22.9	25.2	27.5	28.7	1.8
Total	**240.9**	**249.7**	**260.5**	**269.0**	**277.6**	**285.9**	**0.7**

[a]Electricity losses incurred in the transmission and distribution of electric power. May include some heat production.
[b]Fuel inputs used in the production of electricity and heat at central-station generators.

Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run AEO2008.D030208F, web site www.eia.doe.gov/oiaf/aeo; and World Energy Projections Plus (2008).

Table F3. Delivered Energy Consumption in the United States by End-Use Sector and Fuel, 2005-2030
(Quadrillion Btu)

Sector/Fuel	2005	Projections					Average Annual Percent Change, 2005-2030
		2010	2015	2020	2025	2030	
Residential							
Liquids	1.5	1.3	1.3	1.3	1.3	1.3	-0.5
Natural Gas	5.0	4.9	5.2	5.3	5.3	5.3	0.3
Coal	0.0	0.0	0.0	0.0	0.0	0.0	-0.7
Electricity	4.6	4.9	5.0	5.3	5.5	5.9	1.0
Renewables	0.4	0.4	0.4	0.4	0.4	0.4	-0.7
Total	**11.5**	**11.7**	**11.9**	**12.3**	**12.6**	**12.9**	**0.4**
Commercial							
Liquids	0.7	0.6	0.7	0.7	0.7	0.7	-0.2
Natural Gas	3.1	3.0	3.3	3.5	3.6	3.8	0.8
Coal	0.1	0.1	0.1	0.1	0.1	0.1	-0.1
Electricity	4.4	4.7	5.2	5.7	6.1	6.6	1.7
Renewables	0.1	0.1	0.1	0.1	0.1	0.1	0.0
Total	**8.4**	**8.6**	**9.4**	**10.0**	**10.7**	**11.3**	**1.2**
Industrial							
Liquids	9.8	9.7	9.6	9.3	9.2	9.2	-0.2
Natural Gas	7.9	8.4	8.4	8.4	8.4	8.3	0.2
Coal	1.9	1.9	1.9	2.1	2.1	2.3	0.6
Electricity	3.5	3.5	3.6	3.6	3.6	3.5	0.1
Renewables	1.9	2.3	2.7	3.3	4.2	4.3	3.4
Total	**25.0**	**25.8**	**26.3**	**26.7**	**27.5**	**27.7**	**0.4**
Transportation							
Liquids	27.3	28.3	29.6	30.4	31.0	32.1	0.7
Natural Gas	0.6	0.7	0.7	0.8	0.8	0.8	1.1
Coal	0.0	0.0	0.0	0.0	0.0	0.0	—
Electricity	0.0	0.0	0.0	0.0	0.0	0.0	1.3
Total	**27.9**	**29.0**	**30.4**	**31.2**	**31.9**	**33.0**	**0.7**
All End-Use Sectors							
Liquids	39.2	39.9	41.2	41.7	42.2	43.4	0.4
Natural Gas	16.6	17.0	17.6	17.9	18.2	18.3	0.4
Coal	2.0	2.0	2.0	2.2	2.2	2.3	0.6
Electricity	12.5	13.2	13.9	14.5	15.3	16.1	1.0
Renewables	2.5	2.9	3.3	3.9	4.7	4.8	2.7
Delivered Energy	**72.8**	**75.1**	**78.0**	**80.2**	**82.6**	**84.9**	**0.6**
Electricity-Related Losses[a]	27.3	28.3	29.3	30.7	31.9	33.2	0.8
Total	**100.1**	**103.3**	**107.3**	**110.8**	**114.5**	**118.0**	**0.7**
Electric Power[b]							
Liquids	1.2	0.6	0.6	0.6	0.6	0.6	-2.7
Natural Gas	6.0	6.9	6.7	6.1	5.4	5.1	-0.6
Coal	20.7	21.0	22.2	23.7	25.5	27.5	1.1
Nuclear	8.2	8.3	8.4	9.1	9.5	9.6	0.6
Renewables	3.4	4.6	5.1	5.7	6.0	6.2	2.4
Total	**39.7**	**41.5**	**43.1**	**45.2**	**47.2**	**49.2**	**0.9**
Total Energy Consumption							
Liquids	40.5	40.5	41.8	42.2	42.8	44.0	0.3
Natural Gas	22.6	23.9	24.4	24.0	23.7	23.4	0.1
Coal	22.8	23.0	24.2	25.9	27.7	29.9	1.1
Nuclear	8.2	8.3	8.4	9.1	9.5	9.6	0.6
Renewables	6.0	7.6	8.5	9.7	10.9	11.2	2.5
Total	**100.1**	**103.3**	**107.3**	**110.8**	**114.5**	**118.0**	**0.7**

[a]Electricity losses incurred in the transmission and distribution of electric power. May include some heat production.
[b]Fuel inputs used in the production of electricity and heat at central-station generators. Includes net electricity imports.
Sources: **2005:** Based on Energy Information Administration (EIA), *Annual Energy Review 2006*, DOE/EIA-0384(2006) (Washington, DC, June 2007). **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run AEO2008.D030208F, web site www.eia.doe.gov/oiaf/aeo.

Table F4. Delivered Energy Consumption in Canada by End-Use Sector and Fuel, 2005-2030
(Quadrillion Btu)

Sector/Fuel	2005	Projections					Average Annual Percent Change, 2005-2030
		2010	2015	2020	2025	2030	
Residential							
Liquids	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Natural Gas	0.6	0.7	0.7	0.7	0.7	0.7	0.5
Coal	0.0	0.0	0.0	0.0	0.0	0.0	-1.2
Electricity	0.6	0.6	0.7	0.7	0.8	0.8	1.4
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**1.4**	**1.5**	**1.6**	**1.6**	**1.7**	**1.7**	**0.9**
Commercial							
Liquids	0.4	0.5	0.5	0.5	0.5	0.5	0.5
Natural Gas	0.5	0.5	0.5	0.6	0.6	0.6	0.7
Coal	0.0	0.0	0.0	0.0	0.0	0.0	—
Electricity	0.5	0.6	0.7	0.8	0.8	0.8	2.1
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**1.5**	**1.6**	**1.7**	**1.8**	**1.9**	**1.9**	**1.2**
Industrial							
Liquids	1.4	1.4	1.4	1.4	1.4	1.5	0.2
Natural Gas	1.8	2.0	2.2	2.5	2.7	3.0	2.0
Coal	0.5	0.6	0.7	0.7	0.8	0.8	2.1
Electricity	0.8	0.9	0.9	1.0	1.1	1.1	1.1
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	0.7
Total	**4.5**	**4.9**	**5.2**	**5.6**	**6.0**	**6.3**	**1.4**
Transportation							
Liquids	2.4	2.6	2.7	2.8	2.9	3.0	0.7
Natural Gas	0.0	0.0	0.0	0.0	0.0	0.0	0.6
Coal	0.0	0.0	0.0	0.0	0.0	0.0	—
Electricity	0.0	0.0	0.0	0.0	0.0	0.0	0.7
Total	**2.4**	**2.6**	**2.7**	**2.8**	**2.9**	**3.0**	**0.9**
All End-Use Sectors							
Liquids	4.4	4.6	4.7	4.9	5.0	5.1	0.7
Natural Gas	2.9	3.2	3.4	3.8	4.0	4.3	1.5
Coal	0.5	0.6	0.7	0.7	0.8	0.8	2.1
Electricity	1.9	2.1	2.3	2.5	2.6	2.8	1.5
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	0.4
Delivered Energy	**9.7**	**10.5**	**11.2**	**11.9**	**12.4**	**13.0**	**1.2**
Electricity-Related Losses[a]	4.7	5.1	5.5	5.7	6.0	6.3	1.2
Total	**14.3**	**15.7**	**16.7**	**17.6**	**18.4**	**19.3**	**1.2**
Electric Power[b]							
Liquids	0.2	0.1	0.1	0.1	0.1	0.1	-2.8
Natural Gas	0.6	0.6	0.7	0.7	0.7	0.8	1.5
Coal	1.2	1.2	1.2	1.2	1.2	1.2	0.0
Nuclear	1.0	1.2	1.3	1.4	1.4	1.5	1.7
Renewables	3.7	4.1	4.5	4.9	5.2	5.5	1.6
Total	**6.6**	**7.3**	**7.8**	**8.2**	**8.7**	**9.1**	**1.3**
Total Energy Consumption							
Liquids	4.5	4.8	4.9	5.0	5.1	5.2	0.6
Natural Gas	3.5	3.8	4.1	4.4	4.8	5.1	1.5
Coal	1.7	1.8	1.9	1.9	2.0	2.0	0.7
Nuclear	1.0	1.2	1.3	1.4	1.4	1.5	1.7
Renewables	3.7	4.1	4.6	4.9	5.2	5.5	1.6
Total	**14.3**	**15.7**	**16.7**	**17.6**	**18.4**	**19.3**	**1.2**

[a]Electricity losses incurred in the transmission and distribution of electric power. May include some heat production.
[b]Fuel inputs used in the production of electricity and heat at central-station generators.
Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Table F5. Delivered Energy Consumption in Mexico by End-Use Sector and Fuel, 2005-2030
(Quadrillion Btu)

Sector/Fuel	2005	Projections					Average Annual Percent Change, 2005-2030
		2010	2015	2020	2025	2030	
Residential							
Liquids	0.3	0.3	0.3	0.4	0.4	0.4	1.1
Natural Gas	0.0	0.1	0.1	0.1	0.1	0.1	3.6
Coal	0.0	0.0	0.0	0.0	0.0	0.0	—
Electricity	0.2	0.2	0.3	0.3	0.4	0.5	4.1
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**0.5**	**0.6**	**0.7**	**0.8**	**0.8**	**0.9**	**2.5**
Commercial							
Liquids	0.1	0.1	0.1	0.1	0.1	0.1	1.4
Natural Gas	0.0	0.0	0.0	0.0	0.0	0.0	3.6
Coal	0.0	0.0	0.0	0.0	0.0	0.0	—
Electricity	0.1	0.1	0.2	0.2	0.3	0.3	5.4
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**0.2**	**0.2**	**0.2**	**0.3**	**0.4**	**0.4**	**4.0**
Industrial							
Liquids	1.2	1.2	1.3	1.3	1.4	1.6	1.1
Natural Gas	1.0	1.1	1.3	1.5	1.7	1.8	2.6
Coal	0.0	0.1	0.1	0.1	0.2	0.2	5.1
Electricity	0.5	0.5	0.5	0.6	0.7	0.8	2.5
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	0.6
Total	**2.7**	**2.9**	**3.2**	**3.6**	**4.0**	**4.4**	**2.0**
Transportation							
Liquids	1.9	2.1	2.5	2.8	3.1	3.5	2.4
Natural Gas	0.0	0.0	0.0	0.0	0.0	0.0	3.1
Coal	0.0	0.0	0.0	0.0	0.0	0.0	—
Electricity	0.0	0.0	0.0	0.0	0.0	0.0	2.5
Total	**1.9**	**2.1**	**2.5**	**2.8**	**3.1**	**3.5**	**2.4**
All End-Use Sectors							
Liquids	3.4	3.6	4.1	4.6	5.0	5.5	1.9
Natural Gas	1.0	1.2	1.4	1.6	1.8	2.0	2.6
Coal	0.0	0.1	0.1	0.1	0.2	0.2	5.1
Electricity	0.7	0.8	1.0	1.2	1.4	1.6	3.3
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Delivered Energy	**5.2**	**5.7**	**6.7**	**7.5**	**8.3**	**9.2**	**2.3**
Electricity-Related Losses[a]	1.7	1.7	1.7	1.9	2.1	2.3	1.4
Total	**6.9**	**7.4**	**8.4**	**9.4**	**10.4**	**11.6**	**2.1**
Electric Power[b]							
Liquids	0.6	0.6	0.6	0.6	0.5	0.5	-0.9
Natural Gas	0.8	0.9	1.1	1.5	1.9	2.3	4.1
Coal	0.3	0.4	0.4	0.4	0.4	0.4	0.2
Nuclear	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Renewables	0.4	0.5	0.5	0.6	0.6	0.6	1.5
Total	**2.4**	**2.5**	**2.7**	**3.1**	**3.5**	**3.9**	**2.1**
Total Energy Consumption							
Liquids	4.1	4.2	4.7	5.1	5.5	6.0	1.6
Natural Gas	1.9	2.1	2.5	3.1	3.7	4.3	3.4
Coal	0.4	0.4	0.5	0.5	0.5	0.5	1.3
Nuclear	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Renewables	0.4	0.5	0.5	0.6	0.6	0.6	1.5
Total	**6.9**	**7.4**	**8.4**	**9.4**	**10.4**	**11.6**	**2.1**

[a]Electricity losses incurred in the transmission and distribution of electric power. May include some heat production.
[b]Fuel inputs used in the production of electricity and heat at central-station generators.
Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Table F6. Delivered Energy Consumption in OECD Europe by End-Use Sector and Fuel, 2005-2030
(Quadrillion Btu)

Sector/Fuel	2005	Projections					Average Annual Percent Change, 2005-2030
		2010	2015	2020	2025	2030	
Residential							
Liquids	2.6	2.5	2.5	2.5	2.4	2.4	-0.2
Natural Gas	5.6	5.7	5.7	5.8	5.8	5.9	0.2
Coal	0.4	0.3	0.3	0.3	0.3	0.3	-1.3
Electricity	3.0	3.4	3.7	3.9	4.1	4.3	1.5
Renewables	0.1	0.1	0.1	0.1	0.1	0.1	0.0
Total	**11.7**	**11.9**	**12.2**	**12.5**	**12.8**	**13.0**	**0.4**
Commercial							
Liquids	1.0	0.9	0.9	0.9	0.9	0.9	-0.3
Natural Gas	1.9	2.0	2.0	2.1	2.1	2.1	0.3
Coal	0.1	0.0	0.0	0.0	0.0	0.0	-1.3
Electricity	2.6	3.1	3.4	3.6	3.9	4.1	1.8
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**5.6**	**6.0**	**6.3**	**6.6**	**6.9**	**7.2**	**1.0**
Industrial							
Liquids	9.2	9.1	9.3	9.4	9.4	9.5	0.1
Natural Gas	6.3	6.8	7.1	7.2	7.4	7.5	0.7
Coal	3.7	3.7	3.7	3.5	3.3	3.2	-0.6
Electricity	4.6	5.0	5.3	5.5	5.7	6.0	1.1
Renewables	0.1	0.1	0.1	0.1	0.1	0.1	0.7
Total	**23.9**	**24.6**	**25.5**	**25.6**	**25.9**	**26.2**	**0.4**
Transportation							
Liquids	18.4	18.8	19.5	19.8	19.9	20.0	0.3
Natural Gas	0.0	0.0	0.0	0.0	0.0	0.0	0.4
Coal	0.0	0.0	0.0	0.0	0.0	0.0	-100.0
Electricity	0.3	0.3	0.3	0.3	0.3	0.3	0.1
Total	**18.7**	**19.1**	**19.8**	**20.1**	**20.2**	**20.3**	**0.3**
All End-Use Sectors							
Liquids	31.2	31.2	32.2	32.5	32.7	32.8	0.2
Natural Gas	13.9	14.5	14.8	15.0	15.3	15.5	0.4
Coal	4.3	4.1	4.1	3.9	3.7	3.6	-0.7
Electricity	10.4	11.7	12.5	13.3	14.0	14.7	1.4
Renewables	0.1	0.1	0.1	0.1	0.1	0.2	0.3
Delivered Energy	**59.9**	**61.6**	**63.8**	**64.9**	**65.8**	**66.7**	**0.4**
Electricity-Related Losses[a]	21.5	22.3	23.0	23.6	24.6	25.3	0.7
Total	**81.4**	**83.9**	**86.8**	**88.5**	**90.4**	**92.0**	**0.5**
Electric Power[b]							
Liquids	0.9	0.7	0.6	0.5	0.4	0.4	-3.6
Natural Gas	6.0	6.8	8.7	10.4	11.5	12.5	3.0
Coal	8.9	9.7	9.6	9.4	9.3	9.0	0.0
Nuclear	9.8	9.6	9.5	8.7	9.0	9.3	-0.2
Renewables	6.3	7.1	7.1	7.8	8.4	8.9	1.3
Total	**31.9**	**34.0**	**35.5**	**36.9**	**38.6**	**40.0**	**0.9**
Total Energy Consumption							
Liquids	32.1	31.9	32.8	33.0	33.1	33.2	0.1
Natural Gas	19.9	21.3	23.5	25.5	26.7	28.0	1.4
Coal	13.2	13.8	13.7	13.3	13.0	12.6	-0.2
Nuclear	9.8	9.6	9.5	8.7	9.0	9.3	-0.2
Renewables	6.5	7.2	7.3	7.9	8.6	9.0	1.3
Total	**81.4**	**83.9**	**86.8**	**88.5**	**90.4**	**92.0**	**0.5**

[a]Electricity losses incurred in the transmission and distribution of electric power. May include some heat production.
[b]Fuel inputs used in the production of electricity and heat at central-station generators.
Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Table F7. Delivered Energy Consumption in Japan by End-Use Sector and Fuel, 2005-2030
(Quadrillion Btu)

Sector/Fuel	2005	Projections					Average Annual Percent Change, 2005-2030
		2010	2015	2020	2025	2030	
Residential							
Liquids	0.7	0.6	0.6	0.6	0.6	0.6	-0.6
Natural Gas	0.4	0.4	0.5	0.5	0.5	0.5	0.4
Coal	0.0	0.0	0.0	0.0	0.0	0.0	—
Electricity	1.2	1.3	1.3	1.4	1.4	1.4	0.7
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**2.3**	**2.3**	**2.4**	**2.4**	**2.4**	**2.5**	**0.3**
Commercial							
Liquids	1.0	0.9	0.9	0.9	0.9	0.9	-0.3
Natural Gas	0.6	0.6	0.6	0.6	0.6	0.7	0.5
Coal	0.0	0.0	0.0	0.0	0.0	0.0	-0.7
Electricity	1.0	1.1	1.2	1.2	1.2	1.2	0.8
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**2.6**	**2.6**	**2.7**	**2.8**	**2.8**	**2.8**	**0.4**
Industrial							
Liquids	4.2	4.0	3.9	4.0	4.0	4.1	-0.2
Natural Gas	0.1	0.1	0.1	0.1	0.2	0.2	1.6
Coal	2.0	2.0	2.0	1.9	1.9	1.9	-0.2
Electricity	1.0	1.0	1.0	1.0	1.0	1.0	0.3
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	0.6
Total	**7.3**	**7.1**	**7.1**	**7.1**	**7.1**	**7.2**	**-0.1**
Transportation							
Liquids	4.2	4.0	4.2	4.2	4.1	4.1	-0.1
Natural Gas	0.0	0.0	0.0	0.0	0.0	0.0	—
Coal	0.0	0.0	0.0	0.0	0.0	0.0	—
Electricity	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total	**4.3**	**4.0**	**4.3**	**4.3**	**4.2**	**4.1**	**-0.1**
All End-Use Sectors							
Liquids	10.1	9.5	9.6	9.7	9.7	9.6	-0.2
Natural Gas	1.1	1.2	1.2	1.2	1.3	1.3	0.6
Coal	2.0	2.1	2.0	2.0	1.9	1.9	-0.2
Electricity	3.2	3.5	3.6	3.7	3.7	3.8	0.6
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	0.4
Delivered Energy	**16.5**	**16.1**	**16.4**	**16.5**	**16.6**	**16.6**	**0.0**
Electricity-Related Losses[a]	6.1	6.3	6.5	6.6	6.7	6.8	0.4
Total	**22.6**	**22.4**	**22.9**	**23.1**	**23.3**	**23.4**	**0.1**
Electric Power[b]							
Liquids	0.8	0.7	0.6	0.5	0.4	0.3	-3.5
Natural Gas	2.1	2.3	2.5	2.6	2.6	2.6	0.8
Coal	2.6	2.5	2.4	2.4	2.3	2.2	-0.5
Nuclear	2.8	3.1	3.3	3.4	3.7	3.9	1.3
Renewables	1.0	1.2	1.3	1.4	1.4	1.5	1.5
Total	**9.3**	**9.8**	**10.1**	**10.2**	**10.4**	**10.6**	**0.5**
Total Energy Consumption							
Liquids	10.9	10.1	10.2	10.2	10.1	10.0	-0.4
Natural Gas	3.2	3.5	3.7	3.8	3.8	3.8	0.7
Coal	4.6	4.5	4.4	4.3	4.2	4.2	-0.4
Nuclear	2.8	3.1	3.3	3.4	3.7	3.9	1.3
Renewables	1.0	1.2	1.3	1.4	1.4	1.5	1.5
Total	**22.6**	**22.4**	**22.9**	**23.1**	**23.3**	**23.4**	**0.1**

[a]Electricity losses incurred in the transmission and distribution of electric power. May include some heat production.
[b]Fuel inputs used in the production of electricity and heat at central-station generators.
Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Table F8. Delivered Energy Consumption in South Korea by End-Use Sector and Fuel, 2005-2030
(Quadrillion Btu)

Sector/Fuel	2005	Projections					Average Annual Percent Change, 2005-2030
		2010	2015	2020	2025	2030	
Residential							
Liquids	0.1	0.1	0.1	0.1	0.2	0.2	0.3
Natural Gas	0.4	0.4	0.4	0.5	0.5	0.5	1.0
Coal	0.0	0.0	0.0	0.0	0.0	0.0	-2.0
Electricity	0.2	0.2	0.2	0.3	0.3	0.3	2.4
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**0.7**	**0.8**	**0.9**	**0.9**	**0.9**	**1.0**	**1.1**
Commercial							
Liquids	0.3	0.3	0.3	0.3	0.3	0.3	0.1
Natural Gas	0.1	0.2	0.2	0.2	0.2	0.2	2.1
Coal	0.0	0.0	0.0	0.0	0.0	0.0	—
Electricity	0.4	0.5	0.6	0.7	0.7	0.7	2.6
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**0.8**	**0.9**	**1.1**	**1.1**	**1.2**	**1.2**	**1.8**
Industrial							
Liquids	2.1	2.2	2.4	2.5	2.6	2.7	1.0
Natural Gas	0.2	0.3	0.3	0.3	0.3	0.4	1.9
Coal	0.8	0.8	0.8	0.8	0.9	0.9	0.6
Electricity	0.6	0.7	0.8	0.9	0.9	1.0	2.1
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**3.7**	**3.9**	**4.3**	**4.5**	**4.7**	**5.0**	**1.2**
Transportation							
Liquids	1.8	2.1	2.4	2.6	2.8	2.9	1.9
Natural Gas	0.0	0.0	0.0	0.0	0.0	0.0	1.4
Coal	0.0	0.0	0.0	0.0	0.0	0.0	—
Electricity	0.0	0.0	0.0	0.0	0.0	0.0	2.3
Total	**1.8**	**2.1**	**2.4**	**2.6**	**2.8**	**2.9**	**1.9**
All End-Use Sectors							
Liquids	4.3	4.7	5.2	5.5	5.8	6.1	1.4
Natural Gas	0.7	0.8	0.9	1.0	1.0	1.1	1.5
Coal	0.8	0.8	0.8	0.8	0.9	0.9	0.5
Electricity	1.2	1.4	1.7	1.8	1.9	2.1	2.3
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delivered Energy	**7.1**	**7.8**	**8.7**	**9.2**	**9.6**	**10.1**	**1.5**
Electricity-Related Losses[a]	2.2	2.5	2.9	3.2	3.3	3.6	1.9
Total	**9.3**	**10.3**	**11.6**	**12.4**	**13.0**	**13.7**	**1.6**
Electric Power[b]							
Liquids	0.2	0.2	0.2	0.1	0.1	0.1	-2.4
Natural Gas	0.5	0.6	0.8	0.9	0.9	1.0	3.1
Coal	1.3	1.6	1.7	1.7	1.7	1.9	1.5
Nuclear	1.4	1.4	1.8	2.1	2.3	2.4	2.3
Renewables	0.0	0.1	0.1	0.2	0.2	0.3	8.2
Total	**3.4**	**3.9**	**4.6**	**5.0**	**5.2**	**5.7**	**2.1**
Total Energy Consumption							
Liquids	4.5	4.9	5.4	5.7	5.9	6.2	1.3
Natural Gas	1.2	1.5	1.8	1.9	2.0	2.0	2.2
Coal	2.1	2.4	2.6	2.6	2.6	2.8	1.1
Nuclear	1.4	1.4	1.8	2.1	2.3	2.4	2.3
Renewables	0.0	0.1	0.1	0.2	0.2	0.3	7.7
Total	**9.3**	**10.3**	**11.6**	**12.4**	**13.0**	**13.7**	**1.6**

[a]Electricity losses incurred in the transmission and distribution of electric power. May include some heat production.
[b]Fuel inputs used in the production of electricity and heat at central-station generators.
Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Table F9. Delivered Energy Consumption in Australia/New Zealand by End-Use Sector and Fuel, 2005-2030
(Quadrillion Btu)

Sector/Fuel	2005	Projections					Average Annual Percent Change, 2005-2030
		2010	2015	2020	2025	2030	
Residential							
Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.4
Natural Gas	0.1	0.1	0.1	0.1	0.1	0.2	0.5
Coal	0.0	0.0	0.0	0.0	0.0	0.0	-1.0
Electricity	0.2	0.3	0.3	0.3	0.3	0.3	1.3
Renewables	0.1	0.1	0.1	0.1	0.1	0.1	0.0
Total	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.6**	**0.9**
Commercial							
Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.3
Natural Gas	0.1	0.0	0.1	0.1	0.1	0.1	0.5
Coal	0.0	0.0	0.0	0.0	0.0	0.0	-0.3
Electricity	0.2	0.2	0.2	0.2	0.3	0.3	1.7
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**0.3**	**0.3**	**0.3**	**0.3**	**0.4**	**0.4**	**1.3**
Industrial							
Liquids	0.5	0.5	0.5	0.6	0.6	0.6	0.4
Natural Gas	0.6	0.7	0.7	0.7	0.8	0.8	1.4
Coal	0.2	0.2	0.2	0.2	0.3	0.3	1.9
Electricity	0.4	0.5	0.5	0.5	0.6	0.6	1.3
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	0.7
Total	**1.7**	**1.8**	**2.0**	**2.1**	**2.2**	**2.3**	**1.1**
Transportation							
Liquids	1.5	1.6	1.7	1.8	1.9	2.0	1.1
Natural Gas	0.0	0.0	0.0	0.0	0.0	0.0	7.6
Coal	0.0	0.0	0.0	0.0	0.0	0.0	-100.0
Electricity	0.0	0.0	0.0	0.0	0.0	0.0	0.6
Total	**1.5**	**1.6**	**1.8**	**1.9**	**1.9**	**2.0**	**1.1**
All End-Use Sectors							
Liquids	2.1	2.1	2.3	2.4	2.5	2.6	0.9
Natural Gas	0.8	0.9	0.9	0.9	1.0	1.1	1.2
Coal	0.2	0.2	0.2	0.2	0.3	0.3	1.8
Electricity	0.9	0.9	1.0	1.1	1.2	1.2	1.4
Renewables	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Delivered Energy	**4.0**	**4.2**	**4.5**	**4.8**	**5.0**	**5.3**	**1.1**
Electricity-Related Losses[a]	2.3	2.4	2.4	2.4	2.5	2.5	0.3
Total	**6.3**	**6.6**	**6.9**	**7.2**	**7.5**	**7.8**	**0.8**
Electric Power[b]							
Liquids	0.0	0.0	0.0	0.0	0.0	0.0	-1.2
Natural Gas	0.4	0.4	0.4	0.5	0.5	0.5	1.6
Coal	2.4	2.4	2.4	2.5	2.6	2.7	0.5
Nuclear	0.0	0.0	0.0	0.0	0.0	0.0	—
Renewables	0.4	0.5	0.5	0.5	0.5	0.5	0.8
Total	**3.2**	**3.3**	**3.4**	**3.5**	**3.6**	**3.8**	**0.6**
Total Energy Consumption							
Liquids	2.1	2.1	2.3	2.4	2.5	2.6	0.9
Natural Gas	1.1	1.2	1.3	1.4	1.5	1.6	1.3
Coal	2.6	2.6	2.7	2.8	2.9	3.0	0.6
Nuclear	0.0	0.0	0.0	0.0	0.0	0.0	—
Renewables	0.5	0.6	0.6	0.6	0.6	0.6	0.7
Total	**6.3**	**6.6**	**6.9**	**7.2**	**7.5**	**7.8**	**0.8**

[a]Electricity losses incurred in the transmission and distribution of electric power. May include some heat production.
[b]Fuel inputs used in the production of electricity and heat at central-station generators.
Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Table F10. Total Non-OECD Delivered Energy Consumption by End-Use Sector and Fuel, 2005-2030
(Quadrillion Btu)

Sector/Fuel	2005	Projections					Average Annual Percent Change, 2005-2030
		2010	2015	2020	2025	2030	
Residential							
Liquids	5.0	5.3	5.5	5.8	6.0	6.1	0.7
Natural Gas	6.9	8.2	9.5	10.3	11.1	12.1	2.2
Coal	2.7	2.9	3.2	3.2	3.1	3.0	0.4
Electricity	5.1	7.1	9.1	10.9	12.4	13.8	4.0
Renewables	0.1	0.1	0.1	0.1	0.1	0.1	0.0
Total	**19.9**	**23.5**	**27.3**	**30.2**	**32.6**	**35.0**	**2.3**
Commercial							
Liquids	1.6	1.7	1.8	1.8	1.9	1.9	0.7
Natural Gas	1.0	1.3	1.5	1.7	1.9	2.1	3.2
Coal	0.6	0.7	0.8	0.8	0.8	0.8	1.2
Electricity	3.1	4.4	5.7	6.8	8.0	9.3	4.5
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**6.4**	**8.1**	**9.8**	**11.2**	**12.7**	**14.2**	**3.3**
Industrial							
Liquids	26.9	30.6	33.4	36.9	39.7	42.9	1.9
Natural Gas	27.3	32.1	37.4	41.9	45.1	48.2	2.3
Coal	32.0	36.7	41.6	45.9	50.6	54.7	2.2
Electricity	14.9	20.7	25.7	30.1	34.3	38.1	3.8
Renewables	0.1	0.1	0.1	0.1	0.1	0.1	1.1
Total	**101.2**	**120.2**	**138.2**	**154.8**	**169.7**	**184.0**	**2.4**
Transportation							
Liquids	30.7	38.8	45.5	51.8	58.1	65.2	3.1
Natural Gas	0.3	0.4	0.5	0.6	0.6	0.7	3.1
Coal	0.2	0.2	0.2	0.1	0.0	0.0	-100.0
Electricity	0.4	0.5	0.5	0.6	0.6	0.7	1.9
Total	**31.7**	**39.9**	**46.7**	**53.1**	**59.4**	**66.6**	**3.0**
All End-Use Sectors							
Liquids	64.3	76.3	86.1	96.2	105.6	116.0	2.4
Natural Gas	35.5	41.9	48.9	54.4	58.7	63.1	2.3
Coal	35.5	40.5	45.8	50.1	54.5	58.5	2.0
Electricity	23.6	32.7	41.0	48.4	55.4	61.9	3.9
Renewables	0.2	0.2	0.2	0.2	0.2	0.3	0.4
Delivered Energy	**159.1**	**191.6**	**222.0**	**249.3**	**274.5**	**299.9**	**2.6**
Electricity-Related Losses[a]	62.2	71.2	80.5	90.1	99.8	109.0	2.3
Total	**221.3**	**262.8**	**302.5**	**339.4**	**374.2**	**408.8**	**2.5**
Electric Power[b]							
Liquids	6.5	6.3	6.2	6.2	6.2	6.1	-0.2
Natural Gas	18.4	21.1	24.3	28.4	30.9	33.3	2.4
Coal	39.7	51.0	62.1	70.4	79.3	88.8	3.3
Nuclear	4.2	5.1	7.1	9.7	11.8	12.6	4.5
Renewables	17.0	20.4	21.9	23.8	27.0	30.1	2.3
Total	**85.8**	**103.9**	**121.6**	**138.4**	**155.1**	**170.9**	**2.8**
Total Energy Consumption							
Liquids	70.8	82.6	92.3	102.4	111.9	122.1	2.2
Natural Gas	53.9	63.0	73.1	82.8	89.6	96.4	2.4
Coal	75.2	91.5	107.9	120.5	133.8	147.3	2.7
Nuclear	4.2	5.1	7.1	9.7	11.8	12.6	4.5
Renewables	17.2	20.7	22.1	24.0	27.2	30.3	2.3
Total	**221.3**	**262.8**	**302.5**	**339.4**	**374.2**	**408.8**	**2.5**

[a]Electricity losses incurred in the transmission and distribution of electric power. May include some heat production.
[b]Fuel inputs used in the production of electricity and heat at central-station generators.
Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Table F11. Delivered Energy Consumption in Russia by End-Use Sector and Fuel, 2005-2030
(Quadrillion Btu)

Sector/Fuel	2005	Projections					Average Annual Percent Change, 2005-2030
		2010	2015	2020	2025	2030	
Residential							
Liquids	0.3	0.3	0.3	0.4	0.4	0.4	0.7
Natural Gas	2.2	2.4	2.6	2.9	3.0	3.3	1.6
Coal	0.1	0.1	0.1	0.1	0.1	0.1	-1.2
Electricity	0.4	0.5	0.6	0.7	0.8	0.9	3.2
Renewables	0.1	0.1	0.1	0.1	0.1	0.1	0.0
Total	**3.2**	**3.5**	**3.8**	**4.1**	**4.4**	**4.7**	**1.6**
Commercial							
Liquids	0.0	0.0	0.0	0.0	0.0	0.0	-0.5
Natural Gas	0.2	0.3	0.3	0.3	0.4	0.4	2.6
Coal	0.1	0.1	0.1	0.1	0.1	0.1	-0.6
Electricity	0.4	0.5	0.6	0.7	0.8	0.9	3.2
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**0.8**	**1.0**	**1.1**	**1.3**	**1.4**	**1.5**	**2.3**
Industrial							
Liquids	2.4	2.6	2.7	2.8	2.8	2.8	0.6
Natural Gas	8.4	8.8	9.4	9.9	10.2	10.6	0.9
Coal	1.7	1.7	1.8	1.8	1.8	1.9	0.4
Electricity	1.8	2.2	2.6	2.9	3.1	3.3	2.4
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	0.7
Total	**14.3**	**15.3**	**16.6**	**17.4**	**18.0**	**18.6**	**1.1**
Transportation							
Liquids	2.5	2.9	3.2	3.4	3.6	3.8	1.6
Natural Gas	0.0	0.0	0.0	0.0	0.0	0.0	1.1
Coal	0.0	0.0	0.0	0.0	0.0	0.0	—
Electricity	0.2	0.2	0.2	0.2	0.2	0.2	0.5
Total	**2.7**	**3.1**	**3.4**	**3.6**	**3.8**	**4.0**	**1.6**
All End-Use Sectors							
Liquids	5.3	5.8	6.3	6.6	6.8	7.0	1.1
Natural Gas	10.8	11.5	12.4	13.1	13.6	14.3	1.1
Coal	2.0	2.0	2.1	2.1	2.1	2.1	0.3
Electricity	2.8	3.4	4.0	4.5	4.9	5.3	2.5
Renewables	0.2	0.2	0.2	0.2	0.2	0.2	0.1
Delivered Energy	**21.0**	**22.9**	**24.9**	**26.4**	**27.6**	**28.8**	**1.3**
Electricity-Related Losses[a]	9.3	9.8	10.0	10.3	10.4	10.8	0.6
Total	**30.3**	**32.7**	**34.9**	**36.7**	**38.0**	**39.6**	**1.1**
Electric Power[b]							
Liquids	0.4	0.3	0.3	0.2	0.2	0.2	-3.0
Natural Gas	5.8	6.2	6.5	6.6	6.6	6.8	0.7
Coal	2.8	2.8	3.0	3.2	3.2	3.6	1.0
Nuclear	1.5	1.7	2.1	2.6	3.2	3.4	3.2
Renewables	1.6	2.2	2.2	2.2	2.2	2.2	1.2
Total	**12.2**	**13.2**	**14.0**	**14.8**	**15.3**	**16.1**	**1.1**
Total Energy Consumption							
Liquids	5.7	6.2	6.6	6.8	7.0	7.2	0.9
Natural Gas	16.6	17.7	18.9	19.6	20.2	21.1	1.0
Coal	4.8	4.8	5.0	5.3	5.2	5.7	0.7
Nuclear	1.5	1.7	2.1	2.6	3.2	3.4	3.2
Renewables	1.8	2.3	2.3	2.3	2.3	2.3	1.1
Total	**30.3**	**32.7**	**34.9**	**36.7**	**38.0**	**39.6**	**1.1**

[a]Electricity losses incurred in the transmission and distribution of electric power. May include some heat production.
[b]Fuel inputs used in the production of electricity and heat at central-station generators.
Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Table F12. Delivered Energy Consumption in Other Non-OECD Europe and Eurasia by End-Use Sector and Fuel, 2005-2030
(Quadrillion Btu)

Sector/Fuel	2005	Projections					Average Annual Percent Change, 2005-2030
		2010	2015	2020	2025	2030	
Residential							
Liquids	0.2	0.2	0.2	0.2	0.2	0.2	0.8
Natural Gas	2.1	2.3	2.4	2.5	2.6	2.7	1.1
Coal	0.1	0.1	0.1	0.1	0.1	0.1	-1.1
Electricity	0.5	0.6	0.7	0.8	0.8	0.9	2.6
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**2.8**	**3.1**	**3.4**	**3.6**	**3.8**	**3.9**	**1.3**
Commercial							
Liquids	0.1	0.1	0.1	0.1	0.1	0.1	0.5
Natural Gas	0.3	0.3	0.3	0.3	0.4	0.4	1.6
Coal	0.0	0.0	0.0	0.0	0.0	0.0	0.3
Electricity	0.2	0.3	0.4	0.4	0.5	0.5	3.5
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**0.6**	**0.7**	**0.8**	**0.8**	**0.9**	**1.0**	**2.3**
Industrial							
Liquids	1.7	1.9	1.8	1.9	2.0	2.1	0.9
Natural Gas	4.8	5.4	6.0	6.5	6.7	7.0	1.5
Coal	1.8	2.0	2.2	2.3	2.3	2.2	0.7
Electricity	1.2	1.4	1.6	1.8	2.0	2.2	2.5
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**9.5**	**10.7**	**11.7**	**12.5**	**13.0**	**13.4**	**1.4**
Transportation							
Liquids	2.0	2.6	3.1	3.5	3.9	4.4	3.2
Natural Gas	0.0	0.0	0.0	0.0	0.0	0.0	2.6
Coal	0.0	0.0	0.0	0.0	0.0	0.0	-100.0
Electricity	0.1	0.1	0.1	0.1	0.1	0.1	0.6
Total	**2.1**	**2.7**	**3.2**	**3.6**	**4.0**	**4.5**	**3.1**
All End-Use Sectors							
Liquids	3.9	4.8	5.2	5.7	6.3	6.8	2.2
Natural Gas	7.1	8.0	8.7	9.4	9.7	10.1	1.4
Coal	1.9	2.1	2.3	2.4	2.4	2.3	0.6
Electricity	1.9	2.3	2.8	3.1	3.4	3.7	2.6
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Delivered Energy	**14.9**	**17.2**	**19.0**	**20.6**	**21.8**	**22.9**	**1.7**
Electricity-Related Losses[a]	5.5	5.2	5.5	6.0	6.2	6.6	0.7
Total	**20.4**	**22.4**	**24.5**	**26.5**	**28.0**	**29.4**	**1.5**
Electric Power[b]							
Liquids	0.4	0.3	0.3	0.3	0.3	0.3	-1.4
Natural Gas	2.3	2.4	2.4	2.8	2.9	3.2	1.3
Coal	2.1	2.0	2.7	2.7	2.9	3.2	1.7
Nuclear	1.3	1.4	1.4	1.8	1.9	1.9	1.5
Renewables	1.3	1.4	1.5	1.5	1.7	1.7	1.1
Total	**7.4**	**7.5**	**8.3**	**9.0**	**9.6**	**10.3**	**1.3**
Total Energy Consumption							
Liquids	4.3	5.1	5.5	6.1	6.6	7.1	2.0
Natural Gas	9.5	10.4	11.1	12.1	12.6	13.3	1.4
Coal	4.0	4.1	5.0	5.0	5.3	5.5	1.2
Nuclear	1.3	1.4	1.4	1.8	1.9	1.9	1.5
Renewables	1.3	1.4	1.5	1.5	1.7	1.7	1.1
Total	**20.4**	**22.4**	**24.5**	**26.5**	**28.0**	**29.4**	**1.5**

[a]Electricity losses incurred in the transmission and distribution of electric power. May include some heat production.
[b]Fuel inputs used in the production of electricity and heat at central-station generators.
Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Table F13. Delivered Energy Consumption in China by End-Use Sector and Fuel, 2005-2030
(Quadrillion Btu)

Sector/Fuel	2005	Projections					Average Annual Percent Change, 2005-2030
		2010	2015	2020	2025	2030	
Residential							
Liquids	0.8	0.7	0.7	0.7	0.7	0.7	-0.2
Natural Gas	0.4	0.8	1.0	1.3	1.6	1.9	6.2
Coal	2.1	2.3	2.5	2.5	2.4	2.2	0.2
Electricity	0.9	1.5	2.1	2.8	3.5	4.1	6.1
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**4.2**	**5.4**	**6.4**	**7.3**	**8.1**	**8.9**	**3.0**
Commercial							
Liquids	1.0	1.0	1.0	1.0	0.9	0.9	-0.1
Natural Gas	0.1	0.2	0.3	0.4	0.5	0.6	5.7
Coal	0.2	0.2	0.3	0.3	0.3	0.3	0.4
Electricity	0.4	0.7	1.0	1.4	1.7	2.0	6.9
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**1.7**	**2.2**	**2.6**	**3.0**	**3.4**	**3.8**	**3.2**
Industrial							
Liquids	6.9	8.3	8.6	9.8	11.0	12.7	2.5
Natural Gas	1.0	1.6	2.1	2.5	2.8	3.0	4.7
Coal	22.1	25.4	29.3	32.8	36.7	40.3	2.4
Electricity	6.1	10.4	13.5	16.1	18.8	21.2	5.1
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	2.0
Total	**36.1**	**45.7**	**53.5**	**61.2**	**69.3**	**77.3**	**3.1**
Transportation							
Liquids	4.8	7.6	9.8	12.2	14.8	17.5	5.3
Natural Gas	0.0	0.0	0.0	0.0	0.0	0.0	9.2
Coal	0.2	0.2	0.2	0.1	0.0	0.0	-100.0
Electricity	0.1	0.1	0.1	0.1	0.2	0.2	4.7
Total	**5.0**	**7.9**	**10.1**	**12.5**	**15.0**	**17.7**	**5.2**
All End-Use Sectors							
Liquids	13.3	17.6	20.1	23.7	27.5	31.8	3.5
Natural Gas	1.5	2.6	3.5	4.2	4.9	5.5	5.3
Coal	24.7	28.2	32.3	35.7	39.3	42.8	2.2
Electricity	7.5	12.7	16.8	20.4	24.2	27.6	5.3
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	2.0
Delivered Energy	**47.0**	**61.1**	**72.6**	**84.0**	**95.8**	**107.7**	**3.4**
Electricity-Related Losses[a]	20.1	26.2	31.4	36.6	42.2	47.5	3.5
Total	**67.1**	**87.3**	**104.0**	**120.6**	**138.0**	**155.2**	**3.4**
Electric Power[b]							
Liquids	0.5	0.4	0.4	0.4	0.4	0.4	-1.1
Natural Gas	0.4	0.6	1.0	1.6	1.7	1.9	6.5
Coal	22.2	32.1	39.9	46.8	53.9	60.6	4.1
Nuclear	0.5	0.7	1.7	2.7	3.5	4.1	8.8
Renewables	4.0	5.1	5.2	5.5	6.8	8.0	2.9
Total	**27.6**	**38.9**	**48.2**	**57.0**	**66.4**	**75.0**	**4.1**
Total Energy Consumption							
Liquids	13.8	18.0	20.5	24.1	27.9	32.2	3.4
Natural Gas	1.9	3.2	4.5	5.8	6.6	7.4	5.5
Coal	46.9	60.3	72.1	82.5	93.2	103.4	3.2
Nuclear	0.5	0.7	1.7	2.7	3.5	4.1	8.8
Renewables	4.0	5.1	5.3	5.5	6.8	8.1	2.9
Total	**67.1**	**87.3**	**104.0**	**120.6**	**138.0**	**155.2**	**3.4**

[a]Electricity losses incurred in the transmission and distribution of electric power. May include some heat production.
[b]Fuel inputs used in the production of electricity and heat at central-station generators.
Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Table F14. Delivered Energy Consumption in India by End-Use Sector and Fuel, 2005-2030
(Quadrillion Btu)

Sector/Fuel	2005	Projections					Average Annual Percent Change, 2005-2030
		2010	2015	2020	2025	2030	
Residential							
Liquids	0.8	0.8	0.9	0.9	0.9	0.9	0.4
Natural Gas	0.0	0.0	0.1	0.1	0.1	0.1	3.9
Coal	0.1	0.1	0.2	0.2	0.2	0.2	2.4
Electricity	0.5	0.7	1.0	1.3	1.6	1.8	5.5
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**1.4**	**1.8**	**2.1**	**2.4**	**2.8**	**3.0**	**3.0**
Commercial							
Liquids	0.0	0.0	0.0	0.0	0.0	0.0	—
Natural Gas	0.0	0.0	0.0	0.0	0.0	0.1	—
Coal	0.1	0.2	0.3	0.3	0.3	0.3	3.0
Electricity	0.2	0.3	0.4	0.5	0.6	0.7	5.8
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**0.3**	**0.4**	**0.6**	**0.8**	**0.9**	**1.0**	**5.0**
Industrial							
Liquids	2.5	2.7	3.1	3.6	4.2	4.8	2.6
Natural Gas	0.8	1.1	1.4	1.5	1.7	1.8	3.6
Coal	2.4	2.6	2.8	3.1	3.5	3.9	2.1
Electricity	1.4	1.9	2.3	2.7	3.0	3.3	3.5
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	2.0
Total	**7.1**	**8.2**	**9.7**	**11.0**	**12.4**	**13.9**	**2.7**
Transportation							
Liquids	1.4	1.9	2.6	3.1	3.6	4.0	4.3
Natural Gas	0.0	0.0	0.1	0.1	0.1	0.1	4.0
Coal	0.0	0.0	0.0	0.0	0.0	0.0	—
Electricity	0.0	0.1	0.1	0.1	0.1	0.1	2.9
Total	**1.5**	**2.0**	**2.7**	**3.3**	**3.7**	**4.2**	**4.2**
All End-Use Sectors							
Liquids	4.8	5.4	6.6	7.7	8.6	9.7	2.9
Natural Gas	0.8	1.2	1.5	1.6	1.8	2.0	3.7
Coal	2.6	2.9	3.3	3.6	4.0	4.4	2.1
Electricity	2.1	2.9	3.8	4.5	5.2	5.9	4.2
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	2.0
Delivered Energy	**10.3**	**12.4**	**15.1**	**17.5**	**19.7**	**22.0**	**3.1**
Electricity-Related Losses[a]	5.9	7.0	8.1	9.1	10.2	11.2	2.6
Total	**16.2**	**19.4**	**23.2**	**26.6**	**29.9**	**33.2**	**2.9**
Electric Power[b]							
Liquids	0.2	0.2	0.2	0.2	0.2	0.2	-0.1
Natural Gas	0.5	0.7	1.0	1.4	1.8	2.0	5.7
Coal	6.0	7.0	8.3	9.3	10.1	11.1	2.5
Nuclear	0.2	0.5	0.8	1.3	1.6	1.8	9.4
Renewables	1.1	1.5	1.5	1.6	1.8	1.9	2.4
Total	**8.0**	**9.9**	**11.8**	**13.7**	**15.5**	**17.0**	**3.1**
Total Energy Consumption							
Liquids	5.0	5.6	6.8	7.9	8.9	9.9	2.8
Natural Gas	1.3	1.9	2.5	3.0	3.6	4.0	4.6
Coal	8.6	9.9	11.6	12.9	14.1	15.5	2.4
Nuclear	0.2	0.5	0.8	1.3	1.6	1.8	9.4
Renewables	1.1	1.5	1.5	1.6	1.8	1.9	2.4
Total	**16.2**	**19.4**	**23.2**	**26.6**	**29.9**	**33.2**	**2.9**

[a]Electricity losses incurred in the transmission and distribution of electric power. May include some heat production.
[b]Fuel inputs used in the production of electricity and heat at central-station generators.
Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Table F15. Delivered Energy Consumption in Other Non-OECD Asia by End-Use Sector and Fuel, 2005-2030
(Quadrillion Btu)

Sector/Fuel	2005	Projections					Average Annual Percent Change, 2005-2030
		2010	2015	2020	2025	2030	
Residential							
Liquids	0.7	0.7	0.8	0.8	0.8	0.9	1.1
Natural Gas	0.3	0.5	0.7	0.7	0.8	0.8	3.9
Coal	0.0	0.1	0.1	0.1	0.1	0.1	0.6
Electricity	0.8	0.9	1.4	1.6	1.8	2.0	3.7
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**1.8**	**2.2**	**2.9**	**3.2**	**3.4**	**3.8**	**2.9**
Commercial							
Liquids	0.2	0.2	0.2	0.3	0.3	0.3	1.6
Natural Gas	0.1	0.1	0.1	0.1	0.1	0.1	2.7
Coal	0.0	0.0	0.0	0.0	0.0	0.0	2.9
Electricity	0.7	0.9	1.1	1.4	1.6	1.9	4.2
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**0.9**	**1.2**	**1.5**	**1.8**	**2.0**	**2.3**	**3.7**
Industrial							
Liquids	4.4	4.5	5.6	6.0	6.3	6.5	1.6
Natural Gas	3.2	4.3	5.4	6.7	7.9	9.1	4.2
Coal	2.3	2.8	3.1	3.3	3.6	3.8	2.0
Electricity	1.3	1.6	2.0	2.4	2.7	3.1	3.4
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	0.7
Total	**11.3**	**13.2**	**16.1**	**18.5**	**20.5**	**22.5**	**2.8**
Transportation							
Liquids	6.4	7.5	9.1	10.4	11.7	13.1	2.9
Natural Gas	0.0	0.0	0.0	0.0	0.0	0.0	3.0
Coal	0.0	0.0	0.0	0.0	0.0	0.0	-100.0
Electricity	0.0	0.0	0.0	0.0	0.0	0.0	2.0
Total	**6.5**	**7.5**	**9.1**	**10.4**	**11.7**	**13.1**	**2.9**
All End-Use Sectors							
Liquids	11.8	12.9	15.7	17.4	19.1	20.8	2.3
Natural Gas	3.6	4.8	6.2	7.6	8.8	10.1	4.2
Coal	2.4	2.9	3.2	3.4	3.7	3.9	2.0
Electricity	2.8	3.4	4.5	5.3	6.1	6.9	3.7
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	0.7
Delivered Energy	20.6	24.1	29.6	33.8	37.7	41.7	2.9
Electricity-Related Losses[a]	6.0	6.4	7.4	8.4	9.6	10.7	2.3
Total	**26.6**	**30.5**	**37.0**	**42.2**	**47.3**	**52.4**	**2.7**
Electric Power[b]							
Liquids	1.0	0.9	0.9	0.8	0.8	0.7	-1.5
Natural Gas	2.9	3.4	4.5	5.9	6.7	7.4	3.8
Coal	2.9	3.2	3.8	3.8	4.5	5.4	2.5
Nuclear	0.4	0.5	0.6	0.7	0.9	0.8	3.0
Renewables	1.5	1.8	2.0	2.5	2.9	3.3	3.1
Total	**8.8**	**9.8**	**11.8**	**13.7**	**15.7**	**17.6**	**2.8**
Total Energy Consumption							
Liquids	12.8	13.8	16.6	18.3	19.8	21.5	2.1
Natural Gas	6.5	8.2	10.7	13.5	15.5	17.4	4.0
Coal	5.3	6.1	7.0	7.2	8.2	9.3	2.3
Nuclear	0.4	0.5	0.6	0.7	0.9	0.8	3.0
Renewables	1.6	1.8	2.0	2.5	2.9	3.3	3.1
Total	**26.6**	**30.5**	**37.0**	**42.2**	**47.3**	**52.4**	**2.7**

[a]Electricity losses incurred in the transmission and distribution of electric power. May include some heat production.
[b]Fuel inputs used in the production of electricity and heat at central-station generators.
Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Table F16. Delivered Energy Consumption in the Middle East by End-Use Sector and Fuel, 2005-2030
(Quadrillion Btu)

Sector/Fuel	2005	Projections					Average Annual Percent Change, 2005-2030
		2010	2015	2020	2025	2030	
Residential							
Liquids	0.9	0.9	1.0	1.0	1.0	1.1	0.8
Natural Gas	1.3	1.4	1.6	1.7	1.7	1.9	1.5
Coal	0.0	0.0	0.0	0.0	0.0	0.0	-1.9
Electricity	0.8	1.1	1.2	1.3	1.4	1.5	2.7
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**2.9**	**3.4**	**3.7**	**4.0**	**4.2**	**4.5**	**1.7**
Commercial							
Liquids	0.2	0.2	0.2	0.2	0.3	0.3	2.3
Natural Gas	0.2	0.2	0.2	0.3	0.3	0.3	2.8
Coal	0.0	0.0	0.0	0.0	0.0	0.0	—
Electricity	0.4	0.5	0.6	0.7	0.9	1.0	3.7
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**0.8**	**0.9**	**1.1**	**1.2**	**1.5**	**1.7**	**3.2**
Industrial							
Liquids	3.7	4.5	5.1	5.8	6.3	6.7	2.3
Natural Gas	5.0	5.9	7.1	8.3	8.7	9.1	2.4
Coal	0.1	0.1	0.1	0.1	0.1	0.1	2.4
Electricity	0.7	0.7	0.8	0.9	0.9	1.0	1.5
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	0.7
Total	**9.5**	**11.2**	**13.1**	**15.1**	**16.1**	**16.9**	**2.3**
Transportation							
Liquids	4.9	5.8	6.2	6.7	7.3	7.9	1.9
Natural Gas	0.0	0.0	0.0	0.0	0.0	0.0	1.6
Coal	0.0	0.0	0.0	0.0	0.0	0.0	—
Electricity	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**4.9**	**5.8**	**6.2**	**6.8**	**7.3**	**8.0**	**1.9**
All End-Use Sectors							
Liquids	9.7	11.4	12.5	13.8	14.9	16.0	2.0
Natural Gas	6.5	7.6	9.0	10.2	10.8	11.4	2.3
Coal	0.1	0.1	0.1	0.1	0.1	0.1	2.3
Electricity	1.9	2.3	2.7	2.9	3.2	3.6	2.6
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	0.4
Delivered Energy	**18.1**	**21.4**	**24.2**	**27.1**	**29.0**	**31.0**	**2.2**
Electricity-Related Losses[a]	4.7	5.0	5.3	5.5	5.7	5.8	0.8
Total	**22.9**	**26.4**	**29.5**	**32.6**	**34.7**	**36.8**	**1.9**
Electric Power[b]							
Liquids	2.3	2.6	2.8	3.1	3.3	3.5	1.6
Natural Gas	3.8	4.2	4.4	4.6	4.8	5.0	1.2
Coal	0.3	0.4	0.4	0.4	0.4	0.4	0.4
Nuclear	0.0	0.0	0.1	0.1	0.1	0.1	—
Renewables	0.2	0.2	0.3	0.3	0.3	0.4	2.5
Total	**6.6**	**7.4**	**8.0**	**8.4**	**8.9**	**9.4**	**1.4**
Total Energy Consumption							
Liquids	12.0	14.0	15.3	16.9	18.2	19.5	2.0
Natural Gas	10.2	11.7	13.4	14.9	15.7	16.4	1.9
Coal	0.4	0.5	0.5	0.5	0.5	0.5	0.7
Nuclear	0.0	0.0	0.1	0.1	0.1	0.1	—
Renewables	0.2	0.3	0.3	0.3	0.3	0.4	2.4
Total	**22.9**	**26.4**	**29.5**	**32.6**	**34.7**	**36.8**	**1.9**

[a]Electricity losses incurred in the transmission and distribution of electric power. May include some heat production.
[b]Fuel inputs used in the production of electricity and heat at central-station generators.
Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Table F17. Delivered Energy Consumption in Africa by End-Use Sector and Fuel, 2005-2030
(Quadrillion Btu)

Sector/Fuel	2005	Projections					Average Annual Percent Change, 2005-2030
		2010	2015	2020	2025	2030	
Residential							
Liquids	0.7	0.8	0.9	0.9	1.0	1.0	1.3
Natural Gas	0.2	0.3	0.4	0.4	0.5	0.5	3.8
Coal	0.1	0.2	0.2	0.2	0.3	0.3	2.6
Electricity	0.5	0.7	0.8	1.0	1.0	1.1	3.4
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**1.5**	**2.0**	**2.3**	**2.6**	**2.7**	**2.8**	**2.5**
Commercial							
Liquids	0.1	0.1	0.1	0.1	0.1	0.1	2.0
Natural Gas	0.0	0.0	0.0	0.0	0.0	0.0	3.9
Coal	0.1	0.1	0.1	0.1	0.1	0.1	2.3
Electricity	0.2	0.3	0.4	0.5	0.5	0.5	4.1
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**0.3**	**0.4**	**0.6**	**0.7**	**0.7**	**0.8**	**3.5**
Industrial							
Liquids	1.5	1.8	2.0	2.2	2.1	2.1	1.3
Natural Gas	1.4	1.7	2.3	2.6	2.9	3.3	3.5
Coal	1.2	1.3	1.5	1.5	1.6	1.6	1.0
Electricity	1.0	1.1	1.3	1.5	1.7	1.9	2.7
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**5.1**	**5.9**	**7.0**	**7.8**	**8.3**	**8.8**	**2.2**
Transportation							
Liquids	3.1	3.7	4.1	4.5	4.9	5.3	2.2
Natural Gas	0.0	0.0	0.0	0.0	0.0	0.0	1.9
Coal	0.0	0.0	0.0	0.0	0.0	0.0	-100.0
Electricity	0.0	0.0	0.0	0.0	0.0	0.0	1.8
Total	**3.1**	**3.7**	**4.1**	**4.5**	**4.9**	**5.3**	**2.2**
All End-Use Sectors							
Liquids	5.3	6.4	7.0	7.6	8.0	8.4	1.8
Natural Gas	1.6	2.1	2.7	3.1	3.4	3.8	3.5
Coal	1.4	1.6	1.8	1.9	1.9	2.0	1.2
Electricity	1.7	2.0	2.5	3.0	3.3	3.6	3.1
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Delivered Energy	**10.1**	**12.1**	**14.0**	**15.6**	**16.7**	**17.7**	**2.3**
Electricity-Related Losses[a]	4.4	4.5	4.9	5.4	5.8	6.1	1.4
Total	**14.4**	**16.5**	**18.9**	**20.9**	**22.5**	**23.9**	**2.0**
Electric Power[b]							
Liquids	0.7	0.6	0.5	0.5	0.5	0.4	-2.0
Natural Gas	1.6	1.8	2.1	2.9	3.3	3.7	3.5
Coal	2.8	2.9	3.3	3.5	3.6	3.6	1.1
Nuclear	0.1	0.1	0.2	0.2	0.2	0.2	2.2
Renewables	0.9	1.1	1.2	1.3	1.5	1.8	2.7
Total	**6.1**	**6.5**	**7.4**	**8.4**	**9.1**	**9.7**	**1.9**
Total Energy Consumption							
Liquids	6.0	7.0	7.5	8.1	8.5	8.8	1.6
Natural Gas	3.2	3.8	4.9	6.0	6.7	7.5	3.5
Coal	4.2	4.4	5.1	5.3	5.6	5.6	1.1
Nuclear	0.1	0.1	0.2	0.2	0.2	0.2	2.2
Renewables	0.9	1.1	1.2	1.3	1.5	1.8	2.7
Total	**14.4**	**16.5**	**18.9**	**20.9**	**22.5**	**23.9**	**2.0**

[a]Electricity losses incurred in the transmission and distribution of electric power. May include some heat production.
[b]Fuel inputs used in the production of electricity and heat at central-station generators.
Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Table F18. Delivered Energy Consumption in Brazil by End-Use Sector and Fuel, 2005-2030
(Quadrillion Btu)

Sector/Fuel	2005	Projections					Average Annual Percent Change, 2005-2030
		2010	2015	2020	2025	2030	
Residential							
Liquids	0.3	0.3	0.3	0.3	0.3	0.3	1.0
Natural Gas	0.0	0.0	0.0	0.0	0.0	0.1	8.0
Coal	0.0	0.0	0.0	0.0	0.0	0.0	—
Electricity	0.3	0.4	0.5	0.6	0.6	0.7	3.1
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**0.6**	**0.7**	**0.8**	**0.9**	**1.0**	**1.0**	**2.4**
Commercial							
Liquids	0.0	0.0	0.1	0.1	0.1	0.1	1.2
Natural Gas	0.0	0.0	0.0	0.0	0.0	0.0	5.1
Coal	0.0	0.0	0.0	0.0	0.0	0.0	—
Electricity	0.3	0.4	0.6	0.7	0.9	1.0	4.8
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**0.4**	**0.5**	**0.7**	**0.8**	**1.0**	**1.1**	**4.5**
Industrial							
Liquids	1.6	1.8	1.9	2.0	2.2	2.4	1.7
Natural Gas	0.4	0.4	0.5	0.5	0.6	0.7	2.3
Coal	0.4	0.7	0.8	0.9	0.9	1.0	3.9
Electricity	0.6	0.7	0.8	0.9	1.0	1.1	2.3
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	0.7
Total	**2.9**	**3.6**	**3.9**	**4.3**	**4.7**	**5.1**	**2.2**
Transportation							
Liquids	2.5	2.9	3.1	3.3	3.6	3.9	1.8
Natural Gas	0.1	0.1	0.1	0.1	0.1	0.1	3.0
Coal	0.0	0.0	0.0	0.0	0.0	0.0	—
Electricity	0.0	0.0	0.0	0.0	0.0	0.0	1.9
Total	**2.5**	**3.0**	**3.2**	**3.5**	**3.7**	**4.0**	**1.8**
All End-Use Sectors							
Liquids	4.4	5.0	5.3	5.7	6.1	6.6	1.7
Natural Gas	0.5	0.5	0.6	0.7	0.8	0.9	2.6
Coal	0.4	0.7	0.8	0.9	0.9	1.0	3.9
Electricity	1.2	1.6	1.9	2.2	2.5	2.8	3.2
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	0.7
Delivered Energy	**6.4**	**7.8**	**8.7**	**9.5**	**10.3**	**11.3**	**2.3**
Electricity-Related Losses[a]	2.8	3.3	4.0	4.6	5.2	5.7	3.0
Total	**9.3**	**11.1**	**12.6**	**14.1**	**15.5**	**17.0**	**2.4**
Electric Power[b]							
Liquids	0.1	0.1	0.1	0.1	0.1	0.1	-1.1
Natural Gas	0.2	0.5	0.7	0.7	0.9	1.0	6.4
Coal	0.1	0.1	0.2	0.2	0.2	0.2	4.5
Nuclear	0.1	0.2	0.2	0.2	0.2	0.2	3.3
Renewables	3.5	4.0	4.8	5.5	6.3	7.0	2.8
Total	**4.0**	**4.9**	**5.9**	**6.8**	**7.6**	**8.5**	**3.1**
Total Energy Consumption							
Liquids	4.4	5.1	5.4	5.8	6.2	6.7	1.7
Natural Gas	0.7	1.0	1.3	1.4	1.6	1.9	4.2
Coal	0.4	0.8	1.0	1.1	1.1	1.2	4.1
Nuclear	0.1	0.2	0.2	0.2	0.2	0.2	3.3
Renewables	3.5	4.0	4.8	5.5	6.3	7.0	2.8
Total	**9.3**	**11.1**	**12.6**	**14.1**	**15.5**	**17.0**	**2.4**

[a]Electricity losses incurred in the transmission and distribution of electric power. May include some heat production.
[b]Fuel inputs used in the production of electricity and heat at central-station generators.
Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Table F19. Delivered Energy Consumption in Other Central and South America by End-Use Sector and Fuel, 2005-2030
(Quadrillion Btu)

Sector/Fuel	2005	Projections					Average Annual Percent Change, 2005-2030
		2010	2015	2020	2025	2030	
Residential							
Liquids	0.4	0.4	0.5	0.5	0.5	0.5	1.0
Natural Gas	0.4	0.5	0.7	0.7	0.8	0.9	3.2
Coal	0.0	0.0	0.0	0.0	0.0	0.0	0.7
Electricity	0.5	0.6	0.7	0.8	0.9	0.9	2.3
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**1.3**	**1.6**	**1.9**	**2.1**	**2.2**	**2.3**	**2.3**
Commercial							
Liquids	0.1	0.1	0.1	0.1	0.1	0.1	1.7
Natural Gas	0.1	0.1	0.2	0.2	0.2	0.2	2.4
Coal	0.0	0.0	0.0	0.0	0.0	0.0	—
Electricity	0.3	0.5	0.6	0.6	0.7	0.7	2.9
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**0.5**	**0.7**	**0.8**	**0.9**	**1.0**	**1.0**	**2.6**
Industrial							
Liquids	2.2	2.6	2.6	2.7	2.8	2.8	1.0
Natural Gas	2.4	2.8	3.1	3.3	3.5	3.6	1.7
Coal	0.1	0.1	0.1	0.1	0.1	0.1	1.4
Electricity	0.7	0.8	0.9	0.9	0.9	1.0	1.2
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	0.7
Total	**5.4**	**6.3**	**6.7**	**7.0**	**7.3**	**7.5**	**1.3**
Transportation							
Liquids	3.2	3.9	4.3	4.6	5.0	5.5	2.2
Natural Gas	0.2	0.2	0.3	0.3	0.3	0.4	2.9
Coal	0.0	0.0	0.0	0.0	0.0	0.0	—
Electricity	0.0	0.0	0.0	0.0	0.0	0.0	3.2
Total	**3.4**	**4.2**	**4.5**	**4.9**	**5.3**	**5.8**	**2.2**
All End-Use Sectors							
Liquids	5.9	7.1	7.4	7.9	8.4	8.9	1.7
Natural Gas	3.1	3.6	4.2	4.6	4.9	5.1	2.0
Coal	0.1	0.1	0.1	0.1	0.1	0.1	1.4
Electricity	1.6	2.0	2.2	2.4	2.5	2.6	2.0
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	0.6
Delivered Energy	**10.7**	**12.8**	**13.9**	**14.9**	**15.8**	**16.7**	**1.8**
Electricity-Related Losses[a]	3.5	3.8	4.0	4.2	4.4	4.6	1.0
Total	**14.1**	**16.6**	**17.9**	**19.1**	**20.3**	**21.3**	**1.7**
Electric Power[b]							
Liquids	0.9	0.8	0.7	0.6	0.5	0.4	-3.3
Natural Gas	0.9	1.3	1.6	1.9	2.1	2.3	3.7
Coal	0.4	0.5	0.6	0.6	0.6	0.6	1.8
Nuclear	0.1	0.1	0.1	0.1	0.1	0.1	2.4
Renewables	2.9	3.1	3.1	3.4	3.6	3.8	1.1
Total	**5.2**	**5.8**	**6.1**	**6.6**	**6.9**	**7.2**	**1.4**
Total Energy Consumption							
Liquids	6.8	7.9	8.1	8.5	8.9	9.3	1.3
Natural Gas	4.0	5.0	5.8	6.4	7.0	7.4	2.4
Coal	0.4	0.5	0.7	0.7	0.7	0.7	1.8
Nuclear	0.1	0.1	0.1	0.1	0.1	0.1	2.4
Renewables	2.9	3.1	3.2	3.4	3.6	3.8	1.1
Total	**14.1**	**16.6**	**17.9**	**19.1**	**20.3**	**21.3**	**1.7**

[a]Electricity losses incurred in the transmission and distribution of electric power. May include some heat production.
[b]Fuel inputs used in the production of electricity and heat at central-station generators.
Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

Appendix G

Projections of Liquid Fuels and Other Petroleum Production in Five Cases:

- Reference
- High Price
- Low Price
- High Economic Growth
- Low Economic Growth

Table G1. World Total Liquids Production by Region and Country, Reference Case, 1990-2030
(Million Barrels Oil Equivalent per Day)

Region/Country	History (Estimates)			Projections					Average Annual Percent Change, 2005-2030
	1990	2005	2006	2010	2015	2020	2025	2030	
OPEC[a]	**25.2**	**36.1**	**35.8**	**37.4**	**40.9**	**44.4**	**46.7**	**49.3**	**1.3**
Asia (Indonesia)	**1.5**	**1.1**	**1.1**	**0.9**	**0.9**	**0.9**	**1.0**	**1.0**	**-0.7**
Middle East	**16.1**	**23.8**	**23.6**	**23.7**	**26.2**	**28.8**	**30.2**	**31.8**	**1.2**
Iran	3.1	4.2	4.1	4.1	4.0	4.0	4.2	4.5	0.2
Iraq	2.1	1.9	2.0	2.0	2.2	3.4	3.8	4.0	3.1
Kuwait	1.2	2.7	2.7	2.6	2.9	3.0	3.1	3.3	0.9
Qatar	0.4	1.1	1.1	1.6	2.2	2.7	2.9	3.2	4.3
Saudi Arabia	7.0	11.1	10.7	10.5	11.9	12.6	13.1	13.7	0.8
United Arab Emirates	2.3	2.8	2.9	2.9	2.9	3.0	3.1	3.1	0.3
North Africa	**2.7**	**3.8**	**3.9**	**4.7**	**5.0**	**5.1**	**5.4**	**5.8**	**1.7**
Algeria	1.3	2.1	2.1	2.7	3.1	3.4	3.6	4.0	2.6
Libya	1.4	1.7	1.8	2.0	1.8	1.8	1.7	1.7	0.1
West Africa	**2.3**	**3.9**	**3.9**	**5.1**	**5.7**	**5.9**	**6.2**	**6.7**	**2.2**
Angola	0.5	1.3	1.4	2.5	2.7	2.8	2.9	3.1	3.7
Nigeria	1.8	2.6	2.4	2.6	3.1	3.1	3.3	3.5	1.2
South America	**2.5**	**3.4**	**3.3**	**3.0**	**3.1**	**3.6**	**3.9**	**4.1**	**0.8**
Ecuador	0.3	0.5	0.5	0.4	0.5	0.5	0.5	0.6	0.5
Venezuela	2.3	2.9	2.8	2.5	2.6	3.1	3.4	3.5	0.9
Non-OPEC	**41.1**	**48.2**	**48.4**	**51.8**	**54.7**	**57.0**	**59.8**	**63.2**	**1.1**
OECD	**20.0**	**21.8**	**21.4**	**21.5**	**21.7**	**21.5**	**22.0**	**22.3**	**0.1**
OECD North America	**14.7**	**15.1**	**15.2**	**16.2**	**17.0**	**17.2**	**17.7**	**18.0**	**0.7**
United States	9.7	8.2	8.2	9.4	9.9	10.2	10.2	9.8	0.7
Canada	2.0	3.1	3.3	3.8	4.4	4.6	5.0	5.3	2.2
Mexico	3.0	3.8	3.7	3.0	2.7	2.4	2.6	2.8	-1.1
OECD Europe	**4.5**	**5.9**	**5.5**	**4.5**	**3.9**	**3.5**	**3.4**	**3.4**	**-2.1**
OECD Asia	**0.8**	**0.7**	**0.7**	**0.8**	**0.8**	**0.8**	**0.9**	**0.9**	**0.8**
Japan	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	1.4
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	5.8
Australia and New Zealand	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.4
Non-OECD	**21.1**	**26.5**	**27.0**	**30.3**	**33.1**	**35.5**	**37.8**	**40.9**	**1.8**
Non-OECD Europe and Eurasia	**11.6**	**11.9**	**12.3**	**14.0**	**15.9**	**16.8**	**17.5**	**18.9**	**1.8**
Russia	10.1	9.5	9.7	10.2	11.4	12.1	12.6	13.5	1.4
Caspian Area	1.1	2.1	2.3	3.5	4.2	4.5	4.7	5.1	3.6
Other	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.3	-0.9
Non-OECD Asia	**4.4**	**6.5**	**6.5**	**6.9**	**7.1**	**7.4**	**7.6**	**7.7**	**0.7**
China	2.8	3.7	3.8	3.8	3.9	4.0	4.0	4.1	0.4
India	0.7	0.8	0.8	1.1	1.1	1.2	1.4	1.3	1.8
Other	1.0	1.9	1.9	2.0	2.1	2.2	2.2	2.3	0.7
Middle East (Non-OPEC)	**1.3**	**1.7**	**1.6**	**1.5**	**1.5**	**1.5**	**1.6**	**1.6**	**-0.2**
Africa	**1.7**	**2.6**	**2.6**	**3.0**	**3.3**	**3.7**	**4.1**	**4.5**	**2.3**
Central and South America	**2.1**	**3.8**	**3.9**	**4.9**	**5.2**	**6.0**	**7.0**	**8.2**	**3.1**
Brazil	0.8	1.9	2.1	3.2	3.6	4.3	5.0	5.7	4.4
Other	1.3	1.8	1.9	1.7	1.6	1.7	2.0	2.5	1.2
Total World	**66.3**	**84.3**	**84.2**	**89.2**	**95.7**	**101.3**	**106.5**	**112.5**	**1.2**
OPEC Share of World Production	38%	43%	43%	42%	43%	44%	44%	44%	
Persian Gulf Share of World Production	24%	28%	28%	27%	27%	28%	28%	28%	

[a]OPEC = Organization of the Petroleum Exporting Countries (OPEC-13).

Sources: **History:** Energy Information Administration (EIA), Office of Energy Markets and End Use. **Projections:** EIA, Generate World Oil Balance Model (2008).

Table G2. World Conventional Liquids Production by Region and Country, Reference Case, 1990-2030
(Million Barrels Oil Equivalent per Day)

Region/Country	History (Estimates)			Projections					Average Annual Percent Change, 2005-2030
	1990	2005	2006	2010	2015	2020	2025	2030	
OPEC[a]	**25.2**	**35.3**	**35.1**	**36.5**	**39.8**	**43.0**	**45.3**	**47.7**	**1.2**
Asia (Indonesia)	**1.5**	**1.1**	**1.1**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**-0.9**
Middle East	**16.1**	**23.8**	**23.5**	**23.7**	**26.0**	**28.6**	**30.0**	**31.5**	**1.1**
Iran	3.1	4.2	4.1	4.1	4.0	4.0	4.2	4.5	0.2
Iraq	2.1	1.9	2.0	2.0	2.2	3.4	3.8	4.0	3.1
Kuwait	1.2	2.7	2.7	2.6	2.9	3.0	3.1	3.3	0.9
Qatar	0.4	1.1	1.1	1.6	2.0	2.5	2.7	3.0	4.0
Saudi Arabia	7.0	11.0	10.6	10.5	11.9	12.6	13.1	13.7	0.9
United Arab Emirates	2.3	2.8	2.9	2.9	2.9	3.0	3.1	3.1	0.3
North Africa	**2.7**	**3.8**	**3.9**	**4.7**	**5.0**	**5.1**	**5.4**	**5.8**	**1.7**
Algeria	1.3	2.1	2.1	2.7	3.1	3.4	3.6	4.0	2.6
Libya	1.4	1.7	1.8	2.0	1.8	1.8	1.7	1.7	0.1
West Africa	**2.3**	**3.9**	**3.9**	**5.1**	**5.7**	**5.9**	**6.2**	**6.7**	**2.2**
Angola	0.5	1.3	1.4	2.5	2.7	2.8	2.9	3.1	3.7
Nigeria	1.8	2.6	2.4	2.6	3.0	3.1	3.3	3.5	1.2
South America	**2.5**	**2.7**	**2.7**	**2.1**	**2.2**	**2.5**	**2.8**	**2.9**	**0.2**
Ecuador	0.3	0.5	0.5	0.4	0.5	0.5	0.5	0.6	0.5
Venezuela	2.3	2.2	2.1	1.7	1.7	2.0	2.2	2.3	0.1
Non-OPEC	**40.5**	**46.5**	**46.5**	**48.2**	**49.6**	**50.9**	**52.5**	**55.1**	**0.7**
OECD	**19.5**	**20.3**	**19.8**	**18.8**	**17.7**	**16.8**	**16.4**	**16.2**	**-0.9**
OECD North America	**14.3**	**13.7**	**13.6**	**13.6**	**13.2**	**12.6**	**12.3**	**12.1**	**-0.5**
United States	9.6	7.9	7.8	8.7	8.9	8.9	8.6	8.2	0.1
Canada	1.7	2.0	2.1	1.9	1.6	1.3	1.2	1.1	-2.3
Mexico	3.0	3.8	3.7	3.0	2.7	2.4	2.5	2.8	-1.2
OECD Europe	**4.5**	**5.9**	**5.5**	**4.5**	**3.8**	**3.4**	**3.3**	**3.3**	**-2.3**
Denmark	0.1	0.4	0.3	0.3	0.2	0.2	0.1	0.1	-5.1
Norway	1.7	3.0	2.8	2.4	2.0	1.7	1.7	1.6	-2.4
United Kngdom	2.0	1.9	1.7	1.2	1.0	0.8	0.8	0.8	-3.1
Other	0.7	0.7	0.7	0.6	0.7	0.7	0.7	0.8	0.5
OECD Asia	**0.8**	**0.7**	**0.7**	**0.7**	**0.8**	**0.8**	**0.8**	**0.9**	**0.6**
Japan	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	1.4
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9
Australia and New Zealand	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.4

[a]OPEC = Organization of the Petroleum Exporting Countries (OPEC-13).

Table G2. World Conventional Liquids Production by Region and Country, Reference Case, 1990-2030 (Continued)
(Million Barrels Oil Equivalent per Day)

Region/Country	History (Estimates)			Projections					Average Annual Percent Change, 2005-2030
	1990	2005	2006	2010	2015	2020	2025	2030	
Non-OECD	**21.0**	**26.2**	**26.7**	**29.4**	**31.9**	**34.1**	**36.1**	**38.9**	**1.6**
Non-OECD Europe and Eurasia	**11.6**	**11.9**	**12.3**	**14.0**	**15.9**	**16.8**	**17.5**	**18.9**	**1.8**
Russia	**10.1**	**9.5**	**9.7**	**10.2**	**11.4**	**12.1**	**12.6**	**13.5**	**1.4**
Caspian Area	**1.1**	**2.1**	**2.3**	**3.5**	**4.2**	**4.5**	**4.7**	**5.1**	**3.6**
Azerbaijan	0.3	0.4	0.6	1.3	1.3	1.2	1.1	1.0	3.5
Kazakhstan	0.6	1.3	1.4	1.9	2.6	2.9	3.1	3.6	4.0
Turkmenistan	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.4	2.5
Uzbekistan	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-1.2
Other	**0.4**	**0.3**	**0.3**	**0.3**	**0.2**	**0.2**	**0.2**	**0.3**	**-1.0**
Non-OECD Asia	**4.4**	**6.5**	**6.6**	**6.6**	**6.8**	**7.1**	**7.1**	**7.0**	**0.3**
China	2.8	3.8	3.8	3.7	3.7	3.8	3.7	3.8	0.0
India	0.7	0.8	0.9	1.0	1.0	1.1	1.2	1.1	1.1
Brunei	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.2	0.6
Malaysia	0.6	0.7	0.7	0.6	0.6	0.7	0.7	0.7	0.0
Thailand	0.1	0.3	0.3	0.4	0.4	0.4	0.4	0.4	1.4
Vietnam	0.1	0.4	0.4	0.5	0.5	0.5	0.5	0.5	1.1
Other	0.1	0.3	0.3	0.3	0.3	0.3	0.2	0.2	-0.5
Middle East (Non-OPEC)	**1.3**	**1.7**	**1.6**	**1.5**	**1.5**	**1.5**	**1.6**	**1.6**	**-0.2**
Oman	0.7	0.8	0.7	0.7	0.8	0.8	0.8	0.9	0.4
Syria	0.4	0.5	0.4	0.4	0.4	0.4	0.3	0.3	-1.5
Yemen	0.2	0.4	0.4	0.3	0.3	0.3	0.4	0.4	-0.1
Other	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.0
Africa	**1.6**	**2.4**	**2.4**	**2.8**	**2.9**	**3.3**	**3.6**	**4.0**	**2.0**
Chad	0.0	0.2	0.2	0.2	0.2	0.2	0.3	0.4	2.8
Congo (Brazzaville)	0.2	0.2	0.2	0.2	0.3	0.4	0.5	0.6	3.7
Egypt	0.9	0.7	0.7	0.6	0.6	0.7	0.8	0.8	0.4
Equatorial Guniea	0.0	0.4	0.4	0.5	0.4	0.4	0.5	0.4	0.5
Gabon	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.3	0.0
Sao Tome and Principe	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	—
Sudan	0.0	0.4	0.4	0.7	0.7	0.7	0.8	0.9	4.0
Other	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.6	2.7
Central and South America	**2.0**	**3.6**	**3.7**	**4.6**	**4.8**	**5.4**	**6.3**	**7.3**	**2.9**
Brazil	0.7	1.8	1.9	2.9	3.2	3.7	4.3	5.0	4.2
Argentina	0.5	0.8	0.8	0.7	0.5	0.4	0.4	0.4	-2.7
Colombia	0.5	0.5	0.5	0.4	0.4	0.3	0.3	0.3	-2.4
Peru	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.4	4.8
Trinidad and Tobago	0.1	0.2	0.2	0.2	0.2	0.2	0.1	0.2	-0.7
Other	0.1	0.2	0.2	0.2	0.4	0.5	0.8	1.2	7.1
Total World	**65.7**	**81.9**	**81.6**	**84.8**	**89.4**	**93.9**	**97.8**	**102.9**	**0.9**
OPEC Share of World Production	38%	43%	43%	43%	44%	46%	46%	46%	
Persian Gulf Share of World Production	25%	29%	29%	28%	29%	30%	31%	31%	

Note: Conventional liquids include crude oil and lease condensate, natural gas plant liquids, and refinery gain.
Sources: **History:** Energy Information Administration (EIA), Office of Energy Markets and End Use. **Projections:** EIA, Generate World Oil Balance Model (2008).

Table G3. World Unconventional Liquids Production by Region and Country, Reference Case, 1990-2030
(Million Barrels Oil Equivalent per Day)

Region/Country	History (Estimates)			Projections					Average Annual Percent Change, 2005-2030
	1990	2005	2006	2010	2015	2020	2025	2030	
OPEC[a]	**0.0**	**0.8**	**0.7**	**0.9**	**1.2**	**1.3**	**1.5**	**1.6**	**3.1**
Biofuels	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Extra-Heavy Oil (Venezuela)	0.0	0.6	0.6	0.9	0.9	1.0	1.1	1.3	3.0
Coal-to-Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Gas-to-Liquids (primarily Qatar)	0.0	0.0	0.0	0.0	0.2	0.2	0.3	0.3	—
Non-OPEC	**0.6**	**1.7**	**1.9**	**3.6**	**5.1**	**6.1**	**7.3**	**8.1**	**6.4**
OECD	**0.5**	**1.5**	**1.6**	**2.7**	**3.9**	**4.7**	**5.5**	**6.1**	**5.9**
Biofuels	0.0	0.2	0.3	0.6	0.8	1.0	1.3	1.4	7.7
Oil Sands/Bitumen (Canada)	0.4	1.1	1.2	1.9	2.8	3.3	3.8	4.2	5.5
Extra-Heavy Oil (Mexico)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	—
Coal-to-Liquids	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.3	25.0
Gas-to-Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Shale Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Non-OECD	**0.1**	**0.2**	**0.3**	**0.9**	**1.2**	**1.4**	**1.7**	**2.0**	**8.7**
Biofuels	0.1	0.3	0.4	0.6	0.8	1.0	1.1	1.3	5.7
Extra-Heavy Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Coal-to-Liquids	0.1	0.1	0.1	0.2	0.2	0.3	0.5	0.7	6.7
Gas-to-Liquids	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	—
Shale Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7
World									
Biofuels	0.2	0.5	0.6	1.3	1.7	2.1	2.5	2.7	6.7
Oil Sands/Bitumen	0.4	1.1	1.2	1.9	2.8	3.3	3.8	4.2	5.5
Extra-Heavy Oil	0.0	0.6	0.6	0.9	1.0	1.1	1.2	1.3	3.2
Coal-to-Liquids	0.1	0.1	0.1	0.2	0.3	0.5	0.7	1.0	8.2
Gas-to-Liquids	0.0	0.0	0.0	0.1	0.2	0.3	0.3	0.3	—
Shale Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7
World Total	**0.6**	**2.5**	**2.6**	**4.5**	**6.2**	**7.4**	**8.7**	**9.7**	**5.6**
Selected Country Highlights									
Biofuels									
Brazil	0.1	0.2	0.2	0.3	0.4	0.5	0.6	0.7	5.4
China	0.0	0.1	0.1	0.2	0.2	0.2	0.1	0.1	2.6
India	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	3.6
United States	0.0	0.2	0.2	0.5	0.7	0.9	1.2	1.2	8.1
Coal-to-Liquids									
Australia and New Zealand	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
China	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	—
Germany	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
India	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	—
South Africa	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.3	3.9
United States	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.2	—
Gas-to-Liquids									
Qatar	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.2	—
South Africa	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	—

[a]OPEC = Organization of the Petroleum Exporting Countries (OPEC-13).

Sources: **History:** Energy Information Administration (EIA), Office of Energy Markets and End Use. **Projections:** EIA, Generate World Oil Balance Model (2008).

Table G4. World Total Liquids Production by Region and Country, High Price Case, 1990-2030
(Million Barrels Oil Equivalent per Day)

Region/Country	History (Estimates)			Projections					Average Annual Percent Change, 2005-2030
	1990	2005	2006	2010	2015	2020	2025	2030	
OPEC[a]	**25.2**	**36.1**	**35.8**	**37.3**	**35.4**	**35.0**	**34.9**	**35.5**	**-0.1**
Asia (Indonesia)	**1.5**	**1.1**	**1.1**	**0.9**	**0.8**	**0.7**	**0.7**	**0.7**	**-1.8**
Middle East	**16.1**	**23.8**	**23.6**	**23.7**	**22.4**	**22.3**	**22.0**	**22.1**	**-0.3**
Iran	3.1	4.2	4.1	4.1	3.4	3.0	2.9	2.9	-1.5
Iraq	2.1	1.9	2.0	2.0	1.8	2.5	2.6	2.6	1.3
Kuwait	1.2	2.7	2.7	2.6	2.5	2.3	2.2	2.2	-0.7
Qatar	0.4	1.1	1.1	1.6	2.0	2.4	2.6	2.8	3.7
Saudi Arabia	7.0	11.1	10.7	10.5	10.2	9.7	9.4	9.4	-0.7
United Arab Emirates	2.3	2.8	2.9	2.9	2.5	2.4	2.3	2.2	-1.0
North Africa	**2.7**	**3.8**	**3.9**	**4.7**	**4.3**	**4.0**	**3.9**	**4.1**	**0.2**
Algeria	1.3	2.1	2.1	2.7	2.7	2.6	2.7	2.8	1.2
Libya	1.4	1.7	1.8	2.0	1.6	1.3	1.2	1.2	-1.4
West Africa	**2.3**	**3.9**	**3.9**	**5.0**	**4.8**	**4.5**	**4.4**	**4.5**	**0.5**
Angola	0.5	1.3	1.4	2.4	2.2	2.1	2.0	2.0	1.9
Nigeria	1.8	2.6	2.4	2.6	2.6	2.4	2.4	2.4	-0.3
South America	**2.5**	**3.4**	**3.3**	**3.0**	**3.0**	**3.5**	**3.9**	**4.1**	**0.8**
Ecuador	0.3	0.5	0.5	0.4	0.4	0.4	0.4	0.4	-1.3
Venezuela	2.3	2.9	2.8	2.5	2.6	3.1	3.5	3.8	1.1
Non-OPEC	**41.1**	**48.2**	**48.4**	**51.4**	**54.3**	**56.7**	**60.3**	**63.7**	**1.1**
OECD	**20.0**	**21.8**	**21.4**	**21.5**	**22.4**	**23.8**	**25.7**	**27.6**	**1.0**
OECD North America	**14.7**	**15.1**	**15.2**	**16.2**	**17.9**	**19.9**	**21.8**	**23.8**	**1.8**
United States	9.7	8.2	8.2	9.2	9.7	10.3	10.9	11.5	1.3
Canada	2.0	3.1	3.3	3.9	5.6	7.3	8.6	9.8	4.7
Mexico	3.0	3.8	3.7	3.1	2.6	2.3	2.4	2.5	-1.6
OECD Europe	**4.5**	**5.9**	**5.5**	**4.5**	**3.8**	**3.2**	**3.1**	**3.0**	**-2.7**
OECD Asia	**0.8**	**0.7**	**0.7**	**0.8**	**0.8**	**0.8**	**0.8**	**0.8**	**0.4**
Japan	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.5
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	8.4
Australia and New Zealand	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6	-0.1
Non-OECD	**21.1**	**26.5**	**26.9**	**29.9**	**31.9**	**32.9**	**34.7**	**36.1**	**1.3**
Non-OECD Europe and Eurasia	**11.6**	**11.9**	**12.3**	**14.2**	**15.1**	**14.9**	**15.2**	**15.5**	**1.0**
Russia	10.1	9.5	9.7	10.4	10.8	10.7	10.9	11.0	0.6
Caspian Area	1.1	2.1	2.3	3.5	4.0	4.0	4.1	4.2	2.8
Other	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.2	-1.4
Non-OECD Asia	**4.4**	**6.5**	**6.5**	**6.4**	**6.9**	**7.0**	**7.2**	**7.2**	**0.4**
China	2.8	3.7	3.8	3.6	3.8	3.7	3.8	3.8	0.1
India	0.7	0.8	0.8	1.0	1.1	1.2	1.4	1.3	2.0
Other	1.0	1.9	1.9	1.9	2.0	2.0	2.0	2.1	0.3
Middle East (Non-OPEC)	**1.3**	**1.7**	**1.6**	**1.5**	**1.5**	**1.4**	**1.4**	**1.4**	**-0.9**
Africa	**1.7**	**2.6**	**2.6**	**2.9**	**3.3**	**3.7**	**4.0**	**4.3**	**2.1**
Central and South America	**2.1**	**3.8**	**3.9**	**5.0**	**5.2**	**5.9**	**6.9**	**7.8**	**2.9**
Brazil	0.8	1.9	2.1	3.2	3.6	4.3	5.0	5.5	4.2
Other	1.3	1.8	1.9	1.7	1.6	1.6	1.9	2.3	0.8
Total World	**66.3**	**84.3**	**84.2**	**88.7**	**89.7**	**91.7**	**95.2**	**99.3**	**0.7**
OPEC Share of World Production	38%	43%	43%	42%	39%	38%	37%	36%	
Persian Gulf Share of World Production	24%	28%	28%	27%	25%	24%	23%	22%	

[a]OPEC = Organization of the Petroleum Exporting Countries (OPEC-13).

Sources: **History:** Energy Information Administration (EIA), Office of Energy Markets and End Use. **Projections:** EIA, Generate World Oil Balance Model (2008).

Table G5. World Conventional Liquids Production by Region and Country, High Price Case, 1990-2030
(Million Barrels Oil Equivalent per Day)

Region/Country	History (Estimates)			Projections					Average Annual Percent Change, 2005-2030
	1990	2005	2006	2010	2015	2020	2025	2030	
OPEC[a]	**25.2**	**35.3**	**35.1**	**36.3**	**34.0**	**33.0**	**32.5**	**32.8**	**-0.3**
Asia (Indonesia)	**1.5**	**1.1**	**1.1**	**0.9**	**0.8**	**0.7**	**0.7**	**0.6**	**-2.3**
Middle East	**16.1**	**23.8**	**23.5**	**23.6**	**22.3**	**22.0**	**21.6**	**21.7**	**-0.4**
Iran	3.1	4.2	4.1	4.1	3.4	3.0	2.9	2.9	-1.5
Iraq	2.1	1.9	2.0	2.0	1.8	2.5	2.6	2.6	1.3
Kuwait	1.2	2.7	2.7	2.6	2.5	2.3	2.2	2.2	-0.7
Qatar	0.4	1.1	1.1	1.6	1.8	2.1	2.2	2.4	3.1
Saudi Arabia	7.0	11.0	10.6	10.4	10.2	9.7	9.4	9.4	-0.6
United Arab Emirates	2.3	2.8	2.9	2.9	2.5	2.4	2.3	2.2	-1.0
North Africa	**2.7**	**3.8**	**3.9**	**4.7**	**4.3**	**4.0**	**3.9**	**4.1**	**0.2**
Algeria	1.3	2.1	2.1	2.7	2.7	2.6	2.7	2.8	1.2
Libya	1.4	1.7	1.8	2.0	1.6	1.3	1.2	1.2	-1.4
West Africa	**2.3**	**3.9**	**3.9**	**5.0**	**4.8**	**4.4**	**4.3**	**4.4**	**0.5**
Angola	0.5	1.3	1.4	2.4	2.2	2.1	2.0	2.0	1.9
Nigeria	1.8	2.6	2.4	2.6	2.6	2.4	2.3	2.4	-0.4
South America	**2.5**	**2.7**	**2.7**	**2.1**	**1.9**	**1.9**	**2.0**	**2.0**	**-1.3**
Ecuador	0.3	0.5	0.5	0.4	0.4	0.4	0.4	0.4	-1.3
Venezuela	2.3	2.2	2.1	1.7	1.5	1.6	1.6	1.6	-1.2
Non-OPEC	**40.5**	**46.5**	**46.5**	**48.5**	**47.3**	**46.3**	**47.1**	**47.5**	**0.1**
OECD	**19.5**	**20.3**	**19.8**	**18.7**	**17.0**	**16.0**	**15.9**	**15.6**	**-1.1**
OECD North America	**14.3**	**13.7**	**13.6**	**13.5**	**12.7**	**12.3**	**12.3**	**12.1**	**-0.5**
United States	9.6	7.9	7.8	8.5	8.6	8.9	8.9	8.6	0.4
Canada	1.7	2.0	2.1	1.9	1.5	1.2	1.1	1.0	-2.7
Mexico	3.0	3.8	3.7	3.1	2.6	2.2	2.3	2.4	-1.8
OECD Europe	**4.5**	**5.9**	**5.5**	**4.5**	**3.6**	**3.0**	**2.9**	**2.8**	**-3.0**
Denmark	0.1	0.4	0.3	0.3	0.2	0.1	0.1	0.1	-5.9
Norway	1.7	3.0	2.8	2.4	1.9	1.6	1.5	1.4	-3.0
United Kngdom	2.0	1.9	1.7	1.2	1.0	0.7	0.7	0.7	-3.8
Other	0.7	0.7	0.7	0.6	0.6	0.6	0.6	0.6	-0.5
OECD Asia	**0.8**	**0.7**	**0.7**	**0.8**	**0.7**	**0.7**	**0.7**	**0.7**	**0.0**
Japan	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.5
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8
Australia and New Zealand	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6	-0.1

[a]OPEC = Organization of the Petroleum Exporting Countries (OPEC-13).

Table G5. World Conventional Liquids Production by Region and Country, High Price Case, 1990-2030 (Continued)
(Million Barrels Oil Equivalent per Day)

Region/Country	History (Estimates)			Projections					Average Annual Percent Change, 2005-2030
	1990	2005	2006	2010	2015	2020	2025	2030	
Non-OECD	**21.0**	**26.2**	**26.7**	**29.8**	**30.2**	**30.3**	**31.2**	**31.9**	**0.8**
Non-OECD Europe and Eurasia	**11.6**	**11.9**	**12.3**	**14.2**	**15.0**	**14.9**	**15.2**	**15.5**	**1.0**
Russia	**10.1**	**9.5**	**9.7**	**10.4**	**10.8**	**10.7**	**10.9**	**11.0**	**0.6**
Caspian Area	**1.1**	**2.1**	**2.3**	**3.5**	**4.0**	**4.0**	**4.1**	**4.2**	**2.8**
Azerbaijan	0.3	0.4	0.6	1.3	1.2	1.1	0.9	0.8	2.6
Kazakhstan	0.6	1.3	1.4	1.9	2.5	2.6	2.7	3.0	3.2
Turkmenistan	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.3	1.7
Uzbekistan	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-1.7
Other	**0.4**	**0.3**	**0.3**	**0.3**	**0.2**	**0.2**	**0.2**	**0.2**	**-1.7**
Non-OECD Asia	**4.4**	**6.5**	**6.6**	**6.7**	**6.5**	**6.3**	**6.2**	**5.8**	**-0.5**
China	2.8	3.8	3.8	3.7	3.5	3.3	3.2	3.0	-0.9
India	0.7	0.8	0.9	1.0	1.0	1.0	1.1	0.9	0.5
Brunei	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	-0.2
Malaysia	0.6	0.7	0.7	0.6	0.6	0.7	0.6	0.6	-0.6
Thailand	0.1	0.3	0.3	0.4	0.4	0.4	0.4	0.4	1.0
Vietnam	0.1	0.4	0.4	0.5	0.5	0.5	0.5	0.4	0.5
Other	0.1	0.3	0.3	0.3	0.3	0.2	0.2	0.2	-1.4
Middle East (Non-OPEC)	**1.3**	**1.7**	**1.6**	**1.5**	**1.5**	**1.4**	**1.4**	**1.4**	**-0.9**
Oman	0.7	0.8	0.7	0.7	0.8	0.7	0.7	0.7	-0.4
Syria	0.4	0.5	0.4	0.4	0.4	0.3	0.3	0.3	-2.0
Yemen	0.2	0.4	0.4	0.3	0.3	0.3	0.3	0.3	-0.9
Other	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	-0.7
Africa	**1.6**	**2.4**	**2.4**	**2.8**	**2.8**	**2.9**	**3.1**	**3.3**	**1.2**
Chad	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.3	1.9
Congo (Brazzaville)	0.2	0.2	0.2	0.2	0.3	0.4	0.4	0.5	2.8
Egypt	0.9	0.7	0.7	0.6	0.6	0.7	0.7	0.6	-0.3
Equatorial Guniea	0.0	0.4	0.4	0.5	0.4	0.4	0.4	0.4	-0.2
Gabon	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	-0.9
Sao Tome and Principe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	—
Sudan	0.0	0.4	0.4	0.7	0.6	0.6	0.7	0.7	3.0
Other	0.3	0.3	0.4	0.4	0.4	0.4	0.5	0.5	1.8
Central and South America	**2.0**	**3.6**	**3.7**	**4.7**	**4.5**	**4.8**	**5.4**	**6.0**	**2.1**
Brazil	0.7	1.8	1.9	2.9	3.0	3.3	3.7	4.0	3.4
Argentina	0.5	0.8	0.8	0.7	0.5	0.4	0.4	0.3	-3.3
Colombia	0.5	0.5	0.5	0.5	0.3	0.3	0.3	0.2	-3.2
Peru	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.3	4.1
Trinidad and Tobago	0.1	0.2	0.2	0.2	0.2	0.1	0.1	0.1	-1.0
Other	0.1	0.2	0.2	0.2	0.3	0.5	0.7	0.9	6.2
Total World	**65.7**	**81.9**	**81.6**	**84.9**	**81.3**	**79.4**	**79.7**	**80.3**	**-0.1**
OPEC Share of World Production	38%	43%	43%	43%	42%	42%	41%	41%	
Persian Gulf Share of World Production	25%	29%	29%	28%	27%	28%	27%	27%	

Note: Conventional liquids include crude oil and lease condensate, natural gas plant liquids, and refinery gain.
Sources: **History:** Energy Information Administration (EIA), Office of Energy Markets and End Use. **Projections:** EIA, Generate World Oil Balance Model (2008).

Table G6. World Unconventional Liquids Production by Region and Country, High Price Case, 1990-2030
(Million Barrels per Day)

Region/Country	History (Estimates)			Projections					Average Annual Percent Change, 2005-2030
	1990	2005	2006	2010	2015	2020	2025	2030	
OPEC[a]	**0.0**	**0.8**	**0.7**	**1.0**	**1.4**	**2.0**	**2.4**	**2.7**	**5.2**
Biofuels	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	—
Extra-Heavy Oil (Venezuela)	0.0	0.6	0.6	0.9	1.1	1.5	1.8	2.1	5.2
Coal-to-Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Gas-to-Liquids (primarily Qatar)	0.0	0.0	0.0	0.0	0.2	0.4	0.4	0.5	—
Non-OPEC	**0.6**	**1.7**	**1.9**	**2.9**	**7.0**	**10.4**	**13.2**	**16.3**	**9.4**
OECD	**0.5**	**1.5**	**1.6**	**2.7**	**5.3**	**7.8**	**9.8**	**12.0**	**8.8**
Biofuels	0.0	0.2	0.3	0.6	0.9	1.1	1.4	1.5	8.0
Oil Sands/Bitumen (Canada)	0.4	1.1	1.2	2.0	4.1	6.1	7.5	8.7	8.7
Extra-Heavy Oil (Mexico)	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	—
Coal-to-Liquids	0.0	0.0	0.0	0.0	0.1	0.2	0.4	1.2	32.9
Gas-to-Liquids	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	—
Shale Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	—
Non-OECD	**0.1**	**0.2**	**0.2**	**0.2**	**1.7**	**2.6**	**3.4**	**4.2**	**12.0**
Biofuels	0.1	0.3	0.4	0.7	1.2	1.8	2.3	2.7	8.9
Extra-Heavy Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Coal-to-Liquids	0.1	0.1	0.1	0.2	0.4	0.6	1.0	1.4	9.9
Gas-to-Liquids	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	—
Shale Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.7
World									
Biofuels	0.2	0.5	0.6	1.3	2.1	3.0	3.7	4.2	8.6
Oil Sands/Bitumen	0.4	1.1	1.2	2.0	4.1	6.1	7.5	8.7	8.7
Extra-Heavy Oil	0.0	0.6	0.6	0.9	1.2	1.6	1.9	2.3	5.4
Coal-to-Liquids	0.1	0.1	0.1	0.2	0.4	0.8	1.5	2.7	12.8
Gas-to-Liquids	0.0	0.0	0.0	0.1	0.4	0.6	0.7	0.7	—
Shale Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	13.6
World Total	**0.6**	**2.5**	**2.6**	**3.8**	**8.4**	**12.3**	**15.6**	**19.0**	**8.5**
Selected Country Highlights									
Biofuels									
Brazil	0.1	0.2	0.2	0.3	0.6	1.0	1.3	1.5	8.5
China	0.0	0.1	0.1	0.2	0.2	0.3	0.3	0.3	5.7
India	0.0	0.0	0.1	0.1	0.2	0.2	0.2	0.2	6.7
United States	0.0	0.2	0.2	0.5	0.7	0.9	1.1	1.2	7.9
Coal-to-Liquids									
Australia and New Zealand	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
China	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.5	—
Germany	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0
India	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	—
South Africa	0.1	0.1	0.1	0.2	0.3	0.5	0.6	0.7	7.0
United States	0.0	0.0	0.0	0.0	0.0	0.2	0.4	1.2	—
Gas-to-Liquids									
Qatar	0.0	0.0	0.0	0.0	0.2	0.3	0.4	0.4	—
South Africa	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	—

[a]OPEC = Organization of the Petroleum Exporting Countries (OPEC-13).

Sources: **History:** Energy Information Administration (EIA), Office of Energy Markets and End Use. **Projections:** EIA, Generate World Oil Balance Model (2008).

Table G7. World Total Liquids Production by Region and Country, Low Price Case, 1990-2030
(Million Barrels Oil Equivalent per Day)

Region/Country	History (Estimates)			Projections					Average Annual Percent Change, 2005-2030
	1990	2005	2006	2010	2015	2020	2025	2030	
OPEC[a]	**25.2**	**36.1**	**35.8**	**38.4**	**45.3**	**51.5**	**55.8**	**60.0**	**2.1**
Asia (Indonesia)	**1.5**	**1.1**	**1.1**	**1.0**	**1.0**	**1.1**	**1.1**	**1.2**	**0.0**
Middle East	**16.1**	**23.8**	**23.6**	**24.4**	**29.1**	**33.7**	**36.4**	**39.0**	**2.0**
Iran	3.1	4.2	4.1	4.2	4.4	4.7	5.1	5.5	1.0
Iraq	2.1	1.9	2.0	2.1	2.4	4.0	4.5	5.0	4.0
Kuwait	1.2	2.7	2.7	2.7	3.3	3.5	3.7	4.1	1.7
Qatar	0.4	1.1	1.1	1.6	2.4	3.1	3.5	3.9	5.1
Saudi Arabia	7.0	11.1	10.7	10.8	13.3	14.8	15.8	16.8	1.7
United Arab Emirates	2.3	2.8	2.9	3.0	3.3	3.6	3.8	3.8	1.2
North Africa	**2.7**	**3.8**	**3.9**	**4.8**	**5.5**	**6.0**	**6.5**	**7.1**	**2.5**
Algeria	1.3	2.1	2.1	2.8	3.5	3.9	4.4	4.9	3.5
Libya	1.4	1.7	1.8	2.0	2.0	2.1	2.1	2.1	0.9
West Africa	**2.3**	**3.9**	**3.9**	**5.2**	**6.3**	**6.9**	**7.5**	**8.2**	**3.0**
Angola	0.5	1.3	1.4	2.5	2.9	3.3	3.5	3.9	4.6
Nigeria	1.8	2.6	2.4	2.6	3.4	3.6	4.0	4.3	2.0
South America	**2.5**	**3.4**	**3.3**	**3.0**	**3.3**	**3.9**	**4.3**	**4.6**	**1.2**
Ecuador	0.3	0.5	0.5	0.5	0.5	0.6	0.7	0.7	1.3
Venezuela	2.3	2.9	2.8	2.6	2.7	3.3	3.7	3.9	1.2
Non-OPEC	**41.1**	**48.2**	**48.4**	**51.3**	**53.9**	**56.2**	**58.8**	**62.0**	**1.0**
OECD	**20.0**	**21.8**	**21.4**	**21.4**	**20.6**	**19.9**	**19.7**	**19.4**	**-0.5**
OECD North America	**14.7**	**15.1**	**15.2**	**16.1**	**15.8**	**15.5**	**15.2**	**14.8**	**-0.1**
United States	9.7	8.2	8.2	9.4	10.1	10.2	9.8	9.2	0.5
Canada	2.0	3.1	3.3	3.6	2.9	2.7	2.6	2.6	-0.7
Mexico	3.0	3.8	3.7	3.1	2.8	2.5	2.7	3.0	-0.9
OECD Europe	**4.5**	**5.9**	**5.5**	**4.5**	**4.0**	**3.6**	**3.6**	**3.7**	**-1.9**
OECD Asia	**0.8**	**0.7**	**0.7**	**0.8**	**0.8**	**0.8**	**0.9**	**1.0**	**1.0**
Japan	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	1.9
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0
Australia and New Zealand	0.7	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.7
Non-OECD	**21.1**	**26.5**	**26.9**	**29.9**	**33.3**	**36.2**	**39.1**	**42.6**	**1.9**
Non-OECD Europe and Eurasia	**11.6**	**11.9**	**12.3**	**14.2**	**16.3**	**17.5**	**18.7**	**20.3**	**2.2**
Russia	10.1	9.5	9.7	10.4	11.7	12.6	13.5	14.6	1.7
Caspian Area	1.1	2.1	2.3	3.5	4.3	4.7	5.0	5.5	3.9
Other	0.4	0.3	0.3	0.3	0.3	0.2	0.3	0.3	-0.7
Non-OECD Asia	**4.4**	**6.5**	**6.5**	**6.4**	**7.2**	**7.6**	**7.8**	**7.8**	**0.8**
China	2.8	3.7	3.8	3.5	3.9	4.1	4.1	4.2	0.5
India	0.7	0.8	0.8	1.0	1.1	1.2	1.3	1.2	1.7
Other	1.0	1.9	1.9	1.9	2.1	2.3	2.3	2.4	0.9
Middle East (Non-OPEC)	**1.3**	**1.7**	**1.6**	**1.5**	**1.6**	**1.6**	**1.7**	**1.8**	**0.1**
Africa	**1.7**	**2.6**	**2.6**	**2.9**	**3.2**	**3.6**	**4.0**	**4.5**	**2.3**
Central and South America	**2.1**	**3.8**	**3.9**	**4.9**	**5.1**	**5.9**	**6.9**	**8.2**	**3.1**
Brazil	0.8	1.9	2.1	3.2	3.4	4.1	4.8	5.6	4.3
Other	1.3	1.8	1.9	1.7	1.7	1.8	2.1	2.6	1.4
Total World	**66.3**	**84.3**	**84.2**	**89.7**	**99.2**	**107.7**	**114.6**	**122.0**	**1.5**
OPEC Share of World Production	38%	43%	43%	43%	46%	48%	49%	49%	
Persian Gulf Share of World Production	24%	28%	28%	27%	29%	31%	32%	32%	

[a]OPEC = Organization of the Petroleum Exporting Countries (OPEC-13).

Sources: **History:** Energy Information Administration (EIA), Office of Energy Markets and End Use. **Projections:** EIA, Generate World Oil Balance Model (2008).

Table G8. World Conventional Liquids Production by Region and Country, Low Price Case, 1990-2030
(Million Barrels Oil Equivalent per Day)

Region/Country	History (Estimates)			Projections					Average Annual Percent Change, 2005-2030
	1990	2005	2006	2010	2015	2020	2025	2030	
OPEC[a]	**25.2**	**35.3**	**35.1**	**37.4**	**44.3**	**50.3**	**54.5**	**58.6**	**2.0**
Asia (Indonesia)	**1.5**	**1.1**	**1.1**	**1.0**	**1.0**	**1.0**	**1.1**	**1.1**	**-0.1**
Middle East	**16.1**	**23.8**	**23.5**	**24.3**	**29.0**	**33.5**	**36.1**	**38.8**	**2.0**
Iran	3.1	4.2	4.1	4.2	4.4	4.7	5.1	5.5	1.0
Iraq	2.1	1.9	2.0	2.1	2.4	4.0	4.5	5.0	4.0
Kuwait	1.2	2.7	2.7	2.7	3.3	3.5	3.7	4.1	1.7
Qatar	0.4	1.1	1.1	1.6	2.3	2.9	3.3	3.7	4.9
Saudi Arabia	7.0	11.0	10.6	10.7	13.3	14.8	15.8	16.8	1.7
United Arab Emirates	2.3	2.8	2.9	3.0	3.3	3.6	3.8	3.8	1.2
North Africa	**2.7**	**3.8**	**3.9**	**4.8**	**5.5**	**6.0**	**6.5**	**7.1**	**2.5**
Algeria	1.3	2.1	2.1	2.8	3.5	3.9	4.4	4.9	3.5
Libya	1.4	1.7	1.8	2.0	2.0	2.1	2.1	2.1	0.9
West Africa	**2.3**	**3.9**	**3.9**	**5.2**	**6.3**	**6.9**	**7.5**	**8.2**	**3.0**
Angola	0.5	1.3	1.4	2.5	2.9	3.3	3.5	3.9	4.6
Nigeria	1.8	2.6	2.4	2.7	3.4	3.6	3.9	4.3	2.0
South America	**2.5**	**2.7**	**2.7**	**2.2**	**2.4**	**2.9**	**3.3**	**3.5**	**1.0**
Ecuador	0.3	0.5	0.5	0.5	0.5	0.6	0.7	0.7	1.3
Venezuela	2.3	2.2	2.1	1.7	1.9	2.3	2.7	2.8	1.0
Non-OPEC	**40.5**	**46.5**	**46.5**	**48.9**	**51.0**	**53.0**	**55.2**	**58.4**	**0.9**
OECD	**19.5**	**20.3**	**19.8**	**19.0**	**18.2**	**17.3**	**16.8**	**16.5**	**-0.8**
OECD North America	**14.3**	**13.7**	**13.6**	**13.7**	**13.5**	**12.9**	**12.3**	**11.9**	**-0.5**
United States	9.6	7.9	7.8	8.7	9.1	9.1	8.4	7.7	-0.1
Canada	1.7	2.0	2.1	1.9	1.6	1.4	1.3	1.2	-2.0
Mexico	3.0	3.8	3.7	3.1	2.8	2.5	2.7	3.0	-0.9
OECD Europe	**4.5**	**5.9**	**5.5**	**4.5**	**4.0**	**3.6**	**3.6**	**3.6**	**-1.9**
Denmark	0.1	0.4	0.3	0.3	0.2	0.2	0.1	0.1	-4.8
Norway	1.7	3.0	2.8	2.4	2.0	1.8	1.8	1.7	-2.1
United Kngdom	2.0	1.9	1.7	1.2	1.0	0.9	0.9	0.9	-2.8
Other	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.9
OECD Asia	**0.8**	**0.7**	**0.7**	**0.8**	**0.8**	**0.8**	**0.9**	**0.9**	**1.0**
Japan	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	1.9
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4
Australia and New Zealand	0.7	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.7

[a]OPEC = Organization of the Petroleum Exporting Countries (OPEC-13).

Table G8. World Conventional Liquids Production by Region and Country, Low Price Case, 1990-2030 (Continued)
(Million Barrels Oil Equivalent per Day)

Region/Country	History (Estimates)			Projections					Average Annual Percent Change, 2005-2030
	1990	2005	2006	2010	2015	2020	2025	2030	
Non-OECD	**21.0**	**26.2**	**26.7**	**29.9**	**32.7**	**35.6**	**38.5**	**41.9**	**1.9**
Non-OECD Europe and Eurasia	**11.6**	**11.9**	**12.3**	**14.2**	**16.3**	**17.5**	**18.7**	**20.3**	**2.2**
Russia	**10.1**	**9.5**	**9.7**	**10.4**	**11.7**	**12.6**	**13.5**	**14.6**	**1.7**
Caspian Area	**1.1**	**2.1**	**2.3**	**3.5**	**4.3**	**4.7**	**5.0**	**5.5**	**3.9**
Azerbaijan	0.3	0.4	0.6	1.3	1.3	1.2	1.2	1.1	3.8
Kazakhstan	0.6	1.3	1.4	1.9	2.7	3.0	3.3	3.9	4.3
Turkmenistan	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.4	2.8
Uzbekistan	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-1.0
Other	**0.4**	**0.3**	**0.3**	**0.3**	**0.2**	**0.2**	**0.3**	**0.3**	**-0.6**
Non-OECD Asia	**4.4**	**6.5**	**6.6**	**6.7**	**7.0**	**7.4**	**7.6**	**7.6**	**0.6**
China	2.8	3.8	3.8	3.7	3.8	4.0	4.0	4.1	0.3
India	0.7	0.8	0.9	1.0	1.0	1.2	1.3	1.2	1.4
Brunei	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.9
Malaysia	0.6	0.7	0.7	0.6	0.7	0.8	0.8	0.8	0.3
Thailand	0.1	0.3	0.3	0.4	0.4	0.4	0.4	0.5	1.7
Vietnam	0.1	0.4	0.4	0.5	0.5	0.5	0.5	0.6	1.4
Other	0.1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	-0.2
Middle East (Non-OPEC)	**1.3**	**1.7**	**1.6**	**1.5**	**1.6**	**1.6**	**1.7**	**1.8**	**0.1**
Oman	0.7	0.8	0.7	0.7	0.8	0.8	0.9	0.9	0.7
Syria	0.4	0.5	0.4	0.4	0.4	0.4	0.4	0.4	-1.2
Yemen	0.2	0.4	0.4	0.3	0.3	0.4	0.4	0.4	0.2
Other	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.3
Africa	**1.6**	**2.4**	**2.4**	**2.8**	**3.0**	**3.5**	**3.9**	**4.3**	**2.3**
Chad	0.0	0.2	0.2	0.2	0.2	0.3	0.3	0.4	3.1
Congo (Brazzaville)	0.2	0.2	0.2	0.2	0.3	0.4	0.5	0.6	4.0
Egypt	0.9	0.7	0.7	0.6	0.6	0.8	0.8	0.8	0.7
Equatorial Guniea	0.0	0.4	0.4	0.5	0.4	0.4	0.5	0.5	0.8
Gabon	0.3	0.3	0.2	0.2	0.2	0.2	0.3	0.3	0.3
Sao Tome and Principe	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	—
Sudan	0.0	0.4	0.4	0.7	0.7	0.7	0.8	1.0	4.3
Other	0.3	0.3	0.4	0.4	0.4	0.5	0.6	0.6	3.0
Central and South America	**2.0**	**3.6**	**3.7**	**4.7**	**4.9**	**5.6**	**6.7**	**7.9**	**3.2**
Brazil	0.7	1.8	1.9	2.9	3.3	3.9	4.6	5.4	4.6
Argentina	0.5	0.8	0.8	0.7	0.5	0.5	0.4	0.4	-2.4
Colombia	0.5	0.5	0.5	0.5	0.4	0.3	0.3	0.3	-2.1
Peru	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.4	5.1
Trinidad and Tobago	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	-0.4
Other	0.1	0.2	0.2	0.2	0.4	0.5	0.8	1.2	7.5
Total World	**65.7**	**81.9**	**81.6**	**86.3**	**95.2**	**103.3**	**109.8**	**117.1**	**1.4**
OPEC Share of World Production	38%	43%	43%	43%	46%	49%	50%	50%	
Persian Gulf Share of World Production	25%	29%	29%	28%	30%	32%	33%	33%	

Note: Conventional liquids include crude oil and lease condensate, natural gas plant liquids, and refinery gain.
Sources: **History:** Energy Information Administration (EIA), Office of Energy Markets and End Use. **Projections:** EIA, Generate World Oil Balance Model (2008).

Table G9. World Unconventional Liquids Production by Region and Country, Low Price Case, 1990-2030
(Million Barrels Oil Equivalent per Day)

Region/Country	History (Estimates)			Projections					Average Annual Percent Change, 2005-2030
	1990	2005	2006	2010	2015	2020	2025	2030	
OPEC[a]	**0.0**	**0.8**	**0.7**	**1.0**	**1.1**	**1.2**	**1.3**	**1.4**	**2.4**
Biofuels	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Extra-Heavy Oil (Venezuela)	0.0	0.6	0.6	0.8	0.9	0.9	1.0	1.1	2.4
Coal-to-Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Gas-to-Liquids (primarily Qatar)	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.2	—
Non-OPEC	**0.6**	**1.7**	**1.9**	**2.4**	**2.9**	**3.2**	**3.5**	**3.6**	**3.0**
OECD	**0.5**	**1.5**	**1.6**	**2.4**	**2.4**	**2.6**	**2.9**	**2.9**	**2.9**
Biofuels	0.0	0.2	0.3	0.6	0.8	1.0	1.3	1.3	7.4
Oil Sands/Bitumen (Canada)	0.4	1.1	1.2	1.7	1.3	1.4	1.3	1.4	1.0
Extra-Heavy Oil (Mexico)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Coal-to-Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.7
Gas-to-Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Shale Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Non-OECD	**0.1**	**0.2**	**0.2**	**0.0**	**0.5**	**0.6**	**0.6**	**0.7**	**4.0**
Biofuels	0.1	0.3	0.4	0.6	0.4	0.4	0.4	0.4	1.1
Extra-Heavy Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Coal-to-Liquids	0.1	0.1	0.1	0.2	0.1	0.1	0.2	0.2	2.1
Gas-to-Liquids	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	—
Shale Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.7
World									
Biofuels	0.2	0.5	0.6	1.2	1.2	1.4	1.7	1.7	4.8
Oil Sands/Bitumen	0.4	1.1	1.2	1.7	1.3	1.4	1.3	1.4	1.0
Extra-Heavy Oil	0.0	0.6	0.6	0.9	0.9	0.9	1.0	1.1	2.5
Coal-to-Liquids	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	3.2
Gas-to-Liquids	0.0	0.0	0.0	0.1	0.2	0.2	0.3	0.3	—
Shale Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.7
World Total	**0.6**	**2.5**	**2.6**	**3.4**	**4.0**	**4.3**	**4.8**	**5.0**	**2.9**
Selected Country Highlights									
Biofuels									
Brazil	0.1	0.2	0.2	0.3	0.2	0.2	0.2	0.2	0.8
China	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	-1.8
India	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	-0.9
United States	0.0	0.2	0.2	0.5	0.7	0.9	1.2	1.2	8.1
Coal-to-Liquids									
Australia and New Zealand	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
China	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	—
Germany	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-4.3
India	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
South Africa	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-0.6
United States	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Gas-to-Liquids									
Qatar	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.2	—
South Africa	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	—

[a]OPEC = Organization of the Petroleum Exporting Countries (OPEC-13).

Sources: **History:** Energy Information Administration (EIA), Office of Energy Markets and End Use. **Projections:** EIA, Generate World Oil Balance Model (2008).

Table G10. World Total Liquids Production by Region and Country, High Economic Growth Case, 1990-2030
(Million Barrels Oil Equivalent per Day)

Region/Country	History (Estimates)			Projections					Average Annual Percent Change, 2005-2030
	1990	2005	2006	2010	2015	2020	2025	2030	
OPEC[a]	**25.2**	**36.1**	**35.8**	**38.2**	**42.2**	**46.8**	**50.8**	**55.0**	**1.7**
Asia (Indonesia)	**1.5**	**1.1**	**1.1**	**1.0**	**1.0**	**1.0**	**1.1**	**1.1**	**-0.3**
Middle East	**16.1**	**23.8**	**23.6**	**24.2**	**26.8**	**30.1**	**32.5**	**35.0**	**1.5**
Iran	3.1	4.2	4.1	4.2	4.0	4.2	4.5	4.9	0.6
Iraq	2.1	1.9	2.0	2.1	2.2	3.5	4.0	4.4	3.5
Kuwait	1.2	2.7	2.7	2.7	3.0	3.1	3.3	3.6	1.2
Qatar	0.4	1.1	1.1	1.6	2.3	2.9	3.3	3.7	4.9
Saudi Arabia	7.0	11.1	10.7	10.8	12.3	13.3	14.0	15.0	1.2
United Arab Emirates	2.3	2.8	2.9	3.0	3.0	3.2	3.3	3.4	0.7
North Africa	**2.7**	**3.8**	**3.9**	**4.8**	**5.1**	**5.3**	**5.7**	**6.3**	**2.0**
Algeria	1.3	2.1	2.1	2.8	3.2	3.5	3.9	4.4	3.0
Libya	1.4	1.7	1.8	2.0	1.9	1.8	1.8	1.9	0.4
West Africa	**2.3**	**3.9**	**3.9**	**5.1**	**5.8**	**6.2**	**6.7**	**7.4**	**2.6**
Angola	0.5	1.3	1.4	2.5	2.7	2.9	3.1	3.4	4.1
Nigeria	1.8	2.6	2.4	2.6	3.1	3.3	3.5	3.9	1.6
South America	**2.5**	**3.4**	**3.3**	**3.1**	**3.5**	**4.2**	**4.9**	**5.3**	**1.8**
Ecuador	0.3	0.5	0.5	0.5	0.5	0.5	0.6	0.7	0.8
Venezuela	2.3	2.9	2.8	2.6	3.0	3.7	4.3	4.6	1.9
Non-OPEC	**41.1**	**48.2**	**48.4**	**51.9**	**57.0**	**60.6**	**64.8**	**70.0**	**1.5**
OECD	**20.0**	**21.8**	**21.4**	**21.7**	**22.5**	**22.4**	**22.8**	**23.2**	**0.2**
OECD North America	**14.7**	**15.1**	**15.2**	**16.4**	**17.5**	**17.8**	**18.0**	**18.2**	**0.7**
United States	9.7	8.2	8.2	9.4	10.1	10.2	9.8	9.2	0.5
Canada	2.0	3.1	3.3	3.9	4.6	4.9	5.3	5.7	2.5
Mexico	3.0	3.8	3.7	3.1	2.8	2.6	2.9	3.3	-0.6
OECD Europe	**4.5**	**5.9**	**5.5**	**4.6**	**4.1**	**3.8**	**3.8**	**3.9**	**-1.6**
OECD Asia	**0.8**	**0.7**	**0.7**	**0.8**	**0.8**	**0.9**	**1.0**	**1.0**	**1.3**
Japan	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	1.8
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	6.2
Australia and New Zealand	0.7	0.6	0.6	0.6	0.6	0.7	0.7	0.8	1.0
Non-OECD	**21.1**	**26.5**	**26.9**	**30.2**	**34.5**	**38.2**	**42.0**	**46.8**	**2.3**
Non-OECD Europe and Eurasia	**11.6**	**11.9**	**12.3**	**14.3**	**16.6**	**18.1**	**19.5**	**21.7**	**2.4**
Russia	10.1	9.5	9.7	10.5	11.9	13.0	14.1	15.6	2.0
Caspian Area	1.1	2.1	2.3	3.5	4.4	4.8	5.2	5.9	4.2
Other	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	-0.4
Non-OECD Asia	**4.4**	**6.5**	**6.5**	**6.5**	**7.5**	**8.0**	**8.5**	**8.8**	**1.2**
China	2.8	3.7	3.8	3.6	4.1	4.3	4.5	4.7	0.9
India	0.7	0.8	0.8	1.0	1.2	1.3	1.5	1.5	2.3
Other	1.0	1.9	1.9	1.9	2.2	2.4	2.5	2.6	1.3
Middle East (Non-OPEC)	**1.3**	**1.7**	**1.6**	**1.5**	**1.6**	**1.7**	**1.8**	**1.9**	**0.4**
Africa	**1.7**	**2.6**	**2.6**	**2.9**	**3.4**	**4.0**	**4.5**	**5.1**	**2.8**
Central and South America	**2.1**	**3.8**	**3.9**	**5.0**	**5.5**	**6.5**	**7.8**	**9.3**	**3.7**
Brazil	0.8	1.9	2.1	3.3	3.7	4.6	5.5	6.5	4.9
Other	1.3	1.8	1.9	1.7	1.7	1.9	2.3	2.9	1.8
Total World	**66.3**	**84.3**	**84.2**	**90.1**	**99.2**	**107.4**	**115.6**	**125.0**	**1.6**
OPEC Share of World Production	38%	43%	43%	42%	43%	44%	44%	44%	
Persian Gulf Share of World Production	24%	28%	28%	27%	27%	28%	28%	28%	

[a]OPEC = Organization of the Petroleum Exporting Countries (OPEC-13).

Sources: **History:** Energy Information Administration (EIA), Office of Energy Markets and End Use. **Projections:** EIA, Generate World Oil Balance Model (2008).

Table G11. World Conventional Liquids Production by Region and Country, High Economic Growth Case, 1990-2030
(Million Barrels Oil Equivalent per Day)

Region/Country	History (Estimates)			Projections					Average Annual Percent Change, 2005-2030
	1990	2005	2006	2010	2015	2020	2025	2030	
OPEC[a]	**25.2**	**35.3**	**35.1**	**37.2**	**40.6**	**44.8**	**48.3**	**52.3**	**1.6**
Asia (Indonesia)	**1.5**	**1.1**	**1.1**	**1.0**	**0.9**	**0.9**	**1.0**	**1.0**	**-0.6**
Middle East	**16.1**	**23.8**	**23.5**	**24.1**	**26.6**	**29.8**	**32.1**	**34.6**	**1.5**
Iran	3.1	4.2	4.1	4.2	4.0	4.2	4.5	4.9	0.6
Iraq	2.1	1.9	2.0	2.1	2.2	3.5	4.0	4.4	3.5
Kuwait	1.2	2.7	2.7	2.7	3.0	3.1	3.3	3.6	1.2
Qatar	0.4	1.1	1.1	1.6	2.1	2.6	2.9	3.3	4.4
Saudi Arabia	7.0	11.0	10.6	10.7	12.3	13.3	14.0	15.0	1.2
United Arab Emirates	2.3	2.8	2.9	3.0	3.0	3.2	3.3	3.4	0.7
North Africa	**2.7**	**3.8**	**3.9**	**4.8**	**5.1**	**5.3**	**5.7**	**6.3**	**2.0**
Algeria	1.3	2.1	2.1	2.8	3.2	3.5	3.9	4.4	3.0
Libya	1.4	1.7	1.8	2.0	1.9	1.8	1.8	1.9	0.4
West Africa	**2.3**	**3.9**	**3.9**	**5.2**	**5.8**	**6.1**	**6.6**	**7.3**	**2.5**
Angola	0.5	1.3	1.4	2.5	2.7	2.9	3.1	3.4	4.1
Nigeria	1.8	2.6	2.4	2.6	3.1	3.2	3.5	3.8	1.5
South America	**2.5**	**2.7**	**2.7**	**2.2**	**2.2**	**2.6**	**3.0**	**3.1**	**0.6**
Ecuador	0.3	0.5	0.5	0.5	0.5	0.5	0.6	0.7	0.8
Venezuela	2.3	2.2	2.1	1.7	1.7	2.1	2.4	2.5	0.5
Non-OPEC	**40.5**	**46.5**	**46.5**	**49.1**	**51.8**	**54.3**	**57.3**	**61.7**	**1.1**
OECD	**19.5**	**20.3**	**19.8**	**19.1**	**18.4**	**17.6**	**17.1**	**17.0**	**-0.7**
OECD North America	**14.3**	**13.7**	**13.6**	**13.7**	**13.6**	**13.1**	**12.5**	**12.2**	**-0.5**
United States	9.6	7.9	7.8	8.7	9.1	9.1	8.4	7.7	-0.1
Canada	1.7	2.0	2.1	1.9	1.7	1.4	1.3	1.3	-1.8
Mexico	3.0	3.8	3.7	3.1	2.8	2.6	2.8	3.2	-0.7
OECD Europe	**4.5**	**5.9**	**5.5**	**4.5**	**4.0**	**3.7**	**3.7**	**3.8**	**-1.7**
Denmark	0.1	0.4	0.3	0.3	0.2	0.2	0.1	0.1	-4.6
Norway	1.7	3.0	2.8	2.4	2.1	1.9	1.9	1.9	-1.9
United Kngdom	2.0	1.9	1.7	1.2	1.1	0.9	0.9	1.0	-2.6
Other	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.9	0.9
OECD Asia	**0.8**	**0.7**	**0.7**	**0.8**	**0.8**	**0.9**	**0.9**	**1.0**	**1.1**
Japan	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	1.8
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3
Australia and New Zealand	0.7	0.6	0.6	0.6	0.6	0.7	0.7	0.8	1.0

[a]OPEC = Organization of the Petroleum Exporting Countries (OPEC-13).

Table G11. World Conventional Liquids Production by Region and Country, High Economic Growth Case, 1990-2030 (Continued)
(Million Barrels Oil Equivalent per Day)

Region/Country	History (Estimates)			Projections					Average Annual Percent Change, 2005-2030
	1990	2005	2006	2010	2015	2020	2025	2030	
Non-OECD	**21.0**	**26.2**	**26.7**	**30.1**	**33.3**	**36.7**	**40.2**	**44.7**	**2.2**
Non-OECD Europe and Eurasia	**11.6**	**11.9**	**12.3**	**14.3**	**16.6**	**18.1**	**19.5**	**21.7**	**2.4**
Russia	**10.1**	**9.5**	**9.7**	**10.5**	**11.9**	**13.0**	**14.1**	**15.6**	**2.0**
Caspian Area	**1.1**	**2.1**	**2.3**	**3.5**	**4.4**	**4.8**	**5.2**	**5.9**	**4.2**
Azerbaijan	0.3	0.4	0.6	1.4	1.3	1.3	1.2	1.2	4.1
Kazakhstan	0.6	1.3	1.4	1.9	2.7	3.1	3.5	4.1	4.6
Turkmenistan	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.4	3.1
Uzbekistan	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-0.7
Other	**0.4**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**-0.4**
Non-OECD Asia	**4.4**	**6.5**	**6.6**	**6.8**	**7.1**	**7.6**	**7.9**	**8.1**	**0.8**
China	2.8	3.8	3.8	3.7	3.9	4.1	4.2	4.3	0.5
India	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.3	1.6
Brunei	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	1.1
Malaysia	0.6	0.7	0.7	0.6	0.7	0.8	0.8	0.9	0.6
Thailand	0.1	0.3	0.3	0.4	0.4	0.4	0.5	0.5	1.9
Vietnam	0.1	0.4	0.4	0.5	0.5	0.6	0.6	0.6	1.7
Other	0.1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.0
Middle East (Non-OPEC)	**1.3**	**1.7**	**1.6**	**1.5**	**1.6**	**1.7**	**1.8**	**1.9**	**0.4**
Oman	0.7	0.8	0.7	0.7	0.8	0.9	0.9	1.0	0.9
Syria	0.4	0.5	0.4	0.4	0.4	0.4	0.4	0.4	-0.9
Yemen	0.2	0.4	0.4	0.3	0.3	0.4	0.4	0.5	0.5
Other	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.5
Africa	**1.6**	**2.4**	**2.4**	**2.8**	**3.1**	**3.6**	**4.0**	**4.6**	**2.6**
Chad	0.0	0.2	0.2	0.2	0.2	0.3	0.3	0.4	3.4
Congo (Brazzaville)	0.2	0.2	0.2	0.2	0.3	0.5	0.6	0.7	4.3
Egypt	0.9	0.7	0.7	0.6	0.7	0.8	0.8	0.9	1.0
Equatorial Guniea	0.0	0.4	0.4	0.5	0.4	0.5	0.5	0.5	1.0
Gabon	0.3	0.3	0.2	0.2	0.2	0.2	0.3	0.3	0.6
Sao Tome and Principe	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	—
Sudan	0.0	0.4	0.4	0.7	0.7	0.8	0.9	1.1	4.5
Other	0.3	0.3	0.4	0.4	0.4	0.5	0.6	0.7	3.2
Central and South America	**2.0**	**3.6**	**3.7**	**4.7**	**5.0**	**5.8**	**7.0**	**8.4**	**3.5**
Brazil	0.7	1.8	1.9	3.0	3.3	4.0	4.8	5.7	4.8
Argentina	0.5	0.8	0.8	0.8	0.6	0.5	0.5	0.5	-2.2
Colombia	0.5	0.5	0.5	0.5	0.4	0.4	0.3	0.3	-1.8
Peru	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.4	5.4
Trinidad and Tobago	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	-0.2
Other	0.1	0.2	0.2	0.2	0.4	0.6	0.9	1.3	7.7
Total World	**65.7**	**81.9**	**81.6**	**86.3**	**92.4**	**99.1**	**105.7**	**114.0**	**1.3**
OPEC Share of World Production	38%	43%	43%	43%	44%	45%	46%	46%	
Persian Gulf Share of World Production	25%	29%	29%	28%	29%	30%	30%	30%	

Note: Conventional liquids include crude oil and lease condensate, natural gas plant liquids, and refinery gain.
Sources: **History:** Energy Information Administration (EIA), Office of Energy Markets and End Use. **Projections:** EIA, Generate World Oil Balance Model (2008).

Table G12. World Unconventional Liquids Production by Region and Country, High Economic Growth Case, 1990-2030
(Million Barrels Oil Equivalent per Day)

Region/Country	History (Estimates)			Projections					Average Annual Percent Change, 2005-2030
	1990	2005	2006	2010	2015	2020	2025	2030	
OPEC[a]	**0.0**	**0.8**	**0.7**	**1.0**	**1.6**	**2.0**	**2.4**	**2.7**	**5.2**
Biofuels	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	—
Extra-Heavy Oil (Venezuela)	0.0	0.6	0.6	0.9	1.3	1.6	1.9	2.1	5.2
Coal-to-Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Gas-to-Liquids (primarily Qatar)	0.0	0.0	0.0	0.0	0.3	0.4	0.4	0.5	—
Non-OPEC	**0.6**	**1.7**	**1.9**	**2.8**	**5.2**	**6.3**	**7.5**	**8.3**	**6.5**
OECD	**0.5**	**1.5**	**1.6**	**2.7**	**4.0**	**4.8**	**5.7**	**6.2**	**5.9**
Biofuels	0.0	0.2	0.3	0.6	0.9	1.1	1.4	1.4	7.7
Oil Sands/Bitumen (Canada)	0.4	1.1	1.2	1.9	2.9	3.5	4.0	4.4	5.8
Extra-Heavy Oil (Mexico)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	—
Coal-to-Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	18.0
Gas-to-Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Shale Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Non-OECD	**0.1**	**0.2**	**0.2**	**0.1**	**1.2**	**1.5**	**1.8**	**2.1**	**9.0**
Biofuels	0.1	0.3	0.4	0.6	0.9	1.1	1.2	1.4	6.0
Extra-Heavy Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Coal-to-Liquids	0.1	0.1	0.1	0.2	0.3	0.3	0.6	0.7	7.0
Gas-to-Liquids	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	—
Shale Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9
World									
Biofuels	0.2	0.5	0.6	1.3	1.8	2.2	2.6	2.8	6.9
Oil Sands/Bitumen	0.4	1.1	1.2	1.9	2.9	3.5	4.0	4.4	5.8
Extra-Heavy Oil	0.0	0.6	0.6	0.9	1.3	1.6	1.9	2.2	5.3
Coal-to-Liquids	0.1	0.1	0.1	0.2	0.3	0.4	0.7	0.8	7.6
Gas-to-Liquids	0.0	0.0	0.0	0.1	0.3	0.4	0.5	0.5	—
Shale Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9
World Total	**0.6**	**2.5**	**2.6**	**3.8**	**6.8**	**8.3**	**9.9**	**11.0**	**6.2**
Selected Country Highlights									
Biofuels									
Brazil	0.1	0.2	0.2	0.3	0.4	0.6	0.7	0.7	5.6
China	0.0	0.1	0.1	0.2	0.2	0.2	0.2	0.1	2.9
India	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	3.9
United States	0.0	0.2	0.2	0.5	0.7	0.9	1.2	1.2	8.1
Coal-to-Liquids									
Australia and New Zealand	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
China	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	—
Germany	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
India	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	—
South Africa	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.4	4.2
United States	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Gas-to-Liquids									
Qatar	0.0	0.0	0.0	0.0	0.2	0.3	0.4	0.4	—
South Africa	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	—

[a]OPEC = Organization of the Petroleum Exporting Countries (OPEC-13).

Sources: **History:** Energy Information Administration (EIA), Office of Energy Markets and End Use. **Projections:** EIA, Generate World Oil Balance Model (2008).

Table G13. World Total Liquids Production by Region and Country, Low Economic Growth Case, 1990-2030
(Million Barrels Oil Equivalent per Day)

Region/Country	History (Estimates)			Projections					Average Annual Percent Change, 2005-2030
	1990	2005	2006	2010	2015	2020	2025	2030	
OPEC[a]	**25.2**	**36.1**	**35.8**	**37.8**	**40.6**	**43.1**	**44.1**	**45.0**	**0.9**
Asia (Indonesia)	**1.5**	**1.1**	**1.1**	**1.0**	**0.9**	**0.9**	**0.9**	**0.9**	**-1.1**
Middle East	**16.1**	**23.8**	**23.6**	**24.0**	**25.9**	**27.9**	**28.5**	**29.0**	**0.8**
Iran	3.1	4.2	4.1	4.1	4.0	4.0	4.0	4.0	-0.2
Iraq	2.1	1.9	2.0	2.1	2.2	3.3	3.6	3.7	2.7
Kuwait	1.2	2.7	2.7	2.6	3.0	2.9	3.0	3.0	0.5
Qatar	0.4	1.1	1.1	1.6	2.2	2.7	2.9	3.0	4.1
Saudi Arabia	7.0	11.1	10.7	10.6	11.6	12.0	12.1	12.4	0.4
United Arab Emirates	2.3	2.8	2.9	3.0	3.0	3.0	3.0	2.9	0.0
North Africa	**2.7**	**3.8**	**3.9**	**4.8**	**5.0**	**5.1**	**5.1**	**5.3**	**1.3**
Algeria	1.3	2.1	2.1	2.7	3.2	3.3	3.5	3.7	2.3
Libya	1.4	1.7	1.8	2.0	1.9	1.7	1.7	1.6	-0.3
West Africa	**2.3**	**3.9**	**3.9**	**5.1**	**5.7**	**5.8**	**5.9**	**6.1**	**1.8**
Angola	0.5	1.3	1.4	2.5	2.7	2.7	2.8	2.8	3.3
Nigeria	1.8	2.6	2.4	2.6	3.1	3.1	3.1	3.2	0.8
South America	**2.5**	**3.4**	**3.3**	**3.0**	**3.0**	**3.4**	**3.7**	**3.8**	**0.4**
Ecuador	0.3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0
Venezuela	2.3	2.9	2.8	2.5	2.5	2.9	3.2	3.2	0.5
Non-OPEC	**41.1**	**48.2**	**48.4**	**50.9**	**51.7**	**52.6**	**54.1**	**56.3**	**0.6**
OECD	**20.0**	**21.8**	**21.4**	**21.1**	**19.7**	**19.2**	**19.8**	**20.7**	**-0.2**
OECD North America	**14.7**	**15.1**	**15.2**	**15.9**	**15.1**	**15.2**	**15.9**	**16.8**	**0.4**
United States	9.7	8.2	8.2	9.2	9.7	10.3	10.9	11.5	1.3
Canada	2.0	3.1	3.3	3.6	2.8	2.6	2.6	2.7	-0.5
Mexico	3.0	3.8	3.7	3.0	2.7	2.3	2.4	2.6	-1.5
OECD Europe	**4.5**	**5.9**	**5.5**	**4.5**	**3.8**	**3.3**	**3.1**	**3.1**	**-2.6**
OECD Asia	**0.8**	**0.7**	**0.7**	**0.8**	**0.8**	**0.8**	**0.8**	**0.8**	**0.4**
Japan	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.9
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0
Australia and New Zealand	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.1
Non-OECD	**21.1**	**26.5**	**26.9**	**29.7**	**32.0**	**33.3**	**34.3**	**35.6**	**1.2**
Non-OECD Europe and Eurasia	**11.6**	**11.9**	**12.3**	**14.1**	**15.7**	**16.1**	**16.3**	**16.9**	**1.4**
Russia	10.1	9.5	9.7	10.3	11.3	11.6	11.8	12.1	1.0
Caspian Area	1.1	2.1	2.3	3.5	4.2	4.3	4.4	4.6	3.2
Other	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.2	-1.4
Non-OECD Asia	**4.4**	**6.5**	**6.5**	**6.4**	**6.9**	**6.9**	**6.8**	**6.6**	**0.1**
China	2.8	3.7	3.8	3.5	3.8	3.7	3.6	3.5	-0.3
India	0.7	0.8	0.8	1.0	1.1	1.1	1.2	1.1	1.1
Other	1.0	1.9	1.9	1.9	2.0	2.1	2.1	2.0	0.3
Middle East (Non-OPEC)	**1.3**	**1.7**	**1.6**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**-0.6**
Africa	**1.7**	**2.6**	**2.6**	**2.9**	**3.0**	**3.3**	**3.5**	**3.8**	**1.6**
Central and South America	**2.1**	**3.8**	**3.9**	**4.9**	**4.9**	**5.4**	**6.1**	**6.9**	**2.4**
Brazil	0.8	1.9	2.1	3.2	3.3	3.8	4.3	4.7	3.6
Other	1.3	1.8	1.9	1.7	1.6	1.6	1.9	2.2	0.7
Total World	**66.3**	**84.3**	**84.2**	**88.7**	**92.3**	**95.6**	**98.3**	**101.3**	**0.7**
OPEC Share of World Production	38%	43%	43%	43%	44%	45%	45%	44%	
Persian Gulf Share of World Production	24%	28%	28%	27%	28%	29%	29%	29%	

[a]OPEC = Organization of the Petroleum Exporting Countries (OPEC-13).

Sources: **History:** Energy Information Administration (EIA), Office of Energy Markets and End Use. **Projections:** EIA, Generate World Oil Balance Model (2008).

Table G14. World Conventional Liquids Production by Region and Country, Low Economic Growth Case, 1990-2030
(Million Barrels Oil Equivalent per Day)

Region/Country	History (Estimates)			Projections					Average Annual Percent Change, 2005-2030
	1990	2005	2006	2010	2015	2020	2025	2030	
OPEC[a]	**25.2**	**35.3**	**35.1**	**36.9**	**39.6**	**41.9**	**42.8**	**43.6**	**0.8**
Asia (Indonesia)	**1.5**	**1.1**	**1.1**	**0.9**	**0.9**	**0.9**	**0.9**	**0.8**	**-1.2**
Middle East	**16.1**	**23.8**	**23.5**	**23.9**	**25.7**	**27.7**	**28.3**	**28.8**	**0.8**
Iran	3.1	4.2	4.1	4.1	4.0	4.0	4.0	4.0	-0.2
Iraq	2.1	1.9	2.0	2.1	2.2	3.3	3.6	3.7	2.7
Kuwait	1.2	2.7	2.7	2.6	3.0	2.9	3.0	3.0	0.5
Qatar	0.4	1.1	1.1	1.6	2.1	2.5	2.6	2.8	3.8
Saudi Arabia	7.0	11.0	10.6	10.6	11.6	12.0	12.1	12.4	0.5
United Arab Emirates	2.3	2.8	2.9	3.0	3.0	3.0	3.0	2.9	0.0
North Africa	**2.7**	**3.8**	**3.9**	**4.8**	**5.0**	**5.1**	**5.1**	**5.3**	**1.3**
Algeria	1.3	2.1	2.1	2.7	3.2	3.3	3.5	3.7	2.3
Libya	1.4	1.7	1.8	2.0	1.9	1.7	1.7	1.6	-0.3
West Africa	**2.3**	**3.9**	**3.9**	**5.1**	**5.7**	**5.8**	**5.9**	**6.1**	**1.8**
Angola	0.5	1.3	1.4	2.5	2.7	2.7	2.8	2.8	3.3
Nigeria	1.8	2.6	2.4	2.6	3.0	3.1	3.1	3.2	0.8
South America	**2.5**	**2.7**	**2.7**	**2.2**	**2.2**	**2.5**	**2.7**	**2.6**	**-0.1**
Ecuador	0.3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0
Venezuela	2.3	2.2	2.1	1.7	1.7	2.0	2.1	2.1	-0.2
Non-OPEC	**40.5**	**46.5**	**46.5**	**48.4**	**48.8**	**49.2**	**49.9**	**50.9**	**0.4**
OECD	**19.5**	**20.3**	**19.8**	**18.7**	**17.3**	**16.5**	**16.3**	**16.1**	**-0.9**
OECD North America	**14.3**	**13.7**	**13.6**	**13.5**	**12.8**	**12.5**	**12.5**	**12.3**	**-0.4**
United States	9.6	7.9	7.8	8.5	8.6	8.9	8.9	8.6	0.4
Canada	1.7	2.0	2.1	1.9	1.5	1.3	1.1	1.1	-2.5
Mexico	3.0	3.8	3.7	3.0	2.7	2.3	2.4	2.6	-1.5
OECD Europe	**4.5**	**5.9**	**5.5**	**4.5**	**3.8**	**3.2**	**3.1**	**3.0**	**-2.6**
Denmark	0.1	0.4	0.3	0.3	0.2	0.2	0.1	0.1	-5.6
Norway	1.7	3.0	2.8	2.4	1.9	1.7	1.6	1.5	-2.8
United Kngdom	2.0	1.9	1.7	1.2	1.0	0.8	0.7	0.8	-3.5
Other	0.7	0.7	0.7	0.6	0.6	0.6	0.7	0.7	0.0
OECD Asia	**0.8**	**0.7**	**0.7**	**0.7**	**0.7**	**0.8**	**0.8**	**0.8**	**0.3**
Japan	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.9
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4
Australia and New Zealand	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.1

[a]OPEC = Organization of the Petroleum Exporting Countries (OPEC-13).

Table G14. World Conventional Liquids Production by Region and Country, Low Economic Growth Case, 1990-2030 (Continued)
(Million Barrels Oil Equivalent per Day)

Region/Country	History (Estimates)			Projections					Average Annual Percent Change, 2005-2030
	1990	2005	2006	2010	2015	2020	2025	2030	
Non-OECD	**21.0**	**26.2**	**26.7**	**29.7**	**31.5**	**32.8**	**33.6**	**34.8**	**1.1**
Non-OECD Europe and Eurasia	**11.6**	**11.9**	**12.3**	**14.1**	**15.7**	**16.1**	**16.3**	**16.9**	**1.4**
Russia	**10.1**	**9.5**	**9.7**	**10.3**	**11.3**	**11.6**	**11.8**	**12.1**	**1.0**
Caspian Area	**1.1**	**2.1**	**2.3**	**3.5**	**4.2**	**4.3**	**4.4**	**4.6**	**3.2**
Azerbaijan	0.3	0.4	0.6	1.3	1.3	1.1	1.0	0.9	3.0
Kazakhstan	0.6	1.3	1.4	1.9	2.6	2.8	2.9	3.2	3.6
Turkmenistan	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.3	2.0
Uzbekistan	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-1.5
Other	**0.4**	**0.3**	**0.3**	**0.3**	**0.2**	**0.2**	**0.2**	**0.2**	**-1.4**
Non-OECD Asia	**4.4**	**6.5**	**6.6**	**6.7**	**6.7**	**6.8**	**6.6**	**6.3**	**-0.1**
China	2.8	3.8	3.8	3.7	3.7	3.6	3.4	3.3	-0.5
India	0.7	0.8	0.9	1.0	1.0	1.1	1.1	1.0	0.8
Brunei	0.2	0.2	0.2	0.2	0.2	0.3	0.2	0.2	0.1
Malaysia	0.6	0.7	0.7	0.6	0.6	0.7	0.7	0.7	-0.3
Thailand	0.1	0.3	0.3	0.4	0.4	0.4	0.4	0.4	1.2
Vietnam	0.1	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.8
Other	0.1	0.3	0.3	0.3	0.3	0.2	0.2	0.2	-1.0
Middle East (Non-OPEC)	**1.3**	**1.7**	**1.6**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**-0.6**
Oman	0.7	0.8	0.7	0.7	0.8	0.8	0.8	0.8	0.0
Syria	0.4	0.5	0.4	0.4	0.4	0.3	0.3	0.3	-1.8
Yemen	0.2	0.4	0.4	0.3	0.3	0.3	0.3	0.3	-0.6
Other	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	-0.4
Africa	**1.6**	**2.4**	**2.4**	**2.8**	**2.9**	**3.2**	**3.4**	**3.6**	**1.6**
Chad	0.0	0.2	0.2	0.2	0.2	0.2	0.3	0.3	2.3
Congo (Brazzaville)	0.2	0.2	0.2	0.2	0.3	0.4	0.5	0.5	3.2
Egypt	0.9	0.7	0.7	0.6	0.6	0.7	0.7	0.7	0.0
Equatorial Guniea	0.0	0.4	0.4	0.5	0.4	0.4	0.4	0.4	0.1
Gabon	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	-0.5
Sao Tome and Principe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	—
Sudan	0.0	0.4	0.4	0.7	0.7	0.7	0.7	0.8	3.4
Other	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.5	2.2
Central and South America	**2.0**	**3.6**	**3.7**	**4.6**	**4.7**	**5.2**	**5.8**	**6.6**	**2.4**
Brazil	0.7	1.8	1.9	2.9	3.1	3.6	4.0	4.4	3.7
Argentina	0.5	0.8	0.8	0.7	0.5	0.4	0.4	0.4	-3.0
Colombia	0.5	0.5	0.5	0.5	0.4	0.3	0.3	0.3	-2.8
Peru	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.3	4.4
Trinidad and Tobago	0.1	0.2	0.2	0.2	0.2	0.2	0.1	0.1	-0.9
Other	0.1	0.2	0.2	0.2	0.4	0.5	0.7	1.0	6.6
Total World	**65.7**	**81.9**	**81.6**	**85.3**	**88.3**	**91.1**	**92.8**	**94.5**	**0.6**
OPEC Share of World Production	38%	43%	43%	43%	45%	46%	46%	46%	
Persian Gulf Share of World Production	25%	29%	29%	28%	29%	30%	30%	30%	

Note: Conventional liquids include crude oil and lease condensate, natural gas plant liquids, and refinery gain.
Sources: **History:** Energy Information Administration (EIA), Office of Energy Markets and End Use. **Projections:** EIA, Generate World Oil Balance Model (2008).

Table G15. World Unconventional Liquids Production by Region and Country, Low Economic Growth Case, 1990-2030
(Million Barrels Oil Equivalent per Day)

Region/Country	History (Estimates)			Projections					Average Annual Percent Change, 2005-2030
	1990	2005	2006	2010	2015	2020	2025	2030	
OPEC[a]	**0.0**	**0.8**	**0.7**	**1.0**	**1.0**	**1.2**	**1.3**	**1.4**	**2.5**
Biofuels	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Extra-Heavy Oil (Venezuela)	0.0	0.6	0.6	0.8	0.8	0.9	1.0	1.1	2.5
Coal-to-Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Gas-to-Liquids (primarily Qatar)	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.2	—
Non-OPEC	**0.6**	**1.7**	**1.9**	**2.4**	**2.9**	**3.3**	**4.2**	**5.4**	**4.7**
OECD	**0.5**	**1.5**	**1.6**	**2.4**	**2.4**	**2.8**	**3.5**	**4.6**	**4.7**
Biofuels	0.0	0.2	0.3	0.6	0.8	1.0	1.2	1.2	7.2
Oil Sands/Bitumen (Canada)	0.4	1.1	1.2	1.7	1.2	1.3	1.5	1.7	1.7
Extra-Heavy Oil (Mexico)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Coal-to-Liquids	0.0	0.0	0.0	0.0	0.1	0.2	0.4	1.2	32.7
Gas-to-Liquids	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	—
Shale Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	—
Non-OECD	**0.1**	**0.2**	**0.2**	**0.0**	**0.5**	**0.5**	**0.7**	**0.8**	**4.8**
Biofuels	0.1	0.3	0.4	0.6	0.4	0.4	0.5	0.5	1.9
Extra-Heavy Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Coal-to-Liquids	0.1	0.1	0.1	0.2	0.1	0.1	0.2	0.3	2.9
Gas-to-Liquids	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	—
Shale Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.0
World									
Biofuels	0.2	0.5	0.6	1.2	1.2	1.4	1.7	1.8	4.9
Oil Sands/Bitumen	0.4	1.1	1.2	1.7	1.2	1.3	1.5	1.7	1.7
Extra-Heavy Oil	0.0	0.6	0.6	0.8	0.9	0.9	1.0	1.1	2.6
Coal-to-Liquids	0.1	0.1	0.1	0.2	0.2	0.3	0.6	1.5	10.2
Gas-to-Liquids	0.0	0.0	0.0	0.1	0.3	0.4	0.4	0.4	—
Shale Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	13.1
World Total	**0.6**	**2.5**	**2.6**	**3.4**	**3.9**	**4.5**	**5.5**	**6.8**	**4.2**
Selected Country Highlights									
Biofuels									
Brazil	0.1	0.2	0.2	0.3	0.2	0.2	0.3	0.3	1.6
China	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-1.1
India	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	-0.1
United States	0.0	0.2	0.2	0.5	0.7	0.9	1.1	1.2	7.9
Coal-to-Liquids									
Australia and New Zealand	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
China	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	—
Germany	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-3.6
India	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
South Africa	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2
United States	0.0	0.0	0.0	0.0	0.0	0.2	0.4	1.2	—
Gas-to-Liquids									
Qatar	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.2	—
South Africa	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	—

[a]OPEC = Organization of the Petroleum Exporting Countries (OPEC-13).

Sources: **History:** Energy Information Administration (EIA), Office of Energy Markets and End Use. **Projections:** EIA, Generate World Oil Balance Model (2008).

Appendix H

Reference Case Projections for Electricity Capacity and Generation by Fuel

Table H1. World Total Installed Generating Capacity by Region and Country, 2005-2030
(Gigawatts)

Region/Country	History	Projections					Average Annual Percent Change, 2005-2030
	2005	2010	2015	2020	2025	2030	
OECD							
OECD North America	**1,146**	**1,235**	**1,253**	**1,327**	**1,423**	**1,523**	**1.1**
United States[a]	974	1,035	1,025	1,073	1,142	1,213	0.9
Canada	120	138	157	171	186	200	2.1
Mexico	52	61	70	83	95	110	3.0
OECD Europe	**746**	**829**	**884**	**945**	**988**	**1,054**	**1.4**
OECD Asia	**368**	**421**	**442**	**456**	**467**	**484**	**1.1**
Japan	248	271	271	272	271	273	0.4
South Korea	62	86	101	110	117	128	2.9
Australia/New Zealand	58	65	70	74	79	83	1.4
Total OECD	**2,260**	**2,485**	**2,579**	**2,729**	**2,878**	**3,062**	**1.2**
Non-OECD							
Non-OECD Europe and Eurasia	**403**	**466**	**522**	**558**	**595**	**632**	**1.8**
Russia	217	248	282	307	330	353	2.0
Other	186	218	240	251	266	278	1.6
Non-OECD Asia	**781**	**1,128**	**1,438**	**1,777**	**2,128**	**2,472**	**4.7**
China	442	692	890	1,132	1,384	1,618	5.3
India	138	201	249	296	347	398	4.3
Other Non-OECD Asia	201	235	299	349	397	457	3.3
Middle East	**123**	**160**	**177**	**188**	**201**	**216**	**2.3**
Africa	**107**	**135**	**167**	**195**	**218**	**240**	**3.3**
Central and South America	**215**	**263**	**306**	**347**	**382**	**412**	**2.6**
Brazil	91	119	152	179	204	226	3.7
Other Central and South America	124	144	155	169	178	186	1.6
Total Non-OECD	**1,629**	**2,152**	**2,611**	**3,067**	**3,525**	**3,972**	**3.6**
Total World	**3,889**	**4,637**	**5,189**	**5,795**	**6,402**	**7,033**	**2.4**

[a]Includes the 50 States and the District of Columbia.

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

Sources: **History:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run AEO2008.D030208F, web site www.eia.doe.gov/oiaf/aeo; and System for the Analysis of Global Energy Markets/Global Electricity Module (2008).

Table H2. World Installed Liquids-Fired Generating Capacity by Region and Country, 2005-2030
(Gigawatts)

Region/Country	History	Projections					Average Annual Percent Change, 2005-2030
	2005	2010	2015	2020	2025	2030	
OECD							
OECD North America	**141**	**141**	**116**	**116**	**116**	**115**	**-0.8**
United States[a]	122	120	95	95	95	95	-1.0
Canada	4	5	5	5	5	5	1.1
Mexico	15	16	16	15	15	15	0.1
OECD Europe	**54**	**57**	**57**	**55**	**54**	**53**	**-0.1**
OECD Asia	**67**	**67**	**67**	**66**	**64**	**63**	**-0.2**
Japan	59	59	59	58	57	56	-0.2
South Korea	6	6	6	6	6	6	-0.1
Australia/New Zealand	1	1	1	1	1	1	0.1
Total OECD	**261**	**265**	**240**	**237**	**234**	**231**	**-0.5**
Non-OECD							
Non-OECD Europe and Eurasia	**30**	**31**	**32**	**32**	**31**	**31**	**0.1**
Russia	9	10	10	10	10	10	0.4
Other	22	22	22	22	22	22	0.0
Non-OECD Asia	**56**	**57**	**58**	**57**	**56**	**55**	**-0.1**
China	15	15	15	15	14	14	-0.2
India	6	7	7	6	6	6	0.1
Other Non-OECD Asia	35	36	37	36	35	34	-0.1
Middle East	**37**	**43**	**45**	**44**	**44**	**46**	**0.9**
Africa	**10**	**11**	**11**	**10**	**10**	**10**	**-0.1**
Central and South America	**28**	**28**	**28**	**27**	**27**	**26**	**-0.2**
Brazil	4	4	4	4	4	3	-0.2
Other Central and South America	24	24	24	24	23	23	-0.2
Total Non-OECD	**161**	**170**	**173**	**171**	**168**	**168**	**0.2**
Total World	**422**	**435**	**413**	**408**	**403**	**400**	**-0.2**

[a]Includes the 50 States and the District of Columbia.

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

Sources: **History:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run AEO2008.D030208F, web site www.eia.doe.gov/oiaf/aeo; and System for the Analysis of Global Energy Markets/Global Electricity Module (2008).

Table H3. World Installed Natural-Gas-Fired Generating Capacity by Region and Country, 2005-2030
(Gigawatts)

Region/Country	History	Projections					Average Annual Percent Change, 2005-2030
	2005	2010	2015	2020	2025	2030	
OECD							
OECD North America	**348**	**389**	**405**	**435**	**481**	**535**	**1.7**
United States[a]	316	345	342	352	378	409	1.0
Canada	13	20	31	37	46	54	5.7
Mexico	18	23	32	45	57	72	5.7
OECD Europe	**168**	**209**	**270**	**330**	**359**	**376**	**3.3**
OECD Asia	**101**	**131**	**139**	**146**	**152**	**160**	**1.9**
Japan	72	85	82	83	82	84	0.6
South Korea	17	31	38	42	46	50	4.5
Australia/New Zealand	12	16	19	21	24	26	3.1
Total OECD	**617**	**729**	**815**	**911**	**992**	**1,071**	**2.2**
Non-OECD							
Non-OECD Europe and Eurasia	**139**	**186**	**218**	**236**	**257**	**276**	**2.8**
Russia	95	115	138	150	165	177	2.5
Other	44	71	80	86	92	99	3.2
Non-OECD Asia	**104**	**188**	**301**	**450**	**583**	**715**	**8.0**
China	16	58	102	191	270	339	13.0
India	15	37	58	78	106	133	9.1
Other Non-OECD Asia	73	93	141	181	207	243	4.9
Middle East	**74**	**100**	**114**	**125**	**136**	**148**	**2.8**
Africa	**34**	**53**	**78**	**103**	**120**	**137**	**5.7**
Central and South America	**43**	**65**	**84**	**98**	**109**	**119**	**4.2**
Brazil	8	17	28	33	38	43	7.0
Other Central and South America	35	48	56	65	71	76	3.1
Total Non-OECD	**394**	**592**	**794**	**1,012**	**1,206**	**1,395**	**5.2**
Total World	**1,011**	**1,321**	**1,609**	**1,923**	**2,198**	**2,467**	**3.6**

[a]Includes the 50 States and the District of Columbia.

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

Sources: **History:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run AEO2008.D030208F, web site www.eia.doe.gov/oiaf/aeo; and System for the Analysis of Global Energy Markets/Global Electricity Module (2008).

Table H4. World Installed Coal-Fired Generating Capacity by Region and Country, 2005-2030
(Gigawatts)

Region/Country	History	Projections					Average Annual Percent Change, 2005-2030
	2005	2010	2015	2020	2025	2030	
OECD							
OECD North America	**338**	**345**	**354**	**374**	**404**	**439**	**1.0**
United States[a]	314	320	329	349	379	414	1.1
Canada	18	18	18	18	18	18	0.0
Mexico	6	7	7	7	7	7	0.4
OECD Europe	**198**	**212**	**209**	**206**	**203**	**215**	**0.3**
OECD Asia	**97**	**105**	**108**	**109**	**111**	**115**	**0.7**
Japan	46	45	44	44	43	42	-0.4
South Korea	21	28	30	30	30	33	1.9
Australia/New Zealand	30	31	33	36	38	40	1.2
Total OECD	**634**	**661**	**671**	**690**	**718**	**769**	**0.8**
Non-OECD							
Non-OECD Europe and Eurasia	**102**	**102**	**120**	**126**	**131**	**147**	**1.5**
Russia	45	46	52	58	59	69	1.8
Other	58	57	68	68	72	78	1.2
Non-OECD Asia	**425**	**628**	**803**	**961**	**1,130**	**1,304**	**4.6**
China	299	478	619	756	897	1,034	5.1
India	79	96	120	140	155	173	3.2
Other Non-OECD Asia	47	54	64	66	79	97	2.9
Middle East	**5**	**6**	**6**	**6**	**6**	**6**	**0.6**
Africa	**39**	**42**	**47**	**50**	**53**	**53**	**1.2**
Central and South America	**9**	**12**	**16**	**16**	**16**	**17**	**2.5**
Brazil	2	4	4	5	5	6	4.5
Other Central and South America	7	9	11	11	11	11	1.7
Total Non-OECD	**580**	**790**	**991**	**1,159**	**1,336**	**1,526**	**3.9**
Total World	**1,214**	**1,451**	**1,662**	**1,849**	**2,055**	**2,295**	**2.6**

[a]Includes the 50 States and the District of Columbia.

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

Sources: **History:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run AEO2008.D030208F, web site www.eia.doe.gov/oiaf/aeo; and System for the Analysis of Global Energy Markets/Global Electricity Module (2008).

Table H5. World Installed Nuclear Generating Capacity by Region and Country, 2005-2030
(Gigawatts)

Region/Country	History	Projections					Average Annual Percent Change, 2005-2030
	2005	2010	2015	2020	2025	2030	
OECD							
OECD North America	**114**	**117**	**119**	**128**	**134**	**134**	**0.6**
United States[a]	100	101	102	111	116	115	0.6
Canada	13	15	15	16	17	18	1.4
Mexico	1	1	1	1	1	1	0.1
OECD Europe	**133**	**129**	**126**	**114**	**116**	**118**	**-0.5**
OECD Asia	**64**	**67**	**74**	**80**	**84**	**88**	**1.3**
Japan	47	49	52	54	56	58	0.8
South Korea	17	18	22	26	28	30	2.4
Australia/New Zealand	0	0	0	0	0	0	—
Total OECD	**311**	**313**	**318**	**323**	**334**	**341**	**0.4**
Non-OECD							
Non-OECD Europe and Eurasia	**43**	**42**	**46**	**57**	**65**	**66**	**1.7**
Russia	23	23	27	33	40	41	2.3
Other	20	19	19	24	25	25	1.0
Non-OECD Asia	**15**	**21**	**40**	**59**	**75**	**83**	**7.0**
China	7	9	22	35	45	52	8.5
India	3	5	9	14	18	20	8.2
Other Non-OECD Asia	6	6	8	10	12	11	2.8
Middle East	**0**	**0**	**1**	**1**	**1**	**1**	**—**
Africa	**2**	**2**	**2**	**2**	**3**	**3**	**1.9**
Central and South America	**3**	**3**	**4**	**5**	**5**	**5**	**1.6**
Brazil	2	2	3	3	3	3	1.6
Other Central and South America	1	1	1	2	2	2	1.6
Total Non-OECD	**63**	**68**	**93**	**124**	**148**	**157**	**3.7**
Total World	**374**	**381**	**411**	**446**	**482**	**498**	**1.1**

[a]Includes the 50 States and the District of Columbia.

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

Sources: **History:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run AEO2008.D030208F, web site www.eia.doe.gov/oiaf/aeo; and System for the Analysis of Global Energy Markets/Global Electricity Module (2008).

Table H6. World Installed Hydroelectric and Other Renewable Generating Capacity by Region and Country, 2005-2030
(Gigawatts)

Region/Country	History	Projections					Average Annual Percent Change, 2005-2030
	2005	2010	2015	2020	2025	2030	
OECD							
OECD North America	**208**	**242**	**259**	**274**	**289**	**300**	**1.5**
United States[a]	121	149	157	166	175	181	1.6
Canada	75	80	88	94	100	105	1.3
Mexico	12	14	14	14	14	14	0.7
OECD Europe	**212**	**223**	**223**	**240**	**255**	**292**	**1.3**
OECD Asia	**45**	**52**	**53**	**54**	**55**	**57**	**0.9**
Japan	28	33	33	33	33	34	0.8
South Korea	2	3	4	5	6	7	5.9
Australia/New Zealand	16	16	16	16	16	16	0.0
Total OECD	**465**	**517**	**535**	**568**	**599**	**649**	**1.3**
Non-OECD							
Non-OECD Europe and Eurasia	**94**	**105**	**106**	**107**	**111**	**112**	**0.7**
Russia	46	55	55	56	56	56	0.8
Other	48	50	51	51	54	55	0.6
Non-OECD Asia	**203**	**234**	**237**	**250**	**284**	**316**	**1.8**
China	106	132	132	136	158	179	2.1
India	53	56	56	57	62	66	0.8
Other Non-OECD Asia	43	47	49	57	64	72	2.1
Middle East	**8**	**11**	**11**	**12**	**13**	**14**	**2.6**
Africa	**23**	**27**	**29**	**30**	**32**	**38**	**2.0**
Central and South America	**132**	**154**	**175**	**202**	**226**	**245**	**2.5**
Brazil	75	92	113	135	154	170	3.4
Other Central and South America	57	62	62	67	72	75	1.1
Total Non-OECD	**458**	**532**	**559**	**601**	**666**	**725**	**1.8**
Total World	**923**	**1,049**	**1,094**	**1,170**	**1,265**	**1,373**	**1.6**

[a]Includes the 50 States and the District of Columbia.

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

Sources: **History:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run AEO2008.D030208F, web site www.eia.doe.gov/oiaf/aeo; and System for the Analysis of Global Energy Markets/Global Electricity Module (2008).

Table H7. World Total Net Electricity Generation From Central Producers by Region and Country, 2005-2030
(Billion Kilowatthours)

Region/Country	History	Projections					Average Annual Percent Change, 2005-2030
	2005	2010	2015	2020	2025	2030	
OECD							
OECD North America	**4,886**	**5,222**	**5,543**	**5,898**	**6,247**	**6,620**	**1.2**
United States[a]	4,054	4,294	4,485	4,723	4,973	5,235	1.0
Canada	610	672	741	793	836	880	1.5
Mexico	222	256	316	381	439	505	3.3
OECD Europe	**3,304**	**3,696**	**3,971**	**4,213**	**4,439**	**4,666**	**1.4**
OECD Asia	**1,669**	**1,845**	**1,996**	**2,077**	**2,147**	**2,239**	**1.2**
Japan	1,025	1,097	1,138	1,160	1,176	1,192	0.6
South Korea	366	448	536	573	603	653	2.3
Australia/New Zealand	278	300	322	344	368	393	1.4
Total OECD	**9,859**	**10,764**	**11,510**	**12,188**	**12,834**	**13,525**	**1.3**
Non-OECD							
Non-OECD Europe and Eurasia	**1,498**	**1,801**	**2,140**	**2,386**	**2,608**	**2,846**	**2.6**
Russia	884	1,059	1,265	1,409	1,539	1,677	2.6
Other	614	741	874	977	1,069	1,169	2.6
Non-OECD Asia	**3,917**	**5,925**	**7,828**	**9,565**	**11,280**	**12,906**	**4.9**
China	2,368	3,921	5,212	6,428	7,660	8,814	5.4
India	662	919	1,197	1,444	1,677	1,891	4.3
Other Non-OECD Asia	886	1,084	1,419	1,693	1,944	2,200	3.7
Middle East	**603**	**742**	**845**	**934**	**1,033**	**1,132**	**2.6**
Africa	**533**	**649**	**799**	**956**	**1,062**	**1,138**	**3.1**
Central and South America	**905**	**1,118**	**1,289**	**1,445**	**1,583**	**1,716**	**2.6**
Brazil	392	497	606	699	791	880	3.2
Other Central and South America	513	621	683	746	791	835	2.0
Total Non-OECD	**7,455**	**10,234**	**12,902**	**15,286**	**17,565**	**19,738**	**4.0**
Total World	**17,315**	**20,998**	**24,412**	**27,474**	**30,399**	**33,264**	**2.6**

[a]Includes the 50 States and the District of Columbia.

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

Sources: **History:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run AEO2008.D030208F, web site www.eia.doe.gov/oiaf/aeo; and System for the Analysis of Global Energy Markets/Global Electricity Module (2008).

Table H8. World Net Liquids-Fired Electricity Generation From Central Producers by Region and Country, 2005-2030
(Billion Kilowatthours)

Region/Country	History	Projections					Average Annual Percent Change, 2005-2030
	2005	2010	2015	2020	2025	2030	
OECD							
OECD North America	**195**	**126**	**123**	**123**	**125**	**123**	**-1.8**
United States[a]	122	55	57	60	64	66	-2.4
Canada	14	13	12	11	10	8	-2.2
Mexico	58	57	55	52	51	48	-0.8
OECD Europe	**73**	**61**	**52**	**42**	**35**	**32**	**-3.3**
OECD Asia	**104**	**92**	**81**	**69**	**58**	**46**	**-3.2**
Japan	84	74	64	55	45	35	-3.5
South Korea	18	17	15	14	12	10	-2.3
Australia/New Zealand	1	1	1	1	1	1	-0.7
Total OECD	**372**	**279**	**256**	**234**	**218**	**200**	**-2.4**
Non-OECD							
Non-OECD Europe and Eurasia	**57**	**49**	**46**	**45**	**42**	**39**	**-1.5**
Russia	27	25	21	19	17	15	-2.4
Other	30	24	25	26	26	24	-0.8
Non-OECD Asia	**160**	**154**	**145**	**137**	**133**	**122**	**-1.1**
China	45	43	41	39	38	35	-1.1
India	20	21	20	20	20	20	0.0
Other Non-OECD Asia	95	90	85	78	75	68	-1.4
Middle East	**218**	**241**	**262**	**282**	**303**	**323**	**1.6**
Africa	**61**	**56**	**51**	**46**	**43**	**37**	**-1.9**
Central and South America	**88**	**80**	**70**	**61**	**53**	**43**	**-2.9**
Brazil	8	8	8	7	7	7	-0.8
Other Central and South America	80	72	62	53	45	36	-3.1
Total Non-OECD	**584**	**579**	**576**	**571**	**574**	**563**	**-0.1**
Total World	**956**	**858**	**831**	**804**	**791**	**764**	**-0.9**

[a]Includes the 50 States and the District of Columbia.

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

Sources: **History:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run AEO2008.D030208F, web site www.eia.doe.gov/oiaf/aeo; and System for the Analysis of Global Energy Markets/Global Electricity Module (2008).

Table H9. World Net Natural-Gas-Fired Electricity Generation From Central Producers by Region and Country, 2005-2030
(Billion Kilowatthours)

Region/Country	History	Projections					Average Annual Percent Change, 2005-2030
	2005	2010	2015	2020	2025	2030	
OECD							
OECD North America	**877**	**1,062**	**1,147**	**1,158**	**1,162**	**1,216**	**1.3**
United States[a]	756	908	905	833	768	741	-0.1
Canada	42	52	78	95	106	118	4.2
Mexico	78	102	164	230	288	357	6.3
OECD Europe	**710**	**940**	**1,249**	**1,533**	**1,697**	**1,863**	**3.9**
OECD Asia	**352**	**447**	**526**	**554**	**579**	**597**	**2.1**
Japan	261	315	348	367	374	379	1.5
South Korea	56	89	123	126	137	141	3.8
Australia/New Zealand	35	44	55	61	69	76	3.1
Total OECD	**1,939**	**2,449**	**2,922**	**3,246**	**3,438**	**3,675**	**2.6**
Non-OECD							
Non-OECD Europe and Eurasia	**506**	**728**	**885**	**997**	**1,104**	**1,202**	**3.5**
Russia	350	456	590	646	721	774	3.2
Other	156	272	295	351	383	427	4.1
Non-OECD Asia	**392**	**605**	**962**	**1,353**	**1,549**	**1,713**	**6.1**
China	51	82	149	232	253	270	6.9
India	35	86	148	213	278	313	9.2
Other Non-OECD Asia	306	437	665	908	1,018	1,130	5.4
Middle East	**335**	**439**	**512**	**578**	**653**	**731**	**3.2**
Africa	**120**	**211**	**310**	**448**	**516**	**573**	**6.5**
Central and South America	**129**	**259**	**334**	**391**	**445**	**495**	**5.5**
Brazil	26	75	102	115	134	151	7.3
Other Central and South America	103	185	232	276	310	345	4.9
Total Non-OECD	**1,483**	**2,241**	**3,002**	**3,767**	**4,267**	**4,714**	**4.7**
Total World	**3,422**	**4,691**	**5,925**	**7,013**	**7,705**	**8,389**	**3.7**

[a]Includes the 50 States and the District of Columbia.

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

Sources: **History:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run AEO2008.D030208F, web site www.eia.doe.gov/oiaf/aeo; and System for the Analysis of Global Energy Markets/Global Electricity Module (2008).

Table H10. World Net Coal-Fired Electricity Generation From Central Producers by Region and Country, 2005-2030
(Billion Kilowatthours)

Region/Country	History	Projections					Average Annual Percent Change, 2005-2030
	2005	2010	2015	2020	2025	2030	
OECD							
OECD North America	**2,156**	**2,204**	**2,330**	**2,505**	**2,722**	**2,984**	**1.3**
United States[a]	2,014	2,055	2,182	2,357	2,575	2,836	1.4
Canada	102	102	102	102	102	102	0.0
Mexico	40	47	46	46	46	46	0.5
OECD Europe	**980**	**1,097**	**1,083**	**1,069**	**1,055**	**1,044**	**0.3**
OECD Asia	**656**	**697**	**720**	**727**	**741**	**780**	**0.7**
Japan	303	298	293	287	282	277	-0.4
South Korea	150	192	209	207	209	234	1.8
Australia/New Zealand	204	207	218	234	251	269	1.1
Total OECD	**3,792**	**3,998**	**4,133**	**4,302**	**4,519**	**4,808**	**1.0**
Non-OECD							
Non-OECD Europe and Eurasia	**391**	**392**	**534**	**586**	**629**	**756**	**2.7**
Russia	213	214	255	299	299	374	2.3
Other	178	178	279	288	330	382	3.1
Non-OECD Asia	**2,636**	**4,235**	**5,633**	**6,780**	**8,034**	**9,303**	**5.2**
China	1,835	3,245	4,368	5,382	6,412	7,403	5.7
India	488	626	814	953	1,071	1,222	3.7
Other Non-OECD Asia	313	364	451	446	550	678	3.1
Middle East	**30**	**39**	**38**	**38**	**37**	**37**	**0.8**
Africa	**251**	**265**	**312**	**334**	**357**	**359**	**1.4**
Central and South America	**51**	**70**	**93**	**94**	**95**	**98**	**2.6**
Brazil	7	13	16	17	19	23	4.5
Other Central and South America	44	57	77	77	76	76	2.2
Total Non-OECD	**3,360**	**5,001**	**6,609**	**7,833**	**9,152**	**10,553**	**4.7**
Total World	**7,152**	**8,999**	**10,742**	**12,134**	**13,671**	**15,361**	**3.1**

[a]Includes the 50 States and the District of Columbia.

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

Sources: **History:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run AEO2008.D030208F, web site www.eia.doe.gov/oiaf/aeo; and System for the Analysis of Global Energy Markets/Global Electricity Module (2008).

Table H11. World Net Nuclear Electricity Generation From Central Producers by Region and Country, 2005-2030
(Billion Kilowatthours)

Region/Country	History	Projections					Average Annual Percent Change, 2005-2030
	2005	2010	2015	2020	2025	2030	
OECD							
OECD North America	**880**	**917**	**931**	**998**	**1,048**	**1,063**	**0.8**
United States[a]	782	797	807	868	911	917	0.6
Canada	87	110	113	120	127	135	1.7
Mexico	10	11	11	11	11	11	0.1
OECD Europe	**929**	**914**	**902**	**829**	**854**	**879**	**-0.2**
OECD Asia	**418**	**440**	**494**	**546**	**583**	**624**	**1.6**
Japan	278	299	319	336	358	381	1.3
South Korea	139	142	175	210	225	243	2.2
Australia/New Zealand	0	0	0	0	0	0	—
Total OECD	**2,227**	**2,271**	**2,326**	**2,373**	**2,485**	**2,565**	**0.6**
Non-OECD							
Non-OECD Europe and Eurasia	**264**	**289**	**327**	**409**	**472**	**485**	**2.5**
Russia	140	155	190	236	293	305	3.2
Other	124	134	136	172	180	180	1.5
Non-OECD Asia	**106**	**150**	**293**	**446**	**573**	**643**	**7.5**
China	50	65	164	267	351	410	8.8
India	16	37	66	104	134	149	9.4
Other Non-OECD Asia	40	47	64	75	88	84	3.0
Middle East	**0**	**0**	**6**	**6**	**6**	**6**	**—**
Africa	**12**	**14**	**15**	**15**	**21**	**21**	**2.2**
Central and South America	**16**	**23**	**28**	**34**	**34**	**34**	**2.0**
Brazil	10	15	18	22	22	22	1.8
Other Central and South America	6	8	10	12	11	11	2.4
Total Non-OECD	**399**	**476**	**669**	**910**	**1,106**	**1,189**	**4.4**
Total World	**2,626**	**2,747**	**2,996**	**3,283**	**3,591**	**3,754**	**1.4**

[a]Includes the 50 States and the District of Columbia.

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

Sources: **History:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run AEO2008.D030208F, web site www.eia.doe.gov/oiaf/aeo; and System for the Analysis of Global Energy Markets/Global Electricity Module (2008).

Table H12. World Net Hydroelectric and Other Renewable Electricity Generation From Central Producers by Region and Country, 2005-2030
(Billion Kilowatthours)

Region/Country	History	Projections					Average Annual Percent Change, 2005-2030
	2005	2010	2015	2020	2025	2030	
OECD							
OECD North America	**779**	**913**	**1,012**	**1,113**	**1,190**	**1,236**	**1.9**
United States[a]	380	478	534	604	655	675	2.3
Canada	363	395	436	466	491	517	1.4
Mexico	35	40	41	43	44	45	0.9
OECD Europe	**611**	**685**	**686**	**741**	**797**	**848**	**1.3**
OECD Asia	**140**	**168**	**176**	**180**	**186**	**193**	**1.3**
Japan	98	111	114	116	118	120	0.8
South Korea	3	9	13	17	21	25	8.2
Australia/New Zealand	39	49	49	48	48	48	0.9
Total OECD	**1,530**	**1,766**	**1,873**	**2,034**	**2,174**	**2,277**	**1.6**
Non-OECD							
Non-OECD Europe and Eurasia	**279**	**343**	**348**	**348**	**361**	**366**	**1.1**
Russia	154	209	209	209	209	209	1.2
Other	126	134	139	139	152	157	0.9
Non-OECD Asia	**622**	**781**	**796**	**849**	**991**	**1,125**	**2.4**
China	386	486	490	508	605	696	2.4
India	104	149	150	155	173	187	2.4
Other Non-OECD Asia	131	146	156	186	213	241	2.5
Middle East	**19**	**24**	**27**	**30**	**33**	**36**	**2.6**
Africa	**89**	**103**	**111**	**113**	**125**	**148**	**2.0**
Central and South America	**620**	**686**	**764**	**864**	**956**	**1,045**	**2.1**
Brazil	341	386	463	537	608	678	2.8
Other Central and South America	279	300	301	328	348	367	1.1
Total Non-OECD	**1,630**	**1,937**	**2,045**	**2,205**	**2,466**	**2,719**	**2.1**
Total World	**3,160**	**3,703**	**3,918**	**4,239**	**4,640**	**4,996**	**1.8**

[a]Includes the 50 States and the District of Columbia.

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

Sources: **History:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2008*, DOE/EIA-0383(2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run AEO2008.D030208F, web site www.eia.doe.gov/oiaf/aeo; and System for the Analysis of Global Energy Markets/Global Electricity Module (2008).

Appendix I

Comparisons With International Energy Agency and *IEO2007* Projections

Comparisons with IEA's *World Energy Outlook 2007*

The International Energy Agency (IEA) in its *World Energy Outlook 2007* provides projections comparable with those in *IEO2008*. Because IEA releases projections only for the years 2015 and 2030, two time periods are compared here—2005 to 2015 and 2015 to 2030.

In the 2005 to 2015 projection period, the IEA reference scenario reflects growth that more closely resembles the *IEO2008* high economic growth case than its reference case. Both the IEA reference scenario and the IEO2008 high economic growth case project increases in world energy consumption that average 2.3 percent per year, compared with 2.0 percent in the *IEO2008* reference case (Table I1). There are large differences between the IEA reference scenario and the *IEO2008* reference case projections for both the OECD and non-OECD countries.

Within the OECD country group, the IEA projections of growth in energy demand for the United States surpass the upper bound of the range defined by the *IEO2008* low and high economic growth cases for the United States (in part because the IEA reference scenario does not incorporate provisions of the U.S. Energy Independence and Security Act of 2007 [EISA2007], which was enacted after the IEA projections were released) and for Japan. Differences in the near-term outlook for both countries also reflect different projections for world oil prices, which in 2010 are about 25 percent higher in the *IEO2008* reference case than in the IEA reference scenario.

Both outlooks project much faster growth in energy demand among the non-OECD nations than in the OECD, and both have similar projections for growth in non-OECD Europe and Eurasia. *IEO2008* projects 1.6-percent average annual growth in energy use from 2005 to 2015, and IEA projects 1.7-percent annual growth. For

Table I1. Comparison of *IEO2008* and IEA World Energy Consumption Growth Rates by Region, 2005-2015
(Average Annual Percent Growth)

Region	*IEO2008*			IEA Reference Scenario
	Low Growth	Reference	High Growth	
OECD	**0.5**	**0.8**	**1.1**	**1.1**
North America	0.6	0.9	1.2	1.3
United States	0.4	0.7	1.0	1.2
Other North America	1.4	1.7	2.0	1.8
Europe	0.4	0.6	0.9	0.6
Asia	0.5	0.8	1.1	1.4
Japan	-0.1	0.1	0.4	1.1
Other Asia	1.4	1.7	2.0	2.0
Non-OECD	**2.8**	**3.2**	**3.6**	**3.4**
Europe and Eurasia	1.3	1.6	1.9	1.7
Russia	1.1	1.4	1.7	1.7
Non-OECD Asia	3.7	4.1	4.5	4.3
China	4.0	4.5	4.9	5.0
India	3.3	3.6	4.0	3.7
Other Non-OECD Asia	3.0	3.3	3.7	2.9
Middle East	2.2	2.6	2.9	3.9
Africa	2.4	2.7	3.1	1.8
Central and South America	2.3	2.7	3.0	2.6
Total World	**1.7**	**2.0**	**2.3**	**2.3**

Sources: ***IEO2008*:** Energy Information Administration (EIA), World Energy Projections Plus (2008). **IEA:** International Energy Agency, *World Energy Outlook 2007* (Paris, France, November 2007), pp. 592-630.

China and the Middle East, IEA projects much faster growth than *IEO2008* from 2005 to 2015. In each case, IEA's projected growth rates are higher than those in the *IEO2008* high economic growth case. On the other hand, IEA's projected 2.9-percent average annual growth rate for energy consumption in "other non-OECD Asia" (excluding China and India) over the same period is lower than the projection of 3.3 percent per year in the *IEO2008* reference case and, in fact, falls below the projected growth rate in the *IEO2008* low economic growth case. Similarly, IEA projects a modest 1.8-percent annual increase in Africa's energy use from 2005 to 2015, compared with 2.7 percent per year in the *IEO2008* reference case.

In the later years of the projections, *IEO2008* and IEA generally agree, with worldwide energy demand growing by 1.4 percent per year between 2015 and 2030 in both outlooks (Table I2). Both outlooks anticipate similar regional growth over the 2015 to 2030 period. The largest regional differences between the two projections are for China, India, and the Middle East. IEA anticipates that China's energy demand growth will slow to 2.0 percent per year for the final 15 years of the outlook, whereas the *IEO2008* reference case shows China maintaining a 2.7-percent annual growth rate in energy demand through the end of the projection period. The IEA growth projection for energy use in China from 2015 to 2030 is lower than projected in the *IEO2008* low economic growth case. For India, the IEA reference scenario projects 3.7-percent annual growth in energy use from 2005 to 2015 and 3.5-percent growth from 2015 to 2030, whereas *IEO2008* shows the growth rate slowing to 2.4 percent per year from 2015 to 2030.

IEA's optimism regarding demand growth in the Middle East continues to the end of the projection period, with energy use in the region increasing by an average of 2.3 percent per year from 2015 to 2030. *IEO2008*, however, projects average increases of just 1.5 percent per year over the same period in the reference case. The IEA growth rate for the period is higher than projected in the *IEO2008* high economic growth case.

The projections vary not only with respect to levels of total world energy demand but also with respect to the mix of primary energy inputs. In the 2005 to 2015 period, IEA expects faster growth in fossil fuel use and slower growth in the use of non-fossil fuels than does *IEO2008* (Table I3). For nuclear power consumption, the growth rate projected by IEA is below the projection in the *IEO2008* low economic growth case, largely as a result of different assumptions about nuclear power in China. In the *IEO2008* reference case, China's nuclear capacity additions from 2005 to 2015 are nearly double the IEA projection (15 gigawatts and 8 gigawatts net new capacity, respectively).

Table I2. Comparison of *IEO2008* and IEA World Energy Consumption Growth Rates by Region, 2015-2030
(Average Annual Percent Growth)

Region	*IEO2008*			IEA Reference Scenario
	Low Growth	Reference	High Growth	
OECD	**0.2**	**0.6**	**1.0**	**0.6**
North America	0.4	0.8	1.2	0.8
United States	0.3	0.6	1.0	0.7
Other North America	0.9	1.4	1.9	1.3
Europe	0.1	0.4	0.7	0.4
Asia	0.1	0.5	1.0	0.5
Japan	-0.2	0.1	0.5	0.1
Other Asia	0.5	1.0	1.5	1.0
Non-OECD	**1.6**	**2.0**	**2.5**	**2.0**
Europe and Eurasia	0.5	1.0	1.5	0.8
Russia	0.4	0.8	1.3	0.9
Non-OECD Asia	2.2	2.6	3.0	2.2
China	2.4	2.7	3.1	2.0
India	2.1	2.4	2.8	3.5
Other Non-OECD Asia	1.8	2.4	2.9	1.9
Middle East	0.9	1.5	2.1	2.3
Africa	1.0	1.6	2.1	1.8
Central and South America	1.0	1.5	2.1	2.0
Total World	**1.0**	**1.4**	**1.8**	**1.4**

Sources: ***IEO2008*:** Energy Information Administration (EIA), World Energy Projections Plus (2008). **IEA:** International Energy Agency, *World Energy Outlook 2007* (Paris, France, November 2007), pp. 592-630.

The IEA projection for worldwide growth in coal consumption from 2005 to 2015 is bullish in comparison with the *IEO2008* projection, especially for China and India. IEA projects average annual growth of 5.5 percent in China's coal demand from 2005 to 2015, compared with 4.4 percent per year in the *IEO2008* reference case. Similarly, India's coal use grows by 4.7 percent per year in the IEA reference scenario from 2005 to 2015, compared with 2.9 percent per year in the *IEO2008* reference case.

For the period from 2015 to 2030, *IEO2008* and IEA are largely in agreement. The only exception is nuclear power, for which the IEA growth projection falls significantly below that in the *IEO2008* low economic growth case (Table I4). In the IEA projection, the average annual growth rate for world nuclear electricity consumption slows from 1.1 percent in the 2005 to 2015 period to 0.4 percent in the 2015 to 2030 period. *IEO2008* projects average increases of 1.4 percent per year from 2005 to 2015 and 1.5 percent per year from 2015 to 2030.

Comparisons With *IEO2007*

The *IEO2008* outlook for total energy consumption in 2015 is largely the same as the outlook in *IEO2007*. In *IEO2008*, total marketed energy consumption in 2015 is projected to be 563 quadrillion Btu, as compared with 559 quadrillion Btu in *IEO2007* (Table I5). There are, however, some regional differences between the two *IEO*s. In *IEO2008*, total energy consumption for the OECD countries in 2015 is about 5 quadrillion Btu lower than was projected in *IEO2007*. Most (3 quadrillion Btu) of the difference is attributed to lower demand in the United States. The explanation for the lower U.S. consumption is twofold—the projection for average annual GDP growth from 2005 to 2015 is 0.3 percentage points lower in *IEO2008* than was projected in *IEO2007*, and the *IEO2008* reference case reflects the impact of EISA2007, especially with respect to efficiency gains in the building sector.

For the non-OECD countries, the largest differences between the projections for 2015 in *IEO2008* and *IEO2007* involve China. In *IEO2008*, China's projected total energy use in 2015 is 7 quadrillion Btu higher than projected in *IEO2007*. *IEO2008* assumes more rapid economic growth for China between 2005 and 2015 than was assumed in *IEO2007*—8.4 percent per year versus 7.8 percent per year—because China's economic growth has continued to grow more strongly than anticipated in the *IEO2007* projection. Whereas *IEO2007* expected GDP growth to average 10.5 percent in 2006 and then fall gradually through 2010, revisions to the short-term

Table I3. Comparison of *IEO2008* and IEA World Energy Consumption Growth Rates by Fuel, 2005-2015
(Average Annual Percent Growth)

Fuel	*IEO2008*			IEA Reference Scenario
	Low Growth	Reference	High Growth	
Liquids	1.0	1.4	1.8	1.7
Natural Gas	2.0	2.3	2.6	2.6
Coal	2.2	2.6	2.9	3.3
Nuclear	1.2	1.4	1.6	1.1
Renewable/Other	2.1	2.4	2.7	2.1
Total	**1.7**	**2.0**	**2.3**	**2.3**

Note: In the IEA projections, Renewable/Other includes traditional biomass.
Sources: ***IEO2008*:** Energy Information Administration (EIA), World Energy Projections Plus (2008). **IEA:** International Energy Agency, *World Energy Outlook 2007* (Paris, France, November 2007), pp. 592-630.

Table I4. Comparison of *IEO2008* and IEA World Energy Consumption Growth Rates by Fuel, 2015-2030
(Average Annual Percent Growth)

Fuel	*IEO2008*			IEA Reference Scenario
	Low Growth	Reference	High Growth	
Liquids	0.6	1.1	1.6	1.1
Natural Gas	0.9	1.4	1.8	1.7
Coal	1.3	1.7	2.1	1.5
Nuclear	1.1	1.5	2.0	0.4
Renewable/Other	1.4	1.8	2.2	1.7
Total	**1.0**	**1.4**	**1.8**	**1.4**

Note: In the IEA projections, Renewable/Other includes traditional biomass.
Sources: ***IEO2008*:** Energy Information Administration (EIA), World Energy Projections Plus (2008). **IEA:** International Energy Agency, *World Energy Outlook 2007* (Paris, France, November 2007), pp. 592-630.

projections in *IEO2008* include increases in China's GDP to 11.1 percent in 2006 and 11.5 percent in 2007, before it begins to slow from 2008 through 2010.

The near-term differences between the *IEO2008* and *IEO2007* projections are carried through to 2030. The *IEO2008* reference case projection for total energy use worldwide in 2030 is 7 quadrillion Btu (about 1 percent) lower than the *IEO2007* projection. Again, the largest regional differences between the 2030 projections are for the United States and China. In the *IEO2008* reference case, U.S. GDP is projected to increase at an average rate of 2.4 percent per year from 2015 to 2030, 0.5 percentage points lower than the GDP growth rate projected for the United States in *IEO2007*. In addition, the impacts of the EISA2007 legislation are fully realized in the 2030 projection, including increases in the corporate average fuel efficiency standards for U.S. motor vehicles that reduce demand for liquids in the long-term projection. The reference case projection for U.S. total energy use in 2030 is 13 quadrillion Btu (10 percent) lower in *IEO2008* than was projected in *IEO2007*. For China, total projected energy consumption in 2030 is 10 quadrillion Btu higher in *IEO2008* than it was in *IEO2007*, largely because the large short-term increments in energy use carry over into the long-term projection.

Along with regional differences between the *IEO2008* and *IEO2007* projections, there are some differences between the two projections in the mix of energy resources expected to be consumed (Table I6). The *IEO2008* projections for worldwide consumption of liquid fuels and other petroleum are 3 quadrillion Btu lower in 2015 and 10 quadrillion Btu lower in 2030 than in *IEO2007*. The difference can be explained by the higher world oil prices in *IEO2008* and also by the large downward revision in U.S. liquids demand. In 2030, U.S. liquids consumption is 16 percent lower in *IEO2008* than it was in *IEO2007* because of the combination of slower projected economic growth, higher world oil prices, and the impacts of EISA2007.

There are also differences between the *IEO2008* and *IEO2007* projections for consumption of the other fossil fuels: coal consumption is higher in *IEO2008* and natural gas consumption lower. The increase in coal use is attributable largely to higher projected demand in China, based on the strong increase in its consumption during the historical base year (2005). China's coal consumption increased by 13 percent from 2004 to 2005, and as a result, even though its coal use is projected to grow at approximately the same rate as in last year's outlook, coal consumption in China in 2030 is about 9 percent (8 quadrillion Btu) higher than in the *IEO2007* projection. For natural gas demand, nearly two-thirds of the decrease in *IEO2008* from *IEO2007* can be attributed to lower demand in the United States. Higher natural gas prices and the absence of legislation that would limit the expansion of coal-fired generation mean that coal is more competitive economically for electricity generation in the United States, so that coal displaces natural gas use in the later years of the *IEO2008* projection.

Table I5. Comparison of *IEO2008* and *IEO2007* Total World Energy Consumption, Reference Case, 2015 and 2030
(Quadrillion Btu)

Region	2015		2030		Change in *IEO2008*	
	IEO2008	*IEO2007*	*IEO2008*	*IEO2007*	2015	2030
OECD	**260**	**265**	**286**	**298**	**-5**	**-12**
North America	132	137	149	162	-5	-13
United States	107	112	118	131	-5	-13
Europe	87	86	92	89	1	3
Asia	41	42	45	47	-1	-2
Non-OECD	**303**	**294**	**409**	**404**	**8**	**5**
Europe and Eurasia	59	59	69	72	0	-2
China	104	97	155	145	7	10
India	23	22	33	32	2	1
Other Non-OECD Asia	37	36	52	50	1	2
Middle East	30	29	37	38	0	-1
Africa	19	19	24	25	0	-1
Central and South America	31	31	38	41	-1	-3
Total World	**563**	**559**	**695**	**702**	**4**	**-7**

Sources: ***IEO2008*:** Energy Information Administration (EIA), World Energy Projections Plus (2008). ***IEO2007*:** EIA, *International Energy Outlook 2007*, DOE/EIA-0484(2007) (Washington, DC, May 2007), Table A1, p. 83.

The projections for nuclear power in *IEO2008* are largely unchanged on a Btu basis from those in *IEO2007*. In 2030, total net nuclear power generation worldwide on a kilowatthour basis is actually 4 percent higher in *IEO2008* than in *IEO2007*, but the difference is masked by a revision in the conversion factors used to convert kilowatthours to Btu. For renewables, the *IEO2008* demand projection for 2030 is more than 10 percent higher than the *IEO2007* projection. The increase is a result of higher fossil fuel prices and additional government policies aimed at expanding renewable energy use.

Table I6. Comparison of *IEO2008* and *IEO2007* World Energy Consumption by Fuel, Reference Case, 2015 and 2030
(Quadrillion Btu)

Fuel	2015		2030		Change in *IEO2008*	
	IEO2008	*IEO2007*	*IEO2008*	*IEO2007*	2015	2030
Liquids	194	198	229	239	-3	-10
Natural Gas	134	134	165	170	0	-6
Coal	158	152	202	199	6	3
Nuclear	31	33	39	40	-1	0
Renewable/Other	45	43	59	53	2	6
Total	**563**	**559**	**695**	**702**	**4**	**-7**

Sources: ***IEO2008*:** Energy Information Administration (EIA), World Energy Projections Plus (2008). ***IEO2007*:** EIA, *International Energy Outlook 2007*, DOE/EIA-0484(2007) (Washington, DC, May 2007), Table A2, pp. 84-85.

Appendix J

Models Used To Generate the *IEO2008* Projections

World Energy Projections Plus (WEPS+)

The *IEO2008* projections of world energy consumption and supply were generated from EIA's World Energy Projections Plus (WEPS+) model. WEPS+ is a system of sectoral energy models that provide a loosely linked, integrated equilibrium modeling system. It is used primarily to provide alternative energy projections based on different assumptions for GDP growth and fossil fuel prices. The WEPS+ common platform allows the models to communicate with each other and provides a comprehensive, central series of output reports for analysis. For *IEO2008*, WEPS+ incorporates a separate transportation sector model with an extensive level of detail for modes and vehicle types. WEPS+ also incorporates some additional detail on industrial energy use in China and India, additional detail on end-use electricity consumption, and an interface to the System for the Analysis of Global Energy Markets/Global Electricity Module (see below) for generation, capacity, and fuel consumption in the electricity sector.

WEPS+ produces projections for 16 regions or countries of the world, including North America (United States, Canada, and Mexico), OECD Europe, OECD Asia (Japan, South Korea, and Australia/New Zealand), Russia, other non-OECD Europe and Eurasia, China, India, other non-OECD Asia, Brazil, and other Central and South America. Currently, the projections extend to 2030.

In some individual models, the detail also extends to the subsector level. For each end-use sector, WEPS+ projects consumption of the key primary energy sources: liquid fuels and other petroleum, natural gas, coal, nuclear power, and hydroelectricity and other renewables. The model also provides intermediate consumption projections for electricity in the end-use demand sectors. The model projections generally are dependent on aggregate supply prices, GDP levels, and population. Supply projections are also made for the key supply sources corresponding to the primary consumption sources. The modeling system accounts for projections of economic activity represented by GDP, population, and world energy prices. Carbon dioxide emissions from the combustion of fossil fuels are also calculated by region.

WEPS+ includes a detailed model of the world's transportation sector, which provides projections by four transport modes: road, rail, water, and air. A variety of services are represented for each mode, such as light-duty vehicles, two/three-wheel vehicles, heavy trucks, passenger rail, and freight rail. WEPS+ separates service demand (e.g., road travel by cars, commercial trucks, and heavy trucks) from vehicle efficiency and bases the projections on economic growth (as measured by GDP) and fuel prices.

A more detailed representation of the industrial sectors in China and India is incorporated into WEPS+. These projections are based on an econometric estimation of historical consumption patterns at a nine-industry level of detail. End-use electricity consumption was analyzed in detail across several sectors and for the major electricity-consuming regions, and a module incorporating the analysis was included in WEPS+.

Although the modeling was extended in several areas of WEPS+, in the remaining core sections WEPS+ is a microeconomic model, used primarily to provide alternative energy projections under different assumptions about GDP growth and fossil fuel prices. It serves as a repository for reference case output generated from complex models that focus on specific supply or demand series. The reference case reflects output from those models and incorporates analysts' judgment on the potential for demand by end-use sector and fuel type on a regional basis. After the reference case is established, WEPS+ is used to calculate coefficients for the response surface, which are saved in a database. The reference case output tables reflect the same information that is embedded in the input tables. Alternative cases reflect different assumptions about future economic growth and energy prices. When an alternative case is run, the model uses the previously calculated coefficients to produce new projections relative to changes in GDP and energy prices and produces output tables that reflect the changes.

System for the Analysis of Global Energy Markets/Global Electricity Module (SAGE/GEM)

SAGE/GEM is a regional model that provides a technology-rich basis for estimating regional electricity consumption. For each region, SAGE/GEM inputs reference case estimates of electricity demand (e.g., commercial, industrial, residential, and transportation) that were developed on the basis of economic and demographic projections in WEPS+. Projections of electricity generation in SAGE/GEM to meet the electricity

demands are estimated on the basis of each region's existing electricity use patterns (load shape), the existing stock of electricity generation equipment, the characteristics of available new electricity generation technologies, and fuel supply (prices and production).

Period-by-period market simulations aim to provide each region's electricity generation services at minimum cost. Nine load slices are modeled (summer, winter, and intermediate seasons for base, intermediate, and peak loads). SAGE/GEM also allows energy commodities to be traded between regions. Inventories of existing generation technologies by plant type and region are derived from Platts' UDI World Electric Power Plants Database.[24] Generation and consumption for historical years are calibrated with historical data from EIA and the International Energy Agency. Resource availability for fossil fuels is provided by WEPS+ and translated into supply curves for use in SAGE/GEM, taking into consideration fuel consumed in non-electricity sectors. Renewable resource availability is derived from analyst reviews of regional data.

SAGE/GEM is a simplified subset of the SAGE modeling system. A full description of the SAGE model is available in a two-volume set. The first volume provides a general understanding of the model's design, theoretical basis, necessary user-defined assumptions, and output. It also lists the software necessary to develop and analyze the results of SAGE-based policy and energy market scenarios. In addition, Volume I includes a Reference Guide, which explains each equation in detail. The second volume serves as a User's Guide for those actively developing SAGE-based scenario analyses. The documentation is available on EIA's web site in the model documentation section of "Current Publications" (www.eia.doe.gov/bookshelf/docs.html). SAGE documentation is also available as part of the documentation for the MARKAL family of models (www.etsap.org/MRKLDOC-III_SAGE.pdf).

Generate World Oil Balance Model (GWOB)

The projections for world liquids production in *IEO2008* reflect an assessment of world oil supply—based on current production capacity, planned future additions to capacity, resource data, geopolitical constraints, and prices—that is used to generate conventional crude oil production cases. The scenarios (price cases) are developed through an iterative process of examining demand levels at given prices and considering the price and income sensitivity on both the demand and supply sides of the equation. Projections of conventional liquids production for 2008 through 2015 are based on analysis of investment and development trends around the globe. Data from EIA's *Short-Term Energy Outlook* are integrated to ensure consistency between short- and long-term modeling efforts. Projections of unconventional liquids production are based on exogenous analysis.

Nine major streams of liquids production are tracked on a volume basis: (1) crude oil and lease condensate, (2) natural gas plant liquids, (3) refinery gains, (4) Canadian oil sands, (5) extra-heavy oils, (6) coal-to-liquids, (7) gas-to-liquids, (8) shale oils, and (9) biofuels (tracked on both a volume basis and an oil equivalent basis). Biofuels are reported in terms of barrels of oil equivalent, unless otherwise stated.

[24]Platts, *Energy Markets Data*: *UDI Data and Directories*, "World Electric Power Plants Database," web site www.platts.com.

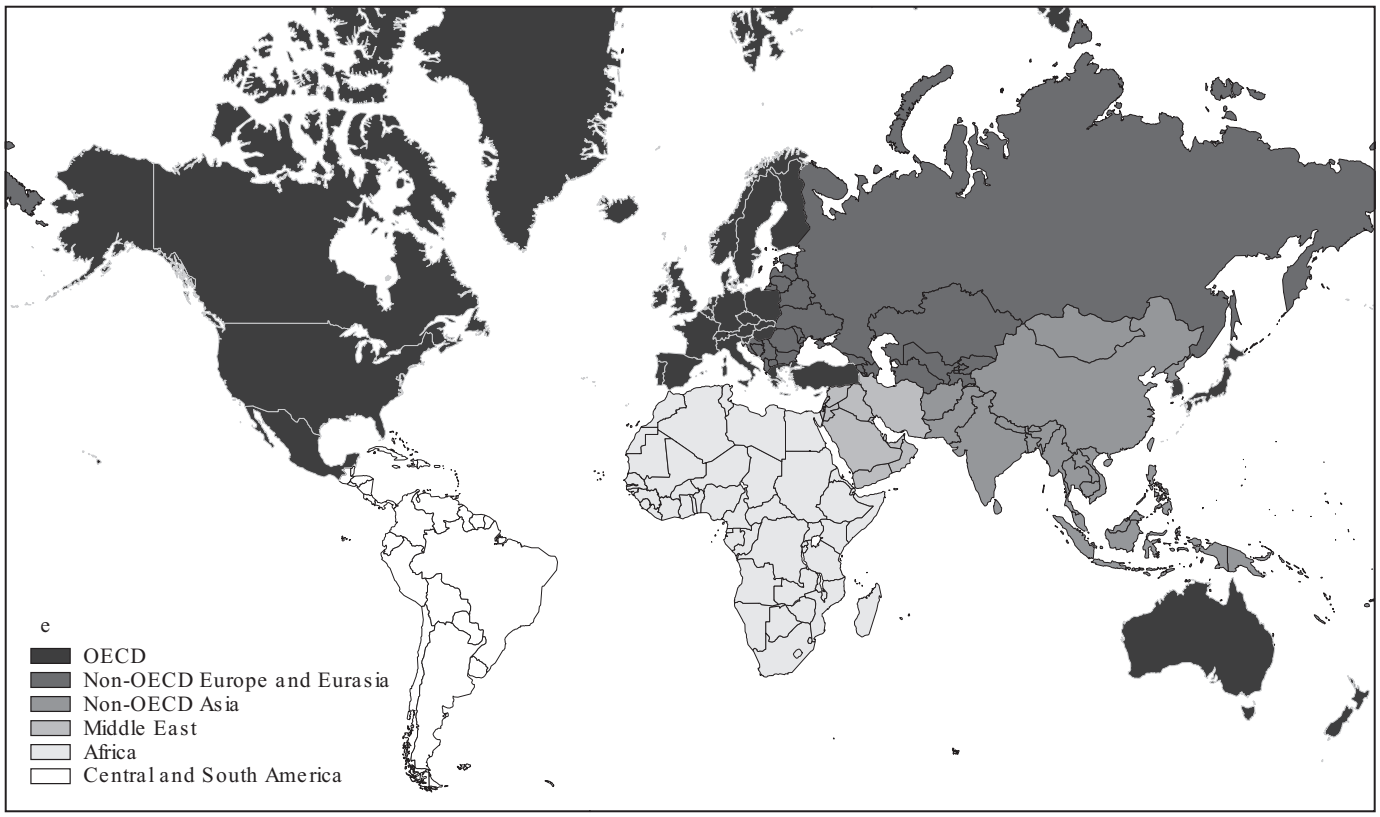
Appendix K

Regional Definitions

The six basic country groupings used in this report (Figure K1) are defined as follows:

- **OECD** (18 percent of the 2008 world population): **North America**—United States, Canada, and Mexico; **OECD Europe**—Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland, Turkey, and the United Kingdom. **OECD Asia**—Japan, South Korea, Australia, and New Zealand.
- **Non-OECD** (82 percent of the 2008 world population):
  - **Non-OECD Europe and Eurasia** (5 percent of the 2008 world population)—Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Estonia, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Macedonia, Malta, Moldova, Montenegro, Romania, Russia, Serbia, Slovenia, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan.
  - **Non-OECD Asia** (53 percent of the 2008 world population)—Afghanistan, Bangladesh, Bhutan, Brunei, Cambodia (Kampuchea), China, Fiji, French Polynesia, Guam, Hong Kong, India, Indonesia, Kiribati, Laos, Malaysia, Macau, Maldives, Mongolia, Myanmar (Burma), Nauru, Nepal, New Caledonia, Niue, North Korea, Pakistan, Papua New Guinea, Philippines, Samoa, Singapore, Solomon Islands, Sri Lanka, Taiwan, Thailand, Tonga, Vanuatu, and Vietnam.
  - **Middle East** (3 percent of the 2008 world population)—Bahrain, Cyprus, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, the United Arab Emirates, and Yemen.
  - **Africa** (14 percent of the 2008 world population)—Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo (Brazzaville), Congo (Kinshasa), Côte d'Ivoire, Djibouti, Egypt, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali,

Figure K1. Map of the Six Basic Country Groupings



Source: Energy Information Administration, Office of Integrated Analysis and Forecasting.

Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Reunion, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, St. Helena, Sudan, Swaziland, Tanzania, Togo, Tunisia, Uganda, Western Sahara, Zambia, and Zimbabwe.

- **Central and South America** (7 percent of the 2008 world population)—Antarctica, Antigua and Barbuda, Argentina, Aruba, Bahama Islands, Barbados, Belize, Bolivia, Brazil, British Virgin Islands, Cayman Islands, Chile, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador, El Salvador, Falkland Islands, French Guiana, Grenada, Guadeloupe, Guatemala, Guyana, Haiti, Honduras, Jamaica, Martinique, Montserrat, Netherlands Antilles, Nicaragua, Panama Republic, Paraguay, Peru, Puerto Rico, St. Kitts-Nevis, St. Lucia, St. Vincent/Grenadines, Suriname, Trinidad and Tobago, Turks and Caicos Islands, Uruguay, U.S. Virgin Islands, and Venezuela.

In addition, the following commonly used country groupings are referenced in this report:

- **Countries that have ratified, accepted, acceded, or approved the Kyoto Climate Change Protocol on Greenhouse Gas Emissions as of April 17, 2008:** Albania, Algeria, Angola, Antigua and Barbuda, Argentina, Armenia, Australia, Austria, Azerbaijan, Bahamas, Bahrain, Bangladesh, Barbados, Belarus, Belgium, Belize, Benin, Bhutan, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Bulgaria, Burkina Faso, Burundi, Cambodia, Cameroon, Canada, Cape Verde, Central African Republic, Chile, China, Colombia, Comoros, Congo (Brazzaville), Congo (Kinshasa), Cook Islands, Costa Rica, Côte d'Ivoire, Croatia, Cuba, Cyprus, Czech Republic, Denmark, Djibouti, Dominica, Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Eritrea, Estonia, Ethiopia, Fiji, Finland, France, Gabon, Gambia, Georgia, Germany, Ghana, Greece, Grenada, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, Hungary, Iceland, India, Indonesia, Iran, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kenya, Kiribati, Kuwait, Kyrgyzstan, Laos, Latvia, Lebanon, Lesotho, Liberia, Libya, Liechtenstein, Lithuania, Luxembourg, Macedonia, Madagascar, Malawi, Malaysia, Maldives, Mali, Malta, Marshall Islands, Mauritania, Mauritius, Mexico, Micronesia, Moldova, Monaco, Mongolia, Montenegro, Morocco, Mozambique, Myanmar, Namibia, Nauru, Nepal, Netherlands, New Zealand, Nicaragua, Niger, Nigeria, Niue, North Korea, Norway, Oman, Pakistan, Palau, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Portugal, Qatar, Romania, Russia, Rwanda, Saint Lucia, Saint Kitts and Nevia, Samoa, Saudi Arabia, Senegal, Serbia, Seychelles, Sierra Leone, Singapore, Slovakia, Slovenia, Solomon Islands, South Africa, South Korea, Spain, Sri Lanka, St. Vincent/Grenadines, Sudan, Suriname, Swaziland, Sweden, Switzerland, Syria, Tanzania, Thailand, Togo, Tonga, Trinidad and Tobago, Tunisia, Turkmenistan, Tuvalu, Uganda, Ukraine, United Arab Emirates, United Kingdom, Uruguay, Uzbekistan, Vanuatu, Venezuela, Vietnam, Yemen, and Zambia.
- **Annex I Countries participating in the Kyoto Climate Change Protocol on Greenhouse Gas Emissions:** Australia, Austria, Belarus, Belgium, Bulgaria, Canada, Croatia, Czech Republic, Denmark, Estonia, European Community, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Monaco, the Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine, and the United Kingdom.[25]
- **European Union (EU):** Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom.
- **G8:** Canada, France, Germany, Italy, Japan, Russia, United Kingdom, and the United States.
- **North American Free Trade Agreement (NAFTA) Member Countries:** Canada, Mexico, and the United States.
- **Organization of the Petroleum Exporting Countries (OPEC):** Algeria, Angola, Ecuador, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, the United Arab Emirates, and Venezuela.
- **Pacific Rim Developing Countries:** Hong Kong, Indonesia, Malaysia, Philippines, Singapore, South Korea, Taiwan, and Thailand.
- **Persian Gulf Countries:** Bahrain, Iran, Iraq, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates.

[25]Turkey is an Annex I nation that has not ratified the Framework Convention on Climate Change and did not commit to quantifiable emissions targets under the Kyoto Protocol. In 2001, the United States withdrew from the Protocol.